Cumhuriyet Dental Journal

25 (Suppl):2022

This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

Published By

Sivas Cumhuriyet University

http:// cdj.cumhuriyet.edu.tr

E-ISSN: 2146-2852

ISSN: 1302-5805

Cumhuriyet Dental Journal

The Official Journal of the Sivas Cumhuriyet University Faculty of Dentistry. The first issue was published in 1998 and journal's name was changed as Cumhuriyet Dental Journal in 2010. Issues are published quarterly since 2018.

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ISSN 1302-5805

e-ISSN 2146-2852

Volume/25- Issue/Supplement-2022

INDEXING

Cumhuriyet Dental Journal, 25(Suppl)
ISSN: 1302-5805
e-ISSN: 2146-2852

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DOI: https://doi.org/10.7126/cumudj.1035066

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

The Effects of 3D Modeling on Planning of Maxillofacial Surgery: A Preliminary CBCT Study#

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Research Article

Acknowledgment
 # This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 10/12/2021
Accepted: 12/01/2022

ABSTRACT

Objectives: The aim is to evaluate the contribution of 3D modeling data to the planning of the maxillofacial surgery and to determine the indications of 3D modeling.
Materials and Methods: In this preliminary study, CBCT images of 2 patients with the Kodak 9000 3D (Kodak Carestream Health, Trophy, France) system were used. The segmentation procedures of the pathologies were performed manually, and was followed by the construction of the 3D models. A questionnaire was prepared by consensus of the research team, including the parameters which are critical in preoperative maxillofacial surgery planning. Five oral and maxillofacial surgeons independently evaluated both the traditional CBCT data and 3D model assisted data under the same viewing conditions. The extent of their decision change was scored using a 2 point Likert scale. Conventional (pre 3D model) versus 3D model assisted data (post 3D model) scores were analyzed. Pair-wise comparisons were completed using Fisher's exact test. Kappa was used to measure inter-observer agreement.
Results: In both of the evaluation sessions (pre and post 3D model), operation time, defect size and complication risk factors showed the highest variation for both patients. The difference between the decision change proportions for the variables of pre and post 3D model sessions were not statistically significant. Except 2 observers with excellent agreement for both evaluations, the agreement rates were fair without statistical significance.
Conclusions: The results showed that personalized 3D modeling constructed by CBCT data may lead to changes in surgical treatment planning protocol of complex cases.
Keywords: 3D Modeling, CBCT, Dental Radiology, Maxillofacial Surgery Planning, Questionnaire

Maksillofasiyal Cerrahide 3 Boyutlu Modellemenin Etkisi: Bir KİBT Ön Çalışması#

Bilgi
 # Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.

Süreç

Geliş: 10/12/2021
Kabul: 12/01/2022

ÖZ

Amaç: Çalışmanın amacı, konik ışınlı bilgisayarlı tomografi (KIBT) kesitlerinin segmentasyonu sonucunda oluşturulan 3 boyutlu modellerin maksillofasiyal cerrahi planlamasına katkısını değerlendirmek ve 3 boyutlu modellemenin kullanım alanlarını belirlemektir.
Yöntem: Bu ön çalışmada, Kodak 9000 3D (Kodak Carestream Health, Trophy, Fransa) KIBT cihazı kullanılarak çekilmiş 2 farklı hastanın görüntüleri kullanılmıştır. Görüntüler her kesitte değerlendirilerek segmentasyonu manuel olarak tamamlanmış ardından 3 boyutlu modellere çevrilmiştir. Cerrahi planlama açısından önemi sebebiyle seçilen 8 parametre kullanılarak araştırma ekibi tarafından gözlemci anketi oluşturulmuştur. Gözlemci olarak seçilen beş oral ve maksillofasiyal cerrah, aynı görüntüleme koşulları altında önce sadece geleneksel KIBT verilerini değerlendirerek, ardından ise 3 boyutlu model ile oluşturulan verileri bağımsız olarak inceleyerek aynı anketi iki kere doldurmuştur. Cerrahların karar verme mekanizmaları üç skorlu Likert ölçeği kullanılarak puanlanmış, geleneksel ve 3 boyutlu model kullanılarak yapılan planlama puanları karşılaştırılarak analiz edilmiştir. İki yöntemin karşılaştırılması için Fisher's Exact testi, gözlemciler arası uyumu ölçmek için ise Kappa testi kullanılmıştır.
Bulgular: Yöntemler karşılaştırıldığında (3 boyutlu model ve geleneksel yöntem), her iki hastada en çok değişkenlik gösteren faktörlerin operasyon süresi, defekt boyutu ve komplikasyon riski olduğu gözlendi. İki yöntem arasındaki karar verme mekanizması incelendiğinde, yöntemlerin sonuçlarının benzer olduğu görüldü. Gözlemciler arasındaki uyum değerlendirildiğinde ise yalnızca 2 gözlemci arasında tam bir uyumun olduğu gözlenmekle birlikte, diğerleri arasında istatistiksel olarak anlamlı olmayan orta düzeyde bir uyumun bulunduğu belirlendi.
Sonuçlar: Çalışmanın sonuçları, KIBT verileriyle oluşturulan, kişiye özgü 3 boyutlu modellemenin karmaşık vakaların cerrahi tedavi planlama protokollerinde değişikliğe yol açabilir.
Anahtar Kelimeler: 3B Modelleme, KIBT, Maksillofasiyal Cerrahi Planlaması, Dental Radyoloji, Anket.

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How to Cite: Ulusoy AC, Şener E, Özden Yüce M, Özer MA, Karaman A, Gökmen F, Boyacioğlu H, Güneri P.(2022) The Effects of 3D Modeling on Planning of Maxillofacial Surgery: A Preliminary CBCT Study, Cumhuriyet Dental Journal, 25(Suppl.):1-6.

Introduction

The advent of 3D technology has revolutionized medical imaging. 3D modeling has been used to improve diagnostic accuracy, plan complex interventions, and aid in medical student and resident understanding of disease.[1] It has been particularly helpful with regard to complex anatomic structures and disorders that are not easily captured or understood in two dimensions.[2] New technological advances have also revolutionized the field of oral and maxillofacial surgery. Advanced imaging techniques, software and computerized manufacturing techniques have made three-dimensional (3D) computer models available not only for research and development, but also for routine clinical applications.[3] Clinicians frequently operate in areas of the face and jaws which cannot be directly observed prior to a procedure, and consequently risking damage to critical structures such as nerves and blood vessels. 3D models are particularly useful for planning maxillofacial surgeries, because the anatomy and procedures in this region are especially complex (Figure 1).

Studies evaluating the efficacy of 3D biomodels in craniofacial and maxillofacial surgeries showed that three-dimensional models contributed positively to diagnosis, operative planning, and informed consent.[4]

Image acquisition and processing are the first steps to create a 3D model. Considering the fact that complex surgical procedures in maxillofacial region injuries require meticulous preoperative planning, it is important to utilize imaging modalities that provide detailed information that can ensure accurate diagnosis and good clinical outcomes.[4,5,6] At this point, cone beam computed tomography (CBCT) has become a mainstay in oral and maxillofacial surgery for many surgeons by offering 3-dimensional and multi-planar views for a more accurate diagnosis and treatment without the financial burden and radiation exposure of conventional computed tomography (CT) scans.[7-9] A number of studies have evaluated the performance of imaging modalities in the surgical treatment of maxillofacial pathologies.[10-15] However, it is noteworthy that most of these studies presented conventional computerized tomography and MRI images for 3D modeling of preoperative planning of maxillofacial pathologies.[13,15,16,17] The number of studies using CBCT images for this purpose is quite scarce.[12,18-22] In addition, it was observed that most of CBCT studies were case reports and there were no clinical studies investigating the effect of 3D modeling on decision of surgical treatment planning using CBCT images.[18-21]

The aim of this preliminary retrospective study was to determine and compare the preoperative surgical treatment decisions of oral surgeons for maxillofacial pathologies by using either CBCT images alone or by personalized 3D model supported surgical treatment planning in order to assess the indications for 3D modeling in surgical treatment planning.

Materials and Methods

Cases

CBCT data obtained from 2 patients with lesions localized in the mandibular posterior region and close relationship with adjacent teeth and vital tissues were included to this retrospective preliminary study. All data were retrieved from the radiology archive and patient files. The first patient was a 49-year-old female with an expansive radiolucent lesion extending from the distal root of mandibular 2nd molar to the 1st molar region involving the periapical tissues of 2nd molar teeth. The second patient was a 47 year-old female with a large tooth extraction cavity in the mandibular 2nd molar region.

Radiographic Technique

CBCT examinations were performed using the Kodak 9000 3D (Kodak Carestream Health, Trophy, France) system and the imaging parameters were 10 mA and 70 kVp with 2.5 mm Al equivalent filtration. CBCT image acquisition of each patient was completed after a single 360° rotation with 10.8 s scan time, and a volume with a spatial resolution of 76 µm (isotropic voxel) was reconstructed using the dedicated software of the imaging system (Kodak Dental Imaging Software v3.10.9). Both patients CBCT images revealed multilocular lesions with radiolucent content located in the mandibular posterior area with indistinct boundaries (Figure 2).

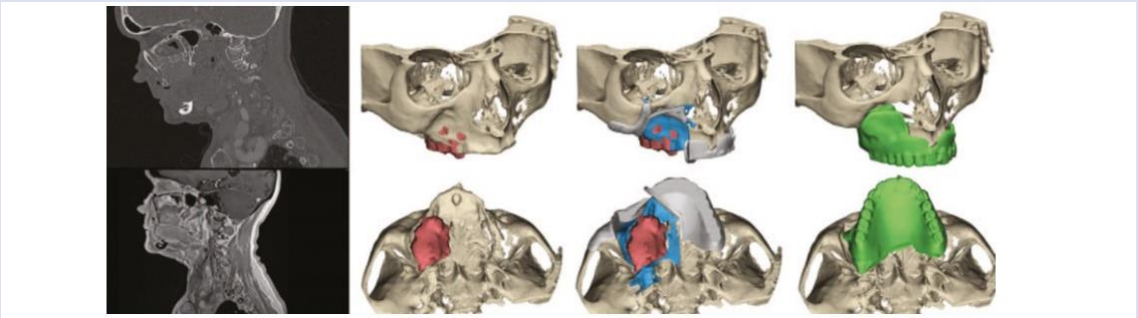

Figure 1. In a case of maxillary malignant lesion (red), CT and MRI data are used for preoperative 3D planning of bone resection (blue), guide design (gray) and obturator (green) (Glas 2020).

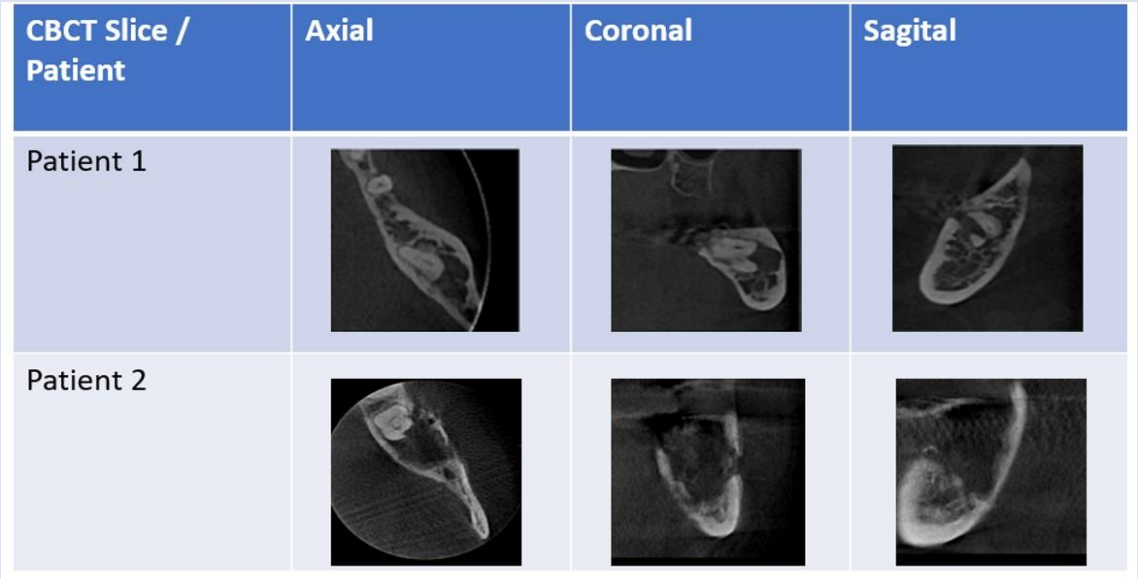

Figure 2. CBTC images of the patients, presenting the pathologies with indistinct borders, penetrating to the cortical plates, and causing erosions of bone.

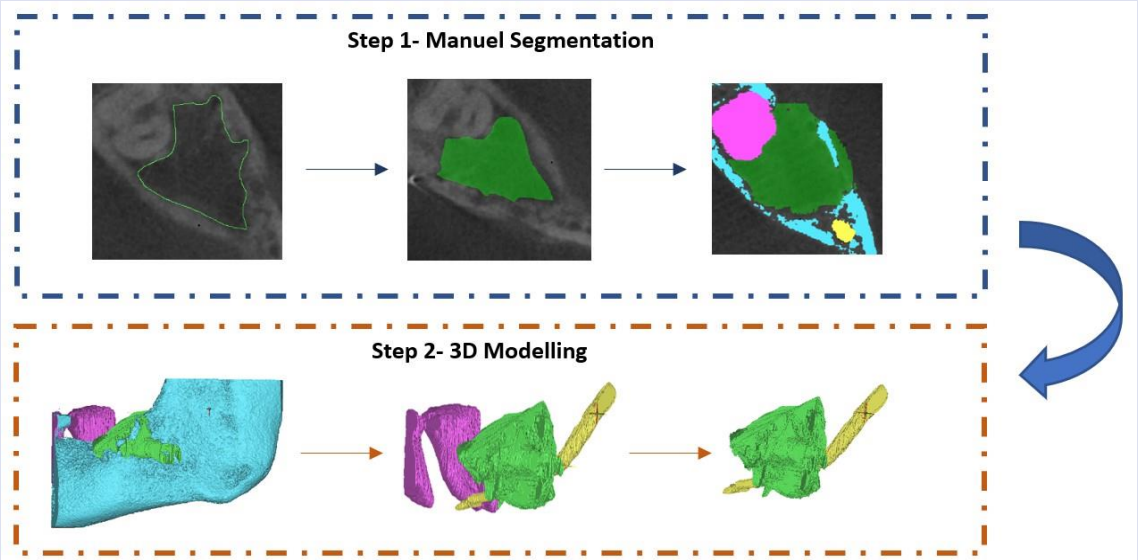

Figure 3. Manuel segmentation and 3D modelling workflow.

Segmentation and Reconstruction

CBCT sections of the patient were imported to "3D Slicer (version 4.8.1 r26813)" software. The region was segmented and recorded by determining the appropriate threshold values. Manual segmentation was performed using cross-sectional images of CBCT images in 3 different (axial + sagittal + coronal) planes by one oral radiologist and converted into 3D model (Figure 3). The slice thickness was 0.076mm in each section. The tooth, related lesion, mandible cortical layer, mandibular canal masks were used. The 3D model in stl format has been smoothed by opening it with the free software "Autodesk Meshmixer (version 3.5.474)".

Evaluation Procedure

Following a thorough literature review about 3D modelling in surgical planning, a questionnaire including 8 parameters [1.Estimated operation time, 2.Anesthesia type (local-general), 3.Intervention direction (extraoral-intraoral), 4.Osteotomy boundaries/defect size, 5.Additional material requirement (plate-graft-membrane), 6.Relationship with vital tissues, 7.Requirement of postoperative medication, 8.Risk of complications] which are critical for preoperative maxillofacial surgery planning was prepared by consensus of the research team.

Five oral and maxillofacial surgeons independently evaluated both the traditional CBCT data and 3D model assisted data under the same viewing conditions. At first,

each surgeon evaluated only the CBCT data and made a traditional planning (pre 3D model). Then, he/she made a new planning by examining the 3D modeling data (post 3D model) within a week after the traditional planning. Both questionnaires for CBCT and 3D modeling data were compared. The inconsistency between the two maxillofacial surgery planning (pre and post 3D model) for each parameter was scored using a 3-point Likert scale (1-decision is not changed, 2- changed).To evaluate whether the maxillofacial surgeon's decision for each parameter changed after using the 3D modeling, this process was performed in both patients.

Statistical Evaluation

Conventional (pre 3D model) versus 3D model assisted data (post 3D model) scores were analyzed with SPSS version 15.0 (SPSS, Chicago, Illinois, USA). In all tests, p-value less than 0.05 was considered statistically significant.

Fishers Exact test was used for pair-wise comparisons of two different evaluation data (pre and post 3D model) including 8 parameters which are critical for preoperative maxillofacial surgery planning. Five observers evaluated both of 2 cases and the interrater reliability of 5 observers was tested by Cohen's kappa coefficient (k) using the Landis and Koch scale scored as: 0.01, poor; 0.01-0.20, slight; 0.21-0.40, fair; 0.41-0.60, moderate; 0.61-0.80, substantial; and 0.81-1.00, almost perfect.

Results

Cohen's kappa coefficient (k) showed that there was a significant agreement between Observer 2 and 5 for both evaluations (p=0.036), while the agreement between other observers was not significant (p>0.05) (Table 1). The mean change values of the scores of eight parameters for both patients are presented in Table 2.

Despite the fact that the surgery duration, osteotomy boundaries/defect size, and complication risk parameters exhibited the highest variance after oral surgeons analyzed 3D modeling for both patients, the differences between the parameters were not statistically significant (p>0.05) and the decisions of the surgeons regarding the other parameters were not affected by 3D modeling (Table 2). There was no statistically significant difference between the two patients in terms of tested parameters (p>0.05) (Table 2).

Discussion

The design of maxillofacial surgery has improved significantly after presentation of 3D virtual planning methods.[5,22] This approach has provided priceless preoperative information to select the most appropriate surgical and reconstructive techniques, and to decide the resection margins, the region of osteotomies, the places for placement of osteosynthesis/graft materials and implants.[17,23] Considering that dental rehabilitation is a vital step of reconstruction, 3D virtual planning becomes particularly useful to hasten the process of oral rehabilitation.[17,24,25]

With the aid of digital technology/3D modeling, personalized operation and reconstruction could be performed[5,24,26,27], and better outcomes than traditional surgery could be achieved.[6,24,26] Even though personalized maxillofacial surgery has been used frequently, a more patient tailored approach using 3D print technology shall be preferred for more accurate reconstruction. [17] On the other hand, 3D modeling based surgical planning requires time and expertise, and this can be named as the disadvantage of this method.[6,24,28]

Although the reduction of the operation duration with 3D modeling and imprinted surgical guides has been reported in the literature[5,6,24,28-31], the impact of 3D modeling on the decision of surgical treatment planning has not been investigated. Therefore, we could not meet any studies in the literature to compare our results. In the present study, 3D modeling changed the decision of oral surgeons with respect to the duration of the operation time, the defect size estimation and influenced the planning of the surgery. In a recent study, Kuralt *et.al.*[27] showed implementation of 3D modeling in periodontal surgery and implantology for better treatment outcomes and reduced risk of complications. Similarly, Jaron *et.al.*[32] revealed the efficacy of 3D modeling and printing in surgical removal of impacted mandibular third molars in order to overcome the high risk of postoperative problems.

The major limitation of this investigation is the number of the cases, which could be the reason of insignificance of the differences; currently we are increasing the study sample size. The other limitation may be the lack of the use of 3D printing, which would additionally effect the preoperative planning process of the surgeons.[32] Spatial evaluation of a case after meticulous segmentation of CBCT images during 3D modeling and precise 3D printing would contribute to the performance of the surgeon and outcome of the surgery.[32]

Table 1. Inter-observer agreement values by Cohen's kappa test (* refers statistical significance, p<0.05).

Cohen's kappa	P value
G1*G2	0.280
G1*G3	0.086
G1*G4	0.146
G1*G5	0.949
G2*G3	0.182
G2*G4	0.383
G2*G5	0.036*
G3*G4	0.383
G3*G5	0.849
G4*G5	0.146

Table 2. The mean change values of the scores of the parameters.

Parameters	Scores for decision change in surgery planning			P
	Patient 1	Patient 2	Mean score for decision change	
Estimated operation time	0.60	0.80	0.70*	0.4
Anesthesia type (local/general)	0.00	0.20	0.10	1.0
Intervention direction (extraoral-intraoral)	0.00	0.20	0.10	1.0
Osteotomy boundaries (defect size)	0.60	0.80	0.70*	0.4
Additional material requirement (plate-graft-membrane)	0.00	0.00	0.00	1.0
Relationship with vital tissues	0.40	0.40	0.40	1.0
Requirement of postoperative medication	0.20	0.40	0.30	0.4
Risk of complications	0.80	0.40	0.60*	1.0

*Revealed the highest change between the pre and post-operative decision-making processes.

Conclusions

In conclusion, 3D modeling may affect the surgeons preoperative decision-making processes, especially regarding the operation duration, osteotomy boundaries/defect size and complication risk. In complex cases, this novel methodology can be utilized in order to provide a better surgical outcome both for the surgeons and the patients. The findings of this preliminary study need validation on larger sample groups, with addition of 3D printing process to the present test protocol.

Acknowledgements

None to declare

Conflicts of Interest Statement

The authors deny any conflicts of interest related to this study.

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Cumhuriyet Dental Journal, 25(Suppl): 7-12, 2022
DOI: https://doi.org/10.7126/cumudj.1024538

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Radicular Groove of Maxillary Premolar: is a "Danger Zone"?#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 16/11/2021
Accepted: 09/02/2022

ABSTRACT

Objectives: To evaluate the presence of radicular groove and dentin thickness on the palatal aspect of the buccal root of maxillary first premolars using cone-beam computed tomography (CBCT).

Materials and methods: Images of 312 maxillary first premolars belonging to 187 patients (between 18-69 years, 94 females and 93 males) who were referred to the clinic were retrospectively reviewed. Root canal treatment, periapical lesion, and post-core were excluded. One and three-rooted premolars were also excluded. CBCT images were viewed on the axial plane to detect grooves. The concave area on the palatal aspect of the buccal root was recorded as a groove. Buccal and palatal dentin thicknesses were measured by two observers at the level of 3 mm below furcation. Statistical analyses were performed.

Results: Buccal and palatal thicknesses were 1.28(±0.25) and 0.87(±0.13) mm, respectively. According to Student's t-test, buccal dentin thickness was statistically higher than palatal dentin. The prevalence of groove was 82.05%. While palatal thickness without groove was 0.93(±0.14) mm, palatal thickness corresponding to groove was 0.82(±0.12) mm. One-way ANOVA showed palatal and buccal thickness in group 1 (18-35 years) was statistically lower than group 3 (>65 years). No statistical difference in thickness was observed between sex and left or right side.

Conclusions: Palatal thickness related to groove can be considered a "danger zone" for post-core and endodontic treatment. Considering the high prevalence (82.05%) and thin dentin of the groove, more conservative canal and post space preparation and CBCT examination are recommended to avoid perforation.

Keywords: CBCT, Dentin, Endodontics, Root Canal Preparation, Root Canal Therapy.

Maksiller Premolar Radiküler Oluğu: "Tehlikeli Bölge"midir?#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
** Sorumlu yazar*

Süreç

Geliş: 16/11/2021
Kabul: 09/02/2022

ÖZ

Amaç: Bu çalışmanın amacı maksiller birinci premolardaki bukkal kökün palatinalinde bulunan oluğun prevalansının ve ayrıca bukkal ve palatinal dentin kalınlığının konik-ışınlı bilgisayarlı tomografi kullanarak (KIBT) incelenmesidir

Yöntem: Çalışmaya, kliniğe başvuran 187 hastaya ait (18-69 yaş arası, 94 kadın ve 93 erkek) 312 premolar dişin KIBT görüntüsü dahil edildi. Kanal tedavili, post uygulanmış, tek veya üç köklü premolar dişler çalışma dışı bırakıldı. Kök oluğunu tespit edebilmek için KIBT görüntüleri aksiyel kesitte incelendi. Bukkal kökün palatinalindeki konkav alanlar oluk olarak kaydedildi. Bukkal ve palatinal dentin kalınlıkları iki gözlemci tarafından, furkasyonun 3 mm altından ölçüldü. İstatistiksel analiz yapıldı.

Bulgular: Bukkal ve palatinal dentin kalınlıkları sırasıyla 1,28(±0,25) ve 0,87(±0,13) olarak bulundu. Student's t-testine göre, bukkal dentin kalınlığı palatinaldeki dentin kalınlığına göre istatistiksel olarak anlamlı derecede fazla bulundu. Bukkal oluk prevalansı %82,05 olarak kaydedildi. Oluk bulunmayan palatinal dentin kalınlığı 0,93(±0,14) mm iken oluk bulunan palatinal dentin kalınlığı 0,82(±0,12) mm olarak tespit edildi. Tek yönlü ANOVA testine göre, palatinal ve bukkal kalınlık grup 1(18-35 yaş)'de istatistiksel olarak anlamlı derecede grup 3 (>65 yaş)'e göre daha inceydi. Cinsiyet ve sağ-sol arasında dentin kalınlığı açısından bir farklılık gözlenmedi.

Sonuçlar: Kök oluğu bulunan bölgedeki dentin kalınlığı kanal tedavisi ve özellikle kök dentininde kayba sebep olan post uygulamaları açısından "tehlikeli bölge" olarak düşünülebilir. Kök oluğunun yüksek prevalansı ve kök oluğundaki ince dentin varlığı düşünüldüğünde, klinikte perforasyon oluşumu engellemek için, işlem öncesi üç boyutlu inceleme ve ayrıca daha konservatif kanal şekillendirmesi ve post boşluğu hazırlığı önerilir.

Anahtar Kelimeler: KIBT, Dentin, Endodonti, Kök Kanalını Hazırlama, Kök Kanal Tedavisi.

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How to Cite: Yanık D, Nalbantoğlu AM.(2022) Radicular Groove of Maxillary Premolar: is a "Danger Zone"?, Cumhuriyet Dental Journal, 25(Suppl): 7-12.

Introduction

Dentin thickness is a crucial parameter to maintain root integrity in the case of excessive removal during preparation in endodontic therapy.[1] Concave and thin dentin areas that have jeopardy for strip perforation are termed as "danger zone", especially the distal region of mesial root in mandibular molars.[2] Numerous studies focused on the dentin thickness of the danger zone in mandibular molars, however mandibular molars are not the only teeth with compromised roots because of dentin thickness.[1,3-5] Radicular groove located on the palatal aspect of the buccal root of the maxillary premolar also can create a risky area for perforation or fracture because it causes the presence of concave and thin dentin area. Radicular groove, also called "developmental depression", "buccal furcation groove", or "furcal concavity", is located in many types of teeth most notably mandibular premolar, maxillary lateral, and maxillary first premolar.[6,7] Radicular groove generally starts at the level of furcation, reaches throughout the surface of the root, and disappears towards the apical part of the root.[8] In maxillary premolars, it is found at the palatal aspect of the buccal root. According to literature, the prevalence of the radicular groove in the maxillary premolar was reported between 58%-100%.[8-19] It was thought that the radicular groove located on the palatal aspect of buccal root in maxillary first premolars means the precursor of two separate buccal roots.[20]

Dentin thickness related to a root variation such as radicular groove requires a more detailed understanding to avoid complications and estimate the long-term prognosis of endodontic treatment. The amount of dentin removed during instrumentation can reach 2-3 mm^3, as concluded in previous studies that mean approximately %10 - %30 of dentin reduction.[21,22] Besides, according to the literature, the minimum dentin thickness to resist compaction forces during obturation without fracture has occurred was 0.2 - 0.3 mm.[21] In the case of post-core treatment, the required dentin thickness is 1 mm to prevent fracture.[23] These calculations become important particularly in the areas that have anatomically thin dentin as in roots with radicular grooves to prevent vertical root fracture or strip perforation.

To sum up, the root dentin thickness related to the radicular groove on the buccal root of the maxillary first premolar has clinical importance and needs careful instrumentation. Knowledge of dentin thickness and root structure in regions that have variations can decrease complications related to over-preparation such as strip perforation or fracture of the root. Therefore, the aim of the present study is to evaluate the dentin thickness and presence of radicular groove on the palatal and buccal aspects on the buccal root of maxillary first premolar using cone-beam computed tomography (CBCT). The null hypothesis of our study is dentin thickness related to the radicular groove is thinner than the dentin without radicular groove.

Materials and Methods

The present study was approved by the ethics committee on human research of the university (#70904504/616). The protocol of our retrospective study was accomplished in accordance with the guidelines outlined in the Declaration of Helsinki. For the study, CBCT images of 312 maxillary first premolars belonging to 187 patients (94 females and 93 males) aged between 18-69 years (mean age 33.4±3) who were referred to the clinic were selected and retrospectively reviewed. CBCT images were collected from the database of the university clinic from May 2019 to August 2020. CBCT images included in our study were obtained as a part of routine dental treatment planning. Patients with no systemic disease and no previous orthodontic treatment were included. Exclusion criteria were teeth with endodontic treatment, filling, post-core and carious lesion, periapical lesion, horizontal or vertical root fracture, external or internal root resorption, under-develop roots with a wide-open apex, and periodontal disease. Patients with a history of trauma were excluded from the study. CBCT images with low or poor quality and artifacts were also excluded. To detect the minimum sample size for Student's t-test, we performed a power analysis based on the data of 30 samples that we measured as a pilot study, with a power of 95%, alfa error of 0.05, effect size f value of 0.36 using the software of G*Power 3.1 (Heinrich–Heine–Universität, Düsseldorf, Germany). We needed a total of 100 samples (50 in each group) as a minimum necessary sample size, likewise, for the one-way ANOVA, we obtained a partial n2 value of 0.063 according to the data of the pilot study and calculated the effect size of f value as 0.25. With the alfa error of 0.05 and the power of 0.95, the required minimum sample size was 252 (84 in each group).

For our study, 312 maxillary first premolars were selected. All maxillary first premolars in our study had two roots. Maxillary first premolars with single or three roots were excluded from the study. Patients are divided into three age groups; group 1: 18-35 years, group 2: 36-65 years, group 3: >65 years.

CBCT images of patients were obtained from Orthophos (Sirona Dental Systems, Bensheim, Germany). Imaging parameters were set as 85 kVp, 6 mA, 14.1 sn exposure time, 0.16 mm voxel size, and 80 x 40 mm field of view according to the "as low as reasonably achievable" (ALARA) principle. Images were exported in DICOM format to the Horos 3.0 software (Horos Project, Annapolis, Maryland, USA) and analyzed. Before measurements, to adjust optimal visualization, contrast and brightness values were regulated by image tools of the Horos software, and all examinations were made in a dark room.

Examinations were performed by two observers (a 10-year experienced periodontist and a five-year experienced endodontist) independently blind to the patient's data. Before the measurement process, two observers were calibrated. For calibration, 10% of the images were evaluated, and the kappa score was stated (range from

0.91 to 0.93). Moreover, all measurements made by observers were performed twice, and the average values were accepted for statistical analysis. The measurements of three maxillary first premolars were performed at one time, after every three measurements, a break was made to eliminate eye fatigue of two observers.

CBCT images were evaluated on the axial plane to detect the presence of the radicular groove. The presence of the groove in all samples was recorded. The dentin thickness of the concave area on the palatal aspect (in our study, it is considered as danger zone) and the dentin thickness on the buccal aspect (in our study, it is considered as safety zone) of the buccal root were measured at the level of 3 mm below furcation (Figure 1). The presence of radicular groove and dentin thicknesses of the palatal aspect (danger zone) and buccal aspect (safety zone) on the buccal root were recorded according to gender and age groups.

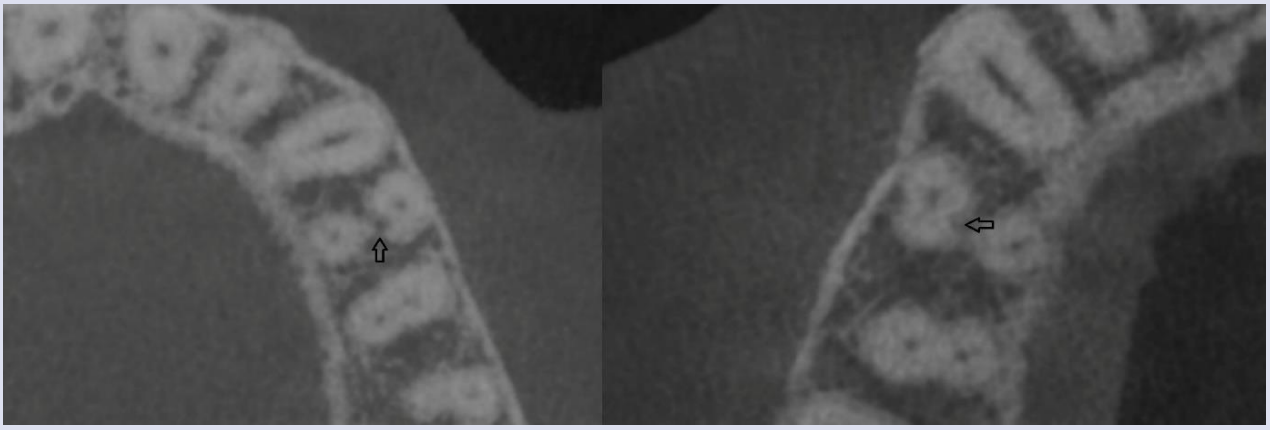

Figure 1. CBCT images of radicular grooves (black arrows) on axial sections.

Statistical analysis was performed by SPSS version 22.0 (IBM Corp., Armonk, NY, USA). The normality distribution of the data of our study was analyzed by Levene's test. Student's t-test was used to compare the dentin thicknesses of the palatal aspect (danger zone) and buccal aspect (safety zone) in maxillary first premolars. Student's t-test was also used to compare the dentin thicknesses between genders. The dentin thicknesses according to age groups were examined by one-way ANOVA and posthoc Tukey test. Chi-square test was used to examine the prevalence of the radicular groove between the right and left premolars, and genders. The level of significance was set at $p<0.05$ for Levene's, Student's t-test, one-way ANOVA, and Chi-square test. Interclass correlation coefficient (ICC) was performed to determine interobserver reliability. A p-value <0.001 was considered statistically significant for the ICC.

Results

We found the prevalence of radicular groove on the palatal aspect was 82.05%. No radicular groove was detected on the buccal aspect of the buccal root (0%). A total of 312 maxillary first premolars were examined, and the radicular groove was detected in 256 teeth. According to the chi-square test, there was no statistical difference in the presence of the radicular groove between the right and left sides (p=0.13) and between genders (p=0.172).

Buccal dentin thickness was statistically higher than the palatal thickness (p=0.016). Buccal thickness was 1.28 (±0.25) mm, and the palatal thickness was 0.87 (±0.13) mm in all maxillary first premolars (with or without radicular grooves). The palatal dentin thickness of teeth that have grooves was 0.82 (±0.16) mm, while the dentin thickness of teeth without grooves was 0.93 (±0.21) mm. Dentin thickness with the radicular groove was statistically thinner than dentin without the radicular groove (p=0.00043). The prevalence of the dentin thickness <1 mm was 100% in roots with radicular grooves. The prevalence of dentin thickness <1 mm was 76.4% in roots without grooves.

The descriptive data about dentin thicknesses according to age and gender was shown in Table 1. There was no statistical difference among gender (p=0.051), and right and left sides (p=0.052) in buccal and palatal dentin thicknesses.

According to the one-way ANOVA test, there were differences between age groups in dentin thicknesses ($p<0.05$). Group 3 has higher dentin thickness than group 1 in palatal dentin thickness (p=0.012). Buccal dentin thickness of group 3 was higher than both group 1 (p=0.001) and group 2 (p=0.003).

The ICC for the measurements by two observers of dentin thicknesses of maxillary first premolars were 0.979 and 0.977, respectively ($p<0.001$ for ICC values).

Table 1. Buccal and palatal dentin thickness of maxillary first premolar by gender and age groups (G1: between 18-35 years, G2: between 36-65 years, G3: >65 years).

		Palatal thickness (mm)			Buccal thickness (mm)			
		Mean(±Std)	Minimum	Maximum	Mean(±Std)	Minimum	Maximum	P value
Max. first premolar (n=312)	G1	0.84 (±0.11)[a]	0.64	1.15	1.25 (±0.23)[a]	0.75	1.81	**0.016***
	G2	0.88 (±0.23)	0.71	1.13	1.27 (±0.19)[b]	0.76	1.84	
	G3	0.91 (±0.15)[a]	0.66	1.19	1.58 (±0.25)[a,b]	0.81	1.85	
	Male	0.90 (±0.26)	0.72	1.19	1.31 (±0.23)	0.78	1.85	
	Female	0.84 (±0.18)	0.64	1.11	1.23 (±0.18)	0.75	1.79	
	Left (#24)	0.87 (±0.21)	0.64	1.05	1.16 (±0.25)	0.81	1.77	
	Right (#14)	0.87 (±0.18)	0.67	1.19	1.38 (±0.29)	0.75	1.85	
	Total	**0.87 (±0.13)**	**0.64**	**1.19**	**1.28 (±0.25)**	**0.75**	**1.85**	

*Presented statistically significant difference (According to Student's t-test; $p<0.05$). Values presented with the same letter vertically means statistically significant differences between groups (According to one-way ANOVA test; $P<0.05$).

Table 2. Previous studies about the prevalence of radicular grooves.

Study	Methodology	Racial origin	Sample size	Teeth	Prevalence
Lammertyn et al. (2009)	Section analysis	Argentinian	141	Maxillary first premolar	83%
Brooker et al. (1985)	Section analysis	North American	25	Maxillary first premolar	100%
Joseph et al. (1996)	Section analysis	Indian	100	Maxillary first premolar	62%
Awawdeh et al. (2008)	Section analysis	Jordanian	379	Maxillary first premolar	100%
Tamse et al.(2000)	Section analysis	Israeli	25	Maxillary first premolar	97%
Katz et al (2006)	Section analysis	Israeli	25	Maxillary first premolar	100%
Liu et al. (2021)	Micro-CT	Chinese	48	Maxillary first premolar	95.83%
Kfir et al. (2020)	CBCT	Israeli	246	Maxillary first premolar	58%
Li et al. (2013)	Micro-CT	Chinese	36	Maxillary first premolar	85.7%
Al-Shahrani et al. (2013)	Micro-CT	Arabian	23	Maxillary first premolar	100%
Gheorghiță et al. (2020)	Section analysis	Romanian	26	Maxillary first premolar	76.9%
Gher et al. (1980)	Section analysis	North American	45	Maxillary first premolar	78%
Our study	CBCT	Turkish	312	Maxillary first premolar	82.05%

Discussion

We found the prevalence of radicular groove was 82.05%. In the literature, the radicular groove in different populations was investigated by section analysis, CBCT, or micro-CT, and reported the prevalence of radicular groove was range from 58% to 100% (Table 2).[8-19] The radicular groove is thought of as a morphological or developmental formation.[24] Embryologically, if that is the precursor of two separate buccal roots, the same entity is expected to be on the buccal surface. However, most of the previous studies have reported no buccal groove on the buccal root.[8,9,12-18] Likewise, our study indicates no buccal groove in all maxillary premolars (0%). Only a few studies report buccal groove on the buccal root in some cases of their study sample.[25,26] In the development of maxillary premolar with two separate buccal roots, the embryological diagram grows eccentrically and forms two epithelial layers that will merge afterward instead of creating a developmental depression or groove from a single unit.[24] Further embryological studies that focused on this formation are needed to understand its biological and developmental factors in the process of development.

In literature, it was found that teeth with radicular grooves are more associated with advanced periodontal loss compared to teeth without grooves due to the difficulty of plaque control in the region corresponding to the radicular groove.[27] In the case of the 50% loss of interproximal bone, the radicular groove complicates the treatment and healing of periodontal disease because of the difficulty in reaching its location.[28] The presence of the radicular groove is challenging for periodontal treatment as well as for endodontic and restorative procedures. Considering the high prevalence found in our study, it can be thought that the long-term outcomes of periodontal treatment of these teeth are compromised.

We reported the dentin thickness in roots with grooves was 0.82 mm. In our study, it was observed that the dentin thickness in roots with radicular grooves was lower than in roots without grooves ($p<0.05$). Therefore, the null hypothesis was accepted. In previous studies using different methodologies, the dentin thickness corresponding to the radicular groove was reported as 0.78 mm-1.18 mm.[8-10,15,16,26] Our results were within the range reported in the literature. Differences reported in the literature can be explained by the fact that different methodologies and racial factors. Above all, studies have examined dentin thickness at different levels of root between furcation level and apex. Some studies divided the root between furcation and apex into three or four, some of the studies divided only the length where the groove was located.[8-10,15,16,26] However, in premolars, the furcation is located at different levels. The separation of roots can occur at the half of overall root length, at coronal third, or near apical portion.[27] Therefore, the cross-section in which the dentin thickness was measured corresponds to different levels at total root length. Since the root has a taper angle throughout all lengths, the dentin thickness according to levels is also different. Consequently, the various results can be

explained by the differences in anatomical parameters of methodologies.

In our study, the dentin thickness of group 3 (>65 years) was statistically higher than groups 1 and 2 ($p<0.05$). This can be explained by the fact that the increase of secondary dentin deposition with age.[28] The dept of radicular groove diminishes depending on cementum deposition with age. A previous study showed the deposition of cementum is greater in concave areas compared to convex areas.[19]

Our study indicated that palatal dentin thickness in buccal roots with radicular grooves is thinner compared to buccal dentin thickness. This result is in congruence with previous studies.[9,10, 26] Dentin thickness relative to buccal groove creates a challenging situation for endodontic treatment. The remaining dentin thickness after root canal preparation is closely associated with the tendency to generate fracture. Considering that vertical root fracture is one of the most common causes of tooth loss and that 56% of vertical root fractures occur in premolars, the clinical importance of anatomical formations in maxillary premolars is come out.[29]

A minimum of 1 mm dentin thickness is required for posts to preserve the integrity of the tooth.[23,30] A kidney-shaped cross-section is seen in roots with furcation grooves and particularly in the deepest part, it cannot provide adequate dentin for posts. As in our results, the dentin thickness of roots with groove is 0.82 mm that less than the dentin thickness required for posts. A more critical fact is the dentin thickness is already less than 1 mm before post space preparation and even canal instrumentation. After canal preparation, the dentin will be thinner and, subsequently, the tooth will be more prone to vertical root fracture. Because 1 mm dentin thickness is a critical threshold, we investigated the dentin thickness according to this value. We found the rate of the dentin thickness < 1 mm was 100% in roots with radicular grooves. The rate of the dentin thickness <1 mm was 76.4% in root without radicular grooves. This can be concluded that the roots with radicular grooves are riskier for fracture. However, in the clinic, endodontic and restorative processes are not performed according to "the tooth in average features". Thin dentin thickness in the root with or without a groove should be considered in post space preparation or canal instrumentation. A previous study found the rate of dentin thickness < 1 mm was 39% in maxillary first premolars with radicular grooves.[9] This result is lower than our study. This discrepancy can be explained by the differences in methodologies of the two studies. To our knowledge, the buccal roots of the maxillary first premolar are not generally recommended for post-core treatment.[30] This approach is confirmed with our results that the dentin thickness corresponding to the radicular groove was lower than 1 mm in all samples.

Internal anatomy is closely associated with external morphological properties of roots such as radicular grooves. Maxillary premolars with a radicular groove had a greater number of variations in their canal anatomy.[23] In a previous study investigating the three-dimensional shape of the root canal using micro-CT, it was concluded that a deeper radicular groove results in a more irregular canal morphology.[16] The irregularity of the canal affects canal instrumentation, irrigation, and filling.[31] We found 85.02% of radicular grooves in maxillary premolars, the potential irregularity of canal morphology should be considered in the endodontic treatment of maxillary premolars.

Dentin thickness corresponding to radicular groove was 0.82 mm, and it was <1 mm in all samples. This region can be assumed as a "danger zone", consequently, it should be avoided too vigorous instrumentation. It is recommended minimally invasive endodontics, for instance, anti-curvature preparation technique to prevent strip perforation. For restorative procedures, when the buccal root would receive post mandatorily, more conservative post forms are recommended.

The limitations of our study are low sample size and to use of CBCT to determine the radicular groove and to measure dentin thicknesses. However, the strength of our study is to be the first study to investigate radicular grooves in the Turkish subpopulation. Further studies are needed to examine the prevalence of radicular grooves in the Turkish population with a larger sample size and more detailed methodologies like micro-CT or section analysis.

Conclusions

Within the limitation of this study, we showed several conclusions; (1) radicular groove rate on maxillary first premolars was high (82.05%), (2) palatal dentin thickness relative to radicular groove was lower than dentin thickness on roots without radicular grooves, (3) buccal dentin thickness is higher than the palatal thickness on the buccal root, (4) buccal root of maxillary premolar was considered "danger zone", for this root, anti-curvature preparation techniques, and more conservative post form should be considered.

Conflicts of Interest

The authors of the present study declare no conflict of interest.

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Cumhuriyet Dental Journal, 25(Suppl): 13-18, 2022
DOI: https://doi.org/10.7126/cumudj.1025444

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Reasons of Dental Volumetric Tomography Requests in a Faculty of Dentistry#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 10/12/2021
Accepted: 12/01/2022

ABSTRACT

Objectives: Examining the reasons for the request of Dental Volumetric Tomography (DVT) by physicians may be beneficial in terms of improving the technique by determining the usage areas in dentistry faculties. The aim of this study is to examine the causes of DVT requests in patients who applied to the faculty of dentistry, and the distribution of these requests according to department, age and gender.

Material and Methods: In this study, Dental Volumetric Tomography (Veraviewapocs 3D R100 (J. Morita Corp., Kyoto, Japan)) request forms of 1571 patients between 2016-2019, taken at the Department of Oral, Dental and Maxillofacial Radiology of the Faculty of Dentistry of X University, were retrospectively analyzed. The age and gender of the patients included in the study, the reasons for requesting DVT and the departments requesting DVT were recorded. Chi-square test was applied on the obtained data to evaluate the relationship between descriptive statistics and reasons for desire age and gender. SPSS 22.0 Package Data Program (SPSS 22.0 Software Package Program, Inc. Chicago, IL, ABD) was used as statistical software in the study.

Results: Of the 1571 patients included in the study, 836 were female and 735 were male, and the mean age was 40.44±0.624 and 39.93±0.683 respectively. Considering the reasons for the DVT request of the patients included in the study, it is seen that the most requests were made for the evaluation of pre-operative implant planning (29.5%), the lesion (20.6%), and the third molar (11.6%) impacted in the mandible, respectively. In addition to these, a total of 26 different causes of DVT were identified, such as TMJ, sinus and trauma evaluations. When we look at the relationship between the reasons for the request and gender in the whole patient group, a significant difference was found compared to the chi-square test.

Conclusions: With the use of DVT in dentistry, its diagnosis and diagnosis capacity has started to develop rapidly. DVT, which enables three-dimensional imaging, enables the evaluation of anatomical structures in the head and neck region with its high resolution capacity. The use of Dental Volumetric Tomography in dentistry is increasing day by day due to its advantages such as giving clear images in terms of radiographically and examining the obtained sections from different angles.

Keywords: Dental Volumetric Tomography, İndication, İmplant Planning, Lesion.

Bir Diş Hekimliği Fakültesindeki Dental Volumetrik Tomografi İstek Nedenleri#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 10/12/2021
Kabul: 12/01/2022

ÖZ

Amaç: Diş hekimliği fakültelerinde Dental Volumetrik Tomografinin (DVT), hekimler tarafından istenme nedenlerinin incelenmesi, kullanım alanlarının belirlenerek, tekniğin geliştirilmesi açısından fayda sağlayabilir. Bu çalışmanın amacı, diş hekimliği fakültesine başvuran hastalardaki DVT istek nedenlerinin, bu isteklerin bölüm, yaş ve cinsiyete göre dağılımlarının incelenmesidir.

Gereç ve Yöntemler: Çalışmada, X Üniversitesi Diş Hekimliği Fakültesi Ağız, Diş ve Çene Radyolojisi Anabilim Dalında çekilmiş, 2016-2019 yılları arasındaki 1571 hastaya ait Dental Volumetrik Tomografi (Veraviewapocs 3D R100 (J. Morita Corp., Kyoto, Japan)) istek formları retrospektif olarak incelendi. Çalışmaya dahil edilen hastaların yaşı, cinsiyeti, DVT istenme nedenleri ve DVT talep eden bölümler kaydedildi. Elde edilen veriler üzerinde tanımlayıcı istatistikler ve istek nedenleri ile yaş ve cinsiyet arasındaki ilişkiyi değerlendirmek için ki-kare testi uygulandı. Çalışmada istatistiksel yazılım olarak SPSS 22.0 Paket Veri Programı (SPSS 22.0 Software Package Program, Inc. Chicago, IL, ABD) kullanıldı.

Bulgular: Çalışmaya dahil edilen 1571 hastanın 836'sı kadın, 735'i erkek olarak belirlendi ve sırasıyla yaş ortalamaları 40,44±0,624 ve 39,93±0,683 olarak tespit edildi. Çalışmaya dahil edilen hastaların DVT istem nedenlerine bakıldığında ise sırasıyla en çok pre-operatif implant planlaması değerlendirilmesi(%29,5), lezyon(%20,6) ve mandibulada gömülü üçüncü molar(%11,6) dişleri değerlendirmek amacıyla istemler yapıldığı görülmektedir. Bunların yanı sıra TME, sinüs ve travma değerlendirmeleri gibi toplamda 26 farklı DVT istem nedeni tespit edildi. Tüm hasta grubunda istem nedenlerinin cinsiyet ile ilişkisine baktığımızda ki-kare testine göre anlamlı bir fark tespit edilmiştir

Sonuç: Günümüzde DVT'nin diş hekimliğinde kullanılmaya başlanması ile tanı ve teşhis kapasitesi hızla gelişmeye başlamıştır. Üç boyutlu görüntülemeye olanak sağlayan DVT yüksek çözünürlük kapasitesiyle baş boyun bölgesindeki anatomik yapıların değerlendirilmesine olanak sağlar. Dental Volumetrik Tomografinin radyografik açıdan net görüntü vermesi ve elde edilen kesitlerin farklı açıdan incelenebilmesi gibi avantajlarından dolayı diş hekimliğinde kullanımı giderek artmaktadır.

Anahtar Kelimeler: Dental Volumetrik Tomografi, Endikasyon, İmplant Planlama, Lezyon.

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How to Cite: Geduk G, Haylaz E.(2022) Reasons of Dental Volumetric Tomography Requests in a Faculty of Dentistry, Cumhuriyet Dental Journal, 25(Suppl): 13-18.

Introduction

Radiological imaging is an important diagnostic method in addition to the clinical evaluation of dental patients. With the use of panoramic radiography, the same natural limitations as in all two-dimensional projections began to appear with diagnostic losses in the increasing demands for radiographic imaging.[1] These diagnostic losses are magnification, superposition, inappropriate size changes, and misrepresentation of structures. Many advances have been made towards three-dimensional radiographic imaging (stereoscopy, computed tomography (CT)) and although CT is available, its use in dentistry has been limited due to its cost, accessibility, and dose values.[2]

The launching of dental volumetric tomography (DVT), which was developed specifically for imaging the maxillofacial region, provided a rapid transition from two-dimensional imaging to three-dimensional imaging and was a milestone in the field of dentistry.[3] Interest in DVT in all areas of dentistry has revolutionized maxillofacial imaging, expanding the role of imaging from diagnosis to image guidance of operative and surgical procedures.[2]

Unlike conventional tomography devices that are large, costly, and expensive to maintain, DVT is suitable for use in clinical dentistry applications because it is advantageous in terms of cost and dose.

DVT produces three-dimensional images that are useful for many oral and maxillofacial conditions and can guide the diagnosis and evaluation of diagnosis, treatment planning, application, and follow-up.[4] Among the usage areas, implantology, surgery, endodontic applications, orthodontics and temporomandibular applications can be shown.[5]

Examination of the reasons why DVT is requested by physicians in dental faculties may be beneficial in terms of developing the technique by determining its usage areas. The aim of this study is to examine the causes of DVT requests in patients who applied to the faculty of dentistry, and the distribution of these requests according to department, age and gender.

Material and Methods

Prior to the study, the approval of the Non-Interventional Clinical Research Ethics Committee of our University (2021/21 decision no.) was obtained. In the study, DVT request forms of 1571 patients between the years 2016-2019, taken at the Department of Oral, Dental and Maxillofacial Radiology of the Faculty of Dentistry of X University, were analyzed retrospectively. (Veraviewapocs 3D R100 (J. Morita Corp., Kyoto, Japan)). The age, gender, reasons for requesting DVT, and departments requesting DVT of the patients were recorded. The rates of requests for DVT by the departments, the most requested cases of DVT, and the mean age of patients who requested DVT were calculated.

Chi-square test was applied on the obtained data to evaluate the relationship between descriptive statistics and reasons for desire, age and gender. SPSS 22.0 Software Package Program (SPSS 22.0 Software Package Program, Inc. Chicago, IL, USA) was used as statistical software in the study.

Results

Of the 1571 patients included in the study, 836 were female and 735 were male, and the mean ages were 40.44±0.624 and 39.93±0.683, respectively (Table 1).

When the reasons for DVT request of the patients are examined, the most requests are seen due to evaluation before implant planning (29.5%), evaluation of lesions (20.6%) and evaluation of impacted third molars in the mandible (11.6%). In addition to these, a total of 26 different causes of DVT were identified, such as Temporomandibular Joint (TMJ), sinus and trauma evaluations (Table 2).

When we observe the distribution of the three most requested examinations by regions, we detected that both jaws and the entire maxilla mandible are seen most frequently in the preoperative implant evaluation, while the distribution of the lesions is most frequently requested from the posterior region of the mandible (Table 3).

When we observe the relationship between the reasons for request and gender in the whole patient group, a significant difference was found compared to the chi-square test ($p<0.05$) (Table 2). Among the reasons for the request, we detected a gender distribution in favor of women, especially in maxillary impacted wisdom teeth, sinus examinations, root resorption and root canal morphology evaluations.

The patient group included in the study was divided into three groups in terms of age 0-30, 31-60, 61-90 for ease of examination. When we examined the relationship between the causes of DVT requests and age, a statistically significant difference was found ($p<0.05$) (Table 4).

When the distribution of the clinics that made the request was examined, it was determined that the Oral, Dental and Maxillofacial Surgery Clinic made the request with the highest number of 1171 patients among 1571 patients, followed by the Endodontics with 222 patients, Periodontology with 96 patients, Pediatric Dentistry with 48 patients and Orthodontics Clinic with 3 patients.

Table 1. Age-Gender Analysis

Gender	N	Mean	Std. Deviation	Minimum	Maximum
Female	836	40.44	0.624	4	89
Male	735	39.93	0.683	4	88
Total	1571	40.20	0.461	4	89

Table 2. Reasons for requesting DVT

DVT reasons	Number of People		Percent
	Female	Male	
Preoperative Implant Planning Evaluation	260	204	29.5%
Postoperative Implant Evaluation	2	2	0.3%
Evaluation of Impacted Mandibular Third Molars	96	87	11.6%
Evaluation of Impacted Maxillary Third Molars	33	17	3.2%
Evaluation of Mandibular Impacted Canines	15	15	1.9%
Evaluation of Maxillary Impacted Canines	63	48	7.1%
Evaluation of Lesions	165	159	20.6%
Temporomandibular Joint Evaluation	7	3	0.6%
Sinus Evaluation	8	15	1.5%
Evaluation of Other Impacted Teeth	42	41	5.3%
Trauma	9	20	1.8%
Evaluation of Supernumerary Teeth	20	29	3.1%
Evaluation of Mesiodens Teeth	14	26	2.5%
Radix	4	8	0.8%
Evaluation of Cleft Lip And Palate	2	1	0.2%
Paresthesia	2	3	0.3%
Oroantral Fistula	3	4	0.4%
Evaluation of Fracture Canal Instrument Location	3	5	0.5%
Evaluation of Soft Tissue Lesions	1	0	0.1%
Vertical Fracture Assessment	16	12	1.8%
Assessment of Root Resorption	18	7	1.6%
Root Canal Morphology Evaluation	46	24	4.5%
Presence of Foreign Body in The Sinus	0	1	0.1%
Dens Invajinatus	1	1	0.1%
Fusion	1	0	0.1%
Follow-Up Evaluation After Root Canal Treatment	5	3	0.5%
Total	**1571**		**100.0%**
	p=0.032		

Table 3. Frequency of DVT by requested regions

Request Reason	MAXA	MAXP	MAXAP	MANA	MANAP	MANAP	MM	Total
Preoperative Implant Planning Evaluation	28 (6%)	43 (9.3%)	89 (19.2%)	11 (2.4%)	74 (15.9%)	92 (19.8%)	127 (27.4%)	464
Evaluation of Impacted Mandibular Third Molars	0	0	0	0	183 (100%)	0	0	183
Evaluation of Lesions	77 (23.8%)	65 (20.1%)	17 (5.2%)	9 (2.8%)	140 (43.2%)	12 (3.7%)	3 (0.9%)	324

MAXA: Maxilla Anterior; MAXP: Maxilla Posterior; MAXAP: Maxilla Anterior Posterior; MANA: Mandible Anterior; MANAP: Mandible Posterior; MANAP: Mandible Anterior Posterior; MM: Maxilla Mandible

Discussion

In our study, the causes of DVT requests and the clinical divisions of these requests, their distribution according to age and gender were examined. Of the request forms included in the study, 836 were requested from female patients and 735 from male patients. The mean age of the female patients was 40.44 and the mean age of the male patients was 39.93.

Among the clinical departments, the Oral, Dental and Maxillofacial Surgery Clinic became the clinic with the highest number of requests with 1171 requests Among the reasons for requesting DVT in the Oral, Dental and Maxillofacial Surgery Clinic; evaluation of third molars and impacted teeth, examination of the placement of the mandibular canal, implant planning, evaluation of formations such as cysts and tumors, and inflammatory conditions in the jaws can be counted.[6]

Anatomical structures should be examined first in order to plan a successful implant. Knowing the anatomy of the mandibular canal, mental foramen and maxillary sinus, as well as examining the bone thickness and height in edentulous areas, is of great importance in determining the position of the implant to be placed in the mouth.[7] The statistical data of our study showed that requests for the evaluation of preoperative implant

planning accounted for 29.5% of all DVT requests. Preoperative implant evaluation is at the top of all requests. In addition, DVT was requested from the Periodontology clinic in order to select the appropriate areas in the bone before the implant surgery, to make the correct measurements, to determine the number and size of the implants to be placed, and to evaluate the adjacent anatomical structures such as the maxillary sinuses and inferior alveolar nerve. In the study of Tarım *et al.*[8], the reasons for the request for implant planning were reported as 25.19%, while Menziletoğlu *et al.*[9]'s study, this rate was reported as 43.12%. Especially in the maxillary posterior region, excessive trabeculation of the alveolar bone, the position of the maxillary sinuses, and sinus pneumatization after tooth extraction may result in failures in implant applications.[10] In the mandible, complications may occur during implant applications in the mandibular posterior region as a result of the inferior alveolar nerve being close to the alveolar crest and the incomplete location of the mandibular canal.[11] For the evaluation of pre-operative implant planning, 9.3% of the DVT requests were requested from the posterior region of the maxilla and 15.9% from the posterior region of the mandible. In the evaluation of pre-operative implant planning, the least requested region was the anterior region of the mandible. In the anterior region of the mandible, the anterior extension of the mandibular canal creates a formation called the 'anterior loop'. Concavities formed in the symphysis region are information that should be considered during implant applications.[12]

When evaluating pathological lesions, panoramic and periapical radiographs are insufficient to evaluate the lesion in three dimensions. In cases where two-dimensional imaging methods are insufficient, it is recommended to take DVT from patients in order to evaluate pathological lesions.[13] With DVT, it is possible to evaluate cysts, tumors and similar lesions in the jaw bones in three dimensions. The dimensions of pathological lesions, their localization, their proximity to anatomical formations and the internal structure of the lesions can be evaluated.[14] It was determined that the rate of DVT desired for imaging the lesions occurring in the jaws was 20.6%, and it took the second place among the reasons for request. In the study of Akarslan *et al.*[15], DVT request evaluation for the evaluation of lesions took the second place in line with our study. In our study, 43.2% of the reasons for the request for the evaluation of lesions were requested from the posterior region of the mandible, and the most desired region was the posterior mandible for evaluation. The rate of DVT desired for the evaluation of lesions in the maxilla anterior region was in the second place with 23.8%. Menziletoğlu *et al.* found this rate as 51.83% for the posterior region of the mandible.

Table 4. Distribution of reasons for request by age groups

DVT reasons	Age Groups			Total
	0-30	31-60	61-90	
Preoperative Implant Planning Evaluation	118	259	87	464
Postoperative Implant Evaluation	1	3	0	4
Evaluation of Impacted Mandibular Third Molars	60	91	32	183
Evaluation of Impacted Maxillary Third Molars	17	24	9	50
Evaluation of Mandibular Impacted Canines	13	13	4	30
Evaluation of Maxillary Impacted Canines	40	52	19	111
Evaluation of Lesions	122	164	38	324
Temporomandibular Joint Evaluation	4	6	0	10
Sinus Evaluation	6	13	4	23
Evaluation of Other Impacted Teeth	38	36	9	83
Trauma	11	12	6	29
Evaluation of Supernumerary Teeth	30	17	2	49
Evaluation of Mesiodens Teeth	14	18	8	40
Radix	5	4	3	12
Evaluation of Cleft Lip And Palate	1	2	0	3
Paresthesia	2	2	1	5
Oroantral Fistula	2	3	2	7
Evaluation of Fracture Canal Instrument Location	5	2	1	8
Evaluation of Soft Tissue Lesions	0	1	0	1
Vertical Fracture Assessment	8	15	5	28
Assessment of Root Resorption	9	13	3	25
Root Canal Morphology Evaluation	20	40	10	70
Presence of Foreign Body in The Sinus	0	1	0	1
Dens Invajinatus	1	0	1	2
Fusion	0	0	1	1
Follow-Up Evaluation After Root Canal Treatment	5	2	1	8
Total	**532**	**793**	**246**	**1571**
			p=0.022	

The close relationship of the roots of the mandibular third molars with the mandibular canal poses a risk during dentoalveolar surgery. Pinpointing the mandibular canal provides a safer approach to tooth extraction and root

elevation. Therefore, it is important to take DVT in addition to periapical and panoramic radiographs to evaluate the close relationship of the mandibular canal and mandibular third molars.[16] In this study, the evaluation of the relationship between the impacted mandibular third molar teeth and the mandibular canal ranks third with 183 DVT requests, and the majority of these patients are in the 31-60 age group. In the literature review by De Vos *et al.*, they reported that the use of DVT in clinical practice is most commonly used in the examination of impacted teeth and implantology. In the study of Akarslan *et al.*, DVT, which was requested to evaluate the relationship of impacted mandibular third molars with the mandibular canal, was ranked third. Except for the evaluation of the impacted mandibular third molars, a request was made for the evaluation of the most impacted maxillary teeth. The least desirable reason was to evaluate impacted mandibular canine teeth.

Panoramic radiographs are widely used for the diagnosis of pathologies such as retention cysts, polyps and tumors in the maxillary sinüs. However, a definitive diagnosis cannot always be made with panoramic radiographs. Determining the state of the maxillary sinuses is important for implant planning. DVT gives us important information on sinus floor augmentation in cases where there is insufficient bone height.[18] DVT gives better results than other radiographs to evaluate odontogenic maxillary sinus inflammation, the spread of periapical lesions to the maxillary sinus, and endodontic-induced maxillary sinus disorders.[19] In our study, DVT was requested from 23 patients to evaluate the sinuses, and these requests consisted of 8 female and 15 male patients. Although it had a rate of 1.5% among all requests, the rate of DVT requested for sinus evaluation was found to be low.

The structure of the bony components of the TMJ, cortical bone integrity, bone formation and destruction in the subcortical bone, developmental anomalies of the TMJ, fractures, and pathological changes such as ankylosis can be better evaluated with DVT compared to conventional radiographs.[20] In our study, only 10 patients requested DVT for TMJ evaluation.

Evaluation of root canal morphology, root resorptions, dentoalveolar trauma, dental anomalies, evaluation of periapical lesions, evaluation before endodontic surgery, determination of the position of the broken instrument are the purposes of DVT in endodontics.[21] A good determination of root canal anatomy directly affects the success of endodontic treatment. Matherne *et al.*[22], in a study comparing direct and indirect digital systems with DVT to determine the number of root canals in 72 extracted teeth, stated that endodontists could not find at least one canal in 40% of teeth, despite taking parallel radiographs with digital radiographs. In our study, the Endodontics Clinic requested DVT from 222 patients, and it was seen that 70 of them were in the first place to evaluate the root canal morphology. In the second place, it was determined that a request was made for the evaluation of vertical root fractures. In a case report, Ball *et al.*[23], they performed root canal treatment in a 64-year-old female patient with the diagnosis of symptomatic apical periodontitis on the right maxillary second premolar tooth, but when the DVT image was taken, they determined that there was vertical bone loss and fracture along the lingual of the root. In another study, Estrela *et al.*[24] performed with 48 periapical radiographs and DVT scans in 40 patients, they noted that while DVT scans showed 100% of the lesions, 68.8% of the lesions could be detected on periapical radiographs. In our study, requesting DVT for the evaluation of root resorption is in the 3rd place among the requests made from the Endodontics Clinic.

DVT evaluation requested for the indications of the Pedodontic Clinic consisted of 48 patients. Evaluation of impacted supernumerary and mesiodens teeth was the first among the reasons for DVT requests in this clinic. In addition, DVT was requested for the evaluation of the eruption path of impacted teeth, root resorptions, dental anomalies, and dentoalveolar trauma. Ertaş *et al.*[8] reported that among the causes of DVT requests, impacted tooth cases were included in the first place in order to determine the direction of eruption, position and whether there was resorption in adjacent teeth. Kolçakoğlu *et al.*[25] reported in their study that the most common cause of DVT requests in children was for the purpose of anatomical-morphological evaluation.

Orthodontic Clinic was the clinic that has the least request among the clinics that made the request with 3 patients. Indications for use of DVT in orthodontics include the positions of impacted teeth, root resorption, orthodontic implant placement, evaluation of individuals with cleft lip and palate, three-dimensional evaluation of asymmetries and upper respiratory tract.[26] DVT request has never been made from Prosthetic and Restorative Dentistry Clinics.

Conclusions

Today, with the use of DVT in dentistry, its diagnosis and diagnosis capacity has started to develop rapidly. DVT, which enables three-dimensional imaging, enables the evaluation of anatomical structures in the head and neck region with its high-resolution capacity.[27] The maxillofacial region is used in the diagnosis and treatment planning of anatomical and pathological structures, evaluation of the temporomandibular joint, implant planning and many other areas. This study shows that the role of DVT in Oral, Dental and Maxillofacial Surgery, Periodontology, Endodontics, Orthodontics and Pediatric Dentistry clinics is important.

Acknowledgment

No funding was received for this study.

Conflicts of Interest

None of the authors of this article has any relationship, affiliation or financial interest regarding the subject or material mentioned in the article.

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Cumhuriyet Dental Journal, 25(Suppl): 19-23, 2022
DOI: https://doi.org/10.7126/cumudj.1026813

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Examination of the Relationship Between Concha Bullosa with Nasal Septum Deviation and Maxillary Sinus Pathologies Using Cone-Beam Computed Tomography#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 10/12/2021
Accepted: 12/01/2022

ABSTRACT

Objective: To evaluate the relationship between concha bullosa (CB) and nasal septum deviation (NSD) with maxillary sinus pathologies with cone-beam computed tomography (CBCT).

Materials and Methods: The whole face CBCT data of 700 (383 male and 317 female) patients aged between 6-92 years who applied to Gaziantep University Faculty of Dentistry Department of Dentomaxillofacial Radiology for any reason between 2017-2019 was evaluated retrospectively. CB, NSD and maxillary sinus pathologies were investigated on the images.

Results: NSD was found as 64.3%, concha bullosa as 27.9% on the right, 24.1% on the left, and maxillary sinus pathologies were 48.6% on the right and 44.4% on the left. While NSD was towards the left, the absence of right concha bullosa was found to be significant. No significant relationship was observed between the presence of CB and maxillary sinus pathologies. There was no significant relationship between NSD and maxillary sinus pathologies.

Conclusions: There was a significant relationship between the presence of CB and NSD, but the presence of CB had no effect on maxillary sinus pathologies. CBCT is an important diagnostic tool in the evaluation of the anatomical variations of the osteomeatal complex and three-dimensional examination of maxillary sinus.

Keywords: Concha bullosa, nasal septum deviation, maxillary sinus pathologies, cone-beam computed tomography.

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How to Cite: Aslan Öztürk EM, Yalçın ED. Examination of the Relationship Between Concha Bullosa with Nasal Septum Deviation and Maxillary Sinus Pathologies Using Cone-Beam Computed Tomography. Cumhuriyet Dental Journal, 25(Suppl):19-23.

Introduction

Concha bullosa (CB) is the pneumatization of the middle turbinate, which normally does not contain air. It is possible for the upper and lower turbinates to be pneumatized, but this is very rare.[1] CB is the most common anatomical variation in the region of the osteomeatal complex (OMC), and although the exact cause of its formation is unknown, it is thought that the course of airflow in the nasal cavity has an important role in its formation.[2] The nasal septum is formed by the union of the septal cartilage and the vomer.[3] The causes of nasal septum deviation (NSD) include intrauterine, perinatal and postnatal traumas, developmental defects, growth anomalies of facial structures, congenital deformities, finger sucking, mouth breathing and pressure applied to the palate with the tongue.[4,5] The presence of CB may cause a broad-based curvature of the nasal septum. Anatomical variations can narrow or block the OMC.[6, 7] Anatomical variations of the OMC predispose to infection. This causes focal symptoms in some patients and accordingly maxillary sinus pathologies may occur.[8] The maxillary sinuses are the largest of the four paranasal sinuses located lateral to the nasal cavity, connected to the ostium and the nasal cavity, and are in close anatomical relationship with the maxillary teeth.[9] Apical surgery, removal of impacted teeth in the posterior maxilla, application of dental implants, endoscopic sinus surgery carries the risk of affecting sinus integrity during other oral surgical procedures and surgical procedures

involving the paranasal sinuses such as rhinoplasty and may therefore cause pathological changes in the sinus.[10] Some osteomeatal obstructions, allergies, odontogenic infections, as well as concha bullosa and nasal septum deviation can cause maxillary sinus pathologies.[11] NSD and CB can cause headache by obstructing or compressing the nasal airway. These are often treated with surgical procedures. Very large CB may compress the uncinate process and obstruct the infundibulum. This is a major risk factor for ethmoid and maxillary sinus diseases. It is important to detect variations before hand in order to prevent possible complications in patients who are planned for endoscopic surgery.[12]

Cone-beam computed tomography (CBCT) is one of the most preferred imaging systems to evaluate the anatomical structure of the head and neck region. According to computed tomography; CBCT is recommended for three-dimensional imaging of the maxillary sinuses and nasal cavity due to its advantages such as lower radiation dose, higher image quality, and less metal artifact caused by dental restorations.[13]

The aim of this study is to retrospectively examine CB and NSD with maxillary sinus pathologies on CBCT images and evaluate the relationship between them.

Materials and methods

Before the study, the ethical approval was obtained from Clinical Researches Ethics Committee of Gaziantep University (Protocol No: 2020/358). In this study, CBCT images of asymptomatic patients aged 6-92 years who underwent CBCT for any reason with the Planmeca Promax 3D (Helsinki, Oy, Finland) CBCT device between 2017-2020 in Gaziantep University Faculty of Dentistry Department of Dentomaxillofacial Radiology were used. Multiplanar images were obtained from 16×9, 16×16 FOV (field of view) with 0.4 mm^3 voxel size and 1 mm slice thickness. Romexis Viewer (Planmeca, Helsinki, Finland) software was used to evaluate the images in the coronal, sagittal and axial planes. Inclusion criteria were CBCT images in which the paranasal sinuses could be examined in the study area and no distortion, magnification, artifact, and foreign bodies were seen. Exclusion criteria; syndrome and facial growth disorder, presence of metabolic disease involving the bone, presence of cyst, tumor and fracture line in the examination area, presence of cyst affecting the maxillary sinuses, tumor and trauma in the maxillofacial region, odontogenic infection.

Image Analysis

Romexis software (Helsinki, Oy, Finlandiya) was used to analyze the images. On CBCT images, the presence of nasal septum deviation, concha bullosa and maxillary sinus pathology were investigated (Figure 1). Maxillary sinus pathologies were categorized as localized mucosal thickening, generalized mucosal thickening, polypoidal mucosal thickening, partial opacification and total opacification (Figure 2). All data were evaluated as right and left.

Statistical Analysis

The kappa statistics was applied to calculate the inter-observer and intra-observer agreement. The Chi-square test was used to examine the relationships among the categorical variables. SPSS software version 22.0 (IBM Corp, Armonk, NY) was used to analyze the data. Statistical significance was accepted as $p < 0.05$.

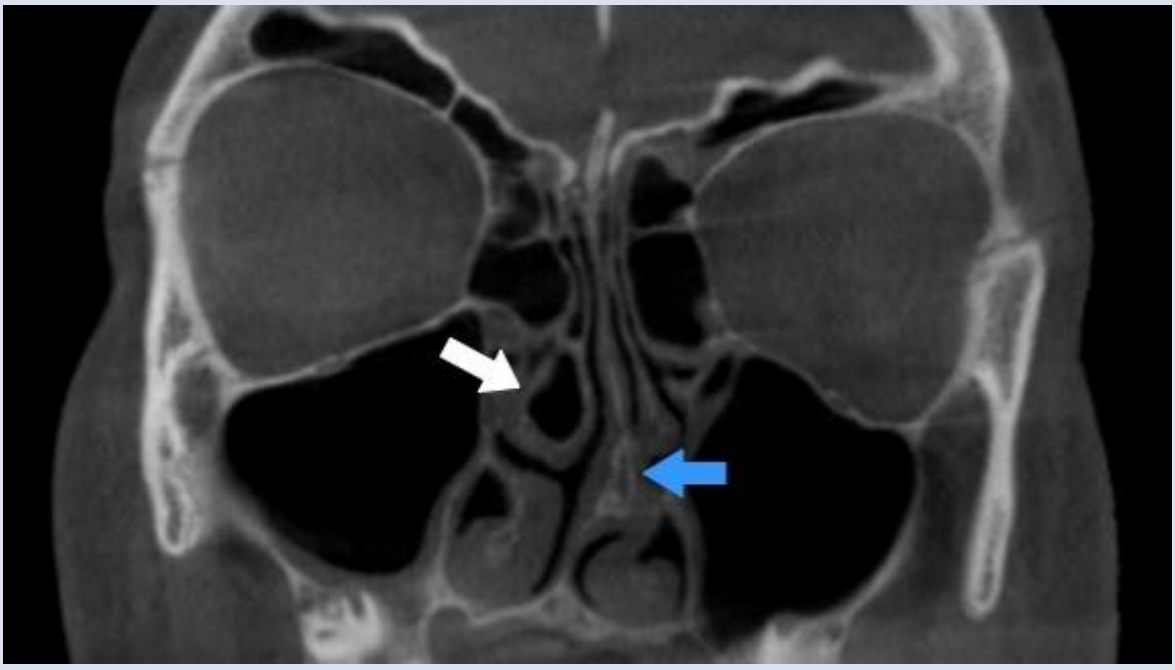

Figure 1. Coronal CBCT image; right concha bullosa (white arrow) and nasal septum deviation to the left (blue arrow).

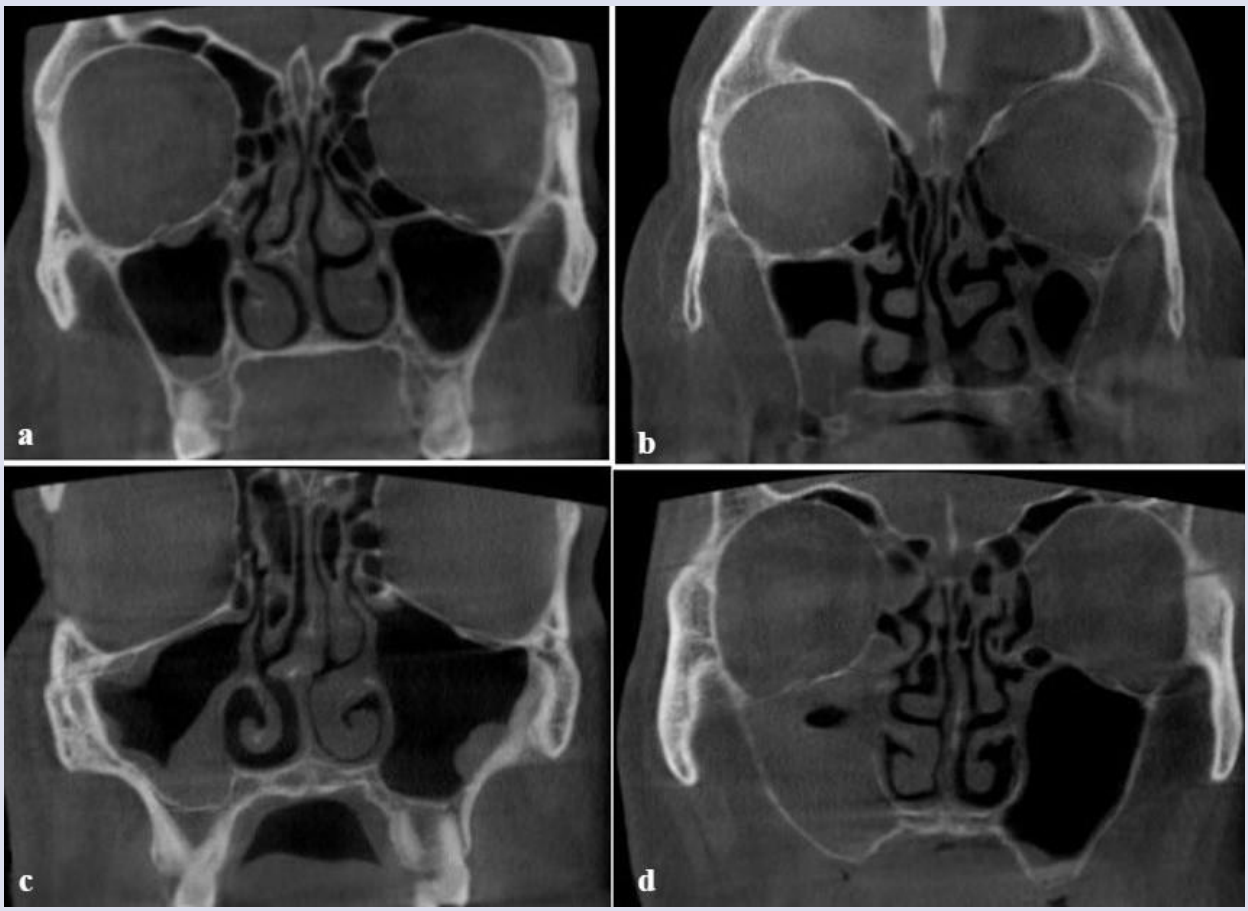

Figure 2. Maxillary sinus pathologies on coronal CBCT images; a. Localized mucosal thickening in the right maxillary sinus, b. Partial opacification in the right maxillary sinus and generalized mucosal thickening in the left maxillary sinus, c. Partial opacification in the right maxillary sinus and polypoidal mucosal thickening in the left maxillary sinus, d. total opacification in the right maxillary sinus.

Results

All evaluations were performed by two dentomaxillofacial radiologists, one is research assistant (EMAO), the other with eight year experience (EDY). Evaluations of two observerswere repeated with an interval of 2 weeks, and the intra and inter-observer reliability coefficient for all the assessments was found to be excellent (0.93 and 0.88, respectively). A total of 700 CBCT images of 383 (54.7%) males and 317 (45.3%) females, aged 6-92 years (with a mean age of 44±18) were investigated. In the analyzed images; NSD was detected with a rate of 64.3%. The direction of NSD was observed as 28.6% on the right and 35.7% on the left. CB was 27.9% on the right, 24.1% on the left, and maxillary sinus pathology was observed with a rate of 48.6% on the right and 44.4% on the left (Table 1). The most common maxillary sinus pathology is localized mucosal thickening with a rate of 27.4% on the right and 24.4% on the left and the least common maxillary sinus pathology is generalized mucosal thickening with a rate of 1.6% on the right and 1.3% on the left. When the relationship with gender is examined; the absence of right CB was found to be significant in males ($p < 0.05$). In addition, it was observed that the presence of right and left maxillary sinus pathology was significant in males ($p < 0.001$) (Table 2). It was determined that the NSD was to the left, while the absence of the right CB was significantly higher ($p < 0.05$) (Table 3). No significant correlation was observed between the presence of CB and maxillary sinus pathology ($p > 0.05$) (Table 4).

Table 1. The frequency of concha bullosa, nasal septum deviation and maxillary sinus pathologies.

Variables	Present N (%)	Absent N (%)
Nasal Septum Deviation	450 (64.3)	250 (35.7)
Right Concha Bullosa	195 (27.9)	505 (72.1)
Right Maxillary Sinus Pathology	340 (48.6)	360 (51.4)
Left Concha Bullosa	169 (24.1)	531 (75.9)
Left Maxillary Sinus Pathologies	311 (44.4)	389 (55.6)

Table 2. Distribution of concha bullosa and maxillary sinus pathologies by gender.

		Female		Male		P
		Present N (%)	Absent N (%)	Present N (%)	Absent N (%)	
Right	Concha Bullosa	101 (14.4)	216 (30.9)	94 (13.4)	289 (41.3)	0.032*
	Maxillary Sinus Pathologies	117 (16.7)	200 (28.6)	223 (31.9)	160 (22.9)	0.001*
Left	Concha Bullosa	86 (12.3)	231 (33.0)	83 (11.9)	300 (42.9)	0.093
	Maxillary Sinus Pathologies	109 (15.6)	208 (29.7)	202 (28.9)	181 (25.9)	0.001*

Chi-square test; *p < 0.05

Table 3. Correlations between side of nasal septum deviation and concha bullosa.

Side of Nasal Septum Deviation	Right Concha Bullosa		P	Left Concha Bullosa		P
	Present N (%)	Absent N (%)		Present N (%)	Absent N (%)	
Right	54 (7.7)	146 (20.9)		53 (7.6)	147 (21.0)	
Left	58 (8.3)	192 (27.4)	0.042*	55 (7.9)	195 (27.9)	0.871
Absent	83 (11.9)	167 (23.)		61 (8.7)	189 (27.0)	

Chi-square test; *p < 0.05

Table 4. Correlations between concha bullosa and maxillary sinus pathologies.

Right Maxillary Sinus Pathologies	Right Concha Bullosa		P	Left Maxillary Sinus Pathologies	Left Concha Bullosa		P
	Present N (%)	Absent N (%)			Present N (%)	Absent N (%)	
Present N (%)	92 (13.1)	248 (35.4)	0.647	Present N (%)	71 (10.1)	240 (34.3)	0.468
Absent N (%)	103 (14.7)	257 (36.7)		Absent N (%)	98 (14.0)	291 (41.6)	

Chi-square test; *p < 0.05

Discussion

Anatomical variations in the OMC predispose to infection and cause focal symptoms in some patients. NSD and CB cause obstruction of the OMC by altering the normal airflow and mucus drainage pathways. Maxillary sinusitis occurs due to this obstruction.[14,15]

When comparing panoramic radiography and CBCT in the evaluation of maxillary sinus and nasal cavity anatomy, CBCT provides valuable information in the examination of sinonasal bone anatomy with its success in three-dimensional imaging. Compared to computed tomography, the isotropic voxel in CBCT prevents distortion in multiplanar reconstruction images, and it is an important advantage that the radiation dose is less than computed tomography.[16]

In the study by Shokri *et al.*[17], CBCT images of 250 patients were scanned to evaluate the anatomical variations of the nasal cavity and ethmoid sinuses; CB was observed in 34.8%, nasal septum deviation was determined in 90.4%. A significant relationship was found between the presence of CB and NSD. In the study conducted by Khojastepour *et al.*[18], CBCT images of 281 patients who requested rhinoplasty were examined for the presence of OMC variations and mucosal thickening; CB was detected in 67.3%, NSD in 49.5% and mucosal thickening in 60.7%. The presence of mucosal thickening was also found to be significant in males. In addition, there is no significant relationship was stated between the presence of CB and NSD and mucosal thickening. In the study conducted by Köse *et al.*[19], CBCT images of 200 patients were examined in terms of NSD, CB, OMC, odontogenic lesions related to the maxillary sinus and mucosal thickening; CB was detected to be 50%, NSD was 59.5%, and mucosal thickening was 56%. No statistically significant correlation was observed between CB, NSD and mucosal thickening. In addition, no significant difference was found between gender and CB, NSD and mucosal thickening. In present study, NSD was determined 64.3%, CB 26% and maxillary sinus pathology 46.5%, and a relationship was found between CB and NSD. However, no significant relationship was observed between CB and maxillary sinus pathology, and between NSD and maxillary sinus pathology. Considering the gender, it was stated that the presence of maxillary sinus pathology was significant in males in our study. It is thought that this difference is due to the difference in the distribution of anatomical variations that cause maxillary sinus pathology between genders. The reason for the differences between these studies; may be due to sample size and anatomical differences between races. In this regard, it is recommended to conduct multicenter studies in different populations to examine the relationship between the surrounding anatomical variations and the maxillary sinus.

Conclusions

In conclusion, there was a significant relationship between the presence of CB and NSD, but the presence of CB had no effect on maxillary sinus pathologies. CBCT is an important diagnostic tool in the three-dimensional evaluation of the anatomical variations of the OMC and the maxillary sinus. Due to the anatomical proximity of the

maxillary sinus and nasal cavity, anatomical variations such as CB and NSD may be a predisposing factor in the development and recurrence of maxillary sinus pathologies, and detecting their presence may significantly affect the prognosis. Radiological evaluation of these variations before surgical interventions for the maxillary sinus and nasal cavity will reduce possible complications of surgery.

Funding

No funding resource is associated with this study.

Conflict of Interest

The authors declare that they have no conflict of interest

Ethical Approval

This retrospective study was approved by Ethical Committee of Gaziantep University (Decision No: 2020/358) and conducted in the Dentomaxillofacial Radiology Department of Gaziantep University, Faculty of Dentistry.

Informed Consent

Formal consent is not required.

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Cumhuriyet Dental Journal, 25(Suppl): 24-28, 2022
DOI: https://doi.org/10.7126/cumudj.1029957

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Evaluation of Antegonial Angle, Antegonial Depth and Gonial Angle in Sex Prediction in the Turkish Pediatric Population of the Eastern Mediterranean Region#

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Research Article

Acknowledgment

#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History
Received: 29/11/2021
Accepted: 01/02/2022

ABSTRACT

Objectives: In this study, it was examined whether antegonial angle (AGA), antegonial depth (AGD), and gonial angle (GA) are associated with sex in a Turkish pediatric sample to be able to determine a reliable method for sex estimation in children.

Materials and Methods: The study was retrospectively carried out on panoramic radiographs previously taken for children's dental treatments for different reasons. An oral and maxillofacial radiologist measured AGA, AGD, and GA on the right and left sides on panoramic radiographs, and their mean values were calculated.

Results: The mean age of 197 children was 11.5±1.28 years. The results revealed that AGA and AGD significantly differed between the children by sex. However, it was not the case for GA by sex.

Conclusions: Overall, it was concluded that AGA and AGD can be used to estimate sex in the Turkish pediatric population from the Eastern Mediterranean region; nevertheless, GA is not reliable.

Keywords: Sex Prediction, Panoramic Radiography, Child, Adolesan, Mandible.

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How to Cite: Temur KT, Soğukpınar Önsüren A. (2021) Evaluation of Antegonial Angle, Antegonial Depth and Gonial Angle in Sex Prediction in the Turkish Pediatric Population of the Eastern Mediterranean Region, Cumhuriyet Dental Journal, 25(Suppl): 24-28.

Introduction

Sex estimation is a crucial part of research in anthropology and forensic science.[1] In general, the sex of an unidentified person can be determined based on their anatomical features.[2] For sex xestimation, the skull is the most dimorphic and most easily sexed region of the skeleton following the pelvis. In cases where cranial bones are not intact, the mandible play an essential role in sex estimation as it is the most dimorphic, largest, and strongest bone of the skull.[3,4] On the other hand, the morphological features of the mandible vary by sex, occlusal status, age, and race.[1,5]

The sex of an unidentified person can be determined based on data from the morphology and metric features of the skull and mandible, soft tissues, forensic odontology, and DNA analysis of teeth.[6] In sex determination from bones, metric analyses on radiographs are often reported to be generally superior due to their objectivity, accuracy, and replicability.[7,8] Advances as modern panoramic radiography devices offer lower radiation dose and good image quality are particularly important in children and adolescents.[9] Although linear measurements can be made on panoramic radiographs in the literature, it is reported as a helpful method, especially for angular measurements.[10]

Sex differences in neonatal and juvenile skeletal morphology are considered insignificant compared to adults.[11] Apaydın *et al.*[12] report that reliable parameters are needed for sex estimation from juvenile mandibular remnants. On the other hand, it is known that skeletal features vary by population; therefore, population-specific standards should be established.[13]

In this study, it was evaluated whether antegonial angle (AGA), antegonial depth (AGD), and gonial angle (GA) differ by sex in a group of Turkish children from the Eastern Mediterranean region to reveal a reliable method to estimate sex in children.

Materials and Methods

The ethical approval for our study was granted by the Clinical Research Ethics Committee of Kahramanmaraş Sütçü İmam University (Meeting No: 2021\29, Decision No:05).

This present study was retrospectively carried out on panoramic radiographs taken for different reasons for dental treatments in the pedodontic clinic between 2019-2021. No additional radiographs were taken in the study. Panoramic radiographs with high image quality, which do not interfere with measurements that fully contain the study parameters, were included in the study. Yet, the radiographs of patients with facial asymmetry, craniofacial anomalies, orthognathic surgery, history of facial trauma, and temporomandibular joint disorder and the radiographs with low image quality were excluded from the study. Out of approximately 1100 radiographs, 197 selected according to study criteria were included in the study. The cases were evaluated by dividing them into 3 groups according to age.

The radiographs in this study were taken by the same staff on the GENDEX GDP -700 (Magnification 1.3) (Kavo Kerr, Biberach, Germany) device at 66 Kv, 6.3 mA 14 sec. in the child module following the manufacturer's recommendations.

AGA, AGD, and GA are the anatomical indices located in the mandible on panoramic radiographs. The panoramic radiograph was recorded on the computer in 2441x1149 pixels, 300 dpi resolution, 8-bit color depth and Joint Photographic Experts Group (JPEG) format. All measurements were made on a 15.6 inch HP LED display notebook (HP, Hq-TRE 71025, Germany) with a resolution of 1366 × 768 pixels in a dark room and silent.

An oral and maxillofacial radiologist measured these indices on the right and left sides using while the ruler tool Adobe Photoshop CS6 was used for linear measurements, the angle tool Image J (ImageJ, a public domain program; US National Institutes of Health, Bethesda, MD, https://imagej.nih.gov/ij/) was used for angular measurements.[14,15]

Mandibular indices included in the study:

- AGA: It was measured tracing to the angle of two lines parallel to the antegonial region which will intersect at the deepest point of the antegonial notch.[15] (Figure 1a)
- AGD: It was measured as the distance between a line parallel to the lower cortical border of the mandible and a line perpendicular to this line from the deepest point of the antegonial notch concavity.[15] (Figure 1b)
- GA: It was measured as the distance between a line tangent to the lower border of the mandible and another line tangent to the distal border of the ramus.[15] (Figure 1c)

To analyze intra-observer reliability, 30% of randomly selected panoramic radiographs were remeasured 2 weeks later.

Statistical Analysis

Statistical analyses were performed using the Jamovi (Version 1.0.4) software. Descriptive statistics (mean, standard deviation, minimum and maximum values, etc.) were calculated for all measurements. Wilcoxon test was used for differences between right and left measurements. Non-numeric data were presented as numbers and percentages. One-way analysis of variance (ANOVA) was performed to reveal the link between the all measurements by sex and age.

Spearman correlation analysis was used to assess Metrics correlation in within-observer measures. In all analyses, a probability level of <0.05 was considered statistically significant.

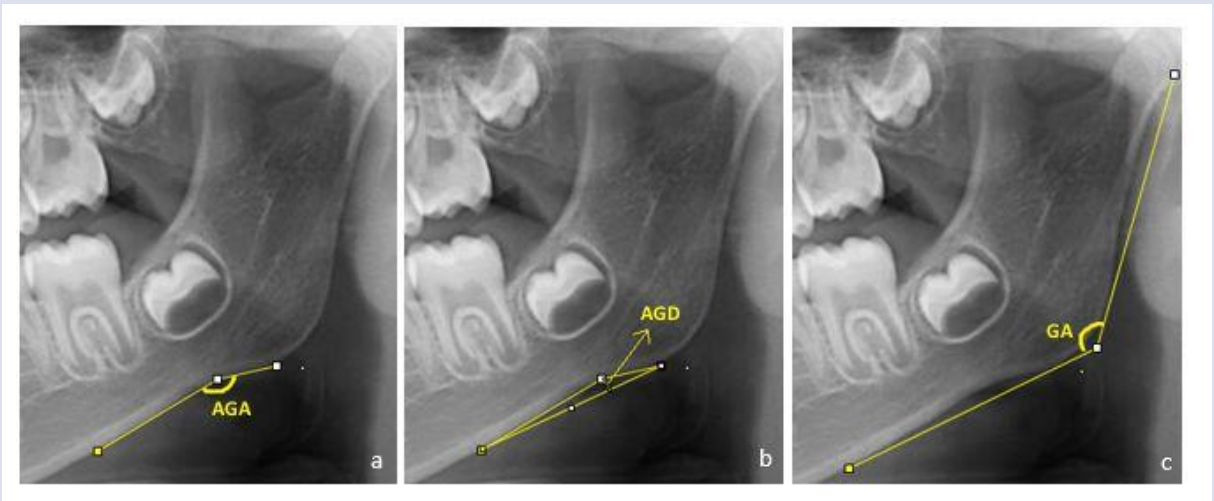

Fig 1a, b, c: AGA, AGD and GA measurement in panoramic radiography

Results

The mean age of 197 patients aged between 4 and 15 years was 11.5±1.28 years. The number of men included in the study was 109, and the number of women was 88. It was determined that there was no statistically significant difference between the ages of boys and girls (p=0.741) (Table 1). The intra-rater reliability coefficients for AGA, AGD, and GA were 0.891, 0.885, and 0.912, respectively.

Since there was no statistically significant difference between all measurements made from the right and left sides, the evaluation was made by taking the average of the right and left sides for each measurement.

AGA and AGD values in the 4-7 and 8-11 age groups show statistically significant differences according to gender. In these age groups, girls have higher AGA values and smaller AGD values than boys. It was determined that GA did not differ according to gender in all age groups. (Table 2).

Table 1. Evaluation of age statistical difference by gender with Student's t test

	Group	N	Mean	Median	SD	SE	p-value
Age	Boy	109	11.44	12	2.79	0.27	0.741
	Girl	88	11.58	12	3.1	0.33	

*Significant P<0.05

Table 2. Evaluation of the relationship between the parameters of gender and age groups with ANOVA test

Parameters	Age	Girl	Boy	p-value
AGA	4-7	167.8 (5.8)	165.8 (6.4)	0.022*
	8-11	169.9 (5.26)	166.06 (5.93)	0.007*
	12-15	166.72 (5.15)	165.66 (5.68)	0.388
	p-value	0.093	0.077	
AGD	4-7	1.42 (0.51)	1.96 (0.69)	0.048*
	8-11	1.05 (0.51)	1.51 (0.71)	0.002*
	12-15	1.41 (0.6)	1.52 (0.72)	0.468
	p-value	0.074	0.191	
GA	4-7	131.49 (5.8)	132.79 (5.5)	0.909
	8-11	128.34 (4.82)	129.46 (4.12)	0.324
	12-15	127.9 (6.17)	125.88 (5.96)	0.146
	p-value	0.354	0.035*	

*Significant P<0.05

Discussion

The results revealed that children aged 4-7 and 8-11 in the Eastern Mediterranean region significantly differed in AGA and AGD values by sex, but it was not the case for GA.

The previous research utilized different parameters in the mandible for sex determination within the pre-adult population. However, the results are often controversial.[12,13,16-19]

Ulusoy *et al.*[16] have recently evaluated linear measurements (ramus height, maximum ramus width, minimum ramus width, bigonial width, bicondylar width, and gonial angle) among 3-13-year-olds and reported that all linear measurements were higher in males although gonial angle did not significantly differ by sex, as in this study.

Akhlaghi *et al.*[20] reported that mandibular anthropometric measurements did not significantly by sex in cadavers under the age of. Nevertheless, they found bigonial width and the distance between the gnathion-gonion were greater among 12-19-year-old men.[13] Unlike this study, both Ulusoy *et al.* and Akhlaghinin *et al.* did not evaluate AGA and AGD

Although the morphological changes in the antegonial region have clinical importance (i.e., a guide region in osteotomy in orthognathic surgery) and can be utilized for sex determination in forensic cases, the literature reported it to have received little attention so far.[15,20]

Yet, current studies have shifted their attention to the antegonial region. In a study, Apaydın *et al.* evaluated mandibular morphometric differences among 5-50-year olds and reported that AGA showed a statistically significant difference in both prepubertal and postpubertal periods of only those aged 5-7 years by sex. Accordingly, AGA was higher in girls than in boys. Yet, GA did not significantly differ by sex, similar to this study.[21]

In their study evaluating children in the prepubertal period, Apaydın *et al.*[12] also suggested that AGA and AGD could be used to determine sex in the mandible among 5-7-year-olds. They found that boys had a lower AGA value than girls but did not consider GA. Their results overlap ours, where we found the female participants had wider AGA and smaller AGD.

On the other hand, Dutra *et al.*[15] evaluated the same parameters as ours in an adult population and concluded

reported that GA did not significantly differ by sex. Yet, morphology of the antegonial region was reported to be affected by sex and dentition status.

In the study of Chole *et al.* with patients aged 15-66 years, men had significantly smaller gonial and antegonial angles and greater antegonial depth than women, overlapping our findings. These results were explained by sex-hormonal differences affecting bone metabolism.[20] Moreover, it was reported that the narrower gonial angle in men may be due to intense muscle activity.[22] However, considering this study population, it is not an expected situation to have a gender-related hormonal difference.

Upadhyay *et al.* analyzed the relationships of the gonial angle with dental status, sex, and age and reported no significant difference in the gonial angle in the primary dentition period and that there was a narrowing in the gonial angle toward the ages of 25-30.[23] Another study voiced that while the gonial angle is 140.17°±5.9° in the primary dentition period, it decreases to 123.61°±6.9° in late dentition.[24] Consistent with the literature, we could not reach statistically significant findings for the gonial angle in all three age groups by gender, but we obtained a greater and smaller gonial angle among 4-7-year-olds and 12-15 year-olds, respectively.

Previous findings may have differed depending on factors such as population-specific morphological changes, genetics, environmental factors, sample size, and observer experience.

On the other hand, we evaluated the mean values of measurements since there was no statistically significant difference between the measurements from the right and left sides. Similarly, the rule of thumb in the literature is to evaluate the mean values of measurements or the measurement from the single side if there is no statistical difference between the radiological measurements.[5,8,16]

Moreover, panoramic radiographs are known to have disadvantages such as being sensitive to magnification, geometric distortion, and positioning errors.[10] While angular measurements are highly reliable in panoramic radiographs, horizontal and lineer measurements have low reliability.[25,10]

Cone beam computed tomography (CBCT) eliminates the disadvantages of panoramic radiographs such as superposition, magnification, and distortion, allowing true-size accurate scanning in all mandible directions.[26,27] From this point of view, it is a limitation that the study did not work on CBCT images. However, since panoramic radiographs are the imaging method frequently used in pediatric clinics and low radiation exposure, measurements made in radiographs taken with correct positioning may be useful in children. Future studies with larger samples of children are needed to support our findings.

Conclusions

Overall, it was concluded that AGA and AGD may be helpful in estimating sex in children from the Eastern Mediterranean region, but it was not the case for GA.

Conflicts of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this study.

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Cumhuriyet Dental Journal, 25(Suppl): 29-33, 2022
DOI: https://doi.org/10.7126/cumudj.1030953

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Temporomandibular Joint Disease and Vitamin D Level in Fibromyalgia#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 01/12/2021
Accepted: 31/01/2022

ABSTRACT

Objectives: The aim of our study is to show the prevalence of temporomandibular joint disease (TMD) in fibromyalgia (FM) patients in Turkish population and to evaluate the relationship between vitamin D levels of FM patients with TMD.

Materials and Methods: Patients diagnosed FM in the last 4 months were examined in terms of TMD using DC/TMD criteria. By using biochemical data of the patients included in the study, the relationship between vitamin D levels and TMD was interpreted.

Results: Among the 39 FM patients who underwent temporomandibular joint examination (mean age 39.8; age range 18-59), the number of patients with TMD (muscle pain, joint pain, mouth opening limitation, disc displacement, degenerative joint disease) was 30 (29 female, 1 male), while the number of patients without any TMD was found 9 (7 female, 2 male). No statistically significant difference was found between those with TMD and those without TMD in terms of vitamin D (Mann-Whitney U test, D vit).

Conclusions: Dentists should be aware that patients with widespread pain in the temporomandibular joint area may be candidates for FM and should be careful in evaluating laboratory tests of these patients. The prevalence of TMJ in FM patients and its relationship with vitamin D should be examined with new studies with large patient participation.

Keywords: Fibromyalgia, Temporomandibular Joint, Vitamin D

Fibromyaljide Temporomandibular Eklem Hastalığı ve D Vitamini Seviyesi#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 01/12/2021
Kabul: 31/01/2022

ÖZ

Amaç: Çalışmamızın amacı, Türk toplumunda fibromyalji (FM) hastalarındaki temporomandibular eklem hastalık (TMEH) prevalansını göstermek ve FM hastalarına ait D vitamini seviyelerinin TMEH ile ilişkisini değerlendirmektir.

Gereç ve Yöntemler: Son 4 ay içerisinde FM teşhisi konmuş hastalar DC/TMD kriterleri kullanılarak TMEH açısından incelenmiştir. Yapılan muayene ile masseter ve temporal kasta ağrı, eklem ağrısı, redüksiyonlu/ redüksiyonsuz disk deplasmanı ve dejeneratif eklem hastalığı sorgulanmıştır. Çalışmaya dahil edilen hastaların biyokimya verileri kullanılarak D vitamini seviyelerinin TMEH ile ilişkisi yorumlanmıştır.

Bulgular: Temporomandibular eklem muayenesi yapılan toplam 39 FM hastasından (yaş ortalaması 39,8; yaş aralığı 18-59) 36'sı kadın 3'ü ise erkektir. Tüm hastalar içerisinde TMEH tespit edilenlerin sayısı 30 (29 kadın, 1 erkek) iken, herhangi bir TMEH bulgusuna rastlanmayan hastaların sayısı 9 (7 kadın, 2 erkek)'dur. TMEH tespit edilen hastaların 26'sında kas ağrısı gözlenmiştir. Kas ağrısı görülmeksizin eklem ağrısı ve dejeneratif eklem hastalığı bulunan sırasıyla 2 ve 1 hasta tespit edilmiştir. TMEH varlığı olanların D vitamini değerleri TMEH varlığı olmayanlara göre düşük olmasına rağmen istatistiksel olarak anlamlı bir farklılık bulunamamıştır (Mann-Whitney U test).

Sonuçlar: Diş hekimleri özellikle temporomandibular eklem bölgesinde yaygın ağrı şikâyeti olan hastaların FM hastası adayı olabileceğinin farkında olmalı ve bu hastaların laboratuvar testlerini değerlendirme konusunda dikkatli olmalıdır. Geniş hasta katılımı ile yapılacak yeni çalışmalar ile FM hastalarındaki TMEH prevalansının D vitamini ile olan ilişkisi incelenmelidir.

Anahtar Kelimeler: Fibromyalji, Temporomandibular Eklem, D Vitamini.

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How to Cite: Şatır S, Şatır Ö. (2021) Temporomandibular Joint Disease and Vitamin D Level in Fibromyalgia, Cumhuriyet Dental Journal, 25(Suppl): 29-33.

Introduction

Fibromyalgia (FM) is a chronic syndrome with symptoms such as widespread body pain, fatigue, cognitive dysfunction, decreased sleep quality-sleep disorder and anxiety.[1] The annual prevalence is between 2-4% and it is 6-9 times more common in women than in men.[2,3] Since there is no laboratory test or radiographic finding associated with the disease yet, FM is diagnosed by clinical evaluation. However, since symptoms such as anxiety, sleep disorder and dizziness can be encountered in many neurological and metabolic disorders, various radiological examinations and laboratory tests are used for differential diagnosis.[4]

Temporomandibular joint diseases (TMD) are the leading painful conditions affecting the masticatory muscles and maxillofacial region and may be associated with FM.[5] In some studies, it has been stated that the rate of TMD in FM is over 71%.[6,7] Sleep bruxism is the primary cause hyperactivity and hypertrophy of masticator muscles in individuals with TMD.[8]

Vitamin D provides calcium (Ca) balance and bone turnover in the body and can affect the entire metabolism due to its receptors in various organs. As a result of studies on vitamin D, it has been reported that its deficiency is associated with many cardiovascular, metabolic, infectious and autoimmune diseases.[9-18]

It has been reported that individuals with vitamin D deficiency have muscle pain, cramp, weakness, and fatigue.[19] In various studies evaluating vitamin D levels in FM patients, its effects on neurological symptoms such as pain were examined.[20,21]

The aim of our study is to show the prevalence of TMD in FM patients and to evaluate the relationship between vitamin D levels of FM and TMD.

Materials and Methods

Ethics committee approval was obtained from Ethics Comitee of Antalya Education and Research Hospital for this study (26/12/2019, 27/11, 2019-393).

Patients

Patients who applied to the Physical Medicine and Rehabilitation Clinic between January 2019 and January 2020 in Antalya Kepez State Hospital and met the criteria of FM according to the American Rheumatology Association 2016 revised diagnostic criteria were determined as candidates for the study. These patients were called back to the clinic for temporomandibular joint (TMJ) examinations for a maximum of 4 months from the date of the diagnosis of FM. Research diagnostic criteria for temporomandibular disorders (DC-TMD) were used to determine the status of TMD.[22] Based on DC-TMD, pain in the masseter and temporal muscle, joint pain, disc displacement with/without reduction, degenerative joint disease were questioned. Masseter and temporal muscle pains are classified as muscle pain, muscle-fascia pain, reflected muscle-fascia pain and local muscle pain according to DC-TMD. Pain caused by horizontal jaw movements and TMJ palpation is considered joint pain. Patients with an opening-closing click during the opening and closing of the jaw are accepted in the reduction disc displacement group and are divided into two classes as intermittent locking and non-intermittent locking. Locking during jaw opening and closing is defined as disc displacement without reduction. If the maximum mouth opening is less than 40mm, it is classified as non-reduction disc displacement with mouth opening limitation, and if there is a maximum mouth opening of 40mm or more, it is classified as non-reduction disc displacement without mouth opening limitation.[22,23] Patients have crepitation during jaw movements are included in degenerative joint disease. Individuals diagnosed with other systemic diseases (osteoarthritis, rheumatoid arthritis, systemic lupus erythematosus, osteoporosis) that may cause TMD, who have a history of trauma associated with the TMJ with any treatment, and orthognathic or TMJ surgery for various reasons (trauma, orthognathic therapy, etc.) were excluded from the study.

Vitamin D

During the FM diagnosis, the vitamin D values obtained from the patients in Antalya Kepez State Hospital were recorded considering the reference ranges retrospectively. Premenopausal women were included in the study in order to prevent the effect of supportive and hormonal therapy taken during menopause in the results.

Statistical Analysis

Mann-Whitney U test which is the non-parametric was used to compare the not normal distribution of vitamin D levels in FM patients with and without TMD ($p<0.05$).

Results

Of the 39 FM patients (mean age 39.8; age range 18-59) who underwent TMJ examination, 36 were female (mean age 39.4; age range 18-44) and 3 were male (mean age 44.3; age range 36-59). While there were 30 (29 female, 1 male) patients with TMD among all patients, 9 (7 female, 2 male) patients without any TMD were detected. Muscle pain was observed in 26 of the patients with TMD. 2 and 1 patients with joint pain and degenerative joint disease were identified, respectively, without muscle pain (Table 1).

Although the vitamin D levels of those with TMD were lower than those without TMD, no statistically significant difference was found (Mann-Whitney U test, $p=0.257$) (Table 2).

Discussion

The prevalence of TMD in FM ranged from 75% to 80%.[24] In this study, the rate of TMD in FM was found to be 76.9%, and this result is consistent with the

literature.[6,7] In addition, the prevalence of TMD in the Turkish population is thought to be around 30%.[25,26] The high rate of TMD we detected in FM patients suggests that this finding is independent of the prevalence of the general population. The presence of various systemic diseases that may cause the symptoms of TMD may affect the prevalence achieved.

Masseter and temporal muscles were identified as the most common muscle pain associated with TMJ pain in FM.[24] As there are studies in which masticator muscle pain is seen in 87% of FM patients[27], there are also researches in which it is seen in all FM patients included in the study.[28] In our study, the rate of patients with temporal and/or masseter muscle pain was 66% among all FM, while was 86% among patients with TMD. Although our results are compatible with the literature, the differences in the examination criteria used in the detection of TMD and the methods to question the presence of pain may cause variability in the results. The length of time between the patients are diagnosed with FM and the TMJ examination can affect the pain characteristics in the masticatory muscles. In addition, a decrease in the prevalence of TMD may have been observed in the patients included in our study due to the initiation of the FM treatment.

In a study that found the disc displacement rate as 22.5% in FM, it was emphasized that asymptomatic TMD were seen in the general population and patients without chronic pain related to the TMJ were considered healthy.[6] In our study, the rate of disc displacement in FM patients was 30%. Considering that the relationship between FM and TMD is more related to pain-parafunction in masticator and facial muscles, the difference between the findings may not be clinically significant.

Vitamin D level is measured by 25-OH vitamin D in serum. Values below 20 ng/mL are defined as vitamin D deficiency, while between 21-29 ng/mL are considered as vitamin D insufficiency.[29] In our study, the average vitamin D level of all FM patients was determined to be 19.89 ng/mL. In patients with TMD, the average vitamin D level was below 20 ng / mL. In patients without TMD, the mean value was determined as 28.83 ng/mL. Vitamin D level did not make a statistically significant difference between patients with and without TMD. However, the fact that patients in the TMD group have low values that meet the definition of vitamin D deficiency makes a clinically significant difference.

In a meta-analysis comparing the vitamin D levels of FM patients with healthy individuals, more studies were found showing that FM patients had significantly lower vitamin D levels.[30] 4 of studies showing that low levels of vitamin D in patients with FM have been made in Turkey and an average vitamin D level of FM patients in these studies 15.45 ng / ml. Results of our study are consistent with vitamin D levels in patients with FM in Turkey.

There is a general acceptance that menopause usually begins at the end of the 40s[31]. Although the mean age of the female patients we included in the study was below 40 and there was no evidence of a relationship between vitamin D and menopause, being in the premenopausal period was determined as the inclusion criterion. Metabolic and physiological changes in premenopausal women overlap with fibromyalgia findings. Therefore, it is difficult to distinguish the effects of both menopause and fibromyalgia on vitamin D levels in women.

The relationship between musculoskeletal pain and vitamin D is a current research topic.[32] In another study, it was stated that there is a correlation between the vitamin D level of FM patients and the presence of pain.[33] Karahan *et al*. stated in a multicenter retrospective study that the duration, localization and severity of pain and vitamin D insufficiency did not present a significant relationship but the topic should be examined with prospective studies.[34] It is reported that there is a significant relationship between chronic widespread pain and vitamin D especially in females.[35] The high prevalence of TMD in FM patients and the prevalence of masticator muscle pain suggest that the relationship between TMD and vitamin D deficiency is possible.

Table 1. Distribution of FM patients (n = 30) with TMD

n (related muscle)	Muscle Pain	Muscle-Fascia Pain	Reflected Muscle-Fascia Pain	Local Muscle Pain	Muscle Pain (-)	Joint Pain (+)
Joint Degeneration (-)	5 (1 t, 1 m, 3 tm)	2 (1 t, 1 m)	3 (1 t, 2 m)	7 (3 t, 2 m, 2 tm)		
Disc Displacement with Reduction (Locking -)	2 (t)	1 (t)			1	
Disc Displacement with Reduction (Locking +)	1 (tm)		2 (1 t, 1 tm)			1
Disc Displacement without Reduction (MOL +)	1 (m)		1 (tm)			1
Disc Displacement without Reduction (MOL -)	1 (t)					
Degenerative Joint Disease					1	

t: Temporal muscle, m: Masseter muscle, tm: Both temporal muscle and masseter muscle, MOL: Mouth opening limitation

Table 2. Vitamin D levels of FM patients with and without TMD

Groups	Vitamin D (25-OH vitamin D) (ng/mL)			p
	Mean	Median	Max-Min	
TMD (+) (n=30)	17.92	16.03	31.71 - 4.23	0.257
TMD (-) (n=9)	28.83	29.72	55.18 - 4.21	
Mann-Whitney U test, p=0.05				

In case of deficiency or insufficiency of vitamin D, which has an important place for a health

y bone structure and proper muscle function, the TMJ consisting of many different elements such as muscles, bones that make up the joint surfaces (mandible and os temporale) and joint disc may be affected.[29,36] In a study, the relationship between vitamin D receptor polymorphism and TMD was examined. Although a significant relationship between Taq1, Apa1 gene polymorphism and TMD could not be detected, it was emphasized that this issue should be studied in large cohort studies.[37] In another study, while vitamin D levels did not show a statistically significant difference between those with TMD and healthy individuals, parathyroid hormone was found to be significantly higher in TMD group. Researchers associated the increase in parathyroid hormone levels with low vitamin D levels and stated that the vitamin D levels of patients with TMD should be evaluated.[38]

The main limitation of our study is that it is based on retrospective data. TMJ examination of the patients included in the study was performed prospectively, but the diagnosis of FM and vitamin D levels are not. The reliability of the data was tried to be increased by shortening the time between FM diagnosis and TMJ examination to a maximum of 4 months. The number of patients included in the study decreased due to this time criteria. Another limitation is that since this study was designed as a cross-sectional study, it did not include comparisons with healthy individuals. Another case-control study may be planned to support the findings of this study.

Conclusions

The rate of FM in individuals with TMD is reported to be between 10% and 20%.[39] Dentists should be aware that patients with widespread pain, especially in the TMJ area, may be candidates for FM and should be careful in evaluating the laboratory tests of these patients. The relationship between the prevalence of TMD and vitamin D in FM patients should be investigated with new studies with larger groups.

Funding

No funding agent.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethics Approval

Ethics committee approval was obtained from Ethics Comitee of Antalya Education Training and Research Hospital for this study (26/12/2019, 27/11, 2019-393).

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Cumhuriyet Dental Journal, 25(Suppl): 34-36, 2022
DOI: https://doi.org/10.7126/cumudj.1031144

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Investigation of the Relationship between Neutrophil/ Lymphocyte Ratio and Analgesic Consumption in Bimaxillary Orthognathic Surgery Patients#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 01/12/2021
Accepted: 16/02/2022

ABSTRACT

Objectives: Neutrophil to lymphocyte ratio; as an inexpensive, easily measurable, and repeatable laboratory parameter is an indicator of subclinical inflammation and is also a parameter that gives an idea about the systemic inflammatory response and cellular immune response. In general, lymphopenia reflects the weakness of cellular immunity, while neutrophilia is indicative of the response to systemic inflammation. The ratio of these two values to each other seems to be a marker showing the adequacy of the cellular immune response against this situation, despite the magnitude of systemic inflammation. This study aimed to investigate the relationship between preoperative neutrophil-lymphocyte ratio (NLR) and postoperative analgesic drug consumption.

Materials and Methods: Within the scope of the study, the files of 50 patients who underwent bimaxillary orthognathic surgery were retrospectively analysed. The preoperative NLR values of the patients and the need for the analgesic drugs in the first 24 hours and after 24 hours were recorded and correlated.

Results: 24% of the patients were girls, and 76% were boys. The average age was 20.54, and the average weight was 65.28 kg. There was a positive, strong, and significant correlation between the preoperative neutrophil count and preoperative NLR value and variables of analgesic drug consumption in the first 24 hours. There was a negative, strong and significant correlation between the preoperative lymphocyte count and the first 24-hour analgesic drug consumption variables.

Conclusions: It was concluded that patients with a preoperative NLR value of 2.11 and above might require four or more analgesics in the first 24 hours. Therefore, the NLR value can give preliminary information about the need for postoperative analgesia, and these values could be taken into account when developing a strategy for postoperative analgesia.

Keywords: Neutrophil-Lymphocyte Ratio, Orthognatic Surgery, Post-Operative Analgesic Drug Consumption.

Bimaksiller Ortognatik Cerrahi Hastalarında NLO ve Analjezik Tüketimi Arasındaki İlişki#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 01/12/2021
Kabul: 16/02/2022

ÖZ

Amaç: Nötrofil/lenfosit oranı; ucuz, kolay ölçülebilir ve tekrarlanabilir bir laboratuvar parametresi olarak subklinik inflamasyonun bir göstergesi ve aynı zamanda sistemik inflamatuar yanıt ve hücresel immün yanıt hakkında fikir veren bir parametredir. Genel olarak, lenfopeni, hücresel bağışıklığın zayıflığını yansıtırken, nötrofili, sistemik inflamasyona yanıtın göstergesidir. Bu iki değerin birbirine oranı, sistemik inflamasyonun büyüklüğüne karşın hücresel immün yanıtın bu duruma karşı yeterliliğini gösteren bir belirteç gibi görünmektedir. Bu çalışmada ameliyat öncesi nötrofil-lenfosit oranı (NLO) ile ameliyat sonrası analjezik tüketimi arasındaki ilişkiyi araştırmayı amaçladık. Gereç ve Yöntemler: Çalışma bimaksiller ortognatik cerrahi uygulanan 50 hastanın dosyalarının retrospektif olarak taranması yolu ile gerçekleştirildi. Hastaların ameliyat öncesi NLO değerleri ile ilk 24 saat ve 24 saat sonra analjezik ilaç ihtiyacı sayıları kaydedildi ve ilişkilendirildi. Bulgular: Hastaların %24'ü kız, %76'sı erkekti. Yaş ortalaması 20,54 ve ortalama ağırlık 65,28 kg idi. Preoperatif nötrofil sayısı ve NLO değeri ile ilk 24 saatte analjezik ilaç tüketimi değişkenleri arasında pozitif, güçlü ve anlamlı bir ilişki. Preoperatif lenfosit sayısı ile ilk 24 saatlik analjezik ilaç tüketimi değişkenleri arasında negatif, güçlü ve anlamlı bir korelasyon vardı. Sonuçlar: Preoperatif NLO değeri 2.11 ve üzerinde olan hastaların ilk 24 saat içinde 4 veya daha fazla analjezik ihtiyacı olabileceği, bu nedenle NLO değerinin postoperatif analjezi ihtiyacı hakkında ön bilgi verebileceği ve postoperatif analjezi için strateji geliştirilirken bu değerlerin dikkate alınabileceği sonucuna varıldı.

Anahtar Kelimeler: Anahtar Kelimeler: Nötrofil-Lenfosit Oranı, Ortognatik Cerrahi, Postoperatif Analjezik İlaç Tüketimi.

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How to Cite: Orbay Yaşlı S, Günay Canpolat G.(2021) Investigation of the Relationship between Neutrophil/Lymphocyte Ratio and Analgesic Consumption in Bimaxillary Orthognathic Surgery Patients, Cumhuriyet Dental Journal, 25(Suppl): 34-36.

Introduction

The cells that make up the immune system consist of granulocyte-agranulocytes and lymphocytes, gathered under the common name of "leukocyte." While granulocyte-agranulocytes are classified within the "natural immune system"; Lymphocytes are included in the "acquired immune system" because they must first recognize the target molecule or pathogen and synthesize some molecules specialized for this target to fulfill their duties. Granulocyte-agranulocyte cells; includes neutrophils, eosinophils, basophils, mast cells, dendritic cells, monocyte-macrophages, and phagocytes. On the other hand, Lymphocytes consist of natural killer cells and specialized cells under "T" and "B" lymphocyte groups.

Neutrophil/lymphocyte ratio (NLR) is an indicator calculated using the neutrophil and lymphocyte values in the whole blood test, and its popularity is increasing day by day. NLR value; As an inexpensive, easily measurable, and reproducible laboratory parameter, it is an indicator of subclinical inflammation and a parameter that gives an idea about the systemic inflammatory response and cellular immune response. In general, lymphopenia reflects the weakness of cellular immunity, while neutrophilia indicates the response to systemic inflammation. The ratio of these two values to each other seems to indicate the adequacy of the cellular immune response despite the magnitude of systemic inflammation.[1-4] In some recent studies, it has been found that NLR can be used to calculate the morbidity and mortality that may occur in some medical interventions such as angiography or appendectomy and to predict the prognosis in some cancer types.[5,6]

Orthognathic surgery is used to correct facial skeletal anomalies and relieve cosmetic concerns.[7] Orthognathic surgery has many advantages, including improved chewing performance and facial aesthetics and reduced temporomandibular joint symptoms.[8-10] Despite the benefits of orthognathic surgery, bimaxillary surgery produces strong pain stimuli.[11] During LeFort I osteotomy and sagittal split ramus osteotomies, the use of electric cautery, saws, drills, milling cutters, chisels, and separators are the leading causes of strong pain signals. Bimaxillary surgery has the highest postoperative pain score compared with other oral and maxillofacial operations.[12]

This study aimed to investigate the relationship between preoperative Neutrophil-lymphocyte ratio (NLR) and postoperative analgesic consumption.

Materials and Methods

The study, which was designed retrospectively, was carried out after obtaining approval from Erciyes University Faculty of Dentistry (2018/316). The study was carried out by retrospectively scanning the files of 50 patients who underwent bimaxillary surgery in the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Erciyes University. Preoperative Neutrophil and lymphocyte values of the patients and NLR values obtained were recorded together with demographic data. In addition, the analgesic needs of the patients in the first 24 hours and after the 24 hours and the number of analgesic drugs administered accordingly were recorded. Analyses were conducted using TURCOSA (Turcosa Analytics Ltd. Co., Turkey, www.turcosa.com.tr). A p-value of less than 0.05% was considered statistically significant.

Results

24% of the patients were female, and 76% were male. The mean age was 20.54 years, and the mean weight was 65.28 kg. There was a positive, strong, and statistically significant correlation between the preoperative neutrophil count and preoperative NLR value and the variables of analgesic consumption in the first 24 hours ($r=0.6814$, $p<0.001$ and $r=0.6148$, $p<0.001$, respectively) (Figure 1). There was a negative, strong, and statistically significant correlation between the preoperative lymphocyte count and the variables of analgesic consumption in the first 24 hours ($r=-0.6773$, $p<0.001$).

There was a positive, strong, and statistically significant correlation between the NLR value and the variables of analgesic consumption in the first 24 hours. ($r=0.6814$, $p<0.001$ and $r=0.6148$, $p<0.001$, respectively)

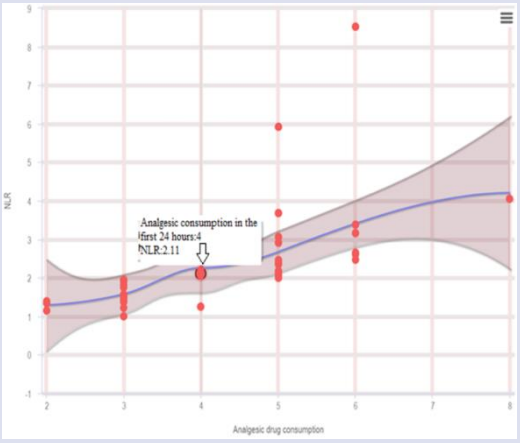

Figure.1 Correlation between the NLR value and the variables of analgesic consumption in the first 24 hours.

Discussion

Our study found that patients with a preoperative NLR value of 2.11 and above may need analgesics four times or more in the first 24 hours, and NLR values calculated preoperatively can give preliminary information about the need for postoperative analgesia.

The history of studies showing that NLR can be a prognostic marker in many disease groups mainly dates back to about ten years ago.

Especially in the oncological field, many studies have been conducted for prognostic and surveillance. In addition, it has been used as a risk indicator in many

studies such as estimation of pulmonary embolism mortality, estimation of stone size in patients with nephrolithiasis, and risk of subarachnoid hemorrhage development in patients with migraine and headache.[13,14,7]

In the literature, it is noteworthy that the number of studies investigating the relationship between NLR and mortality in the cardiovascular and oncology fields is relatively high. In addition, the number of studies investigating the relationship between NLR and postoperative pain or analgesic consumption is relatively few.

The relationship between NLR and postoperative pain or analgesic consumption was investigated in the studies which were conducted by Öner *et al.*, Daoudia *et al.,* Bozkurt *et al.* The NLR cut-off value found in these studies was found to be approximately 2, similar to our research, and it was concluded that an increase in postoperative pain or analgesic consumption would be expected above this value.[15-17]

In a previous study, researchers investigated the relationship between NLR and postoperative pain in patients who underwent orthognathic surgery. As a result, they reported that postoperative analgesic requirements were higher in patients with preoperative NLR ≥2.[18] In our study, it was concluded that patients with a preoperative NLR value of 2.11 and above required more analgesics in the first 24 hours, which was consistent with this previous study. Another study on NLR and analgesic consumption concluded that preoperative NLR values should be calculated because of their simplicity, they should be recorded in clinical practice, and effective regional analgesia methods should be preferred in patients with high NLR.[19]

Conclusions

It was concluded that patients with a preoperative NLR value of 2.11 and above might need analgesics four times or more in the first 24 hours; therefore, preoperative Neutrophil, lymphocyte, and NLR values can give preliminary information about the postoperative analgesic requirement, and these values can be taken into account when developing a strategy for postoperative analgesia. Further studies with a larger number of patients are needed on the relationship between NLR and analgesic consumption.

Conflict of Interest

The authors declared no conflict of interests.

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Cumhuriyet Dental Journal, 25(Suppl): 37-41, 2022
DOI: https://doi.org/10.7126/cumudj.1032492

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Effect of Different Repolishing Procedures on The Color Change of Alkasite#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 05/12/2021
Accepted: 14/02/2022

ABSTRACT

Objectives: An esthetic restoration with an unacceptable color is the main cause for the replacement of anterior tooth restorations. The aim of this study is to evaluate the effect of repolishing on the color change of the new material group of alkasite after exposure to coffee solution.

Materials and Methods: Alkasite material placed in Teflon molds with a diameter of 8 mm and a height of 2 mm was polymerized under the application of mylar strip and a total of 32 samples were obtained. The samples were randomly allocated to groups. Group R: Diamond grained polishing rubbers, Group D: Aluminum oxide discs are applied and the polishing process is completed. After the first color measurement was made, it was immersed in coffee and the measurement was repeated 1 week later. L was divided into two groups (n=8) and repolished with rubber (RR) and discs (RD). In the D group, re-polishing was done with rubber (DR) and disc (DD), and color measurements were repeated. Results were analyzed by using one-way ANOVA and Tukey test at 95% confidence interval.

Results: The greatest color change (ΔE_{00}) was in group R. At the end of seven days, similar color change values were found between the groups of R and D. There is no difference between the RR and RD groups. Significantly less color change was observed in the DD group than in the RR and RD groups. Similarly, the DR group showed less color change than the RR group.

Conclusions: The color stability of the alkasite was affected by the polishing procedure. The repolishing process reduced the color change, but not at a clinically acceptable level.

Keywords: Alkasite, Color Change, Repolishing.

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How to Cite: Karakaş SN, Küden C.(2021) Effect of Different Repolishing Procedures on The Color Change of Alkasite, Cumhuriyet Dental Journal, 25(Suppl): 37-41.

Introduction

Composite resins are popular restorative materials in contemporary dentistry with their aesthetic and physical properties.[1] A newly-introduced tooth-colored restorative material called "alkasite" is classified as a subgroup of composite resins.[2] It is a dual curing, bulk-fill restorative material consisting of a powder and liquid mixture. The powder part contains various alkaline fillers and calcium fluorosilicate glass fillers that release fluoride, calcium, and hydroxyl that neutralize acidic ions around the restoration in the oral cavity. The liquid part consists of monomers that increase the fluidity of the material and enable it to adapt to the smear layer.[3] The source of fluoride release is calcium barium aluminum fluorosilicate glass filler and calcium fluorosilicate glass filler.[4]

Thanks to the improvements made in the structures of the restorative materials, their clinical life has been prolonged and one of the most important factors that cause their renewal is the color incompatibility between the restored tooth and the material.[5] Therefore, the long-term color stability of resin-based materials has become important in the restorative material preference. Discoloration in composites can be caused by intrinsic and extrinsic factors. Intrinsic factors include self-discoloration of the resin material and oxidation or hydrolysis in the resin matrix.[6] External factors include coloration as a result of exogenous contamination exposure to coloring agents and their absorption by the material and the degree of staining may vary according to oral hygiene, nutrition, and smoking habits.[7] Among the factors that can affect the degree of external coloration are the surface roughness and the hydrophilicity of the material and the thermal stress and the pH value in the oral cavity.[1] The surface quality depends on the polishing technique.[8] Lu *et al.*[9] showed a positive relationship between surface roughness and external staining while Bagheri *et al.*[10] concluded that surface polishing was not important in determining the staining sensitivity.

The optical properties of dental composite resins are affected by restorative procedures such as finishing and

polishing.[11] There is a lack of knowledge in the literature regarding the coloring of the new alkasite material. The aim of this study is to evaluate the color change of the alkasite, which is a new material group caused by different re-polishing systems after exposure to coffee solution. The H_0 hypothesis of this study is that there will be no difference in the color change that will be caused by different polishing systems as a result of the repolishing process.

Materials and Methods

Approval for the study was obtained from the Cukurova University, Faculty of Medicine Clinical Research Ethics Committee (2021/108.43). Based on previous study[12] sample size was calculated eight for each group using the G*Power analysis package program (G*Power 3.1; Universität Düsseldorf) at 80% power and 0.05 significance level in the present study.

Samples of alkasite (Cention N, Ivoclar Vivadent, Liechtenstein) material used in color A2 were prepared in Teflon molds with a diameter of 8 mm and a height of 2 mm. According to the manufacturer's instructions, the material was mixed with a spatula until a smooth consistency was obtained. Mixing time completed within 60 seconds. The material was placed in the mold with a spatula, mylar strip and 1 mm thick glass were placed, respectively, and excess material was allowed to overflow. Samples were allowed to harden for 5 min.

A total of 32 samples were prepared from the material and according to the polishing system, firstly, they were divided into 2 groups, and then each group was divided into 2 subgroups (n=8).

Group R: Polishing rubbers with diamond grain

Group D: Aluminum oxide discs

The unpolished bottom surfaces of the samples are numbered. After polishing, the samples were kept in distilled water at 37°C for 24 hours in an incubator (FN 500, Nüve, Turkey). The first color measurements were made using a spectrophotometer (Vita Easyshade, Vita Zahnfabrik, Bad Sackingen, Germany). Group R was divided into two subgroups and repolished with rubber (RR) and discs (RD) polishers. In group D, repolishing was done with rubber (DR) and disc (DD) polishers, and color measurements were repeated.

CIE L (lightness), C (chroma), and H (hue) values were determined at baseline and day 7 on a white background using the CIE D65 illuminator and the CIE 2° standard colorimetric observer.[13] The coffee used in this study was prepared by dissolving 10 g of coffee (Nescafe Classic, Nestle, Switzerland) in 400 ml of hot water. Each batch of samples was stored in an incubator at 37°C for one day and seven days. The coffee solution was freshly prepared and replenished daily. Color measurements were repeated at the end of the seventh day. Before each measurement, the samples were washed with distilled water for 1 minute and dried. Three measurements were made on the upper surface for each sample and the average was taken. Color change values between baseline and seven days later were calculated using the $CIEDE_{2000}$ formula:

$$\Delta E_{00} = \left[\left(\frac{\Delta L'}{K_L S_L}\right)^2 + \left(\frac{\Delta C'}{K_C S_C}\right)^2 + \left(\frac{\Delta H'}{K_H S_H}\right)^2 + R_T \left(\frac{\Delta C'}{K_C S_C}\right)\left(\frac{\Delta H'}{K_H S_H}\right)\right]^{1/2}$$

Statistical analyzes were performed using the SPSS program (IBM SPSS for Mac 26; Chicago, USA). The Shapiro-Wilk test was used to determine the normality distribution of the data. Results were evaluated by using one-way ANOVA and Tukey test at 95% confidence interval.

Results

The mean and standard deviations of ΔL, Δa, Δb, Δc, ΔH values of alkasite after repolishing with different systems are presented in Table 1. While ΔL and Δa values were in parallel with the ΔE values between the groups, the DD group showed the highest Δc and the lowest ΔH values.

The mean color change (ΔE_{00}) and standard deviations after 7 days calculated with the $CIEDE_{2000}$ formula are shown in Figure 1. The greatest ΔE00 was in the R group. At the end of seven days, similar color change values were found between the R and D groups ($p > .05$). There was no difference between the RR and RD groups. Significantly less color changes were observed in the DD group than in the RR and RD groups (p=0.003, p=0.042, respectively). Similarly, the DR group showed less color change than the RR group (p=0.015).

Table 1. Mean and standard deviation values of ΔL, Δa, Δb, Δc, ΔH of color indexes of the experimental groups

Groups	ΔL	Δa	Δb	Δc	ΔH
RR	16.5±4.1^{a}	-2.35±1.3^{a}	1.6±1.1^{a}	1.4±1.2^{a}	7.3±3.2^{a}
RD	13.8±3.5^{ab}	-3.35±2.01^{a}	1.2±1.1^{a}	1.4±1.32^{a}	5.9±3.5^{ab}
DD	9.3±3.3^{c}	0.16±0.8^{b}	2.7±1.5^{b}	3±0.9^{b}	-0.2±2.1^{b}
DR	10.7±3.4^{bc}	-0.75±0.8^{b}	2.3±0.81^{ab}	2.3±0.9^{ab}	2.6±2.1^{bc}
p	0.008	0.000	0.037	0.03	0.000

R: Rubber, D: Disk, L: lightness, a: red-green, b: blue-yellow, c: chroma, H: hue

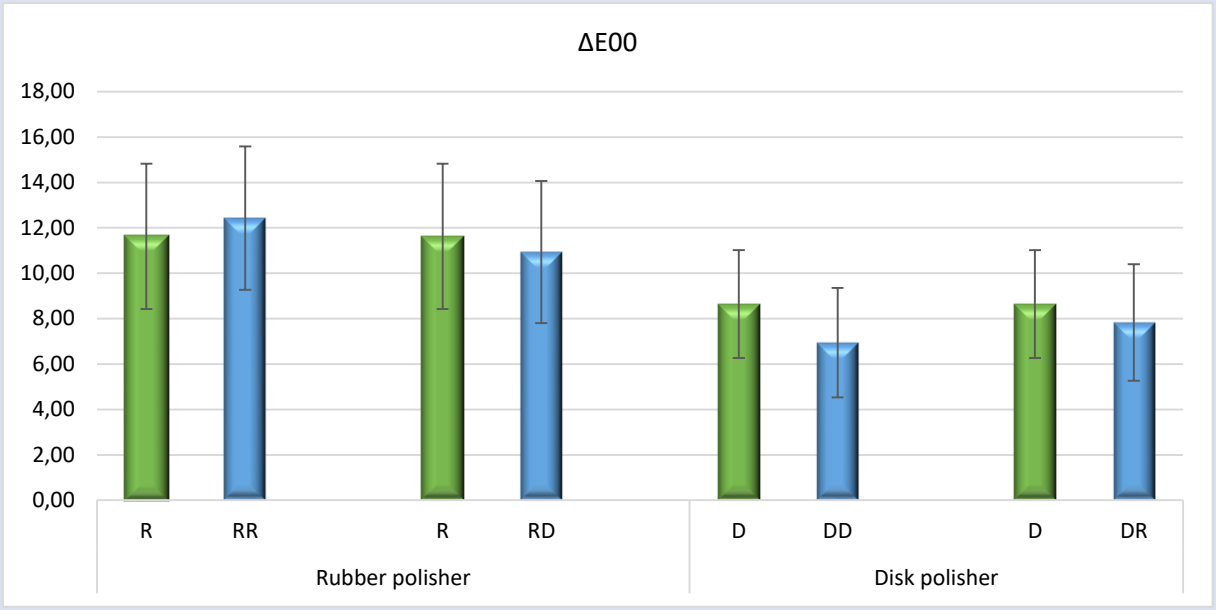

Figure 1. ΔE_{00} value of colour change of alkasite according to polishing and repolishing groups

Discussion

The surface texture of a tooth-colored restoration affects plaque build-up, discoloration, wear, and the esthetic appearance of the restoration.[14] Therefore, proper finishing and polishing are critical procedures that increase both the esthetics and lifetime of restored teeth.[15] In this study, the effect of repolishing on the color change of the current fluorine-released resin-containing bulk-fill alkasite material after being immersed in coffee repolishing with different polishing systems was investigated. As a result of the study, it was found that repolishing affected the color change and the H_0 hypothesis of the study was rejected.

The discoloration capacity of coffee on resins can be attributed to the degree of water absorption of the composite resins and the hydrophilicity of the matrix resin. Coffee contains yellow colorants with different polarities.[16, 17] In this study, coffee was used as a coloring agent because it is frequently consumed in daily life. Ertaş *et al.*[18] observed that immersion in coloring beverages for 24 hours corresponds to approximately 1 month of clinical aging. In this study, was examined the color changes over more than 6 months with measurements on the 7th day.

Recent studies have shown that the $CIEDE_{2000}$ formula better reflects the color differences perceived by the human eye than the CIELab formula ($\Delta E*ab$).[19] CIE_{2000} was used to determine the color change in this study. $CIEDE_{2000}$ ΔE_{00} is reported to have a 50:50% detectability threshold of 0.8 and an acceptability threshold of 1.8.[20] In this study, as a result of immersion of alkasite material in coffee, it showed a color change above clinical acceptability at the end of the 7th day in all polishing systems.

Different surface finishes and polishing processes can affect the color resistance by changing the surface roughness of the resins.[9,11,21] It has been reported that multi-step finishing and polishing systems outperform single-step systems in maintaining surface roughness.[22] Flury *et al.*[23] reported that a multi-step (Sof-Lex, 3M ESPE, USA) finishing and polishing system with aluminum oxide on tooth-coloured materials is less than a 2-step finishing and polishing system with diamond particles (Vita Enamic Polishing Set, VITA, Germany) They stated that it creates surface roughness.

Aydın *et al.*[12] compared the effect of multiple and single polishing systems of composite resins on color change, the most color change occurred in the multi-polishing system.[24] In this study, unlike other studies, the multi-disc system caused the least color change in the alkasite material. These results can be explained by the fact that the structure of alkasite differs from composite resins and a smoother surface can be obtained with aluminum oxide discs. Ergücü *et al.*[25] compared the color changes of five polished composites with two one-stage polishing systems when exposed to a coffee solution. They concluded that there was no significant difference between the OptraPol and PoGo polished groups. Samples finished with Mylar strip matrix showed the most intense coloration, while the most colorless surfaces were obtained with OptraPol. This finding is consistent with the present study.

Mundim *et al.*[26] found no significant differences in color values or between composite resins before and after repolishing samples immersed in distilled water and coke. Immersion of samples in coffee resulted in greater

discoloration of all composite resin types, and repolishing with discs reported contributing to clinically reduced staining. Studies are reporting that a superior whitening effect is obtained with the repolishing technique on composite resins compared to bleaching.[27,28] In this study, it was observed that there was a decrease in the color change of alkasite when polished with multi-pitch discs.

Limitations of this study include allowing staining on both sides of the material, unlike clinical staining conditions. The staining agents in food and beverages and restorative materials are frequently together in the oral cavity. However, the rinsing effect of saliva and oral hygiene procedures wash restorative materials. This study experimented to imitate the clinical conditions, but the effect of hygiene and scrubbing on the filling materials was not contained and the samples were in coffee nonstop during the immersion time. Moreover, the restricted sample size of in vitro conditions is also within the limitations of the present study.

Conclusions

The color stability of the alkasite was affected by the polishing procedure. Although the repolishing process reduced the color change, it could not bring it to clinically acceptable levels. The least color change in the alkasite material occurred in the multi-step aluminum polishing discs.

Conflicts of Interest

The authors declare no conflicts of interest.

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Cumhuriyet Dental Journal, 25(Suppl): 42-46, 2022
DOI: https://doi.org/10.7126/cumudj.1032866

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

A Retrospective Evaluation of Bifid Mandibular Canal Prevalence of Southeastern Anatolia Population by Cone-Beam Computed Tomography#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 05/12/2021
Accepted: 16/02/2022

ABSTRACT

Introduction: Bifid mandibular canal (BMC) is often detected incidentally on radiological examination and can be observed in unilateral or bilateral forms. The correct localization of the BMC plays an important role in the prevention of complications such as paresthesia, anesthesia, bleeding, traumatic neuroma, which may occur during or after surgical operations on the mandible such as sagittal split ramus osteotomy, impacted third molar tooth extraction, and dental implant surgery.

Objective: This study aims to retrospectively evaluate the prevalence of bifid mandibular canal (BMC) in the Southeastern Anatolian population via Conical Beam Computed Tomography (CBCT).

Material and Method: In this retrospective study, CBCT images of 615 patients, who applied to the Department of Oral and Maxillofacial Surgery in the Faculty of Dentistry at Dicle University, Turkey, for various reasons from 2015 to 2020, is evaluated and cases with bifid mandibular canals are examined. The prevalence evaluation is conducted by statistical analyses in terms of sex and laterality.

Results: According to the analyses, the BMC prevalence did not constitute a significant difference in terms of the age variable. The incidence of unilateral BMC was higher than bilateral BMC. Additionally, the prevalence of BMC was higher in males compared to.

Conclusion: BMC, which can be detected more easily and frequently via CBCT technology, is an anatomical formation that should be taken into account during oral and maxillofacial practices.

Keywords: Bifid Mandibular Canal, Alveolaris Inferior, Cone-Beam Computerized Tomography, Anatomical Variation.

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How to Cite: Güneş N, Güler R, Demircan Agin H, Dündar S, Eratilla V.(2021) A Retrospective Evaluation of Bifid Mandibular Canal Prevalence of Southeastern Anatolia Population by Cone-Beam Computed Tomography, Cumhuriyet Dental Journal,25(Suppl): 42-46.

Introduction

The bifid mandibular canal (BMC) is the division of the mandibular canal into two, passing through the ramus or dentoalveolar structure, each canal containing a separate vascular nerve package. Although anatomical variations of the mandibular canal can be observed on panoramic radiographs, these variations can be overlooked in panoramic radiographs due to a lack of experience by many clinicians.[1-5]

Furthermore, due to negative reasons such as the pharynx, soft palate, uvula, and ghost images in panoramic radiography, difficulties may be experienced while determining the anatomical location of the mandibular canal. Because of these negative features of panoramic radiography, Cone-beam Computed Tomography (CBCT), which emits less radiation and has a lower cost compared to Computed Tomography (CT), is considered practical in the evaluation of bifid mandibular canals.[3-5]

Although the mandibular canal is recognized as the only bilateral structure originating from the mandibular foramen, extending along the mandible and ending in the mental foramen, the presence of a second, or even third, accessory branch was reported in the literature. Despite the lack of concrete evidence on the etiology of the bifid mandibular canal (BMC), it was also reported that BMC could occur due to incomplete fusion of the inferior alveolar nerve during embryonic development. Furthermore, BMC cases were often detected incidentally on radiological examinations and observed in unilateral or bilateral forms.[4-6]

In clinical practice, the correct localization of BMC plays an important role in preventing complications such as paresthesia, anesthesia, bleeding, traumatic neuroma, which may occur during or after surgical operations in the mandible, such as sagittal split ramus osteotomy, impacted third molar tooth extraction, and dental implant surgery.[1-7]

To the best of our knowledge, there has been no study in the literature evaluating the bifid mandibular canal with Computed Tomography (CT) or Cone-beam Computed

Tomography (CBCT) examining the Southeastern Anatolian population. Accordingly, we think that our study will contribute to the literature in this regard along with the three-dimensional evaluation of the bifid mandibular canal, which both increases the reliability and emphasizes the authenticity of the current study. Within this scope, this study aims to retrospectively evaluate the prevalence of the bifid mandibular canal in the Southeastern Anatolian population via Cone-beam Computed Tomography (CBCT).

Material and Methods

In this retrospective study, CBCT images of 615 patients, who applied to the Department of Oral and Maxillofacial Surgery in the Faculty of Dentistry at Dicle University for various reasons from 2015 to 2020, are evaluated and cases with bifid mandibular canal were evaluated in terms of age, sex and laterality. Before the study was initiated, the study was approved by the Faculty of Dentistry Clinical Research Ethics Committee at Dicle University (Case no: 2020-48). Then, the images of the patients were analyzed to determine the prevalence ratios.

Within the framework of the study, 305 male (49.59%) and 310 female (50.41%) patients were included in the study. In the analyses, it was determined that the mean age of the patients was 34 (ranging from 18 to 65). CBCT data and assessments were derived from diagnostic images as part of the evaluation during treatment planning for implant surgery, orthognathic surgery, wisdom teeth surgery, or orthodontic treatment practices. Additionally, informed consent was obtained from all the patients before obtaining the radiological data.

During the imaging procedures, all the radiological scans were conducted in the supine position with Icat CBCT device (Imaging Sciences International Hatfield PA, USA) operating at 110 kVp, 1-20 mA, 15×12 field of view (FOV) and standard resolution mode (0.2 mm) (voxel size). Moreover, lack of demographic data, images obtained only from the maxilla, radiographic images of intraosseous lesions, low-quality images, images without 15x12 FOV were determined as the exclusion criteria for the patients.

The presence of BMCs was detected by an experienced oral and maxillofacial radiologist using the "zoom" tool at the NNT station (QR srl, Verona, Italy) in dim light conditions and manipulation of brightness/ contrast ratios on a computer monitor (RadiForce MX270W with 27-inch high-resolution widescreen monitor running on 2560x1440 resolution). Sex and laterality were taken into account while analyzing BMCs. The data were obtained by evaluating the CBCT images in axial directions and orthopantomography images (Figure 1, 2, 3). While evaluating BMC, attention was paid to examining 2 radiolucent lines and at least 3 radiopaque borders on the monitor in the image analysis.

Statistical Analysis

For the statistical analyses, IBM SPSS 21.0 package software was used with the data. The measured variables were presented as mean ± standard deviation (SD) while the categorical variables were presented in numbers and percentages (%). The Kruskal-Wallis test was used to compare the groups with more than two samples. The Chi-square ($\chi 2$) test was used for the intergroup comparison of categorical variables. The hypotheses were two-sided, and the level of statistical significance was regarded as $p \leq 0.05$.

Results

According to the results of our study, the percentage of BMC in the total population (615 patients) was 24.39%. Among those with BMC, 53.33% were males while 46.67% were females. Of the 615 patients, the incidence of unilateral BMC was 22.11% while the rate of bilateral BMC was 1.14%. When the patients with BMC were examined (150 patients), the rate of unilateral incidence was 90.67% in addition to the 9.33% of bilateral incidence.

Figure 1. Bifid mandibular canal on the orthopantomography image with both sides of the mandible.

Figure 2. BMC on the right side of the mandible in the axial tomographic (cone-beam computerized tomography) section.

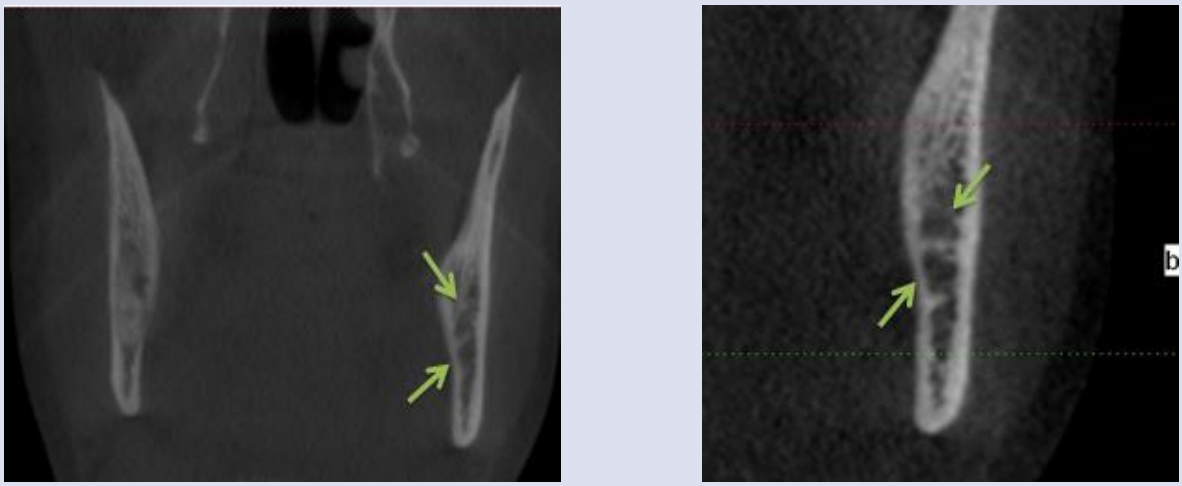

Figure 3. BMC on the left side of the mandible in the axial tomographic (cone-beam computerized tomography) section.

A total of 150 BMCs were detected in 143 patients. While BMC was detected in the bilateral form in 7 patients, it was detected unilaterally in 136 patients. Among the patients with BMC, 73 were males and 70 were females (Table 1). The prevalence of unilateral BMC was statistically significant compared to bilateral BMC ($p<0.05$; $p=0.016$) (Table 2). The prevalence of BMC in males was higher in a statistically significant way compared to females ($p<0.05$; $p=0.008$). When the incidence of BMC was evaluated in terms of the age variable, no statistically significant difference was observed (Table 3).

Discussion

Bifid mandibular canal (BMC) is an anatomical variation formed by the division of the mandibular canal into two branches. The reason why BMC occurs is not exactly known. The most likely cause is incomplete fusion of three different inferior alveolar nerves innervating the three mandibular teeth groups during the embryonic developmental stage of the seventh week of pregnancy.[4,5]

Accurate recognition of the anatomy and variations of the mandibular canal is important during oral and maxillofacial surgical applications involving the lower jaw, such as surgical implant placement, surgical fixation of mandibular fractures, extraction of impacted teeth, and orthognathic surgery. In cases where the bifid mandibular canal cannot be detected, many undesirable conditions such as paresthesia, traumatic neuroma, anesthesia, and bleeding may be encountered during surgical procedures.[9,10]

In the literature, previous studies reported that the prevalence of BMC was evaluated by panoramic radiography. However, the image obtained with panoramic radiographs is 2 dimensional, which may lead to a failure of detecting a possible BMC due to superpositions. Accordingly, a need for studies in further detail arises. Furthermore, few studies examined BMC with Computed Tomography (CT) and Cone-Beam Computed Tomography (CBCT), which reinforces the need for further detail. Evaluation of BMC in 3 dimensions improves the reliability of the data obtained in the analyses.

Table 1. Total prevalence of BMC in sex and laterality

Results	AGE RANGE	BMC
615 Patients - 310 Females -305 males	18-25	19
150 BMC in 143 Patients	26-33	21
Unilateral in 136 patients	34-41	24
Bilateral in 7 patients	42-49	27
73 males - 70 females	50-57	28
310 Females-305 males	58-65	24

Unilateral BMC: 136/615, Bilateral BMC: 7/615

Table 2. Prevalence of BMC in sex

Total	615	143	p
Female	310	70	0.008**
Male	305	73	

	615	143	p
Unilateral	136	136	0.016*
Bilateral	7	7	

*p<0.05 **p<0.01

Table 3: Statistical Analysis in terms of Age

Ranks			
	Group	N	Mean Rank
BMC	18-25	1	1.00
	26-33	1	2.00
	34-41	1	3.50
	42-49	1	5.00
	50-57	1	6.00
	58-65	1	3.50
	Total	6	

Test Statistics[a,b]	
	BMC
Kruskal-Wallis H	5.000
df	5
Asymp. Sig.	0.416[ns]
a. Kruskal Wallis Test	
b. Grouping Variable	

ns: p>0.05

Compared to CT, CBCT is advantageous in the evaluation of bone structures in the maxillofacial region with its features such as less radiation, shorter imaging time, high resolution in bone, and low cost. Therefore, CBCT was chosen to analyze BMC in this study.[11-14]

The mandibular canal is an anatomical formation that extends bilaterally from the mandibular foramen to the mental foramen, which carries the alveolaris inferior neurovascular vascular nerve package. Knowing the location, shape and anatomical structure of the mandibular canal is essential for surgical applications involving the mandible. Although the mandibular canal can be detected as a single formation, its anatomical variations were also detected. Bifid is a term of Latin origin, which means divided into two. In a study conducted by Chavez et al., it was reported that three different lower dental nerves might be combined to form a single nerve during embryonic development. In such cases, bifid and trifid mandibular canals could occur as a result of incomplete fusion of these three nerves.[14,15]

Anatomical structures should be studied carefully during clinical and surgical applications. Knowing the anatomical variations of the mandibular canal can help prevent undesirable conditions such as traumatic neuroma, paresthesia, anesthesia, and bleeding related to BMC during surgical procedures performed on the mandibular canal. Previous studies in the literature reported that the anatomical structures and locations of BMCs were taken into account while detecting BMC. Nortje *et al.*[16] and Langlais *et al.*[17] used panoramic radiography to detect BMCs. Moreover, Naitoh *et al.*[18] used CBCT for the detection of BMCs in their study. In studies where the mandibular canal and its variations were evaluated with panoramic radiography, problems such as ghost images that may occur on the opposite side of the mandible and overlapping of neighboring structures may be encountered. In previous studies, it was thought that BMC was under-detected due to the limitations of panoramic radiography.[18]

CBCT Panoramic radiography is more advantageous compared to CT thanks to its features such as high quality and 3D image acquisition in detecting the mandibular canal and its variations. The application of CT in dentistry is limited. It is possible to detect BMCs with CT, but it is not preferred due to disadvantages such as high cost, low accessibility, and high radiation dose. In this study, BMC was analyzed in three dimensions with CBCT. We think that the evaluation of BMC in 3

dimensions improves the reliability of the study. Accordingly, our study can ensure significant contributions to the literature as well as compensate for the lack of studies investigating the Southeastern Anatolian Region in Turkey.[14-19]

In this study, only the prevalence of BMC was evaluated. However, the BMC length and angle along with the BMC classification can also provide valuable data on the subject. Accordingly, further studies are required on the properties of BMC.[4]

Conclusions

In conclusion, in this study, BMC was evaluated with CBCT in the Southeastern Anatolian population. Although the bifid mandibular canal is a rare phenomenon, it is increasingly reported with advanced imaging methods and is an important anatomical variation that should be taken into account during oral and maxillofacial pratices.

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Cumhuriyet Dental Journal, 25(Suppl): 47-56, 2022
DOI: https://doi.org/10.7126/cumudj.1032878

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

The Effects of Different Desensitizers and Their Combinations with ER, CR: YSGG Laser on Dentin Tubules, and Shear Bond Strength to Dentin#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 06/12/2021
Accepted:08/02/2022

ABSTRACT

Objectives: The aim of this in vitro study was to investigate the effectiveness of Sodium Fluoride, Propolis and Er, Cr:YSGG laser alone and in combination with laser applications on dentin tubules by SEM and to examine the effects of these applications on the shear bond strength (SBS) of a universal adhesive to dentin.

Materials and Methods: Dentin samples obtained by removing the buccal enamel of 72 caries-free permanent, mandibular third molars were randomly divided into six groups (n:12): Control, Sodium Fluoride (Enamelast, Ultradent), Propolis (Fanus Propolis), Er, Cr:YSGG Laser (Biolase, Waterlase), Enamelast-Er,Cr:YSGG Laser, Propolis-Er,Cr:YSGG Laser. While the agents were applied to the dentin surfaces alone in the agent groups, laser was applied after the agent applications in the combination groups. No application was performed to the control group. After storing the samples in artificial saliva for 14 days, Clearfil Tri-S Bond Universal (Kuraray) and composite resin (Estelite Sigma Quick, Tokuyama) were applied to their surfaces. SBS tests were conducted using the Universal Tensile-Compression Test System (Instron 3382, USA). The tubule plugging efficiencies of the agents were examined on two dentin samples from each group by SEM. One-way analysis of variance (One-way ANOVA) was performed for statistical analysis of the data. For $p<0.05$, the results were considered statistically significant.

Results: No statistically significant difference was found in any comparison between all the test groups. In SEM examinations, occluded dentinal tubules were observed more frequently in the groups where the applications were performed in combination with laser, compared to the application of the agents alone. Although some of the dentinal tubules were open, the tubules were generally closed.

Conclusions: Although combination applications of Er, Cr:YSGG Laser with Sodium Fluoride and Propolis showed greater dentin tubule plugging efficiency, these applications did not have a negative effect on the SBS of Clearfil Tri-S Bond Universal compared to the control group. The changes caused by the laser application on the dentin surface and the content of the adhesive system may have prevented the SBS from being adversely affected.

Keywords: Dentin Hypersensitivity, Dentin Desensitizing Agents, Propolis, Er Cr:YSGG Laser, Shear Bond Strength

Farklı Hassasiyet Gidericilerin ve ER, CR: YSGG Lazer ile Kombinasyonlarının Dentin Tübülleri Üzerine ve Dentine Makaslama Bağlanma Dayanımına Etkisi#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 06/12/2021
Kabul:08/02/2022

ÖZ

Amaç: Bu in vitro çalışmanın amacı Sodyum Florid, Propolis ve Er,Cr:YSGG lazerin tek başına ve lazerle kombine uygulamalarının dentin tübülleri üzerindeki etkinliğinin SEM ile incelenmesi ve bu uygulamaların bir üniversal adezivin dentine makaslama bağlanma dayanımına (MBD) etkisinin incelenmesidir.

Gereç ve Yöntemler: 72 adet çürüksüz daimi alt 3. molar dişin bukkal mine dokusu uzaklaştırılarak elde edilen dentin örnekleri rastgele altı gruba (n:12) ayrıldı: Kontrol, Sodyum Florid (Enamelast, Ultradent), Propolis (Fanus Propolis), Er,Cr:YSGG Lazer (Biolase, Waterlase), Enamelast-Er,Cr:YSGG Lazer, Propolis-Er,Cr:YSGG Lazer. Ajan gruplarında ajanlar tek başına dentin yüzeylerine uygulanırken, kombinasyon gruplarında ajan uygulamalarından sonra lazer uygulanmıştır. Kontrol grubuna herhangibir uygulama yapılmadı. Örnekler 14 gün boyunca yapay tükrük içinde bekletildikten sonra yüzeylerine Clearfil Tri-S Bond Universal (Kuraray) ve kompozit rezin (Estelite Sigma Quick, Tokuyama) uygulandı. MBD testleri Universal Çekme-Basma Test Sistemi (Instron 3382, Amerika) kullanılarak yapıldı. Ajanların tübül tıkaç etkinlikleri, her gruptan iki adet dentin örneği üzerinde SEM ile incelenmiştir. Verilerin istatistiksel analizi için Tek Yönlü Varyans Analizi (One-way ANOVA) yapıldı. $p<0,05$ için sonuçlar istatistiksel olarak anlamlı kabul edildi.

Bulgular: Tüm test grupları arasında hiçbir karşılaştırmada istatistiksel olarak anlamlı farklılık tespit edilmemiştir. SEM incelemelerinde, lazerin kombine uygulandığı gruplarda ajanların tek başına uygulanmasına göre tıkalı dentin tübüllerine daha sık rastlandı. Dentin tübüllerinin bir kısmı açık olmasına rağmen tübüller genellikle kapalıydı.

Sonuçlar: Er,Cr:YSGG Lazer'in Sodyum Florid ve Propolis'le kombine uygulamaları daha fazla dentin tübül tıkaç etkinliği göstermekle birlikte, Clearfil Tri-S Bond Universal'in MBD'si üzerinde kontrol grubuna göre olumsuz bir etki oluşturmamıştır. Lazer uygulamasının dentin yüzeyinde oluşturduğu değişimler ve kullanılan adeziv sistemin içeriği MBD'nin olumsuz etkilenmesini önlemiş olabilir.

Anahtar Kelimeler: Dentin Hassasiyeti, Dentin Hassasiyet Giderici Ajanlar, Propolis, Er Cr:YSGG Lazer, Makaslama Bağlanma Dayanımı

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How to Cite: Bulut Eyüboğlu G, Serin Kalay T.(2022) The Effects of Different Desensitizers and Their Combinations with ER, CR: YSGG Laser on Dentin Tubules, and Shear Bond Strength to Dentin, Cumhuriyet Dental Journal, 25(Suppl): 47-56.

Introduction

Dentin hypersensitivity (DH) is a clinical problem that occurs due to thermal, chemical, mechanical or osmotic stimuli in the dental tissue and is a very common clinical problem in the community. It is characterized by sudden, short-term and sharp pain on a specific tooth surface that cannot be explained by any dental pathology.[1,2] The rate of DH detected with a careful examination has been reported to be approximately 15%. This rate varies between 70–98% in individuals with periodontal disease.[3 4] DH occurs when the dentin tissue is opened to the oral environment as a result of erosion, abrasion and abfraction that cause tooth tissue loss, as well as factors such as gingival recession, wrong brushing habits, diet and gastroesophageal reflux.[5-7] DH is most commonly diagnosed in the canine and premolar teeth and in the cervical regions of the buccal surfaces of the teeth.[4,8] Today, the incidence of DH is increasing gradually due to reasons such as gingival recession, consumption of acidic foods and incorrect brushing habits owing the increase in periodontal diseases.[6,9,10]

The aim of the treatment of DH is to occlude the tubules opened to the oral environment and/or to prevent the formation of pain by stopping depolarization of the pulpal nerve extensions in the open dentinal tubules[11,12] Since DH is quite common in the community, there are a large number of dentin desensitizing agents (DDAs) with different contents in the market for its treatment.[1,13,14]

Sodium fluoride (NaF, 5%) varnish applications have been widely used for many years in the treatment of DH.[15] Fluoride varnishes cause calcium fluoride (CaF_2) to accumulate on the exposed dentin surface and act as a mechanical barrier to occlude open dentinal tubules.[15, 16] Although clinical studies support the successful results of fluoride in the treatment of DH, many clinical studies have suggested that fluoride has limited efficacy.[17,18] It has been suggested that its effect is limited because the barrier formed due to the small CaF_2 crystals formed by fluoride cannot provide sufficient occlusion and these crystals dissolve slowly in saliva.[4,17,19]

In addition, studies have reported the presence of components that may be cytotoxic for teeth and gingival tissues in the structure of DDAs.[16,20] Since these components are mostly applied to the cervical region at the tooth-gingival junction, their contact with the gingival tissue is often possible. Morover, since DH is a chronic condition, repeating DDA applications is often necessary in the treatment of DH. Therefore, the biocompatibility of the agents used in the treatment of DH is becoming increasingly important.

Propolis is a resinous natural substance obtained by honey bees (Apis mellifera) from various plant sources.[21,22] Propolis has been used for many years in folk medicine for the treatment of several illnesses in many countries and there is a growing interest in using it in natural and biologically active supplements. Antibacterial, antifungal, anti-inflammatory, immunomodulatory, antiviral and antioxidant properties of propolis have been demonstrated in a variety of flavonoids and phenolic acids present in its structure.[23-25]

Propolis has also shown successful results in dentistry, wound healing, caries prevention, root canal disinfection, and cavity disinfectant, and has been added to the structure of toothpastes and mouthwashes.[26-29] Furthermore, propolis has been used in the treatment of DH and its occlusive efficacy in different dentin tubule has varied.[30,31] In another study, tubular plugs were reported to be resistant to citric acid.[32] In these studies, propolis extracts dissolved in ethanol were generally preferred, and water-based propolis extracts dissolved in water have also been introduced to the market in recent years. The advantage of water-based propolis is that it is biocompatible because it dissolves in water, and thus the dark discoloration of ethanol-based propolis is not seen in water-based.[22]

In recent years, the use of lasers in the treatment of DH, as well as DDA applications in the treatment of DH, has become increasingly common.[33,34] It has been explained by theories such as providing DH removal efficiency with laser applications, occlusion of dentinal tubules by melting dentinal tubules, evaporation of dentinal fluid and suppression of nerve conduction.[19,35] It has been reported that the Er, Cr:YSGG laser provides the accumulation of insoluble salts in the dentinal tubules by evaporation of the dentinal tubule fluid, resulting in occlusion of the dentinal tubules and reduction of DH.[33,35,36] In different studies, it has been reported that laser applications showed both dentin tubule plug effectiveness alone, and combined applications with DDAs further incresed tubule plug effectiveness.[37-39]

Additionally, in cases where tooth tissues are lost after DDA applications, restorative treatments are performed with resin composites. For this reason, tubule plugs formed in the dentinal tubules after the application of desensitizers may have negative effects on the bond strength of the filling materials.[40,41] Therefore, it is important to know the effect of the DDAs and applications on bond strength. Although there are studies on bond strength in the use of sodium fluoride and laser alone in the literature, as far as we know, studies on the bond strength of propolis to dentin are very limited, and there is no information about the combined applications of sodium fluoride and propolis with laser.

For these reasons, in this in vitro study; it was aimed at investigating the effects of sodium fluoride (NaF), water-based propolis and Er, Cr: YSGG laser alone and combined application of propolis with Er, Cr: YSGG laser and NaF with laser, which are used in the treatment of DH on the shear bond strength (SBS) of a universal adhesive system to dentin.

Secondly, it was aimed to examine the tubule plug activity created by these applications on the dentin surface by scanning electron microscopy (SEM).

The initial hypotheses of this study are:

- There is no difference between the SBS values of a universal adhesive to dentin after propolis, NaF and laser application alone.
- There is no difference between the SBS values of a universal adhesive after the combined application of Propolis and NaF with laser (Propolis- Er, Cr: YSGG Laser and NaF- Er, Cr: YSGG Laser).
- There is no difference between the SBS values of a universal adhesive to dentin after the application of Propolis, NaF and Er, Cr:YSGG laser alone or in combination.
- The tubule plug activities created by these applications are similar to each other.

Materials and Methods

Ethical approval of this study was obtained from the Scientific Research Ethics Committee of Karadeniz Technical University, Faculty of Medicine with the number 2021/220 (Decision No: 27.09.2021).

In this in vitro study, the SBS of a universal adhesive (Clearfil Tri-S Bond Universal, Kuraray Noritake Dental Inc., Osaka, Japan) to dentin was investigated after sodium fluoride (5% NaF, Enamelast, Ultradent, UT, USA), which has been used for many years in the treatment of DH and water-based propolis (Fanus Propolis, Fanus, Trabzon, Turkey) and Er, Cr:YSGG laser, both alone and in combination. In addition, the plug efficiencies of these applications on the dentinal tubules were examined by SEM.

Preparation of Dentin Samples

In the study, 72 caries-free permanent lower third molar teeth extracted for orthodontic or oral reasons were used. Teeth were stored in 0.1% thymol until experiments were performed. The enamel tissues on the buccal surfaces of the teeth were removed under water cooling by a low speed precision cutting device (Micra Cut 125, low speed precision cutting device, Metkon, Bursa) and a 0.3 mm thick diamond separator (Diamond cut-off wheel B 102, ATM GMBH, Germany). Thus, the superficial dentin tissues in the buccal surfaces of the teeth were exposed. Then, dentin samples were obtained by cutting the teeth horizontally from the apical of the enamel-cementum junctions.

Dentin samples were placed horizontally in the middle of the previously prepared plastic molds and with the dentin surface facing outward. Dentin samples were obtained by pouring autopolymerizing acrylic resin (Imicryl, SC, Konya, Turkey) into the mold. Prepared samples were sanded with 600, 800, 1200, 1500 and 2000 grain silicon carbide (SiC) papers in a 200 RPM rotary sanding device (Beta Grinder Polisher, Buehler) to form a standard smear layer and obtain a smooth surface. Preparation of dentin samples, DDAs and Laser applications and all analyses were performed by a single operator.

Applications of Dentin Desensitizing Agents and Er,Cr:YSGG Laser

Dentin samples were soaked in 17% EDTA (Werax, Tunadent, Izmir, Turkey) solution for five minutes to remove the smear layer and simulate the opened dentinal tubules. The samples were washed under running water to remove residues and then sonicated with an ultrasonic cleaner in distilled water for five minutes.

72 test samples were randomly divided into six groups as n:12: Group C (Control), Group EN (5% NaF, Enamelast), Group P (Propolis), Group L (Er,Cr:YSGG Laser), Group EN-L (Enamelast-Er,Cr:YSGG Laser), Group P-L (Propolis-Er,Cr:YSGG Laser). Ten of the samples prepared for each group were used for SBS tests and two for SEM examinations. The contents and application instructions of the DDAs and Laser were given in Table 1. In Group EN-L and P-L groups, laser application was performed after the agents were applied to the dentin surface. No application was made to the control group.

All dentin samples were placed in artificial saliva (0.213 g/l $CaCl_2{\cdot}2H_2O$, 0.738 g/l KH_2PO_4, 1.114 g/l KCl, 0.381 g/l NaCl, and 12 g/l Tris buffer; pH adjusted to 7 with KOH) after DDAs and laser applications. The artificial saliva used in this study was prepared at Biochemistry Laboratory of Faculty of Medicine in Karadeniz Technical University. Dentin samples of the control group were placed in artificial saliva without applying DDAs. Artificial saliva was replaced every other day, and test samples were brushed with circular movements applied 8-10 times with a soft toothbrush under light pressure at each replacement procedure. At the end of 14 days, the samples were taken from artificial saliva, washed with water, and brushed with a soft toothbrush with circular movements applied 8-10 times, again by applying a slight force. The dentin surfaces of the test samples were washed again and dried with air-water spray for 5 seconds.

Clearfil Tri-S Bond Universal adhesive was then applied to the surfaces of the test specimens according to the manufacturer's instructions and light cured for 20 seconds (S10, 3M ESPE, St. Paul, MN, USA). Then, composite resin (Estelite Sigma Quick, A2, Tokuyama Dental, Japan) was applied to the dentin surfaces by using a specially designed plexiglass apparatus containing a cylindrical cavity with a height of 3 mm and a diameter of 2.56 mm in the middle. The composite was applied to the dentin surfaces in 2 layers with a thickness of 1.5 mm. The polymerization of composite resins was completed by applying light to each layer for 20 seconds (Table 2). SBS tests were performed after the test specimens were stored for 24 hours at 37ºC, in a 100% humidity environment.

Shear Bond Strength Test

The SBS test of the samples was performed using the Universal Tensile-Compression Test (Instron 3382, USA).

Table 1. Dentin Desensitizing Agents, Laser, Manufacturers, Contents, Lot Numbers and Application Instructions.

Materials	Manufacturer	Contents	Lot Numbers	Application Instructions
Enamelast Fluride Varnish	Ultradent Products, USA	-Sodyum fluorid (5%), -Xylitol	BHFSD	Lightly dry area to be treated. Using a painting motion, apply a thin smooth layer to as many dry tooth surfaces as possible. Gently flow cool water over the teeth.
Propolis (Water-Based Propolis)	Fanus Propolis, Turkey	-50% resin and vegetable balsam, -30% wax, -10% essential and aromatic oils, -5% pollen, -5% other substances -Polyphenols (flavonoid aglycones, phenolic acids, and their esters, phenolic aldehydes, alcohols, and ketones), sesquiterpene quinones, coumarins, steroids, amino acids,	09-650	Propolis application was performed in circular motions without applying much force for 60 seconds (32).
Er, Cr:YSGG Laser	Waterlase, Biolase, San Clemente, USA	0.25 Watt 0% water, 10% air, 20 Hz in non-contact mode (35). A 6 mm MZ6 tip with a diameter of 600 µm was used for Er, Cr:YSGG laser application.	18002402	Irradiation was performed for a total of 20 s vertically and horizontally from the 1-mm irradiation distance to the dentin tissue.

Table 2: Manufacturers, Contents, Lot Numbers and Application Instructions of Universal Adhesive and Composite Resin

Materials	Manufacturer	Contents	Lot Numbers	Application Instructions
Clearfil Tri-S Bond Universal	Kuraray Noritake Dental Inc., Japan	-BisGMA, -HEMA, -Ethanol, -10-MDP monomer -Hydrophilic aliphatic di methacrylate -Colloidal silica -Di-camphorquinone -Silan coupling agents -Water Ph:2,3	850043	1. The adhesive is actively applied to the tooth surface for 10 seconds. 2. Apply light air for more than 5 seconds until the adhesive shows no movement. 3. Light cure for 10 seconds
Estelite Sigma Quick	Tokuyama Dental, Japan	-BisGMA, -TEGDMA - 72% by weight, 71% by volume silica-zirconia fillers, -Spherical submicron fillers with an average size of 0.2 micron	W970	1. After the isolation, apply to the cavity by layering technique. 2. Light-cure from a distance of 2 mm.

After the test samples were fixed to the Instron device, a load was applied to the composite-dentin interface parallel to the acrylic surface (the speed of the test device was set to 1 mm/s). The results obtained in Newtons were converted to Megapascals (MPa). The fracture surfaces of the test samples were examined under X30 magnification with an optical microscope (Olympus Metallurgical Microscope, Tokyo, Japan) for the determination of different failure types (adhesive, cohesive and mixed).

SEM Examinations

Two test samples prepared for each group were used in SEM examinations. The agents were applied to the dentin surfaces according to the manufacturer's instructions. After waiting for 6 hours, the excess of the agents were removed from the surfaces in order to examine the dentinal tubule orifices. In combination groups, laser application was performed immediately after the agent application. After waiting for the same time, the excess agent on the dentin surfaces was removed and SEM examinations were performed. Then the dentin samples were covered with a thin layer of gold film and SEM examinations (Zeiss EVO LS 10, UK) were performed at 5 kV and magnifications with X2000 and X5000.

Statistical Analysis

SPSS for Windows 17.0 (Statistical Package for Social Sciences, SPSS Inc., Chicago, 20 IL, USA) was used for

statistical analysis. Descriptive statistics were presented as mean, standard deviation (Mean and Sd), and Min-Max values. One-way Analysis of Variance (One-way ANOVA) was performed for statistical analysis of the data. For $p<0.05$, the results were considered statistically significant.

Results

Results of Shear Bond Strength Test

Table 3 shows the mean ± standard deviation and minimum-maximum values of the SBS of the test groups. The One-way Anova results of data are given in Table 4. According to Table 4, no statistically significant difference was observed in all comparisons between the groups ($p>0.05$).

Evaluation of Optical Microscope Images of Dentin Samples

As a result of the examination of the fracture surfaces of the test samples with an optical microscope, adhesive type failure was detected in all of the specimens.

Scanning Electron Microscopy (SEM) Analysis Results

1. Group C

In the SEM images of the control group, it was determined that EDTA application removed the smear layer and dentin tubules of different diameters were exposed (Figure 1).

2. Group EN

In the SEM images of the EN group, it was observed that the dentinal tubule orifices were usually open as well as the presence of locally closed or narrowed tubules (Figure 2).

3. Group P

In the propolis group, there were usually tubule plugs besides open dentin tubules (Figure 3).

4. Group L

The dentinal tubules were generally narrowed or occluded, but open dentinal tubules were also present on Er,Cr:YSGG laser treated dentin surfaces (Figure 4).

5. Group EN-L

In the SEM images of the Enamelast-Er,Cr:YSGG laser treated group, the dentinal tubules were generally closed and the plugs on the tubule orifices were seen (Figure 5).

6. Group P-L

In the group in which the laser was applied in combination with propolis, occluded dentin tubules were more common than in the groups in which the propolis was applied alone (Figure 6).

Discussion

DH is a condition that is increasing especially in developed countries and negatively affects the life comfort of individuals. When DH is not treated, it causes disruptions in oral hygiene practices, leading to the emergence of different dental problems. Therefore, DH treatment is becoming more and more important both to improve the quality of life of patients and as a part of preventive dentistry. For these reasons, the search for a fast-acting and long-lasting treatment of DH is increasing. While new researches continue in the treatment of DH, laser applications and combined applications of laser agents are becoming more common. [19,34,35,37,39.]

Table 3. Shear Bond Strength Values of the Test Groups

	Shear Bond Strength Values (MPa)		
Groups (n:10)	**Mean ± Standard deviation**	**Min**	**Max**
Group Control (C)	10.106 (4,93)	4.96-	21.40
Group Enamelast (EN)	10.043 (3,21)	5.72-	15.75
Group Propolis (P)	7.829 (2.22)	3.90-	10.35
Group Er,Cr:YSGG Laser (L)	9.711 (2,34)	6.02-	13.65
Group EN- L	9.415 (1,01)	7.85-	10.72
Group P-L	9.182 (1.63)	6.87-	11.42

Table 4. The One-way Anova Table

Sum of Squares		df	Mean Square	F	Sig.
Between Groups	35.231	5	7.046	.868	.509
Within Groups	438.535	54	8.121		
Total	473.767	59			

*According to the One-way Anova table, no statistically significant difference was observed in all comparisons between the groups ($p>0.05$).
For $p<0.05$, the results were considered statistically significant.

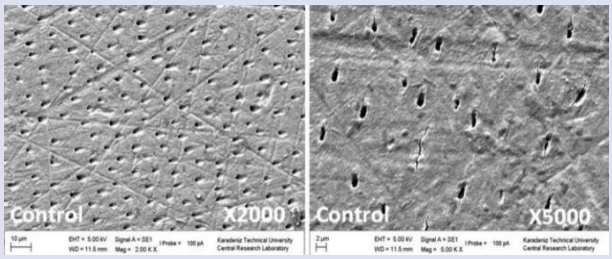

Figure 1. In the SEM images of the control group, exposed dentin tubules of different diameters were observed.

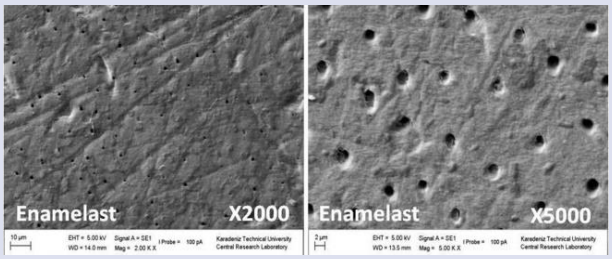

Figure 2. In the SEM images of the EN group, dentinal tubule orifices were usually open as well as the presence of locally closed or narrowed tubules.

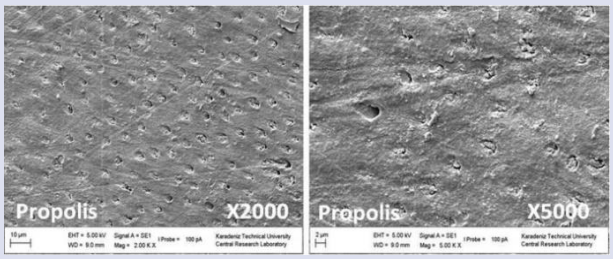

Figure 3. In the Propolis group, tubule plugs were usually observed besides open dentin tubules.

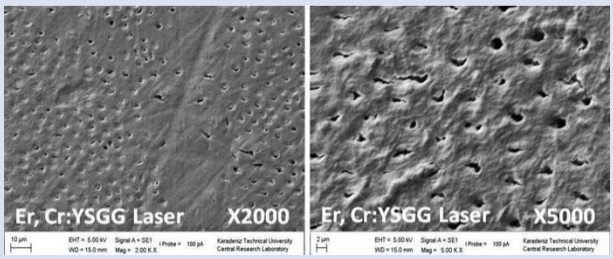

Figure 4. In the SEM images of the Er,Cr:YSGG laser group, dentinal tubules were generally narrowed or occluded, but open dentinal tubules were also present.

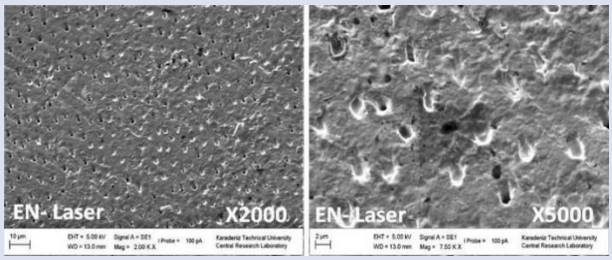

Figure 5. In the SEM images of the Enamelast-Er,Cr:YSGG laser group, the dentinal tubules were generally closed and the plugs were observed on the tubule orifices.

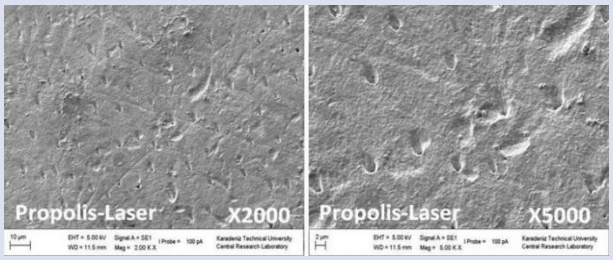

Figure 6. In the SEM images of the Propolis-Er,Cr:YSGG laser group, occluded dentin tubules were more common than in the groups in which the propolis was applied alone.

In this in vitro study, the effects of the applications of NaF (Enamelast), which has been used for many years in the treatment of DH and Propolis, which has shown successful results in different fields in medicine and dentistry and has come to the fore with its biocompatible properties, and Er,Cr:YSGG laser, which has become increasingly popular in the treatment of DH in recent years, and their combined application on the SBS of a universal adhesive system (Clearfil Tri-S Bond Universal) to dentin were investigated. Additionally, the dentin tubule plug efficiencies of these applications were examined by SEM.

According to the findings of this study, it didn't show a significant difference between the SBS values of all groups to dentin. Therefore, our first 3 hypotheses about the SBS values of a universal adhesive to dentin after different desensitizer applications were accepted. Our 4th hypothesis was "Tubule plug activities created by these applications are similar to each other." rejected because the tubule plug activities in the SEM images of the groups were different.

In this study, Enamelast application did not negatively affect the SBS compared to the control group and other groups. In SEM examinations, the dentin tubules were open in control group (Figure 1). In the SEM images of group EN, the tubules were usually open, as well as the presence of partially closed or narrowed dentin tubules (Figure 2).

There are different results in the literature regarding the bond strength of DDAs containing fluoride to dentin. In an in vitro study, it was reported that a self-etch adhesive reduces microtensile bond strength due to fluoride plugging open dentinal tubules with calcium fluoride crystals and blocking dentinal tubules.[41] In

another study, it was reported that fluoride gel reduces bond strength due to tubule occlusion.[42]

In another study, after long-term application of sodium fluoride to the dentin surface, the micro-shear bond strength of a self-etch adhesive system (Clearfil SE Bond) was found to be higher than in other experimental groups (Novamin, demineralized dentin, nonfluoridated dentin). Moreover, although the bond strength of the dentin applied with NaF after acid etching decreased compared to the self-etch system.[43] It has been suggested that the acid application stimulates alkaline phosphatases and metalloproteases activity and release in dentin and inhibits the bond strength of these enzymes, whereas fluoride released from NaF protects the hybrid layer from enzymatic degradation, which increases the bond strength.[44] In addition, it has been reported that the acidic 10-MDP momomer in the Clearfil SE Bond (self-etch adhesive system) increases the bond strength to dentin by forming insoluble salts with apatite crystals in dentin.[45] 10-MDP momomer that is included in the structure of self-etch and universal adhesive systems and which is used in the composition of Clearfil Tri-S Bond Universal, may have contributed to the increase in bond strength.

Universal adhesive systems are systems in which the adhesive procedures in self-etch systems are combined in a single system in terms of both reducing technical sensitivity and ease of application, and can be applied together or alone with acid etching when desired.[46,47] Furthermore, in mild universal adhesive systems, there was no difference in bond strength between self-etch or total-etch mode. However, in the absence of acid etching, the more superficial interactions of these materials on the dentin both reduce the risk of postoperative sensitivity and prevent the degradation of collagen fibrils. This contributes to the bond strength in the long term.[48-51] Therefore, in this study, we preferred to use Clearfil Tri-S Bond Universal, a mild universal adhesive system, in self-etch mode for reducing technical sensitivity and ease of application.

Besides, in our study, the adhesive applications performed 14 days after the fluoride application did not adversely affect the bond strength of EN compared to the other groups. The reason for the differences between the findings of other studies in the literature may be due to the chemical content of the fluoride agent used, the difference between the material methods and the tubule plug effectiveness of the applied fluoride, as well as the adhesive systems used. In our study, storing the dentin samples in artificial saliva for 14 days after EN application and brushing the dentin surfaces at regular intervals may have caused the existing tubule plugs to be removed and the dentin tubules to open. This may have prevented the adverse effects of adhesive applications.

Furthermore, in this study, removal of the excess of the EN varnish from the dentin surface for examining tubule orifices by SEM may have partially affected the tubule plugs.[52,53] Although it is not a clinical practice to remove fluoride varnish from the tooth surface, the varnish can be removed from the tooth surface over time by tooth brushing. However, performing adhesive procedures immediately after fluoride varnish has been applied to the tooth surface may damage the adhesive procedures.

Propolis, which is a natural substance in resin structure, generally showed tubule plug activity in the SEM images of this study (Figure 3). In different studies, propolis has been used in the treatment of DH and has shown dentin tubule occlusive activity.[30-32] In a study by Chen *et al.*[32], it was determined that the tubule plugs formed by propolis were resistant to citric acid application and the tubules were mostly clogged after acid application. It has been reported that the flavonoids contained in propolis gel interact with the dentin and reduce the fluid movement of the crystals formed in the dentin, thus showing DH-reducing activity. It has also been suggested that due to its resinuous structure, propolis could mechanically bond to the pores in the dentinal tubules and thus block the dentinal tubules.[30,32] In our study similar to that study, in the propolis group, plugged dentin tubules were found in addition to occasional open dentin tubules. The probable cause of tubular plugs may be the resinous structure of propolis and the crystals formed by the reaction of high concentrations of flavonoids in its structure with dentin tubules.

In a study in which ethanol-based propolis was used as an intracanal medicament and root canal disinfectant, it caused discoloration on the coronal surfaces. Although the physical and chemical properties of propolis vary considerably, its original color being amber and the minerals such as flavonoids and iron in its content may cause discoloration. In addition, ethanol may facilitate their diffusion and increase the discoloration.[54]

Therefore, in our study, 10% water-based propolis, which is colorless, was preferred in order not to cause discoloration, especially in the anterior teeth. Although water is not as good a solvent as ethanol, water-based propolis contains a fairly high concentration of flavonoids and is nontoxic. For this reason, it is an important advantage that water-based propolis does not cause discoloration, especially in cases where repetitive applications are required in the clinical treatment of DH.[22] To the best of our knowledge, this is the first study in terms of the use of water-based propolis in the treatment of dentin sensitivity.

Although the SBS of Clearfil Tri-S Bond Universal to dentin after propolis application was slightly lower than other groups, there was no statistically significant difference between the other groups ($p<0.05$). In different studies where propolis was used as a cavity disinfectant, propolis did not adversely affect the bond strength.[55,56]

In this study, Er,Cr:YSGG laser application in SEM images closed the dentinal tubules in general, although there were open tubules in places (Figure 4). Besides, the laser application did not adversely affect the bond strength in dentin samples.

In a study, it was reported that Er, Cr: YSGG laser could dissolve peritubular dentin even at low power

(0.25 Watt) and narrowed dentin tubule diameters similar to Nd:YAG laser.[36] In addition, in clinical studies examining the effect of Er, Cr:YSGG laser on DH, it has been shown that the effect can last for the medium and long term even after a single application.[35,57] In a clinical study comparing the desensitizing efficiency of different laser types, Er, Cr:YSGG laser was reported to be more effective for 6 months.[58]

In an in vitro study by Gürgan *et al.*, it has been reported that the Er, Cr:YSGG laser application to the dentin surface is affected by the power of the laser and the preparation differences depending on the adhesive type. In addition, it has been determined that SBS is higher depending on the power of the laser.[59]

Moreover, it has been suggested that laser application may have increased the bond strength to dentin due to the formation of a rough and irregular surface on the dentin surface.[60] In addition, intertubular dentin undergoes more selective ablation because it contains more water and less minerals than peritubular dentin, and it has been reported that the protrusive irregular dentin surfaces formed after ablation may have contributed to the bond strength.[61-63] In an in vitro study by Ergücü *et al.*[64], it was reported that the use of Er, Cr:YSGG laser did not adversely affect the bond strength of a total etch and self-etch adhesive to intact and caries-affected dentin.

In our study, dentinal tubules were opened by EDTA application. This may have facilitated the penetration of the laser on the tubule surfaces and inside the tubules due to the removal of the smear layer, and may have facilitated the penetration of the adhesives into the tubules. Moreover, the 10-MDP monomer in the structure of Clearfil Tri-S Bond Universal also contributes to the bond strength by forming a chemical bond with the calcium in the structure of hydroxyapatite.[45,65] Additionally, since the laser application was only used in the mode of the treatment of DH in our study, the output power of the laser may be lower than in other studies. It is because at higher power, higher bond strength could be obtained.

In this study, the combination application of Enamelast and Er, Cr:YSGG Laser did not reduce the SBS compared to the other groups. In a study, (Aqua Prep F, 35% HEMA, 2% NaF) was applied to the dentin surface alone and in combination with the Nd:YAG and Er:YAG laser, and the adhesion of lithium disilicate ceramic to the dentin surface with a self-adhesive resin cement was investigated. Although the application of Aqua Prep F in combination with Nd:YAG Laser or alone did not affect the bond strength, the agent combination with the Er:YAG laser increased the bond strength compared to the alone application of the agent. In this study, the use of different types of lasers and the use of higher power may have increased the bond strength.[66]

We could not find any study on the effect of combined applications of fluoride-containing desensitizer and Er, Cr:YSGG Laser on the bond strength. Therefore, we could not adequately discuss the effect of combined application of EN-Laser on bond strength with adhesive resins.

In our study, dentin tubule plug efficiencies were also investigated after combined EN-L application (Figure 5). The combination of EN with laser showed greater tubule plug efficacy compared to EN alone. Studies have reported that the combination of NaF with different types of lasers increases the effectiveness of dentin tubule plugs.[37,67-69] In addition, it has been suggested that laser applications with fluoride can increase the penetration of fluoride into the tubules and inhibit demineralization.[67,70]

In our study, when the effect of combined application of propolis and laser on SBS was examined, this combination did not reduce the bond strength compared to both the control group and other groups. We could not find any study on the effect of combined application of propolis with laser on bond strength. In addition, the tubule plug efficiency of propolis and laser combination was found to be higher in SEM examinations (Figure 6). Although the tubule plug efficiency of the propolis-laser combination was higher than the alone application in our study, as far as we know, there is no study examining the tubule plug effectiveness of propolis in combination with the laser. There is a need for in vitro and clinical studies where the results of this study can be discussed in detail.

One of the limitations of this study is that the effectiveness of DDA applications was not re-examined, since SEM examinations were not repeated after waiting in artificial saliva. In addition, performing bond strength tests using a single adhesive prevented the comparison of SBS values of different systems after DDA applications. Moreover, performing SBS experiments only in the early period limits the evaluation of long-term results.

Conclusions

While the combined applications of Er,Cr:YSGG Laser with Sodium Fluoride and propolis showed greater tubule plug efficiency on the dentin surface, the application of the agents alone or in combination with the laser did not create a negative effect on the SBS of Clearfil Tri-S Bond Universal adhesive compared to the control group. According to the findings of this study, it may be recommended to apply these agents in combination with laser in the treatment of DH.

In the light of this study, there is a need for studies in which different adhesive systems are used after different desensitizing agents, propolis, laser and combined applications, and the results of early and late period studies performed under different conditions could be evaluated. Moreover, in addition to the DDA applications and adhesive systems, morphological differences of dentin and the pulpal pressure in vital teeth will also affect the results. For these reasons, the results of this study should be confirmed by future clinical studies.

Conflict of Interest

The authors of this article certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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Cumhuriyet Dental Journal, 25(Suppl): 57-65, 2022
DOI: https://doi.org/10.7126/cumudj.1033084

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

The Effects of the Covid-19 Pandemic on the Demand for Dental Treatment#

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Research Article

Acknowledgment

#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 06/12/2021
Accepted: 08/02/2022

ABSTRACT

Objectives: To report on the level of knowledge of people about Covid-19 symptoms, transmission routes and personal protective equipment use during the Covid-19 pandemic normalization process, to determine the health institutions they will prefer for dental treatment.

Materials and Methods: A total of 226 individuals aged 18 and over who went to dental institutions like faculties of dentistry, dental clinics, public and private hospitals at least once in the last 2 years participated in this survey.

Results: The majority of the participants (36%) are between the ages of 20-30; 43% of them are university graduated; 70% of them belong to small family; 29% of them live in a household with 3 people. Participants have a high level of knowledge about Covid-19 symptoms and transmission routes. Surgical masks (94%), hand disinfectants (95%) are the most common measures taken for Covid-19, while N95. (24%) and visor (21%) are used the least. No significant relationship was found between socio-demographic characteristics, the level of knowledge about Covid-19 symptoms and transmission routes, and the use of personal protective equipment. Faculty of dentistry monitor body temperature and mask use, and dental clinics monitor the use of masks more carefully than other health institutions. Among the reasons for the preference of health instutiations the precautions taken regarding the epidemic were not preferred, but only the ease of transportation and financial reasons (p=0,00) were effective. 46% of the participants are aware of the measures taken by health institutions against Covid-19.

Conclusions: Participants have sufficient knowledge about the transmission routes and symptoms of Covid-19. The Covid-19 pandemic was not effective in determining the health institution they would prefer.

Keywords: Covid-19, Hospital Preference, Level of Knowledge, Dental Treatment, Pandemic.

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How to Cite: Aydemir M,Hergüner Siso Ş, Murrja E, Najafova L. (2021) The Effects of the Covid-19 Pandemic on the Demand for Dental Treatment, Cumhuriyet Dental Journal, 25(Suppl): 57-65.

Introduction

In the winter months of 2020, the pandemic process started in the world because of a virus that spread from Wuhan city to China and from there to the whole world and caused deadly pneumonia. This virus is an RNA virus and is in the same family as corona SARS-CoV and Middle East respiratory syndrome coronavirus (MERS-CoV). Starting in China, this virus caused thousands of people to become ill and die, then spread to Europe (most of all it affected Italy) and the United States of America (USA). Due to the very high rate of spread and high contagiousness of the disease, the World Health Organization (WHO) had to declare a pandemic, this new disease is called the coronavirus 2019 disease (COVİD - 2019). According to researches, the most likely route of transmission of the disease can be carried out by respiratory droplets. That is if there is a situation such as talking, coughing and sneezing. There are insufficient numbers of studies on the transmission of the virus by other means.[1] Like other coronaviruses, SARS-Cov-2 infection shows symptoms such as fever, cough, and asthenia in patients.[2]

Rotating instruments and ultrasonics used by physicians during dental treatment in clinics come into contact with body fluids and spray contaminated aerosols.[3] Dentists are in the high-risk group because the most likely route of transmission of the virus is through droplets. Measures should be taken to protect dentists, assistants, clinic staff, and patients from the disease during the pandemic process we live in.[4] Appliances used in dental treatments are contaminated with various microorganisms. Perforation of the mucosa with sharp tools can cause infections.[3] Some studies measure the fear and fuss of healthcare workers during the pandemic process.[5,6]

Dentists are one of the highest risk groups among healthcare professionals during the Covid-19 pandemic process. In Italy, during the isolation process of the pandemic process, dental clinics were not closed by the state. The reason for this was to reduce the burden of hospitals serving Covid-19 patients. However, the medical and dental committee strongly recommended that patients should not be treated by physicians, except for those requiring emergency treatment in clinics.[7] It

was reported that within the scope of the measures specified in the study guide published by the Ministry of Health in Turkey on June 1, aerosol-containing treatments, especially emergency and compulsory treatments, can be applied.

With the pandemic that took place in 2019, there have been some changes in the preferences of patients in the following years. These events will cause a change in the literature on hospital choice. In the declaration published by the Ankara Chamber of Physicians in 2020, it is stated that the treatment of patients other than Covid-19 is disrupted and access to the right to health is difficult. It was stated that patients with chronic diseases did not go to hospitals except for emergencies due to the concern of being infected with the virus, non-emergency elective surgeries and treatments were postponed until after the pandemic with the agreed decision of the physician and the patient. In this study, how the Covid-19 pandemic affects the rate of patients going to the hospital for dental treatment and hospital preferences for dental treatments during the pandemic were evaluated.

H_0: The Covid-19 pandemic did not affect individuals' perspectives on dental treatments.

Studies are investigating the level of fear and psychological disturbance of dentists and hygienists during the coronavirus outbreak.[7-9] Interestingly, there are a few studies that measure the level of fear and chaos in patients who come to dentistry faculties and clinics during this difficult pandemic process. Likewise, there is no study that measures the knowledge level of patients who apply to dentists during the pandemic process about COVID-19, according to which criteria the patients make their choice of the health institution and the factors that affect this choice. The aim of this study is to measure the knowledge of patients who apply to the dentist about Covid-19 disease, to determine their perspective on dental treatment in this process, to investigate the criteria by which the health institution chooses in case of need for this treatment and the factors affecting it.

Materials and Methods

This study is approved by the Ministry of Health of the Republic of Turkey (No: 2020-09-03T002437). This study is approved by the Institutional Ethics Committee of Istanbul Aydın University (No: B.30.02.AYD.0.00.00-050.06.04/320). This study is conducted in accordance with the Principles of the Declaration of Helsinki.

The study started in June 2020, which is accepted as the beginning of the normalization process in our country. Adult patients aged 18 years and older who applied to the state hospital, dental policlinics, Faculties of Dentistry, private hospitals, and private clinics due to the need for dental treatment were included in the study and the participation was purely voluntary. These patients were asked to fill out the questionnaire form before their treatment. The form was filled out under the supervision of clinical staff. No record was made regarding the identity information of the participants (name, surname and identity number).

The questionnaire used in the study consists of two parts. The first part includes questions about demographic data and systemic diseases. The second part includes COVID-19 and patient-related questions (Table 1). After the participants answered all the questions, the relevant data of the study were saved electronically and evaluated with the G*power 3.1 program. As a result of the evaluation made according to the Chi-Square analysis, the required sample size was determined as at least 223 individuals. In this case, it is expected that the power of the test will be approximately 80.04%. The data obtained from the study were evaluated with the Chi-Square test and Fisher's exact test.

Results

65% of the participants were female and 35% were male. The range with the highest number of participants is the 20-30 age group with 36%; university graduated with 43%; small family with %70 and a household of 3 people with 29%. These values were statistically significant. Marital status and income level responses were homogeneously distributed.

49% of the study participants mostly work the same hours as before the pandemic. 86% of the participants have social insurance and 32% have private health insurance. 81% of the participants do not have any chronic disease. (Table 1)

In the questions asked to the participants to measure their level of knowledge about Covid-19 symptoms, it was seen that fever was the most known symptom with 81%, while diarrhea and headache were the least known symptoms with 61%. Participants have a significant level of knowledge about all symptoms. (Table 2).

The difference between all answers in the questions measuring the level of knowledge of the participants about the ways of transmission of Covid-19 is statistically significant. The most common transmission routes are coughing (93%) and sharing personal belongings (90%). 54% have no information about the transmission from pets. The least known transmission routes are emergency and non-emergency treatments and dental treatments. In addition, the participants asked, "Do you know that the aerosol (water droplets) scattered in the air and suspended in the air during dental treatment play a role in the spread of the Covid-19 virus?" the answer to the question was yes with 65% (Table 3).

Table 4 shows the precautions taken by the participants for Covid 19. Mainly surgical masks, hand sanitizers, and cologne are used. The use of N95, visor, and gloves are statistically significantly less.

No significant relationship was found between socio-demographic characteristics and questions measuring the level of knowledge about Covid-19 symptoms. No significant relationship was found between the socio-demographic characteristics and the questions measuring the level of knowledge about the transmission routes of Covid-19. No

significant relationship was found between socio-demographic characteristics and the use of personal protective equipment. (p>0.05)

There is no significant difference in the level of knowledge about symptoms and transmission routes, or the use of protective equipment in patients with chronic disease. (p>0.05). In addition, the level of education did not affect the level of knowledge about Covid-19 or the rate of use of protective equipment (p>0.05).

140 people out of 226 participating in the study had dental treatment during the normalization process. 86 people did not have dental treatment. During the normalization process, those who had dental treatment preferred dental policlinics with 32%, dentistry of faculties with 30%, private hospitals with 21%, private clinics with 13%, and state hospitals with 4%.

No significant relationship was found between income level and the preferred hospital. (p>0.05) In addition, there was no significant relationship between income level and the reason for choosing the preferred institution. It is statistically significant that the participants with social health insurance prefer the institution for 'financial reasons' (p=0.03).

Among the reasons for choosing the institution by the participants with private health insurance, 'health insurance' was significantly the most important reason (p=0.00). (Table 5)

The frequency of going to the dentist for the group who had dental treatment during the normalization process; decreased by 56%, remained unchanged by 38.9%, and increased by 5%. There was no significant change in the frequency of going to the dentist during the normalization process for individuals with chronic diseases.

The reasons for going to the dentist during the normalization process were pain (35%), tooth decay (19%), gingival problems (10%), filling replacement (9%), control (6%), aesthetics (4%), trauma (3%), and other reasons (14%).

Table 1. Socio-demographic characteristics

Socio-demographic characteristics	Categories	n	%	χ^2	p
Gender	Female	148	65%	21.68	0.001[1]**
	Male	78	35%		
Age	Age Under 20	21	9%	107.027	0.001[1]**
	20-30	81	36%		
	31-40	58	26%		
	41-50	44	19%		
	51-60	11	5%		
	over 60	11	5%		
Educational status	Illiterate	2	1%	213.637	0.001[1]**
	Literate	7	3%		
	Primary School	23	10%		
	Secondary Education	19	8%		
	High School	59	26%		
	University	97	43%		
	PhD-Master	19	8%		
Marital Status	Married	127	56%	3.240	0.072[1]
	Single	99	44%		
Family Type	Nuclear family	159	70%	260.832	0.001[1]**
	Extended Family	44	19%		
	Single parent family	15	7%		
	Single person household	8	4%		
Number of people in the household	1 Person	16	7%	96.310	0.001[1]**
	2 Persons	29	13%		
	3 Persons	65	29%		
	4 Persons	61	27%		
	5 Persons	33	15%		
	6 Persons	15	7%		
	7 Persons and above	7	3%		
Income level	Minimum salary and below	50	22%	8.204	0.084[1]
	2500-3500	59	26%		
	3501-4500	40	18%		
	4501-5500	34	15%		
	5501+	43	19%		
How is your working order during the Covid-19 pandemic?	As before the pandemic	111	49%	125.540	0.001[1]**
	Decreased working hours	84	37%		
	Unemployed during the pandemic	14	6%		
	Increased working hours	17	8%		
Do you have social insurance?	Yes	195	86%	119.009	0.001[1]**
	No	31	14%		
Do you have private health insurance?	Yes	72	32%	153.566	0.001[1]**
	No	154	69%		
Do you have a chronic disease?	Yes	42	19%	237.168	0.001[1]**
	No	184	81%		

Table 2. Covid 19 Diagnoses and Symptoms (n=226)

Covid 19 Diagnoses and Symptoms	Categories	n	%	χ^2	p
Have you been diagnosed with Covid-19?	Me	19	8.3%	156.389	0.001[1]**
	My relatives	78	34.2%		
	No one	131	57.5%		
Fever	Yes	184	81%	235.124	0.001[1]**
	I don't know	21	9%		
	No	21	9%		
Cough	Yes	173	77%	189.991	0.001[1]**
	I don't know	28	12%		
	No	25	11%		
Shortness of breath	Yes	179	79%	213.991	0.001[1]**
	I don't know	24	11%		
	No	23	10%		
Headache	Yes	138	61%	86.796	0.001[1]**
	I don't know	62	27%		
	No	26	12%		
Muscle pain	Yes	153	68%	123.035	0.001[1]**
	I don't know	47	21%		
	No	26	12%		
Sore throat	Yes	152	67%	121.522	0.001[1]**
	I don't know	50	22%		
	No	24	11%		
Loss of taste and smell	Yes	170	75%	177.680	0.001[1]**
	I don't know	34	15%		
	No	22	10%		
Diarrhea	Yes	137	61%	85.814	0.001[1]**
	I don't know	64	28%		
	No	25	11%		

Table 3. Thoughts on Covid 19 Contagion (n=226)

Thoughts on Covid 19 Contagion	Categories	n	%	χ^2	p
Coughing	Yes	211	93%	367.602	0.001[1]**
	I don't know	14	6%		
	No	1	0%		
Handshake	Yes	199	88%	306.434	0.001[1]**
	I don't know	22	10%		
	No	5	2%		
Hands touching mouth. nose or eyes after touching surfaces such as doorknob or table	Yes	197	87%	296.664	0.001[1]**
	I don't know	23	10%		
	No	6	3%		
Pets	Yes	31	14%	53.796	0.001[1]**
	I don't know	121	54%		
	No	74	33%		
Loud speech (closer than 1-1.5m)	Yes	136	60%	92.637	0.001[1]**
	I don't know	72	32%		
	No	18	8%		
Sneezing (without disposable napkin or into elbow)	Yes	195	86%	285.938	0.001[1]**
	I don't know	21	9%		
	No	10	4%		
Shared use of personal belongings	Yes	204	90%	330.938	0.001[1]**
	I don't know	18	8%		
	No	4	2%		
Traveling in public transport	Yes	196	87%	291.619	0.001[1]**
	I don't know	23	10%		
	No	7	3%		
Emergency or non-emergency medical treatments	Yes	129	57%	90.805	0.001[1]**
	I don't know	84	37%		
	No	13	6%		
Dental treatment	Yes	130	58%	104.133	0.001[1]**
	I don't know	89	39%		
	No	7	3%		
Do you have any information about the aerosol (water	Yes	148	65%	141.619	0.001[1]**

Table 4. Measures Taken Regarding Covid 19 (n=226)

Measures Taken Regarding Covid 19	Categories	n	%	χ^2	p
Surgical mask	Yes	212	94%	173.469	0.001[1] **
	No	14	6%		
N95	Yes	55	24%	193.336	0.001[1] **
	No	170	76%		
Visor	Yes	48	21%	215.823	0.001[1] **
	No	178	79%		
Glove	Yes	107	47%	107.743	0.001[1] **
	No	179	53%		
Hand sanitizer	Yes	214	95%	180.549	0.001[1] **
	No	12	5%		
Cologne	Yes	197	87%	124.885	0.001[1] **
	No	29	13%		

Table 5. Health insurance-hospital preference relationship

Health insurance status		Reason for choosing your preferred institution						Total
		Health insurance	Financial reasons	Ease of transportation	Reliability	Having sufficient measures on the pandemic	Other	
Do you have private health insurance?	Yes	19*	6	12	25	12	4	47
		40.4%	12.8%	25.5%	53.2%	25.5%	8.5%	
	No	8	13	21	41	22	8	92
		8.7%	14.1%	22.8%	44.6%	23.9%	8.7%	
Do you have social insurance?	Yes	24	11*	27	57	32	10	114
		21.1%	9.6%	23.7%	50.0%	28.1%	8.8%	
	No	3	8	6	9	2	2	25
		12.0%	32.0%	24.0%	36.0%	8.0%	8.0%	

*p<0.05

Considering the support received from health institutions during the Covid-19 normalization process, there was a significant increase only in the support received from policlinics (p=0.00). 60% of the participants reported that the service they received from dental policlinics improved, 38% did not change, and 2% reported worsening. In state hospitals, 28.6% of the participants reported that the support they received worsened, 28.6% did not change, and 42.8% increased, in university hospitals, it worsened with 10.4%, did not change with 66.6%, improved by 23%, in private hospitals worsened with 9.3%, did not change with 50%, improved with 40.7%, in private clinics worsened with 4.7%, did not change with 62%, and improved with 33.3%.

When the reasons for the preference of health institutions are examined regardless of hospital name, reliability with 34.6%, sufficient preventive measures related to the pandemic with 17.8%, ease of transportation with 17.3%, health insurance with 14.1% and other with 6.3% are the reasons of choice. (Table 7) When evaluated in terms of each hospital in itself, reliability has been the most preferred reason, but this situation is not at a statistically significant level. Among the reasons for the preference of health institutions, the measures taken regarding the epidemic were not the reason for preference. When an evaluation is made between the preferred hospitals and the reasons for preference, state hospitals are preferred due to financial reasons (p=0.00) and ease of transportation (p=0.02), while private hospitals were preferred due to ease of transportation (p=0.04). No reason for the preference was identified in the other health institutions. (Table 6)

During the Covid-19 normalization process, the rate of being informed about the measures against Covid19 taken by the hospitals they prefer is 75%. While state hospitals, private hospitals and private clinics use all communication methods such as e-mail/SMS and social media, dental policlinics used more e-mail/SMS (p=0.00) and phone call (p=0.04), university hospitals used significantly more e-mail/SMS. (Table 6).

There was no significant relationship between age and the ways of informing about the measures taken by the preferred institution.

During the Covid-19 normalization process, the preferred hospitals, and the change in the frequency of patients going to the dentist were found to be independent of each other (p>0.05).

During the Covid-19 normalization process, no significant relationship was found between the reason why patients went to the dentist (pain, trauma, dental caries, etc.) and the hospitals they preferred.

When the measures taken by the preferred institutions against the Covid-19 virus are evaluated, it is seen that all institutions pay high attention to the measures taken against Covid-19. In university hospitals temperature measurement at the entrance (p=0.04) and mask use (p=0.05), in dental policlinics mask use (p=0.05) stood out significantly. (Table 6)

Table 6. Questions For The Preferred Hospital

Questions		Hospital of Preference					Total
		SH	DF	PH	PC	DP	
What is your reason for choosing your preferred institution during the Covid-19 pandemic?	Health insurance	1 3.7%	8 29.6%	5 18.5%	5 18.5%	8 29.6%	27
	Financial reasons	5(p=0.00) 26.3%	8 42.1%	5 26.3%	4 21.1%	4 21.1%	19
	Ease of transportation	5(p=0.02) 15.2%	10 30.3%	14(p=0.04) 42.4%	7 21.2%	14 42.4%	33
	Reliability	4 6.1%	23 34.8%	16 24.2%	10 15.2%	27 40.9%	66
	Having sufficient measures on the pandemic	1 2.9%	6 17.6%	6 17.6%	9 26.5%	18 52.9%	34
	Other	0 0.0%	7 58.3%	3 25.0%	0 0.0%	2 16.7%	12
How did you learn about the measures taken by your preferred institution against Covid-19 during the Covid-19 pandemic?	E-Mail And SMS	1 2.8%	3 8.3%	8 22.2%	8 22.2%	22 61.1%	36
	Social Media	1 3.1%	13 40.6%	9 28.1%	2 6.3%	14 43.8%	32
	Word of mouth	2 5.4%	10 27.0%	10 27.0%	5 13.5%	14 37.8%	37
	Incoming Call	4 14.3%	11 39.3%	5 17.9%	5 17.9%	18 64.3%	28
	Other	3 8.3%	17 47.2%	11 30.6%	7 19.4%	4 11.1%	36
What did you see from the measures taken by your preferred institution against the Covid-19 virus during the Covid-19 pandemic?	I was told to come 15 minutes before my appointment and come alone	4 4.7%	25 29.4%	20 23.5%	17 20.0%	35 41.2%	85
	I was not allowed in without a mask	7 5.5%	39 30.7%	31 24.4%	17 13.4%	50 39.4%	127
	My temperature was measured at the entrance	7 5.9%	35 29.4%	29 24.4%	19 16.0%	48 40.3%	119
	The waiting room was in accordance with the social distance rules	6 4.9%	43 35.0%	31 25.2%	18 14.6%	44 35.8%	123
	There was a hand sanitizer	6 4.7%	43 33.3%	31 24.0%	17 13.2%	49 38.0%	129
	Air conditioner not operating	4 5.5%	24 32.9%	15 20.5%	10 13.7%	29 39.7%	73
	The environment was being ventilated	5 4.5%	34 30.6%	26 23.4%	16 14.4%	46 41.4%	111
	The number of people in the elevator was determined according to the social distance rules	1 1.2%	28 33.7%	25 30.1%	9 10.8%	25 30.1%	83
	Employees and physicians were using the necessary protective equipment	6 4.8%	42 33.3%	29 23.0%	17 13.5%	49 38.9%	126
Could you rate your preferred institution in terms of Covid-19 measures?	Very inadequate	2 40.0%	3 60.0%	3 60.0%	2 40.0%	2 40.0%	5
	Insufficient	1 12.5%	4 50.0%	1 12.5%	2 25.0%	0 0.0%	8
	Intermediate	1 4.0%	9 36.0%	7 28.0%	3 12.0%	5 20.0%	25
	Sufficient	2 3.0%	23 34.3%	16 23.9%	9 13.4%	22 32.8%	67
	Quite Enough	1 2.9%	9 25.7%	6 17.1%	5 14.3%	21 60.0%	35
If you have a similar problem, would you apply to the same institution again?	Yes	3 2.7%	37 33.6%	24 21.8%	15 13.6%	43 39.1%	110
	No	2 13.3%	6 40.0%	4 26.7%	3 20.0%	2 13.3%	15
	I don't know	0 0.0%	3 25.0%	3 25.0%	3 25.0%	3 25.0%	12
Has the support you received from the institution you went for dental treatments changed due to the Covid-19 outbreak?	Got Worse	2 16.7%	5 41.7%	3 25.0%	1 8.3%	1 8.3%	12
	Hasn't Changed	2 2.6%	32 41.6%	16 20.8%	13 16.9%	19 24.7%	77
	Got Better	3 6.0%	11 22.0%	13 26.0%	7 14.0%	30 60.0%	50

SH: State hospitals; DF: Dentistry of faculties; PH: Private hospitals; PC: Private clinics; DP: Dental Policlinics

Tablo 7. Distribution of hospital preference reasons

		n	Percent	
What is your reason for choosing your preferred institution during the Covid-19 pandemic?	Health insurance	27	14.1%	19.4%
	Financial reasons	19	9.9%	13.7%
	Ease of transportation	33	17.3%	23.7%
	Realibility	66	34.6%	47.5%
	Having sufficient measures on the pandemic	34	17.8%	24.5%
	Other	12	6.3%	8.6%

When participants are asked to evaluate their preferred institution in terms of Covid-19 measures; the vast majority of them scored their preferred hospitals as 'sufficient and very sufficient' in terms of Covid-19 measures. (Table 6)

When faced with a similar dental problem, the rate of choosing the same institution again was highest in private clinics and lowest in public hospitals. (Table 6)

Discussion

The rapid spread of the COVID-19 virus worldwide has posed significant health system problems in all affected countries. The response rate and type of reaction given by individuals to this disease worldwide differed according to the state of the health systems in the country where the individuals live, the economies of the countries, and the health strategies they follow[10] For this reason, it is recommended to conduct studies on how this global event may affect the behavior of individuals[11,12] Similar decisions were taken in our country as of March 2020, and only emergency dental applications were made until June 2020.[13] With the normalization process starting from this date, there has been a tendency to start routine dental practices under the recommendations of the Ministry of Health.[14] Therefore, the current study was conducted on patients who preferred private or state institutions for dental treatments as of August 2020.

As of January 2020, routine dental practices other than emergency dental treatments have been suspended worldwide due to the high risk of contamination.[10] With the normalization process starting from this date, there has been a tendency to start routine dental practices under the recommendations of the Ministry of Health.[13] Therefore, the current study was conducted on patients who preferred private or state institutions for dental treatments as of August 2020.[14] Therefore, the current study was conducted on patients who preferred private institutions or public institutions for dental treatments as of August 2020.

In this study, questions measuring the level of knowledge about Covid-19 symptoms, transmission routes and personal protective equipment to be used against the Covid-19 virus were asked to the participants. Covid-19 symptoms, transmission routes and personal equipment usage levels of the participants were found to be significantly sufficient. While our study is similar to some previous studies carried out with different participants such as the community and healthcare professionals[15-17] it has quite highly positive results compared to the study of Srichan *et al.*[18] it is thought that a high level of education increases knowledge, attitude, and behavior.

No significant relationship was found between socio-demographic characteristics and Covid-19 findings, knowledge levels of transmission routes, personal protective equipment use. Education level did not affect the level of knowledge about Covid-19 or the rate of use of protective equipment. 77% of the participants in the study are at high school or higher education level, and 51% are university graduates. The fact that most of the participants were educated people may explain this situation.

Those who have had the Covid-19 disease were expected to be more cautious about using protective equipment. However, it is thought that there is no significant change in the use of personal protective equipment, as those who have had Covid-19 disease may have thought that they have become immune and this immunity will protect them. However, more information is needed to reach a definite conclusion on this subject.

It has been reported that dental treatments are a serious contamination risk for physicians, dental assistants, and patients since they include aerosol-generating treatment applications.[10,19] Sun *et al.* reported that the majority of parents thought that their children could become infected with the virus while undergoing dental treatment, while very few of them thought that the risk of transmission was similar to that in other public places or that there was no significant risk.[20] Similarly, it was seen that most of the individuals participating in this study thought that there was a risk of contamination during dental treatments (58%) and that they found routine dental treatment applications containing aerosols risky (65%).

There are studies in the literature about the variables associated with hospital preference. When the literature is examined, patient characteristics that affect the choice of hospital can be classified as the patient's age, income status, previous experience, perceptions about the hospital, the type and severity of the person's current systemic diseases.[21,22] In addition to the characteristics of the patients, the characteristics of the hospital they will choose are also important in choosing the hospital. When the literature is examined, it is seen that some of these features are related to the health services and financing opportunities in the regions where the research is conducted. Although there are such differences in terms of variables, it consists of hospital characteristics,

service delivery quality, location, size and types of services that affect the choice of hospital.[23,24]

When the institutions that the individuals participating in the study applied to for dental treatments during the normalization process were questioned, it was determined that the most preferred institutions were dental policlinics and faculties of dentistry, while state hospitals were in the last place in terms of preference. During the normalization period, state hospitals could not apply dental treatments other than emergency treatments, as they were assigned to the filiation service. Therefore, we think that this is the reason that state hospitals were not preferred.

When the reasons for preferring these institutions were evaluated, all health institutions showed a preference distribution such as financial reasons, ease of transportation, and protective measures. However, state hospitals were preferred due to financial reasons and ease of transportation. As a matter of fact, it has been determined that income level is an important variable among the variables affecting the hospital preference of patients.[25] Private hospitals, on the other hand, have been preferred due to the ease of transportation. Mosadeghrad *et al.*[26] stated that the location of the hospital is among the prominent variables in hospital preference. The fact that transportation vehicles other than private vehicles were found to be risky in terms of contamination may have been effective in this preference. No cause was identified in other health institutions. However, when the reasons for preference were examined independently of the hospital name, reliability was the most preferred reason (%34.6). When evaluated in terms of each hospital in itself, reliability has been the most preferred reason. As a result, it can be said that patients prefer to go to the hospitals they trust during the Covid-19 period.

In the Covid-19 normalization period, when the support received from health institutions is evaluated, there has been a significant increase in the support received only from dental policlinics. State hospitals and university hospitals have served in short working times due to pandemic conditions. However, as a result of the flexible working hours of the dental policlinics, their accessibility has been higher than the other institutions. The support received from dental policlinics may have increased because of this.

Huaqiu Guo *et al.*[27] in a study conducted on 2537 patients, researchers found that the number of patients who applied to clinics for dental procedures during the pandemic decreased by 38% compared to the pre-COVID-19 outbreak. It has been stated that the most common reasons for patients to go to dental clinics are due to pulpal or periapical lesions and abscess, which is stated as emergency dental treatment, and the number of patients who applied for non-emergency treatments decreased by 70% compared to before the COVID-19 outbreak. Similar to this study, it was observed in our study that the frequency of going to the dentist decreased by 56% during the normalization period. In addition, it was observed that the participants applied to the hospitals mostly because of pain. The findings show that COVID-19 had a significant impact on the behavior of patients in need of dental treatment.

During the pandemic, patients obtained information about the disease from various sources. A previous survey conducted in Hong Kong during the 2003 SARS outbreak found that approximately 80% of the respondents paid attention to SARS via regularly watching or listening to the news.[28] In the study conducted in India by Vijai and Joyce (2020), it was found that 89.9% of the respondents had a high level of knowledge about COVID-19, and newspaper and television news were the highest sources of information.[16] Similar to the literature, in this study, the rate of patients being informed about the measures taken by the hospitals they prefer against Covid19 was found to be 75%.

Hospital experiences, which were spread by word of mouth before the internet and social media became widespread, now spread rapidly over the internet and social media to include the opinions of third parties.[29] Public hospitals, private hospitals and private clinics in our study used all communication methods such as e-mail, message, and social media during the pandemic. The usage of e-mail, message and phone call methods in polyclinics and the usage of e-mail and message information in university hospitals were significantly more. In addition, no significant difference was found between age and the methods of being aware of the measures taken by the preferred institution. Since the majority of the participants are young individuals, we can say that all communication methods have been effective in informing.

It was stated that the hospitals included in the study paid high attention to the Covid-19 measures. It has been observed that the patients score the hospitals they prefer considering these measures as 'sufficient and very sufficient' in terms of Covid-19 measures.

When the current study limits were evaluated, the comparison and discussion of some results obtained from this study was limited due to the lack of similar studies in the literature. In addition, this cross-sectional study was carried out as of the first gradual normalization process after April 2020, which is defined as the peak period in our country. Therefore, the results of the study may vary according to the pandemic period in which the evaluation was made. It is thought that conducting such studies before, during and after the peak periods of the pandemic processes will have an impact on the results. For this reason, it is important to carry out similar studies on larger populations in a way that can compare different pandemic processes, to obtain comprehensive data and comparability of data.

Conclusions

- Participants have sufficient knowledge about the transmission routes and symptoms of Covid-19.

- It can be concluded that the measures taken against the Covid-19 virus alone are not effective in determining the health institution.

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Cumhuriyet Dental Journal, 25(Suppl):66-71, 2022
DOI: https://doi.org/10.7126/cumudj.1031418

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

A Bibliometric Analysis of the Most Cited Articles Published in the Cumhuriyet Dental Journal#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 02/12/2021
Accepted: 21/02/2022

ABSTRACT

Objectives: The aim of this study was to evaluate the bibliometric profile of the most cited articles published in Cumhuriyet Dental Journal (CDJ).

Materials and Methods: TR Dizin database was used to search the most frequently cited articles. After the screening process, a researcher organized the articles according to the citation counts. The citation counts, publication year, authorship, contributing institutions and countries, manuscript language, field of dental research, study type and design, data analysis method and keywords were evaluated.

Results: 123 citations were made to 76 articles. The citation counts ranged from 1 to 6. While the highest citation counts (n=17) were in 2012, the highest citation prevalence (1.93) was in 2011. There was a predominance of research area of Dental Materials (23.7%), original articles (69.7%), experimental studies (38.2%) and analytical data analysis method (90.2%). Original research articles in Dental Materials (88.9%) and Behavioral, Epidemiological and Health Services Research (100%), review articles in Prosthodontics (37.5%), and case reports in Diagnostic Research (57.1%) was more common. The highest citation prevalence was found in Periodontology (2.75). Most of the articles (28.9%) have 3 authors. Most of the articles (90.8%) originated from Turkey with the greatest contributions from Cumhuriyet University Faculty of Dentistry (22.4%). The manuscript language was Turkish at a rate of 57.9%. Among a total of 282 keywords, the most frequently used keywords were ''bond strength'' (n=6) and ''composite resin'' (n=5).

Conclusions: The profile of citations in CDJ shows that original research in the research areas of Dental Materials and Behavioral, Epidemiological and Health Services Research is predominant, with growing participation of local authors.

Keywords: Bibliometric Analysis, Bibliographic Databases, Journal Article.

Cumhuriyet Dental Journal'da Yayınlanan ve En Çok Atıf Alan Makalelerin Bibliyometrik Analizi#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 02/12/2021
Kabul: 21/02/2022

ÖZ

Amaç: Bu çalışmanın amacı, Cumhuriyet Dental Journal (CDJ)'de yayınlanan ve en çok atıf alan makalelerin bibliyometrik profilini analiz etmektir.

Yöntem: CDJ'de yayınlanmış ve atıf alan makaleleri belirlemek için TR Dizin veri tabanı kullanıldı. Tarama sürecinden sonra, bir araştırmacı makaleleri atıf sayılarına göre düzenledi. Makaleler; atıf sayıları, yayın yılı, yazar sayıları, katkıda bulunan kurum ve ülkeler, metin dili, dental araştırma alanı, çalışma tipi ve tasarımı, veri analiz yöntemi ve anahtar kelimeler açısından değerlendirildi.

Bulgular: Tarama sonucunda 76 makaleye 123 atıf yapıldığı belirlendi. Atıf sayıları 1 ile 6 arasında değişmekteydi. Atıf sayısı en çok (n=17) olan yıl 2012 iken, atıf prevalansı (1,93) en yüksek olan yıl 2011 idi. Çalışmaların özellikleri ile ilgili olarak, Dental Materyaller araştırma alanının (%23,7) orijinal makalelerin (%69,7), deneysel çalışmaların (%38,2) ve analitik veri analizi yönteminin (%90,2) ağırlıklı olduğu görüldü. Orijinal araştırma makaleleri Dental Materyaller (%88,9) ve Davranışsal, Epidemiyolojik ve Sağlık Hizmetleri Araştırmaları (%100) alanlarında, derleme makaleleri Protetik Diş Tedavisi alanında (%37,5) ve olgu sunumu makaleleri Diagnostik Araştırmalar alanında (%57,1) daha yaygındı. Tek makale ile temsil edilen makaleler dışlanarak hesaplanan atıf prevalansında en yüksek değer Periodontoloji (2,75) alanında bulundu. Makalelerin çoğu (%28,9) 3 yazarlıydı. Sorumlu yazarların çoğu (%90,8) Türkiye kaynaklı iken en büyük katkı Cumhuriyet Üniversitesi Diş Hekimliği Fakültesi'den (%22,4) sağlanmıştı. Metin dili %57,9 oranında Türkçe idi. Toplam 282 anahtar kelime arasında en sık kullanılanların ''bağlanma dayanımı'' (n=6) ve ''kompozit rezin'' (n=5) olduğu görüldü.

Sonuçlar: CDJ'de atıf alan makalelerin profili, yerel araştırmacıların artan katılımıyla Dental Materyaller ve Davranışsal, Epidemiyolojik ve Sağlık Hizmetleri Araştırmaları alanlarında yürütülen orijinal araştırmaların baskın olduğunu göstermektedir.

Anahtar Kelimeler: Bibliyometrik Analiz, Bibliyografik Veritabanları, Dergi Makalesi.

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How to Cite: Deste Gökay G, Oyar P, Durkan R.(2021) A Bibliometric Analysis of the Most Cited Articles Published in the Cumhuriyet Dental Journal, Cumhuriyet Dental Journal, 25(Suppl): 66-71.

Introduction

Bibliometrics is a method that is used to statistically evaluate the publications that can be accessed through medical databases, and to measure scientific activities on the basis of individuals, departments or institutes, universities and countries.[1] By focusing on the type, impact and quality of scientific literature with bibliometric analysis, it can establish a reference for future studies. The number of publications published in a certain time period, the number of citations, the effect of the publication in relation to the impact factor of the relevant journal are the parameters that can be used in this method. It can help map changes in a scientific community over time. Bibliometric analysis has been an important method to measure the level of development of a particular scientific field. It allows researchers to identify key study topics and explore current ideas in a particular field.[2]

Citation analysis, one of the most common methods in bibliometric analysis, deals with how often other authors cite a scientific article.[3] It serves to assess the clinical and scientific significance of a article.[4] In addition, citation analysis recognizes significant contributions from authors, institutions, countries, and journals within a given scientific community.[5,6] Research results presented as a result of citation analyzes, study designs and topics of highly cited scientific articles have the potential to influence trends in future research.[7,8]

Cumhuriyet Dental Journal (CDJ) has been published 4 times a year since 1998 by Cumhuriyet University Faculty of Dentistry. The journal accepts original research articles, reviews, and case reports. It has been indexed in TR Dizin since 2011 and Scopus since 2010. CDJ publishes in the ''Science'' category and ''Dentistry'' subject area in the TR Dizin database.[9] While the citation average is 0.31 citations/article, the number of self-citation is 53 and the self-citation rate is 42.06%. It is indexed in the field of ''General Dentistry'' in Scopus database and its 2020 cite score is 1.0.[10] Although the language of the article is currently English, it was previously accepting articles in Turkish and English.

With the increase in the number of studies using the bibliometric analysis method in the international scientific field, the importance of this method in the national science field has increased and various publications have begun to be made on this subject.[11-13] Number of publications published in scientific journals scanned in TR Dizin is increasing rapidly. In the literature review, no study was found regarding the quantity of the articles published and cited in the CDJ. The aim of this study is to analyze the bibliometric profile of the most cited articles published in CDJ.

Materials and Methods

TR Dizin database was used to identify articles published and cited in the CDJ. TR Dizin search parameters filtered by selecting ''descending by citation count''. Electronic bibliometric searching was completed on 14 October 2021.[14] Articles that received at least one citation were recorded in descending order according to the number of citations. There was no restrictions/exclusions of publication year or study design of the article. Bursa Uludağ University Social and Human Sciences Research and Publication Ethics Committee decided that an ethics committee decision is not required for this study (decision date: 24.12.2021 ID number: 2021/11).

The following bibliometric parameters of each article were recorded and analyzed: publication title, citation count, publication year, number of authors, corresponding author's affiliation and country, manuscript language, field of Dentistry according to the International Association for Dental Research (IADR)[15], study type (original scientific article, review article and case report), study design (observational, experimental and documentary), data analysis method (descriptive and analytical) and keywords.

Initially, the abstract of each article was analyzed, and in cases where this analysis was not sufficient for data extraction, the full text of the article was read. The categorization was made by one researcher (G.D.G.), when undecided, it was taken by consensus with other researchers.

Data were recorded in a standardized form in Microsoft Office Excel 2010 (Microsoft Press, Redmond, WA, USA) and statistical evaluation was performed using the program's calculation toolbar. A descriptive analysis was performed for categorical variables and central tendency (mean, median, largest, smallest) and frequency measurements for quantitative variables.

Results

According to the TR Dizin database, 76 articles which published in CDJ and received at least one citation were accessed. 76 most cited articles received a total of 123 citations with a citation range of 1-6 citations. The first-ranked most cited paper with 6 citations was "Assessment of periodontal condition and systemic diseases in patients with periodontal diseases visiting periodontology clinic''. The highest number of cited articles published in 2012 (n=17 articles). The articles with the highest number of citations were published in 2011 (29 citations). The publication year with the highest prevalence of citations (i.e. number of citations/number of articles=1.93) was 2011 (Figure 1).

Regarding authorship, 76 articles included of a total of 283 authors, with a mean of 3.72±1.26 authors/articles, a median of 4.00, a minimum of 1, and a maximum of 6 authors. There was a greater number of articles with 3 authors (28.9%). Based on the affiliation of the corresponding author, researchers from four countries contributed to the articles. Among these, Turkey had the highest number of articles (90.8%), followed by India (4.0%), Cyprus (4.0%) and Iran (1.2%). Among 31 institutions, the greatest contribution was made by the Cumhuriyet University Faculty of Dentistry (n=17), followed by the Erciyes University Faculty of Dentistry (n=5), Gazi University Faculty of Dentistry (n=5) (Figure 2). The manuscript languages were Turkish (n=44) (82 citations) and English (n=32) (41 citations).

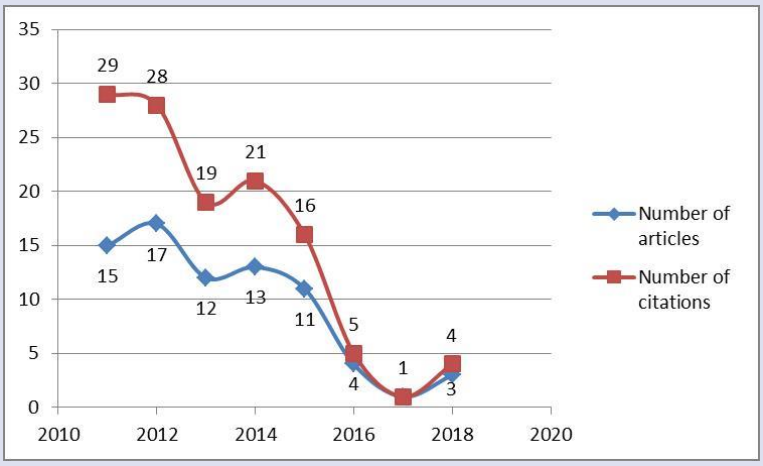

Figure 1. Number of articles and citations published in CDJ according to publication year.

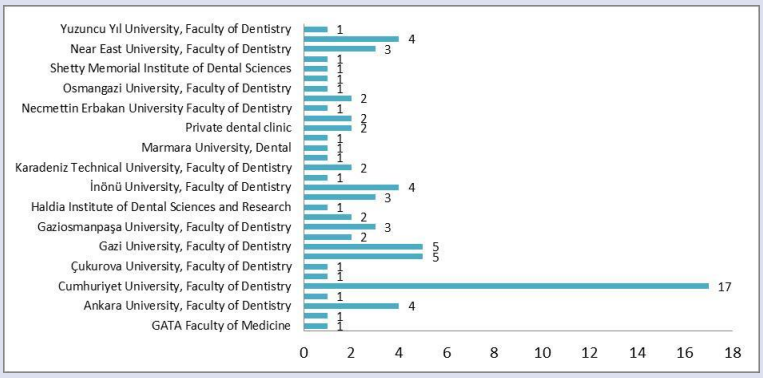

Figure 2. Distribution of the cited articles according to corresponding author affiliations

Table 1. Distribution of the cited articles according to the characteristics of the studies

Variables	N	%
Article type		
Original scientific article	53	69.7
Review article	14	18.4
Case report	9	11.9
Study design		
Observational	26	34.2
Experimental	29	38.2
Documentary	21	27.6
Data analysis method		
Descriptive	7	13.7
Analytical	44	86.3

Regarding the characteristics of the cited articles, there was a predominance of original scientific articles (69.7%) (92 citations), experimental studies (38.2%) (35 citations) and analytical data analysis method (86.3%) (73 citations) (Table 1).

The predominant areas of dentistry in the cited articles were Dental Materials (23.7%), followed by Behavioral, Epidemiological & Health Services Research (14.5%) and Prosthodontics (10.5%). While the most cited research area was Dental Materials (28 citations), Periodontology had the highest prevalence of citations with 2.75 citations/articles (Figure 3) (calculated by excluding research areas represented by one article).

Original scientific articles represented the article type most used in the area of Behavioral, Epidemiological & Health Services Research (100%), Practice-Based Research (100%) and Dental Materials (88.9%), and review articles in Microbiology/Immunology (50%) and Mineralized Tissue Research (50%) and case reports in Diagnostic Research (57.1%) (Table 2).

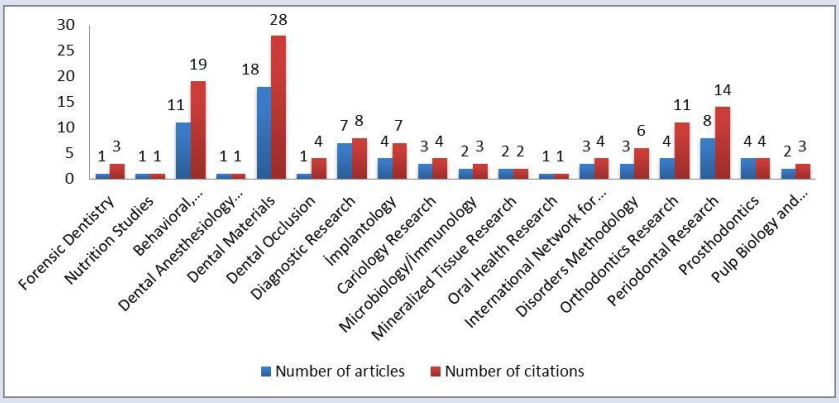

Figure 3. Number of articles and citations published in CDJ according to area of Dentistry.

Table 2. Distribution of the characteristics of the cited articles according to area of Dentistry

Dental Research Area	Article type			Study design			Data analysis method	
	OS	R	CR	O	E	D	DP	A
Forensic Dentistry	1	0	0	0	0	1	0	1
Nutrition Studies	1	0	0	0	1	0	0	1
Behavioral, Epidemiological & Health Services Research	11	0	0	7	0	4	4	7
Dental Anesthesiology Research	0	1	0	0	0	1	0	0
Dental Materials	16	2	0	0	16	2	0	15
Dental Occlusion	1	0	0	1	0	0	0	1
Diagnostic Research	2	1	4	4	0	3	0	2
İmplantology	3	0	1	3	1	0	1	2
Cariology Research	2	1	0	0	2	1	0	2
Microbiology/İmmunology	1	1	0	0	1	1	0	1
Mineralized Tissue Research	1	1	0	0	1	1	0	1
Oral Health Research	1	0	0	1	0	0	0	1
Orofacial Pain and Related Disorders Methodology	1	1	1	2	0	1	0	1
Orthodontics Research	1	1	1	2	0	1	1	0
Periodontal Research	3	1	0	3	0	1	1	2
Prosthodontics	3	3	2	4	1	3	0	2
Pulp Biology and Regeneration	3	1	0	0	3	1	0	3
Practice-Based Research	2	0	0	2	0	0	0	2

OS: Original scientific; R: Review; CR: Case report; O: Observational; E: Experimental; D: Documentary, DP: Descriptive; A: Analytical;

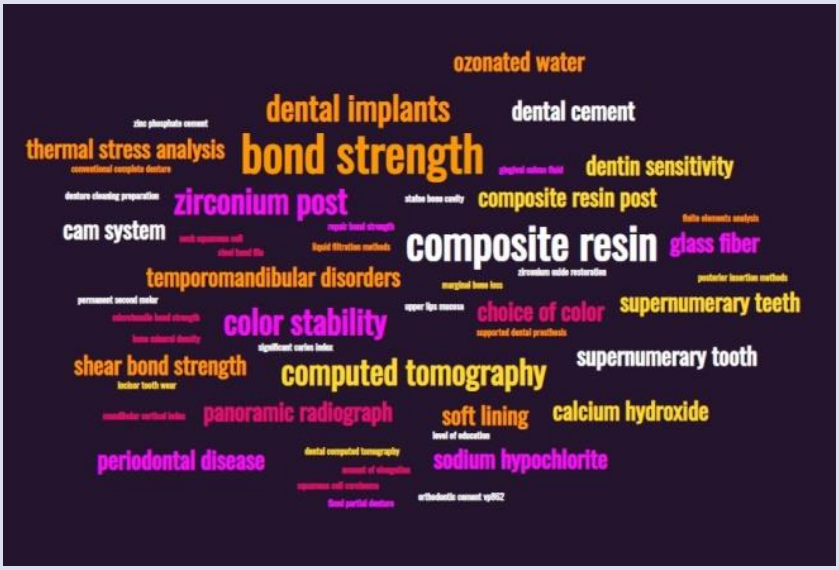

Figure 4. Frequency of keywords in cited articles. Keywords shown in large fonts are used more frequently, keywords shown in small fonts are used less frequently.

Observational studies stood out as the design most frequently used in the area of Practice-Based Research (100%), Implantology (75%) and Periodontal Research (75%) and experimental studies in Dental Materials (88.9%) and Pulp Biology and Regenaration (75%) and documentary studies in Microbiology/Immunology (50%) and Mineralized Tissue Research (50%) (Table 2).

There was no research area in which the descriptive analysis method was dominantly used. Analytical data analysis method was predominant in the area of Practice-Based Research (100%) and Dental Materials (83.3%) (Table 2).

A total of 282 keywords of the 76 most cited articles were identified. The most frequently using keywords were bond strength (n=6) and composite resin (n=5) followed by color stability (n=3) and zirconium post (n=3). All keywords of most cited articles published in the journal is shown in Figure 4.

Discussion

This bibliometric study is the first to identify the most cited articles and their key features in the CDJ. Analysis of cited articles revealed some trends and set directions for future research.

The foundation of the evidence pyramid in evidence-based dentistry consists of levels I to IV: generalizable studies, conceptual studies, descriptive studies, and a single case report.[16] The types of articles published and cited in CDJ are listed as original scientific article, case reports, and review. The most cited articles are original article (n=53, 92 citations), review (n=14, 20 citations) and case reports (n=9, 11 citations), respectively. According to the results obtained, it has seen that the study type with the highest number of citations and citation prevalence was the original studies and the lowest was case reports in CDJ.

At the bottom of the evidence pyramid, case reports provide information about treatment protocols in which interesting symptoms are defined, diagnosis and treatment of diseases are evaluated.[13] It is stated that the importance of case reports in establishing treatment protocols or directing clinical practices is very low. For these reasons, case reports are no longer published in some journals.[12] On the other hand, case reports and series supported by literature information and explained with visual elements attract the attention of readers.[17] Researchers who want to share interesting and different cases, fulfill academic promotion conditions and increase the number of publications continue to prepare and send case reports. However, as shown in the present study, among the article types that were published and cited in CDJ, case reports show the least representation in prevalence.

The systematic reviews and meta-analyses provide the highest quality evidence according to the hierarchy of research evidence.[16] It is noticeable that no systematic review or meta-analysis was included among the cited articles, and it can be said that the level of evidence of the articles is low. This study also supported the fact that many of the most cited articles had the lowest level of evidence shown in other studies.[18,19] However, consideration should be given to including articles higher in the evidence hierarchy, such as randomized controlled trials, systematic reviews, and/or meta-analyses in CDJ.

Number of authors in the articles was among the parameters examined in present study. It is stated that there has been an increase in the rate of multi-author articles published in journals and the number of authors in the articles over the years. With the increase of multi-authorship, cooperation in academic progress, positive aspects of teamwork and complexity of the work can be achieved.[20] On the other hand, it is known that there are authors who are mentioned in the articles and are called "senior authors" although they do not fulfill the criteria for authorship.[20] With an average of 3.72 authors/ articles, it is possible to say that the tendency to multi-authorship is also observed in the articles published and cited in CDJ.

In the CDJ, the most frequently studied area of Dentistry has been Dental Materials. Dental materials science investigates the toxicological effects of biomaterials to be used in the oral cavity and aims to develop and explore these materials.[21] This area may be related to the high competition among technological innovation companies, particularly in the field of nanotechnology. New dental materials are introduced to the market every day. The increasing interest in this field can be explained by the need to investigate material properties such as the interaction of the biomaterial and biological tissues and the mechanical properties of the material due to the application of dental biomaterials to the gingiva, mucosa and hard tissues. Advances in this area will increase the clinician's confidence in new materials.

The field of Epidemiology showed significant representation in the present study. Although a relatively new field, epidemiology studies have been spurred by growing public health concern.[22] These studies are important for the purpose of deepening and improving the understanding of public health with the numerous applications in the field of public health related to the planning and evaluation of health services and for the purposes of identifying the causes of disease.[22] In the light of the results of the present study, it could be suggested that researchers who plan to publish in this journal and who want to get high citations should focus on the original research article type and Dental Materials or Epidemiology study areas.

Keywords are an integral component of a scientific article. When searching the literature, the use of keywords brings more relevant results than using sentences or phrases. They serve as a descriptive code to source scientific research articles with a common denominator.[23] Therefore, it is essential to select and include keywords that can easily reach references related to the research topic within the rich literature.[24] The purpose of identifying the most frequently used

keywords is to guide researchers in searching for most cited articles on CDJ while using the TR Dizin database.

The present study has limitations because there is no mechanism to limit the number of citations for self-citing articles. TR Dizin was used to evaluate the most cited articles. In further studies, more databases such as Scopus and Google scholar could be included to search that published and cited articles in CDJ. Although the number of citations received by a published article indicates the influence the article has had, the citations received may not always be consistent with the findings of that article. This can be considered as a possible limitation of citation analysis without in-depth analysis of each citation. These limitations could provide an avenue to researchers for further research to complement the present study.

Conclusions

The profile of published and cited articles in CDJ shows a predominance of original scientific articles conducted in the areas of Dental Materials and Behavioral, Epidemiological and Health Services Research, with increased participation from local researchers. The present study illustrated some of the scientific contributions of published and cited in the CDJ, providing an insight into evidence-based dentistry for researchers. It can be a guide for researchers who want to publish in this journal indexed in TR Dizin by showing the bibliometric characteristics of the cited articles.

Conflict of Interest Statement

There is no conflict of interest.

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Cumhuriyet Dental Journal, 25(1): 72-77, 2022
DOI: https://doi.org/10.7126/cumudj.1032872

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Fracture Resistance of Endodontically Treated Upper Premolar Teeth Restored with Bulk-fill and Conventional Resin Composite#

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Research Article

Acknowledgment

#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 05/12/2021
Accepted: 22/02/2022

ABSTRACT

Objectives: The aim of this in vitro study was to evaluate the fracture resistance of endodontically treated upper premolar teeth restored with different resin composites.

Materials and Methods: Hundred and eight maxillary premolar teeth were randomly divided into nine groups (n=12). The teeth in the first group were left intact and tested as unprepared group 1 (negative control). Other eight groups were prepared with MOD cavities and endodontically treated. The teeth in group 2 (positive control) were unrestored. Other groups were restored with different resin composites. Group 3: conventional resin composite and group 4-9 six bulk fill resin composite (group 4: 3M Filtek Flowable Bulk Fill, group 5: 3M Filtek Posterior Bulk-fill, group 6: Voco X-tra base, group 7: Voco X-tra fil, group 8: Dentsply SDR Flow, group 9: Dentsply Quixfil). Single Bond Universal was applied as self-etch, according to application instructions. The restored teeth were stored in distilled water for 24 hours at 37°C. The compressive force was applied parallel to the long axis of the teeth. The test was carried out at a speed of 1mm/min. ANOVA and Tukey HSD tests were used in the analysis of the data.

Results: Negative control group showed significantly higher fracture resistance than other tested groups. The bulk-fill resin composites were showed higher fracture resistance than teeth restored with conventional resin composite. No statistically significant differences were found in the fracture resistance values of the bulk-fill resin composites. The significantly lowest values were obtained in the positive control group (group II)

Conclusions: The fracture resistance values of endodontically treated teeth restored with bulk-fill composites were higher than teeth restored with conventional resin composite.

Keywords: Fracture Resistance, Endodontic Treatment, Bulk-Fill Composite, Endodontics, Resin Composite.

Bulk-Fill ve Geleneksel Kompozit Rezin ile Restore Edilmiş Endodontik Tedavi Görmüş Üst Premolar Dişlerin Kırılma Direncinin Değerlendirilmesi#

Bilgi

#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
Sorumlu yazar

Süreç

Geliş: 05/12/2021
Kabul: 22/02/2022

ÖZ

Amaç: Bu in vitro çalışmanın amacı, farklı tip kompozit rezinler ile restore edilmiş endodontik tedavi görmüş üst premolar dişlerin kırılma direncini değerlendirmektir.

Gereç ve Yöntemler: Yüz sekiz maksiller premolar diş rastgele dokuz gruba (n=12) ayrıldı. Birinci gruptaki dişler negatif kontrol grubu olarak belirlendi ve herhangi bir preparasyon yapılmadı. Kalan sekiz gruptaki dişlere MOD preparasyonlar hazırlandı ve endodontik tedavi yapıldı. Sekiz gruptan biri (2.grup) pozitif kontrol grubu olarak seçildi ve dişlere koronal restorasyon yapılmadı. 3. grup (3M UR200) geleneksel kompozit rezin ile restore edildi. Geri kalan 6 grup ise (4. grup 3M Filtek Flowable Bulk-fill, 5.grup 3M Filtek Posterior Bulk-fill, 6. grup Voco X-tra base, 7. grup Voco X-tra fil, 8.grup Dentsply SDR Flow, 9.grup Dentsply Quixfil) altı farklı bulk-fill kompozit rezin ile restore edildi. Restorasyonlarda adeziv olarak Single Bond Universal, uygulama talimatlarına göre self-etch olarak uygulandı. Restore edilen dişler distile suda 37°C'de 24 saat saklandı. Örnekler üniversal test cihazında 1mm/dak hızda kırıldı. Veriler, tek yönlü ANOVA ve post hoc Tukey HSD testi kullanılarak analiz edildi. Analizler, SPSS 20.0 programı ile %5 anlamlılık düzeyinde gerçekleştirildi.

Bulgular: Negatif kontrol grubunda elde edilen skorlar diğer gruplara göre anlamlı ölçüde daha yüksek bulundu. Bulk-fill kompozit rezinler ile restore edilen dişlerin kırılma direnci geleneksel kompozit rezinle restore edilen dişlerden daha yüksek bulundu. Bulk-fill kompozit rezinler ile restore edilen gruplar arasında kırılma direnci açısından anlamlı farklılık bulunmadı. En düşük kırılma skorları ise pozitif kontrol grubunda görüldü.

Sonuçlar: Bulk-fill kompozit ile restore edilen endodontik tedavili dişlerin kırılma direnci skorları, geleneksel kompozit rezinler ile restore edilen dişlerden daha yüksek bulunmuştur.

Anahtar Kelimeler: Kırılma Direnci, Endodontik Tedavi, Bulk-Fill Kompozit, Endodonti Kompozit Rezin.

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How to Cite: Gök A, Dallı M, Dülgergil ÇT.(2021) Fracture Resistance of Endodontically Treated Upper Premolar Teeth Restored with Bulk-fill and Conventional Resin Composite, Cumhuriyet Dental Journal, 25(1):72-77.

Introduction

The loss of anatomical structures, water content, pulp chamber tissue makes teeth more fragile.[1] Extensive restorations, trauma, access cavity preparation, endodontic procedures, post space preparation, extensive cavities are the most reasons for tooth fracture.[2-4] A good coronal restoration and support of the remaining tooth tissue are very important for the long-term success of the endodontic treatment.[5-7] There are many treatment options and different materials to be used according to the amount of tooth tissue remaining after endodontic treatment. Such as direct or indirect resin composites, crown, endo crown, inlay-onlay, or post placement.[7,8]

Resin composite restorations increase the fracture resistance of endodontically-treated teeth by supporting the remaining tooth tissues.[7,9-11] But when the cavity size increase, the traditional maximum two millimeter composite layering technique can both prolong the treatment time and increase the risk of moisture contamination and air bubbles.[12,13]

Bulk-fill resin composites are developed to simplify the placement of direct composite restorations and to overcome these disadvantages.[14] Bulk-fill resin composites are available in low and high viscosity, flowable and packable types. Manufacturers and researchers have reported that bulk-fill resin materials can effectively polymerize up to 4-5 mm (light-cured) and 10 mm (dual-cured) and have low polymerization stresses. Conventional microhybrid composites and flowable composites cannot achieve sufficient polymerization amounts and microhardness at these sizes.[15-18]

There is limited data about the fracture resistance of endodontically treated teeth restored with traditional and bulk-fill resin composites.[19-22] This study was conducted to investigate the fracture resistance of endodontically treated teeth restored with bulk-fill and micro-hybrid composites to gain more information on this subject. The null hypothesis was that there would be no statistically significant difference in the fracture resistance of endodontically treated teeth restored with bulk-fill and conventional resin composites.

Materials and Methods

The present study was approved by the ethics committee of Izmir Katip Celebi University with the number 2014-159. A hundred and eight sound human maxillary premolars were used for this study. Teeth were extracted for periodontal problems and orthodontic reasons. The calculus and soft tissues were removed using a scaler. The teeth were checked for cracks or fractures using a stereomicroscope (Zeiss, Oberkochen, Germany) at 25X magnification. The mesiodistal and buccopalatal dimensions of the teeth were evaluated using a digital calipper (Max Extra Digital Calipper, Numan Özkara İstanbul, Turkey) to ensure that teeth were similar size. The means of buccolingual and mesiodistal dimensions were 9,3mm (9-9,4) and 7,2mm (7-7,5) respectively. The teeth were stored in distilled water at 37°C until use.

Teeth were embedded in self-curing acrylic resin (SC Acrylic, IMICRYL, Konya, Turkey) using a teflon cylinder mold (3cm in diameter and 3 cm in height) up to 1mm below the cemento-enamel junction (CEJ). The teeth were randomly divided into nine groups of 12 teeth (n=12). The teeth in the first group were left intact and tested as a negative control (group 1).

Cavity preparations, endodontic treatments and restorations are done by an operator. The mesio-occluso-distal (MOD) cavities and endodontic access cavities of the eight groups were prepared using a high-speed diamond fissure bur (Aida 1392/556) under cooling air and water. The MOD cavities were prepared a width of one-third of the intercuspal distance (mean 2,2mm) on occlusal, an one-third of the buccopalatal distance (mean 3mm) on gingival. The cavity depth of the preparations was set to 4mm. The bur was changed after three cavities. All edges were smoothed after the preparation.

The canal length was measured with a 10 K file (Dentsply Maillefer, Switzerland). The working length was determined by subtracting 1 mm from this length The canals were prepared with ProTaper Next rotary files up to #X2 (Dentsply Maillefer, Switzerland) according to the manufacturer's guidelines. 5.25% 5ml NaoCl (sodium hypochlorite) was used for irrigation for each tooth. Smear layer was removed with 17% EDTA. 2ml EDTA was used for each tooth. Finally, the canals were rinsed with distilled water and dried with paper points. AH plus canal sealer (Dentsply De-Trey, Konstanz, Germany) and single cone (ProTaper Next-X2) technique was used for filling the canals. The endodontic access cavity was cleaned with alcohol and cotton pellets. The endodontic access cavities were restored up to the MOD cavity floor with a light-cured glass ionomer Glass Liner (WP Dental, Hamburg, Germany).

Groups;

Group 1: Negative control group. Intact teeth without any cavity preparation.

Group 2: Positive control group. MOD preparation and endodontic treatment were done. These teeth were not restored.

For group 3 to 9 adhesive application and matrix placement: The Single Bond Universal (3M ESPE) adhesive was used in self-etch mode. The adhesive was applied for 20 seconds according to the manufacturer's instructions. Then air dried 5 seconds and cured 10 seconds with Anthos T-LED (Anthos, Imola, Italy, 1200 mW/cm2) light cure device. Conventional and Bulk Fill resin composites were cured with Anthos T-LED according to the guidelines. 6mm metal band with a tofflemeire retainer used for cavity restorations.

Group 3: UR 200™ (3M ESPE) conventional microhybrid resin composite. Cavities were restored with UR 200 incrementally, each layer was 2mm thick and light cured for 20 seconds.

Group 4: Filtek Bulk Fill Flowable Restorative (3M ESPE) bulk fill resin composite. The cavity was filled with 4mm thickness Filtek Bulk Fill resin composite. It was light cured for 10 seconds.

Group 5: Filtek Bulk Fill Posterior Restorative (3M ESPE) bulk fill resin composite. The cavity was filled with 4mm thickness Filtek Bulk Fill Posterior Restorative. It was light cured for totally 30 seconds from occlusal, mesial and distal.

Group 6: X-tra base (Voco) bulk fill resin composite. The cavity was filled with 4mm thickness X-tra base resin composite. It was light cured for 10 seconds.

Group 7: X-tra fil (Voco) bulk fill resin composite. The cavity was filled with 4mm thickness X-tra fil resin composite. It was light cured for 10 seconds.

Group 8: SDR (Dentsply) bulk fill resin composite. The cavity was filled with 4mm thickness SDR resin composite. It was light cured for 20 seconds.

Group 9: QUIXFIL (Dentsply) bulk fill resin composite. The cavity was filled with 4mm thickness QUIXFIL resin composite. It was light cured for 10 seconds.

The materials used in study are listed in Table 1.

The restorations were finished with finishing burs. The specimens were stored for 24 hour in distilled water at 37°C.

Fracture strength test

The teeth were submitted to a compression test in a universal testing machine (AGS-X; Shimadzu Corporation, Tokyo, Japan). The test was performed at a speed of 1mm/min with a 5mm diameter round tip, parallel to the long axis of the tooth until a fracture occurred in the tooth or restoration (Figure 1). The testing machine stopped automatically when fracture occurred in the restoration materials or teeth. The maximum force values obtained with the software supporting the operation of the device (TRAPEZIUM X Version 1.3.1, Shimadzu Corp., Japan) were recorded in newtons (N).

Statistical Evaluation

The data was analyzed using a software (SPSS 20.0 for Windows, SPSS Inc, Chicago, IL, USA) at a significance level of 0.05. ANOVA and post hoc Tukey HSD test was used for multiple comparison.

Results

The mean fracture resistance values (N) and the standard deviations of each group are given in Table 2. There was a significant difference between the groups as a result of the ANOVA test ($p<0.05$). Group 1 showed significantly higher fracture resistance than did the other tested groups ($p<0.05$). The lowest fracture resistance was seen in group 2 (positive control group) ($p<0.05$), which was not restored after endodontic treatment. Conventional resin composite (group 3) showed lower fracture resistance than bulk fill resin composites ($p<0.05$). There was no significant difference between the groups restored with bulk fill composites. No statistically significant differences were found between groups restored with bulk-fill resin composites (group 4-9) ($p\geq0.05$).

Table 1. Materials used in the study

Product Name-Shade	Type	Manufacturer / Lot No	Composition
Filtek UR 200-A1	Microhybrid Composite	3M-ESPE Seefeld GERMANY /611629	Bis-GMA, UDMA, Bis-EMA zirconia/silica
Filtek Flowable Bulk-U	Bulk-fill flowable resin composite	3M-ESPE Seefeld GERMANY /461826	Inorganic fillers, Bis-GMA, UDMA, Bis-EMA, zirconia/silica
Filtek Posterior Bulk-A1	Bulk-fill posterior restorative	3M-ESPE Seefeld GERMANY/ 640699	Inorganic fillers, Bis-GMA, UDMA, Bis-EMA, procrylat resins, ytterbium trifluoride, zirconia/silica
X-tra base-U	Bulk-fill flowable resin composite	VOCO Cuxhaven Germany/1409663	Bis-EMA, MMA, silica
X-tra fil-U	Bulk-fill restorative	VOCO Cuxhaven Germany/ 1410271	Bis-GMA, UDMA, BHT, TEGDMA
SDR Flow-U	Bulk-fill flowable resin composite	DENTSPLY Milford, DE USA/ 1309183	Barium and strontium alumino-fluorosilicate glass, TEGDMA, modified UDMA, dimethacrylate, Bis-EMA, pigment, photoinitiator
QUIXFIL-U	Bulk-fill restorative	Dentsply Kontanz, GERMANY/ 1502000709	Bis-EMA, UDMA, TCB TEGDMA, TMPTMA, strontium glass
Single Bond Universal	Universal Adhesive (self-etch mode)	3M ESPE, St Paul, MN, USA/ 527687	MDP phosphate monomers, dimethacrylate resins, HEMA, methacrylate-modified polyalkenoic acid copolymer, fillers, ethanol, water, initiators, silane

*Abbreviations: Bis-EMA: ethoxylated bisphenol A dimethacryrlate, Bis-GMA: bisphenol A glycidyl methacrylate, HEMA: hydroxyethyl methacrylate, MDP: methacryloyloxy-decyl dihydrogen-phosphate, TEGDMA: triethylene glycol dimethacrylate, UDMA: urethane dimethacrylate, PMMA: polymethyl methacrylate, TCB: Tetracarboxylic acid-hydroxyethylmethacrylate-ester, TMPTMA: Trimethylolpropane trimethacrylate, EMA: ethyl methacrylate

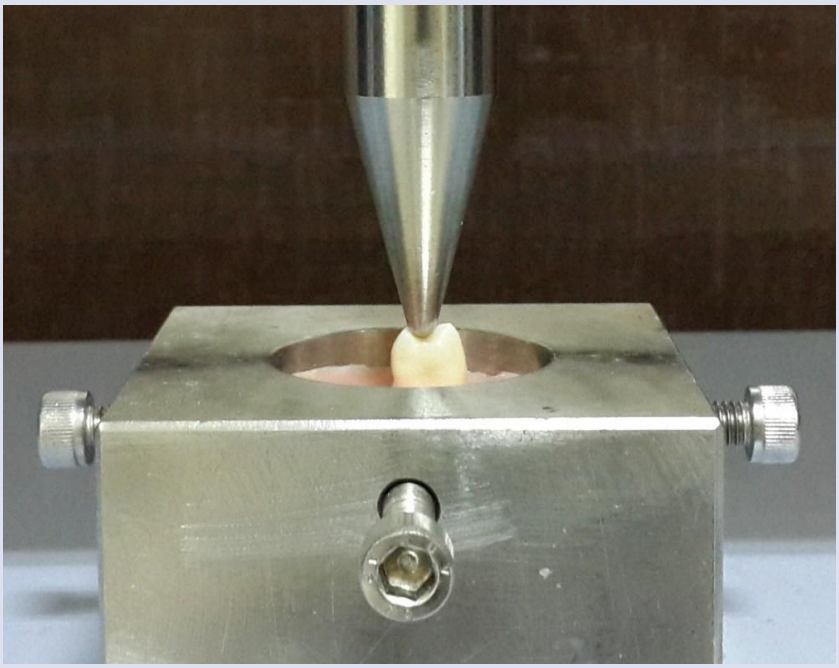

Figure 1. Fracture resistance test

Table 2. Means and standard deviations of fracture resistance of groups

Groups	(n)	Mean (N)	Standart Deviation (N)
Group 1- Negative Control	12	1437.93a	251.94
Group 2- Positive Control	12	283.62b	78.30
Group 3- UR200	12	575.94c	129.07
Group 4- 3M Filtek Flow Bulk	12	1010.79d	221.64
Group 5- 3M Filtek Post Bulk	12	958.98d	249.04
Group 6- X-tra base	12	1056.47d	174.63
Group 7- X-tra fil	12	1100.24d	173.49
Group 8- SDR	12	1023.88d	189.59
Group 9- QUİXFİL	12	965.56d	155.15
ANOVA	F(8,99)	36,648	p<0.05

*Different letters indicate significant differences at level of significance p.0.05.

Discussion

The results of our study confirmed that the use of bulk-fill resins in endodontically treated maxillary premolar teeth increases the fracture resistance of teeth. Therefore, the null hypothesis was rejected.

It is accepted that endodontic treatment reduce the fracture resistance of teeth. Remaining coronal tooth structure, selection of restorative material and correct restoration are the most important factors affecting the success of endodontic treatment, which increases the fracture resistance of teeth after endodontic treatment.[23]

It has been reported that endodontic procedures reduce the fracture resistance of premolars by 5%, occlusal cavity preparation by 20%, and MOD cavity preparation by 63%.[24,25] Other researchers reported that the fracture resistance of upper premolar teeth with class II preparations is lower than that of other teeth.[10,26,27] Accordingly, we used upper premolar teeth and MOD preparation in our study.

The results of the present study showed that the cavity preparation significantly reduced the fracture resistance of the specimens in the positive control group compared to the negative control group (p<0.05). This finding is consistent with the previous studies.[23,28] There were significant differences between bulk-fill resin composites and conventional resin composites in the fracture resistance of endodontically treated upper premolars (p<0.05). The bulk-fill composites were found to be higher than teeth restored with conventional resin composite. These findings can be explained by the fact that bulk-fill composites have lower polymerization stress and lower modulus of elasticity.[28,29]

Also, our findings are not in agreement with studies Atalay *et al.*, Toz *et al.* and Yasa *et al.* that investigated the fracture resistance of endodontically treated teeth restored with bulk-fill and conventional resin composite.[19-21] In their studies, no significant difference was found between groups restored with bulk-fill composites and conventional resin composite. The reason for this situation may be that they used nano-hybrid resin composite as conventional resin composite and we used micro-hybrid composite. Mohan *et al.* and Kaur *et al.* found that the teeth restored with nanohybrid

composite had higher fracture resistance than teeth restored with micro-hybrid resin composite.[30,31]

In our study, no significant difference was found between the fracture resistance of teeth restored with flowable bulk-fill resin composites and packable bulk-fill composites ($p \geq 0.05$). The fracture resistance of teeth restored with flowable bulk-fill composites was higher than other resin composites (X-tra base 1056.47N, SDR 1023.88N, 3M Filtek Flow 1010.79N) except for X-tra fil group (1100.24 N). These findings may be attributed to the elastic buffer effect, low shrinkage stress and low modulus of elasticity of the use of flowable bulk-fill composites.[29,32] Also, these findings are in agreement with Isufi *et al.* and Atiyah *et al.* who reported increased fracture resistance of endodontically treated premolars restored with flowable bulk-fill resin composites.[28,33]

Our in vitro study was conducted under a static load. Fatigue stress is an important process in oral conditions. Therefore, more in vitro and in vivo studies are needed.

Conclusions

Within the limits of this study, our findings demonstrate that the bulk-fill composites increase the fracture resistance of endodontic treated teeth, provide ease of use and decrease the time of application of the upper restoration.

Acknowledgements

This study was supported by the Scientific Research Project Fund of Izmir Katip Celebi University (Project Number: 2014-1-TEZ-61)

Conflict of Interest Statement

The authors report no conflicts of interest.

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Cumhuriyet Dental Journal, 25(Suppl): 78-82, 2022
DOI: https://doi.org/10.7126/cumudj.1030957

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Effect of in-Office Bleaching on the Surface Roughness of Different Composite Resins#

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Research Article

Acknowledgment

#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 01/12/2021
Accepted: 24/02/2022

ABSTRACT

Objectives: The aim of this study is to investigate the effect of a high concentration hydrogen peroxide bleaching agent on the surface roughness of four different composite resins.

Material and Methods: For this purpose, with the help of teflon molds, a total of 24 composite samples (10 x 4 mm) were prepared, with n = 6 for each composite group. The samples were placed in teflon molds in two layers of 2mm and covered by transparent mylar strips at the top and bottom surfaces. The material was compressed with finger pressure between 1mm thick glass plates. The tip of the light device was applied directly from the transparent tape surface for the polymerization of the samples. Polymerization of the samples was carried out using LED light device in each layer. After the samples were polished with finishing discs, they were kept at 37°C for 24 hours in the distilled water. Surface roughness values (Ra) of all samples were measured with a profilometer device. After the first measurements, a whitening agent containing 35% hydrogen peroxide was applied to the surfaces, and surface roughness measurements were repeated after this process. Data were analyzed statistically using analysis of variance (ANOVA) and Tukey tests.

Results: Profilometric evaluations showed a small increase in the surface roughness of all samples with a bleaching agent. When the initial and treated measurements of the groups were compared, the difference between the measurements was found statistically insignificant.

Conclusion: The office bleaching agent containing 35% hydrogen peroxide did not make any difference in the roughness of the nanohybrid and microhybrid composite resins.

Keywords: Hydrogen Peroxide, Surface, Composite, Bleaching, Roughness

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How to Cite: Kaya S, Özel Bektaş Ö. (2021) Effect of in-Office Bleaching on the Surface Roughness of Different Composite Resins, Cumhuriyet Dental Journal, 25(Suppl):78-82.

Introduction

Today, with the increase in the aesthetic expectations of the patients, the demand for teeth whitening treatment has increased. This process effectively removes the discolorations on the teeth without damaging the tooth tissue.[1,2]

Different types of composites are recommended for the restoration of teeth. As a result of advances in filler technology, a new composite formulation has been created with the combination of submicron size (0.04 µm) particles and smaller particles (0.1 µm-1 µm). These materials are classified as "micro-hybrid" composites. The addition of smaller particles to microhybrid composites distinguishes them from conventional hybrid composites and provides better polishing and application.[3] However, although the physical properties of microhybrid composites are superior to traditional microfilled composites, their polishability is not as good as microfilled composites.[4] The latest versions of micro-hybrid composites are "nanohybrid" composite resins developed with nanofiller technology. Nanohybrid composites include a combination of nanometer-sized filler particles (0.005–0.01 µm) and conventional type filler particles. Nanohybrids can be classified as universal composite resins that truly carry the application and polishing properties of microfilled composites and the physical strength and abrasion resistance of traditional hybrid composites.[5]

Whitening treatment can be performed by the dentist using agents containing high concentration (25%-40%) hydrogen peroxide or carbamide peroxide, as well as hydrogen peroxide (HP) at a lower concentration (3-7%) or (6-20%) using carbamide peroxide (CP) agents, it is also applied at home by the patient under the control of the physician. Whitening treatment creates some changes in the natural tooth structure and the existing restorations in the mouth are also affected by this situation. There are many studies are evaluating the effects of different concentrations of bleaching agents on microleakage, bonding strength, adhesion, discoloration, surface hardness, and surface roughness of composite resins.[6-9]

Although it is thought that the bleaching process does not have macroscopically visible effects on composite resin restorations, the microscopic effects it creates may have negative consequences. It is known that rough surfaces cause bacterial involvement[10,11], staining of the restoration[12], and periodontal diseases.[13]

This study aims to investigate the effect of a high concentration hydrogen peroxide bleaching agent on the surface roughness of four different composite resins.

Materials and Methods

In this study, A2 color micro-hybrid Filtek Z250 (3M ESPE, St. Paul, MN, USA), three different nanohybrid filled composite Tetric N-Ceram (Ivoclar Vivadent, Schaan, Liechtenstein), Clearfil Majesty Esthetics (Kuraray, Osaka, Japan), and Filtek Z550 (3M ESPE, St. Paul, MN, USA) were used. The details of the tested materials are shown in Table 1.

Composite disks (10 mm in diameter and 4 mm in thickness) were prepared by using teflon molds. The teflon molds were positioned on a transparent plastic matrix strip lying on a glass plate. The composite materials were placed in 2-mm increments. After inserting the materials into the Teflon mold, a transparent plastic matrix strip was put over them and a glass slide was secured to flatten the surface. Each sample was light cured for 40 s in two steps by using a light-emitting diode (LED) unit (Elipar Freelight 2, 3M ESPE, St. Paul, MN, ABD) at light intensity of 600 mW/cm2 from both upper and lower surfaces of the samples. The distance between the curing light tip and sample was standardized by using a 1-mm glass slide. All the samples were stored in neutral artificial saliva and kept in oven at 37°C. After 24 h, the samples were washed with distilled water and polished with medium, fine, and superfine aluminium oxide disks (Sof-Lex system- 3M ESPE, St. Paul, MN) on a slow-speed handpiece, in accordance with the manufacturer's instructions. After polishing, all the resin specimens were then stored in distilled water for 24 h at 37°C to ensure complete polymerization.

Surface roughness (Ra) measurements of the samples were carried out with a two-dimensional profilometer (Mitutoyo Surftest SJ-201P Surface Roughness Tester, Mitutoyo Corporation, Tokyo, Japan). The cut-off value of the device used is 0.8 mm and the measurement distance is 5 mm. After measuring in three different regions from each sample surface, the average of the measured values obtained was taken. Before measurement, the profilometer was calibrated with the help of a reference block with a Ra value of 3.05 µm. Then, the office bleaching agent 35% HP (H35 Total Blanc Office; Nova DFL, Rio de Janeiro, Brazil) was applied in two 15-minute sessions in accordance with the manufacturer's instructions. The surface roughness of the washed and dried samples was measured again with a profilometer device.

The data obtained from our study were loaded into the SPSS (22.0) program and the parametric test assumptions were fulfilled in the evaluation of the data (Kolmogorov - Smirnov), the Tukey test was used to find the groups that made a difference in the analysis of variance analysis when comparing the measurements obtained from more than two independent groups ($p<0.05$).

Results

The micro-hybrid composite group showed higher surface roughness (RA) than other groups before and after bleaching treatment. Data for initial R_a and after bleaching R_a, are presented in Table 2. It was observed that nanohybrid composites were smoother than microhybrid composite after exposure to higher-concentration hydrogen peroxides ($p< 0,05$). Roughness increased after bleaching in Tetric N Ceram and Filtek Z550 groups, but this increase was statistically not significant. While there was no change in the post-bleaching roughness values in the Filtek Z250 group, the roughness decreased in the Clearfil Majesty group, but it was statistically insignificant. When the before and after measurements of the groups were compared, the difference between the measurements was found to be insignificant ($p>0.05$) (Table 2).

Table 1. Materials used in this study

Material	Type	Main composition	Manufacturer
Tetric N-Ceram	Nanohybrid composite resin	Matrix: Bis-GMA, Bis-EMA (6), UDMA, TEGDMA, Procrylat Filler: Barium aluminium silicate glass(0.4µm,0.7µm), ytterbium trifluoride(200nm), mixed oxide(160nm), Prepolymer (0.7 nm) Filler loading: 80 wt%, 55-57 vol%	Ivoclar Vivadent, Schaan, Liechtenstein
Clearfil Majesty Esthetics	Nanohybrid composite resin	Matrix: Bis-GMA, TEGDMA, hydrophobic aromatic dimethacrylate, hydrophobic aliphatic methacrylate, Fillers: Silanated barium glass filler, prepolymerized organic filler (avarage particle size 0.7 µm) Filler loading: 78 wt%, 66 vol%	Kuraray, Osaka, Japan
Filtek Z250	Microhybrid composite resin	Matrix: BIS-GMA, BIS-EMA, UDMA with small amounts of TEGDMA 60 vol% Fillers: Silanized zirconia/silica particles (size range: 0.01 to 3.5 microns, average size: 0.6micron) Filler loading: 75-85 wt%, 60 vol%	3M ESPE, St. Paul, MN, USA
Filtek Z550	Nanohybrid composite resin	Bis-GMA, UDMA, Bis-EMA, TEGMA ve PEGDMA Fillers: Surface-modified zirconia/silica fillers 3000 nm (3 µm or less), non-agglomerated/nonaggregated surface-modified silica particles 20 nm Filler loading: 82 wt%, 68 vol%	3M ESPE, St. Paul, MN, USA
Total Blanc Office H35	35% hydrogen peroxide	35% hydrogen peroxide, 2% sodium fluoride and 5% potassium nitrate	Total Blanc Office H35, Nova DFL, Rio de Janeiro, Brazil

Table 2. Means and standard deviations (SDs) of the Ra values (µm) for all materials tested

Composites	Initial Ra mean ± SD	Final Ra mean ± SD	
Tetric N Ceram	0.21 ± 0.03	0.23 ± 0.02	p=0.115
Clearfil majesty esthetic	0.30 ± 0.09	0.23 ± 0.05	p=0.098
Filtek Z250	0.33 ± 0.06	0.33 ± 0.06	p=0.296
Filtek Z550	0.22 ± 0.04	0.24 ± 0.03	p=0.206

Discussion

The purpose of this in vitro study was to evaluate the effect of an office bleaching agents on the surface roughness of four different composite resins which have different compositions. Frequently, in daily clinical practice, composite resin restorations exist in teeth that are planned to be bleached. Although the effects of bleaching agents on teeth are known, their effects on restorative materials in vitro are controversial.[14] To evaluate this effect on the surface of composites, different techniques have been used, such as scanning electron microscopy[15] and profilometer.[16] In many research, it has been reported that SEM procedures changed the natural conditions or part of the specimen structure, and the resolution and magnification of the SEM affected the results.[17] That's why we chose to use a profilometer device in our study.

Some studies have shown that in-office bleaching has a detrimental effect on composite surface roughness.[18-20] On the other hand, some researchers reported that there was not any detrimental effect on the surface roughness of composites.[21-23] Different results were also evident regarding the use of lower concentration office bleaching agents. In this study, the results demonstrated that the Ra parameter did not change significantly after bleaching.

All samples were finished and polished before bleaching to simulate clinical conditions. Finishing refers to gross contouring or reducing of the restoration to obtain the desired anatomy, and polishing reduces the roughness and scratches created by finishing instruments.[24] According to the manufacturer's instructions for using Sof-Lex discs, ‘‘a dry surface will produce a smoother, more uniform finish’’.[25] However, working without water cooling can cause an increase in temperature and burns on the restoration surface. Therefore, samples were subjected to finishing and polishing using the Sof-Lex system on a water-cooled, low speed handpiece. Surface irregularities that we see in the microscope examination before bleaching may be caused by the Sof-Lex system. Similar views have been observed in a previous study where wet polishing with Sof-Lex disks had led to a rougher surface than dry polishing.[26]

Resin-containing materials soften and roughen their surfaces when exposed to acid-containing chemicals, and as a result, they become more sensitive to physical forces.[27,28] While hydrogen peroxide is a powerful oxidizer, it is also extremely acidic.[29] On the mechanism of hydrogen peroxide decomposition, as hydrogen peroxide reacts with a tooth, it decomposes into hydroxyl radicals or water and oxygen molecules.[24,30] HP and released free radicals could react with the composites' organic polymer matrix as well as inorganic structures, eventually dissolving the surface by extracting the mineral elements.[30,31] Yu *et al.*[32], in a study examining the effect of a high concentration of hydrogen peroxide on the surface roughness of composites, found that the roughness of micro-hybrid and nanohybrid composites increased after bleaching compared to the control group, but this increase was statistically insignificant. Similarly, in our study, although minimal changes were observed in the surface roughness of both micro-hybrid composite and nanohybrid composites after bleaching, they were statistically insignificant. When the surface roughness data before and after bleaching was evaluated, no difference was found between micro-hybrid and nanohybrid composites.

The differences in the composite resins’ roughness values obtained after the same bleaching regime may be related to the different polymers in their organic phases, and their filler content and particle size.[27] The organic matrix contents of the composites used in this study were approximately similar. However, while all composite samples contain bisphenol-A dimethacrylate (BIS-GMA) and urethane dimethacrylate (UDMA), Clearfill Majesty Esthetics does not contain UDMA. Regarding the organic composition of the composites, Dogan *et al.*[25] also observed that the composite containing the dental resin monomers UDMA in its matrix is more degraded compared to the composite containing bisphenol A Bis-GMA. Similarly, in this study, the surface roughness of the samples containing UDMA was more affected.

The filler load is directly related to the surface area that is taken up by filler particles versus the resin matrix, as the surface smoothness is generally determined by the largest inorganic particles present within the composite.[13] When the data obtained from our study were examined, the microhybrid composite Z250 with the largest particle size (average particle size 0.6 µm) showed the highest roughness values before and after bleaching among the groups, but the rate of change in surface roughness was statistically similar to nanohybrid composite groups.

It has been claimed that roughening is a result of erosion of the matrix, the consequent debonding of resin–filler interfaces would lead to dislodgment and also to elution of fillers.[33] Thus, any difference in surface roughness is expected to occur in composites with higher resin content.[34] The total content of inorganic fillers in our composite samples Clearfil Majesty Esthetics (78% by weight) is lower than in Tetric N-Ceram (80% wt), Filtek

Z250 (83.5% by weight), Filtek Z550 (%82) and might be another reason that this material is more susceptible to alteration during bleaching procedures, as reported by Polydorou *et al.*[34]

Concerning the structure of inorganic fillers in the resin composite, it has been reported that barium-containing glass fillers are more susceptible to water attacks than both quartz and fairly purified amorphous SiO_2. The microfill particles, on the other hand, have more Si available for leaching due to their greater total surface area.[35] Finer glass particles have also been observed to dissolve faster than coarser glass particles. More interfaces are created as a result of the dissolving, which can affect filler degradation.[36] A silica-filled composite may be said to degrade faster from a clinical perspective.

Varanda *et al.*[37], observed that 35% hydrogen peroxide increased the surface roughness of microhybrid composite samples but Doğan *et al.*[25] found that surface roughness decreased in their studies using microhybrid composites. The differences between the results of these studies[25,37] in which AFM was used, are associated with the methodological approach. Varanda *et al.* evaluated the same area in the same sample before (control) and after the use of bleaching agents, but Dogan *et al.* evaluated the different areas to analyze the changes. Whereas the other researchers[38,39] claimed that 35% hydrogen peroxide doesn't affect microhybrid composites. Similarly, in this study, no change was observed in the surface roughness of Filtek Z250.

The critical surface roughness threshold for bacterial adhesion has been identified at 0.2 µm.[13] While no reduction in bacterial accumulation is expected below this threshold, any increase in surface roughness above 0.2 µm results in a simultaneous increase in plaque accumulation, as well as the risk of caries and periodontal inflammation, because of the restoration's esthetics and longevity are all at risk. In addition, Kim *et al.*[8] stated that Ra values less than 0.3 µm after bleaching were clinically acceptable. In this study, the initial and finishing Ra values of the composites were measured between 0.21 µm and 0.33 µm, close to the critical limits.

Main faults in matrices such as pits, pores, and weaknesses equate with the degree of damage. Furthermore, the degree of conversion of the resin matrix and the chemical composition of the matrix can affect this process. The degradation process can also be influenced by powers on the radical formation of bleaching materials and their PH alongside their contact time.[20,40] The effect of each prescribed reason can affect the results of different studies. Surface roughness can also be affected by many factors. In this study which we examined the effect of 35% hydrogen peroxide on micro-hybrid and nanohybrid composites, although there were differences in the measurements after bleaching, these differences were found to be statistically insignificant. To assess the long-term effectiveness of the restorative materials following aesthetics treatments utilizing bleaching chemicals, longitudinal clinical investigations and clinical follow-up evaluations should be done.

Conclusions

Microhybrid composites have rougher surfaces than nanohybrid composites. Although the office bleach containing 35% hydrogen peroxide produced minor changes in the roughness of nanohybrid and microhybrid composite resins, this change is not statiscally significant.

Acknowledgements

Financial support: No financial support was received for this study.

Conflicts of Interest Statement

Conflict of interest: The authors do not have any financial interest in the companies whose materials are included in this article.

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Cumhuriyet Dental Journal, 25(Suppl): 83-87, 2022
DOI: https://doi.org/10.7126/cumudj.1032944

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

The Evaluation of Streptococcus Mutans Colonization in Private School Nursery-Kindergarten Children's Toothbrush#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 10/12/2021
Accepted: 06/01/2022

ABSTRACT

Aim: Disinfection of the toothbrush is an essential parameter for oral hygiene. As a result, especially children cannot clean their toothbrushes sufficiently after brushing their teeth. The purpose of this study was to evaluate the accumulation level of *Streptococcus mutans* colonization at private school nursery-kindergarten children's toothbrushes and evaluate the effectiveness of chlorhexidine solution in four weeks for disinfection.
Methods: This study was approved by the local ethics committee. Two hundred thirty-four private school nursery-kindergarten children were selected for this study, who's aged between 24-72 months. These selected children for this study did not have any dental, antibiotic, antimycotic treatment in the last three months. Before the study, a survey was conducted about parents' education, employment, the income. A pediatric dentist made an oral examination of these children, dental caries, fillings, and missing teeth were determined. Children were divided into two groups; toothbrushes, toothpaste, and practical solutions distilled water and %0.12 chlorhexidine gluconate solution was given in a bottle for four weeks. In addition, the toothbrushes of children were collected every week. After incubation, *Streptococcus mutans* colonization was evaluated under stereomicroscope. All the collected data were statistically evaluated.
Results: The DMF-T scores were statistically significant when evaluated with parents' education and income, but there was no statistical relationship between parents' employment and DMF-T scores. *Streptococcus mutans* colony reduction at the Chlorhexidine group was statistically significant.
Conclusion: From the first brushing, toothbrushes can be contaminated with bacteria. If the toothbrushes are not clean sufficiently, the bacteria taken from the oral environment have a chance to form a colony on the toothbrushes with the effect of moisture. In addition, Streptococcus Mutans is a bacteria that can stay on toothbrushes and cause re-infection. This study shows that toothbrush disinfection is essential to prevent bacteria from re-infection and contamination of oral flora.

Key Words: Oral Health, Disinfection, Toothbrush, Chlorhexidine, *Streptococcus Mutans*.

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How to Cite: Toptancı İR, ÇekenToptancı B, Celepkolu T, Erten Bucaktepe GE. (2022) The Evaluation of Streptococcus Mutans Colonization in Private School Nursery-Kindergarten Children's Toothbrush, Cumhuriyet Dental Journal, 25(Suppl): 83-87.

Introduction

Between 24-72 months, the nursery-kindergarten period is a period in which children begin to socialize, increase their contact with the environment, and display cognitive and sensory development. As a result, children's dental needs and many of their other needs change during this period. With the developing physical and psycho-emotional structure, children participate in various activities, making them vulnerable to diseases that can be transferred from the environment.[1] During this period, children's nutritional habits also changed and accordingly, they faced many nutrition-related problems, especially dental caries. In this period, their tendency to essential is vital in acquiring tooth brushing habits.[2-4] Toothbrushes are of various qualities and features, and after fabrication, toothbrushes are sterile after packaging.[5,6] Bacteria, viruses and fungi accumulate on the surface of the brush bristles after brushing for the first 30 seconds to 4 minutes after the toothbrush is turned on. [5-10] These microorganisms are bacteria found both in the external environment and in the oral cavity. Some microorganisms can live on toothbrushes between 24 hours and 7 days.[5,6,11,12] As a result of routine use of toothbrushes, these microorganisms spread to the oral cavity in the same individual or different individuals.[13,14] Generally, toothbrushes are stored in the bathroom with other individuals from the same family. Contamination occurs as a result of contact with toothbrushes belonging to different individuals. Thus, it can be seen that microorganisms spread from one individual to another individuals. Brushing teeth at the same sink as their friends, storing toothbrushes in school lockers, or carrying them in their backpacks may all be sources of contamination in nursery and kindergarten children. Microorganisms can be transmitted from one person to another if more than one child uses the same toothbrush or changes it among themselves. For this reason, disinfection of toothbrushes is essential in terms of

preventive medicine. Studies on this subject are very few regarding the importance of the issue. [5,6,8,12,15]

This study aims to examine the caries rates and tooth brushing habits of 234 children selected among 1005 kindergarten children aged between 24-72 months, taking into account their parents' education and income level. It also evaluates the response of microbiological agents accumulated in children's toothbrushes to disinfectant chlorhexidine solution.

Material and Methods

This study was accepted by the Dicle University Faculty of Medicine Ethics Committee with the number 25.11.2011-312. 234 children (120 controls, 114 hexidines) who had not received any antibiotic, antimitotic, or dental treatment in the last three months, selected from 1005 private nursery-kindergarten children aged between 24-72 months, were included in this study. Attention was paid to the fact that the children included in the study had completed the primary dentition period. The distribution of these children into groups was made randomly. After the doctors were given information about the survey to parents, the pediatric dentist gave tooth brushing training to the children and parents. After a questionnaire was made for the parents' education, employment, and income status, the oral examination was performed by a pediatric dentist. Care has been taken to ensure that the brushes given to children are travel type, soft and without any extra features, with a closed box. The first microbiological cultures were taken with a brush; after brushing the first dispensed toothbrushes for at least 2 minutes using only water, without using any paste, under the guidance of a dentist. After the first brushing, the samples were placed in the storage container of the toothbrush without any washing. Toothbrushes and the solutions they will use (distilled water and hexidine) were given to the children to be collected every week. Children were provided to brush their teeth for 2 minutes at least twice a day. Spraying the solution on all surfaces of the brushes and brushing control were given to both parents and kindergarten teachers. As a result of evaluating the samples taken in the first week, the samples taken for four weeks were also assessed. The colonization values of S. mutans bacteria were examined. The first samples were given to the children once a week for four weeks, and the data obtained from the brushes taken back the following week were tried to be compared. Spray bottles (50cc) given to the patients were numbered. According to numbers throughout the study, distilled water and 0.12%, Chlorhexidine Gluconate solution was left weekly.

To examine the numbers of Streptococcus Mutans colonies accumulated on the brushes, the samples taken from the brushes are based on the scoring system used in the study of Filho et al. in 2006: [5]

- Score 0: no colony/biofilm.
- Score 1: 1-50 colonies/biofilm
- Score 2: 51-100 colonies/biophilia
- Score 3: Over 100 colonies/biofilm

For Streptococcus Mutans analysis, Bacitracin-Succurose broth enriched with Jensen and Brattall's modification was incubated and kept at 37˚C for four days. The bristles were washed, the planktonic microbiota was removed, and the remaining mushroom-shaped or spike-shaped colonies were counted under a stereomicroscope.

IBM SPSS 21.0 for windows statistical package program was used for the statistical evaluation of our research data. Measured variables were presented as mean ± standard deviation (SD), and categorical variables were presented as numbers and percentages (%). Chi-square ($\chi 2$) test and ANOVA analysis were used for the intergroup comparison of qualitative variables. In addition, Spearman correlation analysis was performed for the relationship between the variables. The hypotheses were two-sided, and a statistically significant result was accepted if $p \leq 0.05$.

Results

In this study, 234 patients with a mean age of 50.87± 9.56 months in the Control group and 50.28± 9.74 months in the Hexidine group, aged between 24-72 months, were included obtaining parental and ethical approval (Table 1). The dmf index of the children participating in our study was 4.09±2.89 for 120 patients in the control group and 3.86 ± 2.78 for 114 patients in the Hexidine group, and 3.98 ± 2.83 for a total of 234 patients (Table 2). No significant difference was found between the dmf index of girls and boys, regardless of the study groups ($p=0.106$ $p \geq 0.05$) (Table 3).

Table 1. The average age of the groups

AGE			
Group	Mean	n	Std. Deviation
Control	50.8750	120	9.56935
Heksidine	50.2807	114	9.74589
Total	50.5855	234	9.63960

Table 2. Dmf scores for groups

DMF			
Group	Mean	n	Std. Deviation
Control	4.0917	120	2.89884
Hexidine	3.8684	114	2.78273
Total	3.9829	234	2.83898

Table 3. Dmf indexes among girls and boys independent of study groups

DMF				
Gender	n	Mean	Std. Deviation	SEM
Girl	113	3.6726	2.82034	.26532
Boy	121	4.2727	2.83725	.25793

SEM: Std. Error Mean

Table 4. Dmf evaluation according to the mother and father study

DMF			
Working	Mean	n	Std. Deviation
Father	4.3548	124	3.04223
Mother	5.0000	1	.
Mother and Father	3.5505	109	2.54764
Total	3.9829	234	2.83898

Table 5. Education levels of the mother

DMF			
Education Mother	Mean	n	Std. Deviation
Out Of School	2.6000	5	3.28634
Primary School	4.7692	13	2.52170
Middle	6.2308	26	3.61450
High School	3.8247	97	2.79139
University	3.6585	82	2.26743
Academic	2.1818	11	2.67650
Total	3.9829	234	2.83898

Table 6. Education levels of the father

DMF			
Education Father	Mean	N	Std. Deviation
Out of School	4.0000	2	5.65685
Primary School	8.0000	1	.
Middle	5.5660	53	3.30215
High School	3.6266	158	2.43249
University	2.4000	20	2.62378
Academic	3.9829	234	2.83898

Table 7. Relationship between income level and dmf.

DMF			
Income	Mean	n	Std. Deviation
Minimum Wage	4.0000	2	5.65685
3000-6000 TL	5.8718	39	3.27012
6000-10000 TL	3.8000	80	2.88339
10000-20000 TL	3.5484	93	2.23858
20000 TL And Above	3.0500	20	2.76205
Total	3.9829	234	2.83898

Table 8. Correlation evaluation of colony distribution of Streptococcus Mutans accumulated in the samples taken from brushes.

	Control	Hexidine	p	r
0. week	120/%51.3	114/%48.7	1	-0.002
1. week	120/%51.3	114/%48.7	0	-0.619
2. week	120/%51.3	114/%48.7	0	-0.509
3. week	120/%51.3	114/%48.7	0	-0.572
4. week	120/%51.3	114/%48.7	0	-0.673

According to the mother and father working rate, no significant difference was observed between the groups in the dmf evaluation (p=0.91 p≥0.05) (Table 4). It has been observed that there is a significant difference between the education levels of the mother and father and the dmf index. It was observed that as the education levels of the parents increased, and the dmf level decreased (p=0.00 and p≤ 0.05) (Table 5,6). It was found that there is a significant relationship between income level and dmf index (p=0.00 and p≤0.05) (Table 7). According to the four-week distribution chart of Streptococcus mutans colonies in the Control and Hexidin groups, significant reductions in the number of colonies were observed in the Hexidin group.

In the statistical evaluation, it was observed that the decrease in the Hexidine group by weeks was significant (0 week p=1,00 p≥0.05 r=-0,002, 1th week p=0,0 and p≤0.05 r=-0,619, 2nd week p=0,0 and p≤0.05 r=-0,509, 3rd week p=0,0 and p≤0.05 r= -0,572, 4th week p=0,0 and p≤0.05 r= -0.673) (Table 8).

Discussion

This study aims to give the children participating in the study the habit of daily brushing. It has been reported that the incidence of caries is lower in individuals who acquire the habit of brushing their teeth at an early age.[16,17] Furthermore, the effectiveness of the education given to families and children can also be monitored by the weekly change of bacteria in the samples taken from toothbrushes. Therefore, it is essential to acquire hygiene education as a habit against various pathogens coming from the external environment and changing nutritional habits, socialization and environmental conditions.[1,2] In some studies conducted in Europe, it has been observed that it plays a significant role in the early detection and prevention of childhood caries in children who receive family assistance for tooth brushing.[4,18] In contrast, it does not play a significant role in studies conducted in the USA.[19]

The mean dmf-t index of the children participating in this study was found to be 3,9829 in 234 children, which was found to be higher than other studies in this age group. In the study performed by Chu et al. in 2012, the mean dmf-t for 764 pre-school children was reported as 2.2.[16] According to 2003 data in the United Kingdom, this rate was 1.6 in children aged five years.[7] In a study conducted in Australia, the mean dmf-t score was 1.5.[20] In a study conducted in Brazil in 2012, the dmf-t index of pre-school children was found to be 1.53±2.6.[21] In our study, there was statistical significance between the parents' income levels and the caries levels of the children. Different results were obtained in previous studies. According to Schroder et al. and Panino et al., there were no significant difference between income level and dmf.[4,18] These results can make it difficult to reach dental protective products because of purchasing power. In this study, it was observed that the level of caries in children with the low educational level of parents was lower than children with parents who received university and academic education. In the study of Chu et al., it was reported that the rate of caries is high in children of families with low socio-economic and educational levels.[2,16,22] However, in our study, the variability between education level and caries may be due to the high-income level of private nursery and kindergarten children. We expect this outcome to be different in general school studies.

In this study, *Streptococcus Mutans* colonies were found in the samples taken after 2 minutes of brushing in

week zero, regardless of the study and control groups. This shows parallelism with other studies.[5,6,12,13] A new toothbrush should be disinfected to prevent the formation of a bacterial biofilm layer on the brush bristles after the first tooth brushing.[5,24] However, disinfection of toothbrushes should be continued daily and replaced with a new toothbrush every 3-4 months.[5,24,25] Various methods have been used for the disinfection of toothbrushes in many studies; microwave, boiled water, ultraviolet light and chemical agents, especially chlorhexidine gluconate solutions, are preferred. Some researchers have tried to create disinfection by covering the toothbrush surfaces with chlorhexidine or disinfectant substances during the production phase.[26-28] In this study, the number of Streptococcus Mutans colonies in the group given chlorhexidine gluconate spray (0.12%) decreased significantly compared to the control group. This result shows parallelism with the studies of Filho et al. in 2000 and 2006.[5,6] This is due to both regular brushing and the effectiveness of chlorhexidine gluconate. Similar results were obtained in the study of Nascimento et al. in 2010 with a commercial solution containing 0.12% chlorhexidine (9). We think that the decrease in the colonization of other bacterial species is due to the effectiveness of clorhexidine. We believe that a reduction in *Streptococcus Mutans* colonies in the oral environment can be achieved at certain rates with tooth brushing.

Conclusions

While the number of bacterial colonization was very high in the first samples taken from private nursery-kindergarten children aged 24-72 months, the decrease in these rates independent of the income-education levels of the parents after regular brushing showed that tooth brushing is essential in this age group. A significant reduction in the amount of *Streptococcus Mutans* colonies accumulated on toothbrushes was observed using chlorhexidine gluconate solution (0.12%) in the disinfection of toothbrushes. To protect children's oral health in this age group, we think that brushing teeth more effectively and microbiological protection of toothbrushes will be precious in terms of public health. New studies should be done on this subject.

Acknowledgements

All authors in this study declare that; no support, financial or otherwise, has been received from any organization that may have an interest in the submitted work and there are no other relationships or activities that could appear to have influenced the submitted work.

Conflicts of Interest

The named authors have no conflict of interest, financial or otherwise.

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Cumhuriyet Dental Journal, 25(Suppl): 88-93, 2022
DOI: https://doi.org/10.7126/cumudj.1032911

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Relationship Between Operator Experience and In Vitro Microleakage of Different Composite Materials in Class II Restorations#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 06/12/2021
Accepted: 08/03/2022

ABSTRACT

Objectives: To evaluate the influence of operator experience on microleakage in class II restorations performing by different restorative materials.
Material and Method: Two cavities of 4x4x3mm dimensions were carried out on the mesial and distal surfaces of 20 molar teeth by one operator. The teeth were randomly assigned to two groups according to the operator's skill: student group and expert group. It was divided into subgroups as specialist bulk-fill composite: Group 1A, student bulk-fill composite: Group 2A, specialist micro-hybrid composite: Group 1B, student micro-hybrid composite: Group 2B, Prime bond nt, a total-etch adhesive system, is used in all restorations. Each operator restored the mesial cavities with the bulk technique using a bulk-fill composite (Tetric-N-Ceram-Bulk) and the distal cavities with the layering technique using a micro-hybrid composite (Filtek Z250, 3M ESPE). After 24 hour of water storage and thermocycling the marginal microleage was evaluted using dye penetration technique and data were analyzed.
Results: When the restorative materials were evaluated without considering the operator, no statistically significant difference was found between them. When the scores of the operators were evaluated without considering the restorative materials used, no statistically significant difference was found between them. When the occlusal and gingival leakage scores of Group 2A were evaluated, more gingival leakage was observed than occlusal. There was no statistically significant difference between the in-group occlusal and gingival leak scores of the other groups.
Conclusion: There was no difference between the expert and the student in terms of microleakage values.

Keywords: Bulk-Fill, Microleakage, Operator Experience, Micro Hybrid Composite Resin, Total-Etch Adhesive.

Sınıf II Restorasyonlarda Operator Becerisi ve Farklı Restoratif Materyallerin Mikrosızıntıya Etkisi#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 06/12/2021
Kabul: 08/03/2022

ÖZ

Amaç: Farklı deneyim düzeylerine sahip uygulayıcıların, farklı restoratif materyaller kullanarak yaptıkları kompozit restorasyonların mikrosızıntı değerlerinin karşılaştırılmasıdır.
Yöntem: Çalışmada 20 çekilmiş dişin mezial ve distal yüzeylerine (tek operatör tarafından) 4x4x3mm boyutlarında kutu kaviteler hazırlandı. Dişler rastgele 2 gruba ayrıldı. Restorasyonlar 16 yıllık restoratif diş tedavisi uzmanı ve diş hekimliği 5.sınıf öğrencisi tarafından yapıldı. Her operatör dişin mesialini bulk-fill kompozit (Tetric-N-Ceram-Bulk) kullanarak bulk tekniğiyle distalini mikro-hibrit kompozit (Filtek Z250, 3M ESPE) kullanarak tabakalama tekniğiyle restore etti. Uzman hekim bulk-fill kompozit: Grup 1A, öğrenci bulk-fill kompozit: Grup 2A, uzman hekim mikro-hibrit kompozit: Grup 1B, öğrenci mikro-hibrit kompozit: Grup 2B olarak alt gruplara ayrıldı. Tüm restorasyonlarda total-etch adeziv sistem (prime bond NT) kullanıldı. Dişler distile suda 24 saat bekletildikten sonra termomekanik yükleme uygulandı. Mikrosızıntı testi için tüm örnekler %0,5'lik bazik fuksinde 24 saat oda ısısında bekletildi. Örnekler 10x40 büyütmede stereomikroskopla incelendi. Veriler Kruskall Wallis, Mann Whitney, Anova post hoc Tamhane ve Wilcoxon signed ranks testleri kullanılarak değerlendirildi.
Bulgular: Uygulayan operatör dikkate alınmadan restoratif materyaller değerlendirildiğinde ve kullanılan restoratif materyaller dikkate alınmadan restorasyonları uygulayan operatör skorları değerlendirildiğinde aralarında istatistiksel olarak anlamlı fark bulunmadı. Grup 2A'nın okluzal ve gingival sızıntı skorları değerlendirildiğinde gingivalde okluzale göre daha fazla sızıntı gözlenmiştir. Grup 1A, Grup 2B ve Grup 1B'nin oklüzal ve gingival değerleri arasında istatistiksel olarak anlamlı fark bulunmadı.
Sonuçlar: Mikrosızıntı değerleri açısında değerlendirildiğinde uzman ve diş hekimliği öğrencisi arasında fark bulunamamıştır.

Anahtar Kelimeler: Bulk-Fill, Mikrosızıntı, Operatör Deneyimi, Mikro Hibrit Kompozit Rezin, Total-Etch Adeziv.

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How to Cite: Murrja E, Hergüner Siso Ş, Aydemir M, Öztürk HN. (2022) Relationship Between Operator Experience and In Vitro Microleakage of Different Composite Materials in Class II Restorations, Cumhuriyet Dental Journal, 25(Suppl): 88-93.

Introduction

Although composite resin has shown great advances since its invention, polymerization shrinkage remains a major cause of clinical failure.

Shrinkage stresses caused by polymerization shrinkage damage the connection between the cavity walls and the restoration, causing the formation of micro-cavities that allow the passage of saliva and oral fluids between the tooth and the restoration. As a result, discoloration, secondary caries, hypersensitivity and inflammatory changes may occur in the pulp tissue.

Researches has focused on improving placement techniques, materials, and the formulation of the composite, particularly the polymeric matrix of the material, to develop systems that reduce polymerization shrinkage stress.[1]

The incremental technique is the most widely used placement technique in direct restorations of composite resin. This technique improves the physical properties and marginal adaptability of composite resins by increasing light penetration and providing adequate polymerization.

In addition to these advantages of the incremental technique, there are disadvantages such as the presence of gaps between the composite layers, the inability of these layers to bond well, the risk of contamination and the long working time.[2]

Recently, composites called bulk-fill, which can be placed in a single move up to 4-6 mm thickness, have been developed in order to simplify and accelerate placement techniques. By decreasing the filler ratio of the bulk-fill composites, increasing the filler particle size and translucency, the depth of polymerization was increased, and polymerization shrinkage was reduced.

Restorations are under thermal and mechanical stress in the oral environment. These stresses can affect the results of microleakage that will occur between the tooth and the restorative material with different physical properties.

Operator experience can be as important as the material in the success of restorations. Although there are many studies on the effect of operators' level of experience on adhesive applications, there is not enough literature evaluating their effect on different composite resin applications.[3]

The aim of this in vitro study is to evaluate the effect of restorations made by operators with different levels of experience on microleakage using different restorative materials.

H_0: There is no difference between the microleakage values of restorations made by operators of different experience levels using different restorative materials.

Material and Methods

This study was approved by the Non-Interventional Ethics Committee of Istanbul Aydın University (File number:2019/91). All experimental stages of our study were carried out in Istanbul Aydın University Research Laboratory.

Sample preparation

Twenty caries-free, restoration-free, and crack-free human third molars extracted for periodontal or surgical reasons were used in this study. All calculus deposits and remaining connective tissue were removed by scaling with a hand instrumentation and the teeth were stored in 0.1% thymol solution, at +4 ^{o}C temperature, until the study was carried out.

Standard class II box cavities were prepared 1 mm above the CEJ on the mesial and distal surfaces of the teeth under water cooling with fissure dimond burs (Meisinger, Germany) by renewing the burs in every five cavities by a single operator (dental specialist). The overall dimensions of the cavities were standardized as follows: 4 mm buccolingual width, 4 mm occlusogingival height, and 3mm gingival wall. No bevel was applied to the cavity edges. The class II box cavities were randomly divided into 2 groups.

Group 1 was restored by a specialist and Group 2 by an undergraduate student. Each operator restored the mesial of the tooth with the bulk technique using bulk-fill composite resin (Tetric-N-Ceram-Bulk) (Group 1A- Group 2A) and the distal with the oblique incremental layering technique using micro-hybrid composite resin (Filtek Z250, 3M ESPE) (Group 1B- Group 2B).

The samples were divided into 4 subgroups (n:10).

Group 1A: Dental specialist-bulk-fill composite resin

Group 2A: Undergraduate student-bulk-fill composite resin

Group 1B: Dental specialist-micro-hybrid composite resin

Group 2B: Undergraduate student-micro-hybrid composite resin

Prime&Bond NT, which is a two-stage total-etch system, was used as an adhesive in all restorations in accordance with the manufacturer's instructions. The restorations were polymerized with a 1200 mW/cm2 LED (Elipar S10, 3M ESPE, Germany). In the restorations made with the incremental technique, the micro-hybrid composite resin (Filtek Z250, 3M ESPE) was applied in 2 mm layers and the restoration was completed. Each layer was light cured for 20 seconds. In the restorations made with the bulk technique, the bulk-fill composite resin (Tetric-N-Ceram-Bulk) was placed in the cavity in a single layer of 4 mm (Table 1). Restorations were light-cured on the occlusal surface for 20 seconds, and after the band was removed, they were light-cured for 20 seconds each on the buccal and lingual surfaces. Afterwards, polishing and finishing processes were completed using Yellow extra fine finishing bur (Meisinger, Germany), aluminum oxide polishing disk (Soflex 3M ESPE,USA) Soflex polishing disc, composite polishing rubber (Hi-Shine,Polydentia, Switzerland) Polydentia composite polishing rubber.

After the restorations were completed, the apical parts of the teeth were covered with wax dental wax (Integra, Bg dental, Turkey) to prevent dye leakage from the apex and kept in distilled water for 24 hours.

Table 1. The Properties of the Composite Resins and Adhesive Agent Used.

Material	Lot numbers	Composition	Manufacturer
Tetric N-Ceram/Hybrid Bulk-fill RC	W42311	Barium glass, Prepolymer, Ytterbium trifluoride, Mixed oxide Bis-GMA, DMA	Ivoclar Vivadent, AG, Schaan, Lichtenstein, GERMANY
Filtek Z250/ Micro-hybrid RC	N946524	Zirconia/Silica Withoutsilane Treatment,Bis-GMA,UDMA,Bis EMA	3M ESPE, St Paul, MN, USA
Etching gel	181187	37%phosphoric acid	SDI,Victoris,Australia
Prime&Bond NT Adhesive Agent	052044	UDMA, PENTA Di- ve tri-metakrilat Di- and tri-methacrylate	Dentsply International, DE, USA

Table 2. Dye Penetration Scale

Score	Dye penetration level for microleakage in the occlusal wall	Dye penetration level for microleakage in the gingival wall
0	No dye penetration	No dye penetration
1	Dye penetration up to 1/2 of the occlusal wall	Dye penetration up to 1/2 of the gingival wall
2	Dye penetration exceeding 1/2 of the occlusal wall	Dye penetration exceeding 1/2 of the gingival wall
3	Dye penetration up to the pulp	Dye penetration up to the pulp

3 cm high, 2.5 cm inner diameter PVC molds were prepared in order to fix the samples to the chewing simulator. The teeth were positioned in the center of the molds by means of chemically cured cold acrylic (Imident, Imicry, Turkey).

The samples were subjected to thermo-mechanical fatigue testing with a chewing simulator (Esetron, Turkiye). A force of 50 N with 240,000 cycles, was applied in a frequency range of 1.6 Hz, simultaneously with 2500 heat cycles at temperatures of +5°C and +55°C, with the samples remaining for 60 seconds at each temperature. Then, all surfaces of the teeth except the restorations and 1 mm circumference were painted with two layers of nail varnish and kept in 0.5% basic fuchsin solution for 24 hours.

Samples were washed under running water. The restorations were divided into two equal parts in the mesiodistal direction with a low-speed precision cutting device (Esetron, Turkiye) under water cooling. The obtained sections were evaluated with a stereo microscope (Carl Zeiss, Munich, Germany) at x40 magnification according to the dye penetration scale (Table 2). Photographs were taken from each section.

The obtained data were evaluated with the IBM SPSS (VER 20.0) program. The microleakage values did not show normal distrubution according to Shapiro Wilks test. Therefore, a non-parametric test, Kruskal Wallis ANOVA post hoc Tamhane, was performed among groups for multiple comparisons The difference between the restorative materials used and the different operators was evaluated with the Mann-Whitney *U* Test. The gingival and occlusal microleakage scores of the restorative materials used were evaluated with the Wilcoxon signed ranks test. The results for all data were analysed at a significant level of $p<0.05$.

Results

The distribution of occlusal and gingival microleakage scores obtained after the microleakage test of the restorations is shown in Table 3.

According to the data obtained in our study, when only the restorative materials used in restorations were evaluated without considering the operator, no statistically significant difference was found between them ($p>0.05$).

When only the operators were evaluated without considering the restorative materials used, no statistically significant difference was found between them ($p>0.05$).

There was a statistically significant difference between the occlusal and gingival microleakage scores in Group 2A ($p<0.05$). More microleakage was observed in the gingival region than in the occlusal region. There was no statistically significant difference between the occlusal and gingival values of Group 1A, Group 2B, and Group 1B ($p>0.05$).

Table 3. Microleakage Scores of the Occlusal and Gingival Margins

Group		Score 0	Score 1	Score 2	Score 3	Median (min-max)
Group 1A	Occlusal	10	0	0	0	0-0
	Gingival	5	5	0	0	0-1
Group 1B	Occlusal	10	0	0	0	0-0
	Gingival	8	2	0	0	0-1
Group 2A	Occlusal	10	0	0	0	0-0
	Gingival	1	9	0	0	0-1
Group 2B	Occlusal	10	0	0	0	0-0
	Gingival	5	5	0	0	0-1

Discussion

One of the main purposes of dental restorations is to cover the exposed dentin and to protect the pulp from external factors. Ensuring an adequate seal between the tooth and the restoration is very important for the success and the longevity of the restorations.

There are many application steps such as adhesive, composite resin and light application processes where mistakes can be made in the construction of restorations. In these processes usage limitations and correct use are as important as the properties of the material used. Therefore, the final result depends not only on the material but also on the knowledge and skills of the operator about the material.

Few studies have been carried out on operator experience, and more adhesive resin applications than restorative materials have been emphasized. Therefore, in this study, the effect of bulk-fill and microhybrid composite resin materials on microleakage with a two-step total-etch adhesive was evaluated.

According to the data of our study, the H0 hypothesis was accepted.

Although the number of samples in the groups varies in microleakage studies, it has been reported that the number of samples for each group should be 2-12 in many studies. In our study, each group consisted of 10 class II box cavities.[4,5]

It has been reported by many studies that the time elapsed after tooth extraction and the storage conditions will affect the experimental results. The most commonly used solutions are %10 formail-acetate, chloramine and %0,05-%0,1 thymol.[6-10] Considering the results of the studies of Goodis *et al.*, the teeth were stored in a glass jar filled with 0.1% thymol at +4 ^{o}C in order to preserve the permeability of the dentin.[11,12]

Many methods such as dye penetration, indicators, radioactive isotopes, microbial permeability, scanning electron microscopy (SEM), artificial caries techniques, and electrical current are used to evaluate the edge sealing of composite restorations. In this study we preferred the dye penetration method, which is the most preferred method among these methods because it is cheap and practical[13], 0.5% basic fuchsin solution we applied as a dye for 24 hours.

Cavity size, shape, and localization influence the results of microleakage studies. Therefore, all cavities in this study were prepared by a single operator in the same size, shape, and localization (Standard Class II box cavity on the mesial and distal surfaces of the teeth, 1 mm above the CEJ, 4 mm buccolingual dimension, 4 mm occlusogingival dimension, 3 mm gingival floor width pulp depth). A beveled margin was not applied to the box cavities, as the composite on the beveled occlusal margins could break under chewing forces due to insufficient thickness.[8,14]

The structure of the tooth used in the studies plays an important role in the data obtained. For this reason, in this study, the mesial side of the same tooth was restored with bulk-fill composite resin and the distal side with micro-hybrid composite resin in order to eliminate the tooth-related variable.

In our study, thermo-mechanical aging was performed by using a chewing simulator in order to provide behaviors similar to the oral environment in *in vitro* conditions and to predict clinical performances. Jung et al and Shahidi et al showed that the microleakage values of composite restorations increased after thermo-mechanical aging in their studies.[15,16]

In this study, a chewing load of 50 N at a frequency of 1.6 Hz was applied for 240,000 cycles to imitate the 1-year aging process. Simultaneously, all teeth were immersed alternately in water baths at the temperature of 5°C (±5°C) and 55°C (±5°C) with a dwell time of 30 seconds in each bath for 2500 cycles.

The total-etch adhesive system is considered to be critical and highly technically sensitive because of including etching, washing and drying steps.[17,18] Acetone-based total-etch systems are more technically sensitive than water and ethanol-based total-etch systems.[19,20] Many researchers evaluated the relationship between operator experience and the success of adhesive systems, and have obtained different results.

In the microleakage study of Giachetti *et al.*, in which they evaluated the operator's skill in restorations using self-etch and total-etch adhesive systems, no difference was found between the student and specialist groups in the self-etch system, whereas specialist group was found to be more successful in the total-etch system.[21]

In their study, Gueders and Geerts reported that when dentists and undergraduate students applied three-step total-etch adhesive system, two-step total-etch system and two-step self-etch adhesive system the microleakakage scores were lower in dentists.[22]

In the study by Karaman *et al.*, in which they evaluated both the effect of total and self-etch systems with operator variability on microleakage, dental specialist and undergraduate students had similar results in total-etch systems and showed little sensitivity to operator skill, while dental specialists were found to be more successful in self-etch adhesives.[23]

Adebayo *et al.* reported that the operator's ability to use material can improve with repeated use of the material.[24]

Miyazaki *et al.* reported in their study that inexperienced operators tend to read and apply the application instructions more carefully, and that technical sensitivity is the main factor in dentin bonding.[25]

When the occlusal and gingival microleakage scores of the operators who applied the restorations were evaluated without considering the restorative materials used in our study, there was no statistical difference between them.

In this study, in addition to the effect of operators on the adhesive system, also their effect on the adhesive-composite resin association was evaluated.

While the total-etch adhesive system and hybrid composite resin are routinely used in dentistry faculty clinics, the bulk-fill composite resin is not routinely used. We think that the reason why there is no difference between the operators, the students tend to carefully read the instructions of the materials used for the first time and apply the materials carefully.

Kader *et al.* evaluated the microleakage of Class II cavities by restoring the micro-hybrid composite resin with the incremental technique and the Bulk-fill composite resin with the bulk technique. They reported that although less microleakage was observed in the restorations made with the layering method, there was no statistically significant difference between the groups.[2]

In the study of Behery *et al.*, in which they evaluated the microleakage in the gingival area in Class 2 cavities, no significant difference was found between bulk-fill and conventional composite resin in terms of microleakage.[26]

Mosharrafian *et al.* reported that there was no significant difference between the restoration techniques in the gingival or occlusal regions in their microleakage study, in which they applied two different bulk fill composite resins in Class II cavities with the bulk technique and the traditional micro-hybrid composite resin with the incremental technique. However, in all three groups, it was reported that the microleakage in the gingival region was significantly higher than the microleakage in the occlusal region.[27]

Garcia Mari *et al.* found no significant difference between bulk fill and conventional composite resin in their microleakage study, in which they restored class II cavities prepared above the CEJ with bulk-fill composite resin using the bulk technique and a conventional composite resin using the incremental technique.[28]

In Razieh *et al.*'s study evaluating the microleakage of bulk-fill composites and conventional composites, no significant difference was found in gingival microleakage scores.[29]

Miletic et al, stated in their studies that there was more microleakage in the gingival in conventional composite resins than in bulk-fill composite resins.[5]

When the restorative materials used in this study were evaluated without considering the operator, no statistically significant difference was observed between the occlusal and gingival microleakage scores. Our results were consistent with the results obtained by Kader *et al.*, Mosharrafian *et al.*, and Garcia Mari *et al.* The reason why our study is not compatible with the results of Miletic *et al.*, may be due to the fact that the prepared cavities were 1 mm above the CEJ.

When evaluated within the group, no statistically significant difference was found between the occlusal and gingival microleakage scores of Groups 1A, 1B, and 2B, but in Group 2A was observed significantly more gingival microleakage than occlusal. Restoration procedures in the gingival region are more difficult than in the occlusal region. Since the student's ability to use the material develops due to the repetitive use of materials, we think that the reason for the difference in Group 2A is the use of a new material that the student does not routinely use in this region, although there is no difference with the material used routinely in gingival region.

Within the limits of this study, it showed that microleakage is more dependent on the interaction between the operator and the operator/material rather than the material chosen.

There main limitation is the *in vitro* design of the study. Ideally, microleakage should be tested with variables such as chewing forces, food types, mouth temperature, humidity, enzymes, bacterial products, and the presence of saliva. Testing with these variables as well as subjecting samples to thermo-mechanical aging to imitate intraoral conditions is also recommended for future research. However, more clinical studies should be done on this subject to confirm the clinical validity of the results obtained in the study.

Also, there was only one operator in each group and this operator may be experienced or inexperienced.

Conclusions

1. When all microleakage values were compared, no difference was found between the dental specialist and the undergraduate student.
2. When all microleakage values were compared, no statistically significant difference was found between bulk-fill composite resin (Tetric N Ceram Bulk fill) and micro-hybrid composite resin (Z250).

While there was a significant difference between the occlusal and gingival microleakage scores in the group in which the bulk-fill composite resin was applied by the undergraduate student, more gingival microleakage was detected. This indicated that microleakage was more dependent on the interaction between the operator and the operator/material rather than the material chosen.

Conflicts of Interest

There is no conflict of interest.

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Cumhuriyet Dental Journal, 25(Suppl): 94-99, 2022
DOI: https://doi.org/10.7126/cumudj.1061217

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Knowledge Levels and Attitudes of Internists about the Relationship between Periodontal Disease and Diabetes#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 21/01/2022
Accepted: 15/03/2022

ABSTRACT

Aims: Periodontitis is a multifactorial, chronic inflammatory disease that can cause irreversible damage to the supporting tissues surrounding the teeth and consequently tooth loss if left untreated, and has been listed as the sixth major complication of diabetic patients. The aim of our study was to evaluate the knowledge levels and attitudes of internists about the relationship between periodontal disease and diabetes.

Methods: In our study, our questionnaire with 22 questions was applied to internists via whatsapp®, e-mail and directly. Participants were asked about specific periodontal complications that they believed patients diagnosed with diabetes were more susceptible to, and their awareness of the bidirectional relationship between diabetes and periodontal diseases was evaluated. 112 internists answered (45% male, 55% female) our questionnaire. The obtained data were analyzed using IBM SPSS programme.

Results: 70% of the internists participating in our survey are between the ages of 25-35. 92.7% of internists know that the department that diagnoses and treats gingival diseases is the periodontology clinic. Despite this, only 72.7% refer their patients with gingival bleeding to the periodontology clinic. 58.4% of internists reported that they did not learn about the relationship between periodontal disease and systemic health during medical school education, and 89% stated that the effect of periodontal disease on systemic health should be explained in medical school education.

Conclusions: Periodontal disease and diabetes are thought to share a common pathogenesis that includes increased inflammatory response at local and systemic levels, and it is known that there is a bidirectional relationship. Therefore, successful treatment of both will affect each other positively. It has been observed that internists have knowledge about diabetes and periodontal disease in Turkey, but it is thought that it would be beneficial to consider the relationship between diabetes and periodontal disease in more detail within the education program of the medical faculty.

Keywords: Diabetes Mellitus, Periodontal Disease, Medical Education, Knowledge.

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How to Cite: Pirim Görgün E, Yurttaş MR. (2022) Knowledge Levels and Attitudes of Internists about the Relationship between Periodontal Disease and Diabetes, Cumhuriyet Dental Journal, 25(Suppl): 94-99.

Introduction

Periodontal diseases are potentially progressive bacterial infections that result in the destruction of tooth-supporting tissues.[1] Diabetes mellitus is a chronic metabolic disorder and it is associated periodontitis through three possible mechanisms as cytokines/adipokins production, alteration of cell-mediated immunity and hyperglycemia.[2] As a result of population aging, urbanization and associated lifestyle changes, the global prevalence of periodontal diseases and diabetes mellitus is rapidly increasing and they have a high prevalence in the worldwide population.

Periodontitis has been defined as the sixth complication of diabetes mellitus. A bidirectional interaction was demonstrated: Patients affected by type 1 and type 2 diabetes have a higher prevalence of periodontitis than the general population, due to several metabolic factors (e.g. chronic hyperglycemia, autoimmunity, dietary and life-style factors); similarly, periodontitis predisposes to type 2 diabetes mellitus mainly via the increase of systemic cytokines release. Conversely, improvement of metabolic control of diabetic patients hold up the progression of periodontitis as well as periodontitis treatment decreases glycosylated hemoglobin levels in blood. An epidemiology study conducted on adults with poorly controlled diabetes mellitus in the USA found that there was a 2.9 increased risk of having periodontal diseases compared to non-diabetes individuals.[3] Due to the bidirectional causal interaction between periodontitis and diabetes mellitus, a close collaboration among dentists and endocrinology specialists is required and strongly recommended.[2] The number of individuals with diabetes mellitus in Turkey between 1997 and 2025 years will be expected to rise from 2.193.508 (7.5%) to 16.143.941 (31.5%).[4]

Oral health is a complementary part of general health. Medical and dental health care providers should work together to improve the general health condition of diabetes. Furthermore, it can help to reduce complications related to periodontal diseases and is an

important step forward of decreasing systemic inflammatory problems that may in turn, enhance the control of diabetes.[5-7] Advancing the knowledge and awareness of medical and dental health care providers, about the relationship between periodontal diseases and diabetes mellitus will enhance better collaborative relations, make quality health care provisions and help exterminate oral health complications associated with diabetes. There have been numerous studies that have assessed the knowledge, opinions, views, and attitude of health care providers on periodontal diseases and diabetes mellitus.[8-11] The findings of these surveys found that they had some knowledge about both diseases and considered oral health and periodontal health important.[8-12] However, they were not confident enough mainly due to insufficient knowledge regarding the oral-systemic interactions and oral health disparities conducted during their training years. To our knowledge, there has been no study conducted on medical doctors especially internists assessing the level of knowledge and awareness on the relationship between periodontal diseases and diabetes mellitus in Turkey. The aim of our study is to evaluate the knowledge levels and attitudes of internists about the relationship between periodontal disease and diabetes.

Methods

In our study, our questionnaire consisting of 22 questions was applied by Whatsapp®, e-mail and face-to-face reviews. The study proposal was reviewed and approved by the Ethical Committee of the Faculty of Medicine, Sivas Cumhuriyet University, on February 2020 (2020-02/15). Participants were asked about specific periodontal complications that they believed patients diagnosed with diabetes were more susceptible to, and their awareness of the bidirectional relationship between diabetes and periodontal diseases was evaluated.

112 internists answered (45% male, 55% female). 70% of the internists participating in our survey are between the ages of 25-35. The internists were informed that the participation in this study was voluntary base.

The first part of the questionnaire recorded the demographic characteristics of participants including age, sex, and years in practice. Participants were then asked to which of the following periodontal complications they believed patients diagnosed with diabetes were more susceptible: gingival inflammation, gingival bleeding, alveolar bone resorption, tooth loss, tooth mobility, and periodontal abscess. The knowledge about specific periodontal complications associated with diabetes was measured by marking correct or incorrect on the questionnaire. Finally, all participants were asked to report whether they believed that diabetes affects periodontal health, whether a periodontal condition might affect the metabolic control of diabetes, and whether a bidirectional association exists between periodontal health and diabetes. For lots of these questions, participants were given the choice of ‘‘yes’’, ‘‘no’’, ‘‘correct’’ or ‘‘incorrect’’.

The questionnaire was comprised of questions prepared with respect to previously published questionnaires.[13-15] The questions were initially translated to Turkish by three lecturers with fluent English language skills. These translated questions were backtranslated to English by a native English speaker, and the translations which were more consistent with the original version were determined. These steps were taken by the method described by Beaton *et al*.[16] The obtained data were analyzed using SPSS version 23 (SPSS, Chicago, USA). Data were described using frequency counts and percentages, and comparisons were made using the Chi-square analysis for different independent samples. The significance level was set as 0.05.

Results

In this study, more than half of the participant doctors (70.9%) were 25-35 years old and 20% of participants were in the age range of 36-45. The remaining participants were 46 years and older. When we divided participantst into groups according to age, no statistically significant difference was observed in the answers given to the questions ($p>0.05$). 55% of the doctors who answered our questionnaire are female. When we divided the groups according to gender, a significant difference was observed in only one question ($p<0.05$). This question is ‘Do you get advice/reference from dentists in systemic diseases?’. While 53.3% of female physicians said ‘yes’, 30% of men physicians answered ‘yes’ ($p=0.01$). 79% of the doctors participating in our study have been at most 15 years since graduated from medical faculty. 17.3% of the doctors participating in our study have been 15-30 years since graduated from medical faculty.

All of the participating doctors are specialist of internal medicine, 13.1% of them has a subspecialty. Endocrinology has the highest rate of subspecialty among internists. In addition, nephrology, hematology, gastroenterology specialists participated.

72.7% of the doctors participating in our survey would refer periodontology to direct their patients with severe gingival bleeding. 20% of the participants would refer dentist to direct their patients with severe gingival bleeding.

About 43.6% of the participant doctors reported that they learned the relationship between periodontal disease and systemic health in medical faculty and great majority of the participant doctors (89%) reported that the effects of periodontal disease on systemic health should taught in medical education. 84.5% of the paticipants had thought that they need additional information about the relationship between peridodontal diseases and diabetes

Nearly half (48.6%) of the participant doctors answered ‘no’ to the question which asked that they can evaluate their patient in terms of periodontal health.

80.9% of the participant doctors noticed that the patients diagnosed with diabetes were prone to gum diseases.

All of the participant doctors reported that they knew periodontal disease markers as gingival inflammation, tooth mobility, tooth loss, gingival bleeding, periodontal abscess, bone destruction. and all of them choosed 'correct' for the expression 'Periodontal disease risk and severity are increased in patients with diabetes'. Again all of the participants noticed that controlling blood glucose level positively affects periodontium health.

Nearly all of the participant doctors 96.3% noticed that periodontal disease can change systemic inflammatory markers. 83.6% of the participant doctors choosed 'correct' for the expression of 'Periodontal disease markers correlate with serum levels' and 89.1% of the participant doctors choosed 'correct' for the expression of 'Treatment of periodontal disease contributes to the control of blood glucose level'. Nearly all of the participant doctors (97.2%) choosed 'correct' for the expression of 'Hematological disorders related to leukocyte function are associated with periodontal health.'

Discussion

In the direction diabetes mellitus-periodontitis, hyperglycemia and poor metabolic control are associated with an increased risk of onset and periodontitis severity and to worse clinical outcomes after periodontal therapy.[6] The increase in the number of patients with diabetes causes an economic burden, which requires a multidisciplinary approach that can help prevent, diagnose, and manage complications related to diabetes mellitus and it was suggested that an oral evaluation for signs of periodontal diseases be performed during an yearly checkup of subjects with diabetes mellitus as both diseases shared same risk factors.[17] Moreover, it was recommended that screening for diabetes mellitus status should be considered as part of a standard periodontal examination.[18]

Notably, limited studies have been conducted on medical students or physicians. Majority of the studies have assessed the knowledge, behaviour, attitudes, and awareness of medical and paramedical health care professionals on the relationship between periodontal diseases and diabetes.[8,9,13,19,20] One such survey was conducted on internal medicine trainees at a single urban teaching hospital in New York city. The findings noted that internal medicine trainees had inadequate knowledge regarding periodontal disease and that they were generally uncomfortable performing a simple periodontal examination.[21] Similarly, another study conducted between endocrinologists and dentists in China found that they were not equally equipped with the knowledge about the relationship between both diseases and that there was a wide gap between their practice and the current evidence, especially for the endocrinologists.[22] Then again, a comparative study conducted on resident doctors undergoing postgraduate training in medicine and dentistry at a Nigerian teaching hospital in Nigeria. They found that a major gap existed among them on the knowledge that linked oral diseases and they were found to have a poor commendation of collaborative management of diabetes mellitus patients.[19] In 2016, a questionnaire study conducted in Kuwait analysed 1799 students of medical, dental, pharmacological and health science on their knowledge of the relationship between oral health, diabetes, body mass index and lifestyle. This study observed that they all had insufficient knowledge especially on the relationship between oral health and diabetes mellitus.[23] A comparative study was conducted by Sede and Ehizele on 100 resident doctors undergoing postgraduate training. The results found that more dental practitioners compared to medical practitioners were aware of the link between oral diseases and diabetes mellitus.[19] Obulareddy *et al.* conducted a questionnaire survey study on 66 medical specialist in India. Although the medical specialists were aware about the relationship between diabetes and periodontitis, the endocrinologists group compared to the diabetologists and general medical doctors had better knowledge.[24] The findings of these surveys revealed that they had some knowledge about both diseases and considered oral health and periodontal health important.[8-12] However, they were not confident enough mainly due to insufficient knowledge with regard to the oral-systemic interactions and oral health disparities conducted during their training years. In our study, all of the participating doctors are specialist of internal medicine, 13.1% of them have a subspeciality. Endocrinology has the highest rate of subspeciality among internists. When we reviewed the literature, this study is the first to investigate periodontal health among internists in Turkey. Other available studies have mostly been done among intern doctors.

The fact that our study coincided with the COVID-19 period partially prevented the manual surveys. It can be thought that the interest of the physicians, whose workload increased, to the questionnaires sent via e-mail and whatsapp decreased. In this study, more than half of the participant internists (70.9%) were 25-35 years old. We can associate this result with the fact that young individuals are more inclined to work online and use the internet more. 80% of the doctors participating in our study have been at most 15 years since graduated from medical school. The fact that most of our participants were young and not many years have passed since their graduation makes us think that we can see the reflections of the current system in medical education more.

In a survey study conducted with medical and dentistry students in Turkey, 133 medical faculty students and 114 dentistry faculty students participated. The rate of correct answers to questions about oral and dental health of medical faculty students is 4.5%-66.9%. This rate is 29.8-97.4% for students of the faculty of dentistry, and there is a significant difference between students in terms of knowledge level. They reported that it would be beneficial

to add oral and dental health issues to the medical faculty education and our results also support this.[25] Previous studies reported that physicians from America and Jordan were more familiar with the possible connection between health of teeth and diabetes.[8,9] In our survey, more than 50% of the participants stated that they did not receive medical training on the relationship of periodontal disease with systemic health. However, from the answers to the questions, we can conclude that they learned the information about periodontal disease during their residency.

A survey similar to our study conducted on medical doctors at Erciyes University in 2014. In the aforementioned study, the questionnaire was applied to interns, general practitioners and specialist medical doctors. In the survey study in which 1766 answers were received, 90.8% of the participants agreed that there is a relationship between periodontal disease and systemic health. 56.5% of the participants stated that they referred their patients to a periodontists.[20] However, in ours as a more recent study 72.7% of the doctors participating would refer periodontists to direct their patients with severe gingival bleeding. 20% of the participants would refer dentist to direct their patients with severe gingival bleeding. We conclude that almost all of the participants know the branch of dentistry that diagnoses and treats gingival diseases. Internists have general knowledge of periodontology, but their referral to the periodontologist is limited.

According to a 50-question survey conducted with 110 interns at Adnan Menderes University Faculty of Medicine, it was determined that the participants did not have sufficient knowledge about oral and dental health. According to this study, in order to increase the knowledge level of physicians about oral and dental health, periodontal disease and its effects on systemic health; It was concluded that oral and dental health issues should be included in the medical school curriculum.[26] In our survey study, 89% of the internists agreed that the effect of periodontal disease on systemic health in medical faculties should be explained. The rate of physicians who want to learn more about the relationship between periodontal disease and diabetes is quite high in our study. About 43.6 % of the participant doctors reported that they learned the relationship between periodontal disease and systemic health in medical school in our study. Considering the importance of the relationship between general health and oral health, this rate is quite low.

All of the participant doctors reported that they knew periodontal disease markers as gingival inflammation, tooth mobility, tooth loss, gingival bleeding, periodontal abscess, bone destruction. This rate 87% in an another study which was done in Turkey.[20] In our study all of them choosed 'correct' for the expression 'Periodontal disease risk and severity are increased in patients with diabetes'. Again all of the participants noticed that controlling blood glucose level positively affects periodontium health. 80.9% of the participant doctors noticed that the patients diagnosed with diabetes were prone to gum diseases. Systemic levels of inflammatory mediators, including CRP, TNF-α and IL-6, which are elevated in periodontal disease may represent the key point between diabetes and periodontitis.[27,28]

The consequences of periodontal diseases and subsequent tooth loss is not only critical for life quality but may also affect the overall health of patients by compromising their ability to uphold a healthy diet and proper glycemic control. In our study, all of the participant internists agreed with periodontal disease markers as gingival bleeding. Similar results(87.4%) were found among the physicians in France.[10] However, lower percentage results (47%) were also found among physicians in Kuwait.[13] Cohen *et al.* found a similar result on tooth mobility(59%) and alveolar bone destruction (47%) among physicians in France but reported low result on tooth loss(21%).[10] Al_Khabbaz *et al.* reported low percentages on tooth mobility (45%), alveolar bone destruction (39%) and tooth loss (49%) among Kuwaitian physicians.[8] In our study nearly all of the participant doctors 96.3% noticed that periodontal disease can change systemic inflammatory markers. 83.6% of the participant doctors choosed 'correct' for the expression of 'Periodontal disease markers correlate with serum levels' and 89.1% of the participant doctors choosed 'correct' for the expression of 'Treatment of periodontal disease contributes to the control of blood glucose level'. Nearly all of the participant doctors (97.2%) choosed 'correct' for the expression of 'Hematological disorders related to leukocyte function are associated with periodontal health.' These findings show that internists in this study in Turkey have an acceptable knowledge of periodontal diseases. All of these questions are the main results that can be seen in the course of diabetes and periodontal disease in general, and majority of our participating doctors have this general information.

In our study, 57.3% of the respondents answered "no" to the question 'Do you get references from dentists in systemic diseases?'. Considering the relationship between general health and oral health, a treatment plan should be created for patients with a holistic approach. On the other hand, Lin et al. reported that physicians with years of experience have a more positive attitude towards P.Ds. and D.M. which is mainly due to their clinical years of experience.[22] Similarly, Al-Habashneh *et al.* found that physicians reported having advised their diabetic patients to visit the dentist more often compared to the general health practitioners.[8] Our findings propose that more appropriate knowledge and perceptions should be considered while observing the dental needs of D.M. patients. Educational processes should involve a learning environment that promotes collaborative learning where diagnosing, maintaining and referring of patients with oral diseases is encouraged.[29] Additionally, an introduction of inter-professional educational programs in dental and medical education will help promote quality care for the most vulnerable of patients in societies.[29,30]

In our study, all of the internists agreed that controlling blood glucose level positively affects periodontium health. A lower percentages (49%, 78%, respectively) was noted among American physicians and Jordanian physicians.[8,9] However, a very low percentage (2.6%) was observed within the Nigerian medical students who agreed with this statement.[11] This will in the future have a profound negative effect on their oral screening, preventive interventions, patient counseling, dental referral and collaboration behavior.

Conclusions

In our study, it was found that internists had general knowledge about diabetes and periodontal disease, but it was concluded that it would be beneficial to discuss the relationship between diabetes and periodontal disease in more detail in the medical faculty education program. Early detection and carefully managed therapeutics with the medical and dental practitioners working hand-in-hand may prove beneficial to the patient's general health and quality of life. The inter-societies consensus proposes specific flow-diagrams to improve the treatment of patients and management of the general population regarding the issue of periodontitis and diabetes.

Acknowledgment

The authors would like to thank all the doctors for their collaboration. This study is a self-funded study not support by an institution. The authors declare that they have no conflicts of interest.

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Cumhuriyet Dental Journal, 25(Suppl): 100-107, 2022
DOI: https://doi.org/10.7126/cumudj.1061216

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Evaluation of Alkalizing Potential of Alkasite Restorations Prepared in Different Sizes [#]

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Research Article

Acknowledgment
[#]This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 21/01/2022
Accepted: 13/03/2022

ABSTRACT

Aim: The aim of the present study was to examine the effect of alkasite material on the pH of the environment when used as a restorative material in different cavity preparations and prepared as a single block in standard sizes.

Methods: Alkalizing potential of the alkasite material was evaluated by restoring extracted teeth with three different restorative materials and preparing edentulous blocks. For this purpose, 30 extracted premolar teeth and silicone molds of standard size (2x2x4 mm) were used. One of the study groups consisted of edentulous alkasite blocks of standard size and the other three groups (O, OM, MOD) were alkasite restorations of cavities of different sizes. The teeth were divided into three groups according to the type of cavity preparation. Restoration of cavities and preparation of the blocks were performed according to Cention N (Ivoclar Vivadent) manufacturer's instructions. All restorations and blocks were immersed individually in distilled water at pH 4. pH measurements were obtained using a pH meter (Sartorius, France) at 10-min, 20-min, 30-min and 60-min timepoints following immersion. Measurements were repeated for all four groups at the end of 24 hours, 48 hours and 7 days.

Results: Alkalizing effect was observed in all groups. pH changes after 24 hours, 48 hours and 7 days showed a significant difference among the groups at the measurement timepoints ($p<0.05$). Maximum pH increases were seen at 24 hours, and minimum pH changes at 48 hours. Within the first 24 hours, MOD restoration group showed the highest pH values at 60 minutes.

Conclusion: Within the limits of the study design, O, MO and MOD dental restoration groups were associated with a significantly greater pH increase compared to alkasite blocks. The effect of alkasite restorative material alone is not sufficient to provide pH increases above the critical threshold. Ions released from the tooth also seem to have an effect on pH increase.

Key Words: Alkasite, pH change, Demineralization.

Farklı Ebatlarda Hazırlanan Alkasite Restorasyonlarının Alkalize Potansiyelinin Değerlendirilmesi[#]

Bilgi
[#]Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 21/01/2022
Kabul: 13/03/2022

ÖZ

Amaç: Bu çalışmanın amacı alkasit materyalinin farklı kavite preparasyonlarında restoratif materyal olarak kullanıldığında ve standart boyutlarda tek blok olarak hazırlandığında ortam pH'ına etkisinin incelenmesidir.

Yöntem: Bu çalışmada alkasit materyalinin alkalileştirme potansiyeli çekilmiş dişlere üç farklı restorasyon yapılarak ve dişsiz bloklar hazırlanarak değerlendirilmiştir. Bu amaçla 30 adet çekilmiş premolar diş ve standart boyutlarda (2x2x4 mm) silikon kalıplar kullanılmıştır. Grubumuzun birini dişsiz standart boyutlarda hazırlanan alkasit bloklar, diğer üçünü farklı boyutlarda kavitelere (O, OM, MOD) yapılan alkasit restorasyonlar oluşturmaktadır. Bu amaçla dişler kavite preparasyon şekline göre 3 farklı gruba ayrılmıştır. Kavitelerin restorasyonu ve blokların hazırlanması Cention N'nin (Ivoclar Vivadent) kullanım prosedürlerine göre yapılmıştır. Hazırlanan her bir restorasyon ve blok ayrı ayrı pH'ı 4'e düşürülen distile su içerisine atılmıştır. Sırasıyla 10dk, 20dk, 30dk ve 60dk içerisinde pH ölçümleri pH metre (Sartorius,France) ile yapılmıştır. Ölçümler 24 saat,48 saat ve 7 gün sonra olacak şekilde 3 farklı zamanda 4 grup için tekrarlanmıştır.

Bulgular: Bütün gruplarda alkalize edici etki görülmüştür. Ölçüm yapılan bütün dakikalar için 24 saat,48 saat ve 7 günde pH değişimleri gruplar arasında anlamlı olarak farklılık göstermiştir ($p<0.05$). Maximum pH artışları 24 saatte görülürken, minimum pH değişimi 48 saatte görülmüştür. İlk 24 saat için 60 dakika sonunda en yüksek pH değerleri MOD restorasyon grubuna aittir.

Sonuçlar: Çalışmamız sınırları içerisinde dişe yapılan O, MO ve MOD resyorasyon gruplarının dişsiz bloklara göre pH artırıcı etkisi anlamlı olarak daha fazladır. Kritik seviyeyi geçecek düzeyde pH artışında, tek başına alkasit materyalinin etkisi yeterli değildir. Dişten salınan iyonların da pH artışında etkisinin olduğunu düşünüyoruz.

Anahtar Kelimeler: Alkasit, pH değişimi, Demineralizasyon.

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How to Cite: Çınar B, Eren D. (2022) Evaluation of Alkalizing Potential of Alkasite Restorations Prepared in Different Sizes, Cumhuriyet Dental Journal, 25(Suppl): 100-107.

Introduction

Resin-based composites have become one of the most commonly used materials in dentistry due to the improvement of their mechanical and aesthetic properties.[1] Some difficulties in the placement of composites, requirement for technical precision, incomplete polymerization**,** and polymerization shrinkage cause mikroleakage at the interface of the restoration and the cavity wall, leading to the development of secondary caries over time.[2] Secondary caries formation, one of the main reasons for the failure of composite restorations, has prompted manufacturers to develop new materials.[3]

Cariogenic foods and beverages contain fermentable carbohydrates which are broken down by oral microorganisms into organic acids, resulting in a decrease in the saliva pH.[4] The critical pH is the pH at which the fluid on the tooth surface is undersaturated relative to hydroxyapatite, allowing calcium and phosphate to dissociate from the enamel. This usually refers to pH values of 5.5 and below. Dissolution of the tooth enamel, i.e., demineralization, begins below the critical pH, and this is the first step in dental caries formation.[5] The oral cavity goes through cycles of remineralization and demineralization continuously. The ratio between remineralization and demineralization determines the strength and hardness of tooth structure. During remineralization, the holes that are formed as a result of mineral dissolution through the demineralization process are filled with minerals, allowing for the restoration of the tooth's mineral content. Repaired crystals are larger than the original crystals. Thus, remineralized enamel becomes less soluble and more resistant to acid attacks.[6]

The majority of the commercially available composite resins have no remineralizing effects.[7] They can only restore cavities following the loss of tooth structure and cannot prevent subsequent complications such as recurrent caries development from the acidic oral environment. There is a growing interest in the use of resin-based bioactive and remineralizing restorative materials to overcome such problems.[8] Different ions are released from these materials upon their interaction with the oral environment. Accordingly, the increase in pH and the induction of hydroxyapatite deposition may reduce the incidence of caries around the restoration margins.[9] Release of fluoride, calcium, and phosphate ions that are involved in tooth remineralization seems to be an integral feature for future restorative materials [10]

Bioactive materials are defined as surface-reactive compounds that elicit a specific biological response by reacting physically, chemically and biologically, and form bonds with the tissue when applied to living tissues. Calcium phosphate compounds, calcium hydroxide, mineral trioxide aggregate, bioactive ceramics, and bioactive glasses used in restorative dentistry are examples of bioactive materials.[11] Bioactive glass materials have several novel properties, and most notably, they have the ability to act as a biomimetic mineralizer, meeting the body's own mineralization needs. Owing to their nanometric particle size, bioactive glass materials are able to release ions faster and increase the remineralization rate.[12]

Cention N is a tooth-colored, bioactive, dual-cure restorative material with high flexural strength, which is supplied in the form of powder and liquid (Table 1).[13] It has been developed to prevent demineralization by releasing acid-neutralizing ions to maintain enamel saturation during the remineralization-demineralization cycle at a low pH. Cention N contains alkaline fillers embedded in a methacrylate resin matrix and releases hydroxyl ions and thus, it can neutralize the pH-lowering activity of acidogenic cariogenic bacteria.[14]

Table 1. Material used in the study

Material	Manufacturer	Composition	Filler
Cention N, alkasite, restorative, material	Ivoclar-Vivadent, Liechtenstein, Switzerland	UDMA, No Bis GMA, No TEGDMA, No HEMA	Barium aluminum silicate glass, Ytterbium trifluoride, Izo filler, calcium barium aluminum fluorosilicate glass, calcium fluorosilicate glass (57.6%)

Ion release and therefore the impact on pH are affected by many factors including the composition of the material, mixing time, temperature, finishing procedures, and environmental conditions.[15] There is no study available in the literature on the effect of the size of restoration made with alkasite material on the pH of the environment. The aim of the present study was to examine the effect of Cention N on the pH of the environment when used as a restorative material in different cavity preparations and prepared as a single block in standard sizes. The alternative hypotheses that were constructed for this purpose were as follows:

- H_0: There is no difference among the alkasite restorations of different sizes in terms of the pH of the environment.
- 2 .H_0: There is no significant difference between restorations prepared as a single, edentulous block and dental restorations in terms of the ability to alkalize the medium.

Material and Methods

Ethics approval for the study was obtained from Sivas Cumhuriyet University Ethics Committee for Non-Interventional Clinical Research Studies on November 17, 2021 (No. 2021-11/16). Teeth to be extracted from adult patients for orthodontic, surgical, or periodontal indications and to be disposed of as medical waste irrespective of the academic research were used with the consent of the patients prior to extraction. The teeth to used in the study were stored at 4°C in a saline solution containing 0.1% thymol crystals to avoid drying and to ensure disinfection.

Group Assignment and Preparation of Samples

Group 1 (Block): Ten silicone molds of standard dimensions (2x2x4 mm) were used for the preparation of the blocks.

For Groups 2, 3, and 4, 30 permanent, non-carious premolar teeth without any restoration were randomly divided into 3 groups (n=10).

Group 2 (O): Occlusal cavities (2x2x2 mm) were created with an aerator under water cooling using diamond burs.

Group 3 (MO): Mesio-occlusal cavities with an occlusal and approximal depth of 2 mm, and 1 mm above the cemento-enamel junction at the approximal were created with an aerator under water cooling using diamond burs.

Group 4 (MOD): Mesio-occlusal distal cavities with an occlusal and approximal depth of 2 mm, and 1 mm above the cemento-enamel junction at the approximal were created with an aerator under water cooling using diamond burs.

Next, the cavities were rinsed with water and dried. Ten silicone molds of standard dimensions (2x2x4 mm) were used for the preparation of the blocks. For restoration of the cavities and preparation of the blocks, Cention N powder and liquid were mixed with a plastic spatula (45- 60 sec) according to manufacturer's instructions at a ratio of 4.6:1 by weight (This ratio is equivalent to 1 drop of liquid for 1 measuring spoon of powder). Working time was 4 minutes after mixing. During that time, Cention N was placed on the teeth and molds by condensation with manual tools without applying any adhesive. Then, self-cure polymerization was achieved without using a light-curing unit. Occlusal adjustments and finishing were done using disc (Sof-Lex, 3M ESPE, St Paul, MN, USA) and silicone rubbers.

pH measurements were obtained using a Sartorius Basic pH meter with an epoxy capped glass electrode. The pH meter was calibrated with standard buffer solutions (pH= 4.0, 7.0, 10.0) purchased from Reagecon (Shannon Free Zone, Ireland). The alkalizing potential of restorations of different sizes was determined based on their ability to increase the pH of the acidified solution. Firstly, the pH of the solution was adjusted to 4.0 with lactic acid. Then, each restoration prepared for this purpose was placed in test tubes containing 5 ml of pH 4.0 solution. Changes in pH of the solutions were assessed at the intervals of 10 minutes, 20 minutes, 30 minutes and, 60 minutes, respectively.

In order to evaluate the alkalizing potential at different timepoints, measurements were repeated at 24 hours, 48 hours**,** and 7 days for all 4 groups. Data on pH changes at all time intervals tested were statistically analyzed at the significance level of 0.05.

Statistical Analysis

Data from the study were analyzed using SPSS software, version 22.0 (IBM Corp., Armonk, NY). The normality of data distribution was checked using the Kolmogorov-Smirnov test. The variables with a normal distribution were analyzed with the F test (ANOVA). Since the data met the assumption of homogeneity of variances on the post hoc test, Tukey's HSD (honestly significant difference) test was used to determine which group differed from the others when testing more than two groups. For the variables with a non-normal distribution, the Kruskal-Wallis test was used to compare measurements from multiple groups, and the Mann-Whitney U test was employed to determine the difference between paired groups. The error level was set at 0.05.

Results

Assessment of pH measurements taken 10 minutes after acidification of the medium at 24 hours, 48 hours and 7 days of restoration

The difference in pH measurements obtained 10 minutes after acidification of the medium at 24 hours, 48 hours, and 7 days was significant among the restoration groups. The samples prepared as a single, edentulous block showed significantly lower pH values at 24 hours when compared with MO and MOD groups, and at 48 hours compared to O, MO and MOD groups and 7 days. For the restored teeth, a significant difference was found in pH values between O and MO and between O and MOD groups at 48 hours, and between O and MO groups at 7 days ($p<0.05$). The highest pH value was observed in the MO restorations at the end of 7 days. The 10-min data are presented in Table 2 and Figure 1.

Assessment of pH measurements taken 20 minutes after acidification of the medium at 24 hours, 48 hours and 7 days of restoration

The difference among the restoration groups in pH measurements obtained 20 minutes after acidification of the medium was significant at 24 hours, 48 hours, and 7 days. The samples prepared as a single, edentulous block displayed significantly lower pH values compared to O, MO and MOD groups at 24 hours, 48 hours and 7 days. For the restored teeth, a significant difference was seen in pH values between O and MO groups and between O and MOD groups at 24 hours. The highest pH value was observed in the MOD restorations at the end of 24 hours. The 20-min data are shown in Table 3 and Figure 2.

Assessment of pH measurements taken 30 minutes after acidification of the medium at 24 hours, 48 hours and 7 days of restoration

The difference in pH measurements was significant among the restoration groups at 30 minutes after acidification of the medium at 24 hours, 48 hours, and 7 days. The samples prepared as a single, edentulous block showed significantly lower pH values compared to O, MO and MOD restoration groups at 24 hours, 48 hours, and 7 days. For the restored teeth, a significant difference was seen in pH values between O and MO groups and between O and MOD groups at 24 hours, and between O and MOD groups at 48 hours. The highest pH value was observed in the MOD restorations at the end of 24 hours. The 30-min data are shown in Table 4 and Figure 3.

Table 2. Assessment of pH measurements taken 10 minutes after acidification of the medium at 24 hours, 48 hours, and 7 days of restoration.

	GRUP	N	Mean	SD	Test	P	Difference
24 hours	BLOCK[1]	10	4.35	0.06	F=6.924	0.001*	1-3
	O[2]	10	4.42	0.08			1-4
	MO[3]	10	4.46	0.03			
	MOD[4]	10	4.46	0.04			
48 hours	BLOCK[1]	10	4.23	0.05	F=19.209	0.001*	1-2
	O[2]	10	4.41	0.07			1-3
	MO[3]	10	4.32	0.03			1-4
	MOD[4]	10	4.33	0.03			2-3.2-4
7 days	BLOCK[1]	10	4.29	0.01	KW=25.784	0.001*	1-2
	O[2]	10	4.39	0.05			1-3
	MO[3]	10	4.48	0.10			1-4
	MOD[4]	10	4.41	0.05			2-3

*The different is significant at the 0.05 level (p<0.05), [1234]Each number denotes a different group 1: Block 2:O 3:MO 4:MOD, Differences are shown in the table.

Tablo 3. Assessment of pH measurements taken 20 minutes after acidification of the medium at 24 hours, 48 hours, and 7 days of restoration.

	GRUP	N	Mean	SD	Test	P	Difference
24 hours	BLOCK[1]	10	4.36	0.05	F=21.805	0.001*	1-2
	O[2]	10	4.45	0.06			1-3
	MO[3]	10	4.55	0.04			1-4
	MOD[4]	10	4.58	0.09			2-4.2-3
48 hours	BLOCK[1]	10	4.34	0.07	F=5.861	0.002*	1-2
	O[2]	10	4.41	0.06			1-3
	MO[3]	10	4.44	0.08			1-4
	MOD[4]	10	4.41	0.04			
7 days	BLOCK[1]	10	4.34	0.03	F=11.019	0.001*	1-2
	O[2]	10	4.44	0.07			1-3
	MO[3]	10	4.51	0.08			1-4
	MOD[4]	10	4.45	0.06			

*The different is significant at the 0.05 level (p<0.05), [1234] Each number denotes a different group 1: Block 2:O 3:MO 4:MOD, Differences are shown in the table

Tablo 4. Assessment of pH measurements taken 30 minutes after acidification of the medium at 24 hours, 48 hours, and 7 days of restoration.

	GRUP	N	Mean	SD	Test	P	Difference
24 hours	BLOCK[1]	10	4.35	0.04	F=51.503	0.001*	1-2
	O[2]	10	4.53	0.05			1-3
	MO[3]	10	4.61	0.05			1-4
	MOD[4]	10	4.66	0.07			2-4.2-3
48 hours	BLOCK[1]	10	4.30	0.05	F=19.883	0.001*	1-2
	O[2]	10	4.42	0.06			1-3
	MO[3]	10	4.48	0.06			1-4
	MOD[4]	10	4.51	0.07			2-4
7 days	BLOCK[1]	10	4.39	0.06	F=8.145	0.001*	1-2
	O[2]	10	4.49	0.09			1-3
	MO[3]	10	4.55	0.06			1-4
	MOD[4]	10	4.49	0.09			

*The different is significant at the 0.05 level (p<0.05), [1234] Each number denotes a different group 1: Block 2:O 3:MO 4:MOD, Differences are shown in the table

Tablo 5. Assessment of pH measurements taken 60 minutes after acidification of the medium at 24 hours, 48 hours, and 7 days of restoration.

	GRUP	N	Mean	SD	Test	P	Difference
24 hours	BLOCK[1]	10	4.47	0.06	KW=25.256	0.001*	**1-2**
	O[2]	10	4.65	0.09			**1-3**
	MO[3]	10	4.64	0.04			**1-4**
	MOD[4]	10	4.74	0.05			**2-4.3-4**
48 hours	BLOCK[1]	10	4.29	0.04	F=31.356	0.001*	**1-2**
	O[2]	10	4.54	0.10			**1-3**
	MO[3]	10	4.53	0.07			**1-4**
	MOD[4]	10	4.60	0.08			
7 days	BLOCK[1]	10	4.35	0.04	F=24.671	0.001*	**1-2**
	O[2]	10	4.52	0.05			**1-3**
	MO[3]	10	4.61	0.11			**1-4**
	MOD[4]	10	4.64	0.08			**2-4**

*The different is significant at the 0.05 level (p<0.05), [1234] Each number denotes a different group 1: Block 2:O 3:MO 4:MOD Differences are shown in the table

Table 6. Comparison of mean pH values among the groups at 24 hours.48 hours. and 7 days.

	GRUP	N	Mean	SD	Test	P	Difference
24 hours	BLOCK[1]	10	4.38	0.04	KW=28.503	**0.001***	1-2
	O[2]	10	4.51	0.06			1-3.
	MO[3]	10	4.57	0.03			1-4.2-4
	MOD[4]	10	4.61	0.04			2-3.3-4
48 hours	BLOCK[1]	10	4.28	0.05	F=24.310	**0.001***	1-2
	O[2]	10	4.44	0.07			1-3
	MO[3]	10	4.44	0.03			1-4
	MOD[4]	10	4.46	0.03			
7 days	BLOCK[1]	10	4.36	0.01	KW=15.109	**0.001***	1-2
	O[2]	10	4.48	0.05			1-3
	MO[3]	10	4.55	0.10			1-4
	MOD[4]	10	4.53	0.05			

*The different is significant at the 0.05 level (p<0.05), [1234] Each number denotes a different group 1: Block 2:O 3:MO 4:MOD Differences are shown in the table

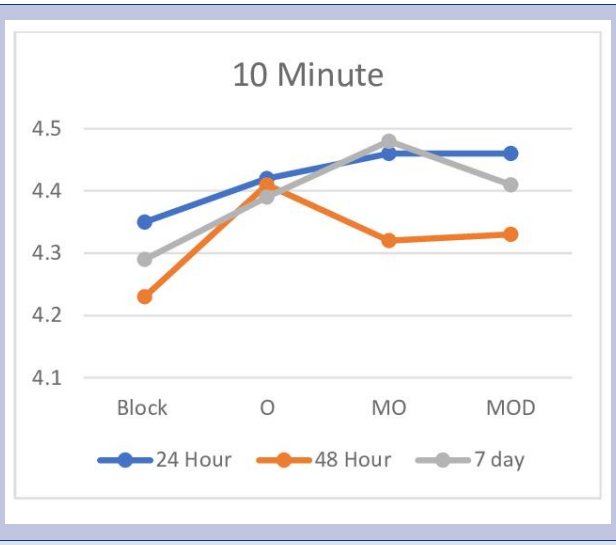

Figure 1. Mean changes in pH value after acidification of the medium (pH=4) and placing samples (24 hours, 48 hours, and 7 days) at 10 minutes

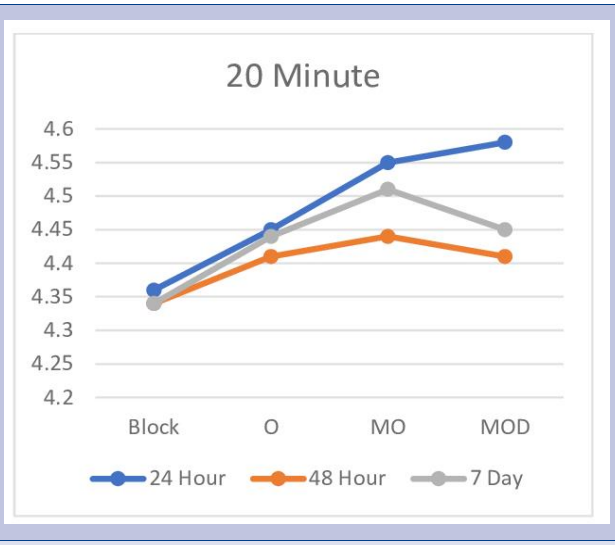

Figure 2. Mean changes in pH value after acidification of the medium (pH=4) and placing samples (24 hours, 48 hours, and 7 days) at 20 minutes.

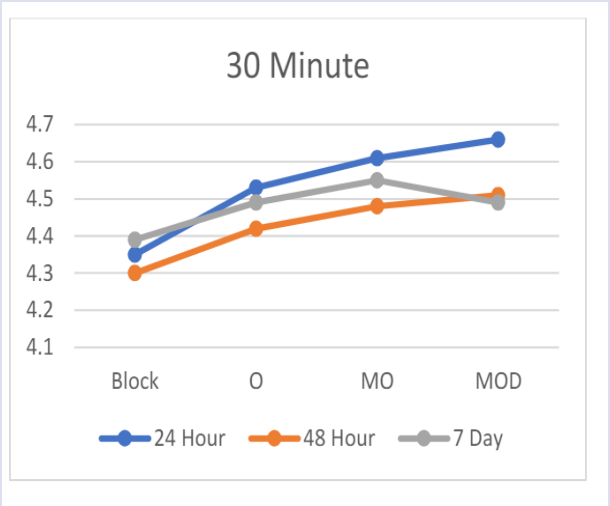

Figure 3. Mean changes in pH value after acidification of the medium (pH = 4) and placing samples (24 hours, 48 hours, and 7 days) at 30 minutes.

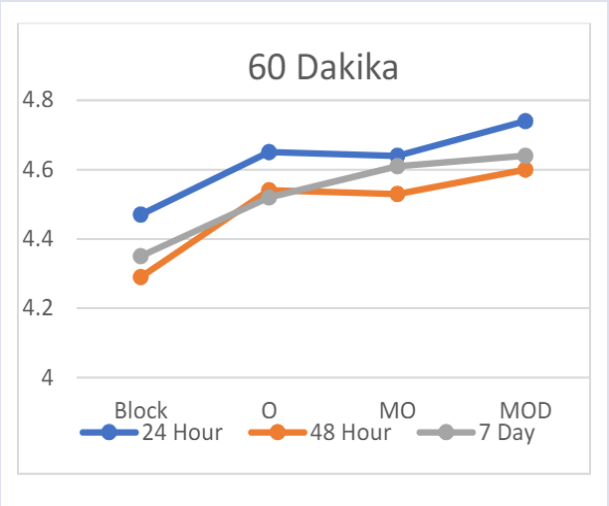

Figure 4. Mean changes in pH value after acidification of the medium (pH = 4) and placing samples (24 hours, 48 hours, and 7 days) at 60 minutes.

Assessment of pH measurements taken 60 minutes after acidification of the medium at 24 hours, 48 hours and 7 days of restoration

The difference among the restoration groups in pH measurements obtained 60 minutes after acidification of the medium was significant at 24 hours, 48 hours, and 7 days. The highest pH values were observed in MOD restorations at all time intervals, and at 24 hours for all groups. The samples prepared as a single, edentulous block exhibited significantly lower pH values compared to restored teeth. Among the restored teeth groups, a significant pH difference was found between O and MOD and between MO and MOD groups at 24 hours, and between O and MOD groups at 7 days. Minimal pH increase was observed at 48 hours. 60-min data are presented in Table 5 and Figure 4.

Mean overall values for 24 hours, 48 hours and 7 days

When the mean measurement values were compared among the groups, the highest pH values were seen at 24 hours and the lowest values at 48 hours. Mean pH values for the individual groups at 24 hours were in the following ranking order: (MOD)> (MO)> (O)>Block and the difference was significant. At 48 hours and 7 days, only samples from the single, edentulous block displayed significantly lower pH values compared to the restored teeth groups. Data are shown in Table 6 and Figure 5.

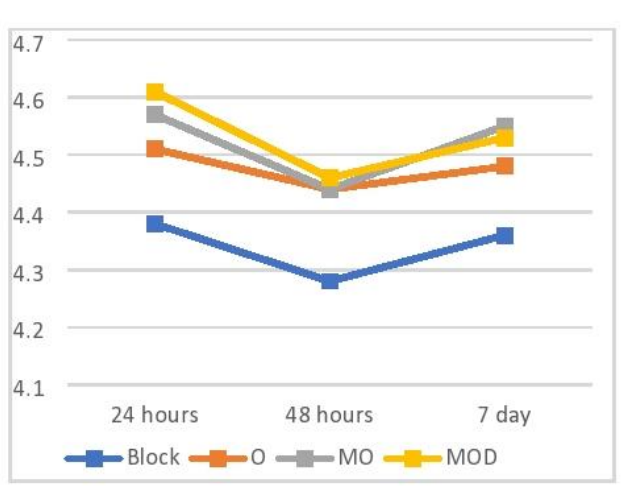

Figure 5. Plot of mean pH values at 24 hours, 48 hours and 7 days.

Discussion

In restorative dentistry, bioactive glass materials are restorative materials that can elicit a positive response by interacting with the biological environment, release specific ions to the bonding interface to protect dental tissues and induce remineralization, and strengthen bonding through apatite formation.[16, 17]

In in vitro studies, ion release is affected by many intrinsic and extrinsic factors. Intrinsic factors include the composition of the material, powder/liquid ratio, mixing time, temperature, material solubility, surface treatments, and finishing procedures. Extrinsic factors include the characteristics of storage medium (e.g., pH, temperature, ionic characteristics, viscosity), and experimental setting (volume, renewal frequency and mixing of the incubation medium). [15]

The bioactivity of Cention N is achieved using three types of inorganic glass, namely barium aluminosilicate glass, calcium barium fluoroaluminosilicate glass, and alkaline fluorosilicate glass known as alkasite fillers[18]. Its formulation does not contain phosphate. Alkaline glass fillers found in the material can release hydroxyl ions, and neutralize the pH of the environment when it drops below the critical threshold.[19] Ion exchange between Ca^{2+} and H^{+} seems to play a role in conferring Cention N this unique feature. The release of fluoride and calcium ions in high quantities creates a favorable milieu for the remineralization of the tooth enamel. The mixed form of Cention N contains 24.6% of alkaline glass, which accounts for ion release.[18] It has been reported that Cention N can remineralize the underlying dental surface when applied without using an adhesive. This material is indicated for use in temporary restorations, and occlusal, proximal, and cervical restorations of posterior teeth.[20]

While there are many studies on Cention N, its alkalizing potential has been investigated in only a few studies. To the best of our knowledge, none of the previous studies compared alkalizing potential of edentulous restoration blocks versus dental restorations of different sizes as in our current study. When the results of our study were evaluated, a significant difference was observed among the groups in the pH values measured at 24 hours, 72 hours and 7 days following restoration ($p<0.05$). In general, MO and MOD restorations showed higher pH values compared to O restorations and edentulous restoration blocks at all timepoints tested. Therefore, our hypotheses were rejected.

The mean pH values measured at 24 hours were higher than those measured at 48 hours and 7 days (Figure 5). Kasraei *et al*. found greater ion release from Cention N at 24 hours compared to other composite materials and suggested that this might be due to the formation of voids in Cention N while mixing the powder and liquid, and the presence of calcium fluorosilicate alkaline fillers. The authors also argued that these voids cause water sorption, which may increase dissolution of the material and thus increase ion release. Additionally, they suggested that greater ion release may have resulted from increased amount of unpolymerized material due to the prevention of polymerization reactions by the voids.[21] When calcium fluorosilicate alkaline fillers are placed in a moist environment (oral cavity), water sorption occurs, and calcium, aluminum ,and fluoride ions are released. These ions do not take part in the setting reaction. [22]

In one study, Singh et al. examined fluoride release from GCI, RMGCI, and Cention N, and reported that Cention N showed the lowest amount of fluoride release on day 1 but significantly high ion release on days 7 and 14. They suggested that while Cention N lacks an initial

burst effect, it constantly releases fluoride ions over the long term. The authors attributed long-term ion release property of Cention N to higher powder/liquid ratio as well as its high content of alkaline glass fillers.[18]

In a study comparing fluoride ion release and pH alterations among 4 different restorative materials fabricated in the form of disc (diameter, 6 mm and height, 2 mm), Kelić et al. reported that Cention N provided the highest ion release and pH changes after 24 hours. They suggested that this was related to its high inorganic filler content.[23] In our study, mean pH values were highest at 24 hours and decreased at 48 hours (Figure 4), suggesting that maximal ion release occurred at 24 hours due to superficial dissolution, followed by slower ion release over time.

In the present study, the samples prepared as a single edentulous block exhibited significantly lower pH values compared to dental restorations. This may be an indication of the alkalizing effect of ions released from the teeth as a result of demineralization.

Lower alkalizing potential and lower release of hydroxyl ions were reported for Cention N in a study comparing Cention N with a resin-modified glass ionomer. Surface modification of Cention N fillers, which rendered them more resistant to dissolution was considered as the most plausible explanation for these findings.[21] In the same study, greater ion release, and higher alkalizing potential of RMGIC were attributed to the presence of poly-HEMA hydrogel phase in its structure, which resulted in further water absorption and greater release of hydroxyl ions. Cention N does not contain HEMA or TEGDMA in its composition, which may cause hydrolytic degradation of bioglass particles.[20,24]

Gupta et al. assessed the release of hydroxyl ions from Cention N and glass ionomer in distilled water and acidic solution and concluded that Cention N was more capable of neutralizing an acidic environment. They also stated that self-cure Cention N had greater alkalizing potential than its light-cure form and RMGI, which could be due to greater solubility and ion release when Cention N is polymerized as self-cure.[25]

In a study by Jingarwar et al. using GIC, RMGIC, and giomer restorative materials, the highest fluoride release was seen at 24 hours with all materials, which was reduced on days 7 and 15. Maximal fluoride release observed at 24 hours, as also seen in our study, was explained by the surface wash-off effect. They suggested that the subsequent decline in fluoride release was probably due to diffusion through cracks and pores. [26]

Our findings showed a marked increase in pH values following acidification of the environment. However, it seems that the pH increase was not great enough to prevent demineralization. As the pH was still below the critical threshold, the demineralization process probably continues clinically, albeit at a slower rate.[18, 27] In our study, the teeth were not evaluated with regard to demineralization and remineralization. Previously, Donly et al. compared demineralization inhibitory effects of Vitremer, Z 100, and Cention N on Class V restorations. They found that the teeth restored with Cention N showed lower demineralization than the teeth restored with Z100, a conventional composite, but higher demineralization than the teeth restored with Vitremer.[28] Kim *et al.* restored bovine teeth with a glass ionomer, RMGIC, and Cention N then examined enamel microhardness at 10 hours after immersion in a demineralization solution (pH adjusted to 4.4 with acetic acid). Also, SEM images were obtained from the enamel surface. The authors found no significant reduction in the microhardness of the teeth restored with Cention N and concluded that Cention N increased the resistance of the dental tissue to demineralization. On post-demineralization SEM images, the enamel not restored with any of these materials showed greater roughness compared to all other groups, and Cention N was found to have greater resistance against demineralization than other restorative materials tested.[29]

Significantly lower pH values were observed for the samples prepared as a single edentulous block in comparison to restored teeth (Figures 1-4). This may indicate the alkalizing effect of ions released from teeth as a result of demineralization. Under oral physiological conditions, it takes about 30 minutes for the saliva to neutralize the acid produced by the biofilm. The amount of saliva in the mouth constantly changes due to swallowing and secretion cycles and depending on the environmental conditions. On average, the normal saliva flow rate is 0.6 ml/min daily.[30] In the current study, the samples were stored in 0.5 ml distilled water at pH 4 and pH readings were obtained at 10-min, 20-min, 30-min and 60-min timepoints following immersion for 24 hours, 48 hours and 7 days. Outside of these time intervals the samples were stored in distilled water at neutral pH 6.8. However, as a limitation of our study, it should be noted that it was not designed to mimic continuous saliva secretion and swallowing to keep the saliva volume constant in the oral environment. Although the alkasite material did not increase the pH of the medium above the critical threshold, it can be suggested that the application of bioactive agents can shorten demineralization time, and have a protective effect on the tooth structure. Due to increased concentrations of calcium, phosphorus and fluoride by alkasite material and its alkalizing potential, the equilibrium can change towards remineralization even in acidic conditions.[31]

Conclusions

The edentulous alkasite blocks exhibited the lowest pH increase at all measurement time intervals. Based on this finding, we think that ions released to the environment due to demineralization of the tooth also have a considerable impact. Although ions released from alkasite material cannot increase the pH above the critical threshold, they can accelerate the process. In vitro studies that mimic intra-oral conditions better are needed to evaluate the alkalizing potential of alkasite material.

Acknowledgements

We would like to thank "Sivas Cumhuriyet University, Faculty of Pharmacy, Department of Chemistry" for all their contributions at the laboratory stage.

Conflicts of Interest

There is no conflict of interest.

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Cumhuriyet Dental Journal, 25(Suppl): 108-113, 2022
DOI: https://doi.org/10.7126/cumudj.1032447

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Effect of Whitening Mouthwash on Color Change of Discolored Bulk-Fill Composite Resins#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 04/12/2021
Accepted: 14/03/2022

ABSTRACT

Objectives: The aim of this in-vitro study is to investigate discoloration of the composite resins with different characteristics which were colored by immersing in coffee, kept in mouthwashes with and without hydrogen peroxide.

Materials and Methods: In this study, 18 samples (6 mm x 2 mm) pre-heated bulk-fill (Viscalor Bulk -(VIS)), dual-cured (Fill Up!-(FUP)) bulk-fill and a microhybrid composite resin (G-aenial posterior-(GCP)) were prepared. After the samples were kept in distilled water for 24 hours, baseline colour measurements were performed with a spectrophotometer. ΔE001 color measurements were made of the samples immersed in coffee for 7 days. The samples were divided into two groups to be kept in mouthwashes with hydrogen peroxide (Crest 3D White) and without hydrogen peroxide (Listerine Advance White) (n=9). ΔE_{002} color measurements were applied after kept in whitening mouthwashes for 24 hours. Discoloration were calculated with the CIEDE2000 formula. Data were statistically analysed with One-way ANOVA and post hoc tukey tests.

Results: For samples immersed in coffee, while statistically highest ΔE values were obtained in GCP (7.30) group, there was no difference between VIS (3.30) and FUP (3.01). Statistically significant colour reduction was observed in VIS and FUP samples kept in both mouthwashes. GCP samples showed colour change above the clinically acceptable threshold (ΔE<2.25).

Conclusions: A decrease in discoloration for all materials was found as an effect of whitening mouthwashes. However, GCP showed clinically unacceptable discoloration after immersed in coffee or mouthwashes. Both whitening mouthwashes provided effective whitening for VIS and FUP groups.

Keywords: Bulk-Fill Composite, Color Stability, Dual-Cured Composites, Pre-Heating, Whitening Mouthwash.

Beyazlatıcı Ağız Gargaralarının Renklendirilmiş Bulk-Fill Kompozit Rezinlerin Renk Değişimine Etkisi#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 04/12/2021
Kabul: 14/03/2022

ÖZ

Amaç: Bu in-vitro çalışmanın amacı, kahveye daldırılarak renklendirilen farklı özelliklerdeki kompozit rezinlerin, hidrojen peroksit içeren ve içermeyen ağız gargaralarında bekletilmelerinin renk değişimine etkisini araştırmaktır.

Yöntem: Bu çalışmada önceden ısıtma özelliğine sahip (Viscalor Bulk (VOCO)-(VIS)) ve dual cured (Fill Up! (Coltene)-(FUP)) bulk-fill kompozit rezinleri ile bir mikrohibrit kompozit rezinden (G-aenial posterior (GC Corp.)-(GCP)) 6 mm çapında 2 mm kalınlığında 18'er adet örnek hazırlandı. Örnekler 24 saat distile su içerisinde bekletildikten sonra başlangıç renk ölçümleri bir spektrofotometre ile yapıldı. 7 gün boyunca kahvede bekletilen örneklerin ΔE_{001} renk ölçümleri yapıldı. Ardından örnekler, hidrojen peroksit içeren (Crest 3D White) ve hidrojen peroksit içermeyen (Listerine Advance White) ağız gargaralarında bekletilmek üzere iki gruba ayrıldı (n=9). 24 saat beyazlatıcı ağız gargarasında bekletildikten sonra ΔE_{002} renk ölçümleri yapıldı. Renk değişiklikleri CIEDE2000 formülü ile hesaplandı. Elde edilen veriler tek yönlü varyans analizi (One-way ANOVA) ve post hoc tukey testleri ile istatistiksel analiz edildi.

Bulgular: Kahvede bekletilen örneklerde GCP (7,30) grubunda istatistiksel olarak en yüksek ΔE değerleri elde edilirken (p<0,05), VIS (3,30) ve FUP (3,01) arasında fark yoktu. Her iki gargarada bekletilen VIS ve FUP örneklerinde istatistiksel olarak anlamlı renk azalması gözlendi. GCP örnekleri klinik olarak kabul edilebilir eşiğin (ΔE<3,3) üzerinde renk değişimi gösterdi.

Sonuçlar: Beyazlatıcı ağız gargarası içerisinde bekletilmesi sonucunda tüm materyallerin renklenmesinde bir düşüş bulunmuştur. Ancak GCP örnekleri hem kahvede hem gargaralar uygulandıktan sonra klinik olarak kabul edilemez düzeyde renk değişikliği göstermiştir. Her iki beyazlatıcı ağız gargarası VIS ve FUP grupları için etkin bir beyazlatma sağlamıştır.

Anahtar Kelimeler: Bulk-Fill Kompozit, Renk Stabilitesi, Dual-Cure Kompozit, Beyazlatıcı Ağız Gargarası.

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How to Cite: Bilgili Can D, Özarslan M.(2022) Effect of Whitening Mouthwash on Color Change of Discolored Bulk-Fill Composite Resins, Cumhuriyet Dental Journal, 25(Suppl):108-113.

Introduction

Nowadays, composite resins are among the most preferred restorative materials due to their improving mechanical, physical and aesthetic properties. With the development of composite resins, one of the composite resins that have been introduced to the market recently and that have undergone changes in their content and polymerization properties is bulk-fill composite resins.[1] Bulk-fill composite resins, which are applied to a depth of 4-5 mm in one step, have been introduced to the market due to the formation of voids, interlayer oral liquid contamination and time-consuming layering technique, when composite resins are applied in layers with a maximum thickness of 2 mm.[2,3]

The use of bulk-fill composites simplifies the procedure for deep and wide restorations and saves clinical time. In addition, it is becoming a more acceptable alternative due to its polymerization properties and better control of stress from polymerization shrinkage.[4] One of the bulk-fill resins with different properties that have been introduced to the market recently is the composite resin designed with thermo-viscous technology. Preheating improves the composite resin's handling properties and reduces film thickness, increasing flow and providing better marginal adaptation.[5] Another contemporary bulk fill composite is the dual cure bulk fill composite for polymerization in deep cavity restoration.[6]

Bulk-fill composite resins are mostly preferred for the posterior region, but it is important to preserve the basic aesthetic properties of the restoration. Despite the improvement of their physical and mechanical properties, the inability of composite resins to maintain their color stability for a long time is one of the most important reasons for rebuilding of restoration.[7] External and internal discoloration can be seen in composite resin restorations.[8] Extrinsic coloration occurs due to insufficient polymerization, heat, UV irradiation, water absorption, or absorption of colorants from food and beverages. Intrinsic discoloration is associated with filler particles, resin matrix and photoinitiators.[9,10]

Rebuild of the stained restoration is a costly treatment option to correct the aesthetic problem. Re-polishing and whitening approaches can be considered as less costly alternative treatments. Researchers have reported that bleaching treatments influence the color change of colored composite restorations.[8]

Current whitening agents have been marketed in various contents. The most used active ingredient is hydrogen peroxide. Oxygen molecules that emerge because of the breakdown of hydrogen peroxide penetrate the teeth, break down the pigmented molecules, and the whitening process takes place.[11] Most research has been done on hydrogen peroxide whitening mouthwashes that have proven whitening ability.[12-14] However, it has been reported that hydrogen peroxide causes many complications.[12,15,16] Commercially available whitening mouthwashes contain low levels of hydrogen peroxide, as well as carbamide peroxide, sodium chloride or alternative bleaching agents.[17]

The aim of this in-vitro study is to investigate the effect of hydrogen peroxide-containing and non-hydrogen peroxide mouthwashes on the color change of composite resins with different properties, which are colored by stored in coffee. The tested hypotheses that: 1) there would be no difference in discoloration among bulk-fill and microhybrid composite resins after coffee immersion, 2) whitening mouthwashes would not provide an effective color change on colored composite resins, 3) there would be no differences in color change between the tested whitening mouthwashes.

Materials and Methods

In this study, preheated (Viscalor Bulk (VOCO)) and dual-cured (Fill Up! (Coltene)) bulk-fill composite resins and a microhybrid composite resin (G-aenial posterior (GC Corp.) were used. The materials used in the study and their contents are given in Table 1.

Eighteen samples of 6 mm diameter and 2 mm thickness were prepared from each of the 3 materials by locating the resin material in a silicone mold After the materials were placed in the molds, they were covered with a mylar strip and microscopic slides were placed on top and bottom surface of mold. In accordance with the following manufacturer recommendations, composite resins were performed and light curing was carried out:

- Viscalor Bulk which unidose composite campules was pre-heated using a CapsWarmer (VOCO, Germany) in T3 mode (up to 68◦C) for 3 min (T3-3 min). It was applied to the mold within 30 seconds. Light cured for 20 seconds at 1000 mW/cm^2 in standard mode (VALO; Ultradent Products, Inc) using an LED light device.
- Fill Up! was applied to the mold, then light cured for 10 seconds at 1000 mW/cm^2 in standard mode using an LED light device to accelerate the curing process by the manufacturing information. After 3 min, Fill-Up! was chemically cured and removed from the mold.

G-ænial POSTERIOR microhybrid composite was applied to the mold in 2 mm thick layers. Each layer was light-cured separately for 20 seconds at 1000 mW/cm^2 in standard mode using an LED light device.

Samples were stored in distilled water at 37°C for 24 hours. The first color measurements (T0) after full polymerization were made using a spectrophotometer (VITA Easyshade Compact; VITA Zahnfabrik) and L*, a*, b* values were recorded. Measurements were made by calibrating the device before each measurement and on a white background (L=53.5, a=3.2, b=12.8) in lighting conditions in D65 standards. All color measurements were made by a single operator.

Table 1. The composition and manufacturer of the materials tested in the study

Material	Manufacturer	Code	Type	Content	FL	Shade	BN
VisCalor bulk	Voco, Cuxhaven, Germany	VIS	Termoviscous bulk-fill composite	Matrix: Bis-GMA, aliphatic dimethacrylate Fillers: Glass ceramic fillers (average 1 µm) silicon dioxide nanoparticles (20-40 nm)	83 wt.%	A2	2101677
Fill-Up	Coltene/Whaledent Altstätten, Switzerland	FUP	Dual curing bulk-fill composite	TMPTMA, UDMA, Bis-GMA, TEGDMA, benzoyl peroxide, dibenzoyl peroxide Fillers: Glass, amorphous silica, zinc oxide (2 µm)	65 wt%	A2	J87573
G-ænial Posterior	GC Corporation Tokyo, Japan	GCP	Micro-hybrid composite	Monomers; Methacrylate monomers, UDMA, dimethacrylate comonomers Fillers; Prepolymerized fillers (silica, strontium and lanthanoid fluoride), fluoroaluminosilicate, fumed silica (16-17 µ)	77 wt%	A2	1806215

BN: Batch Number; FL: Filler load% wt; TM PTMA: Trimetholeolpropane trimethacrylate, UDMA: urethane dimethacrylate, Bis-GMA: bisphenol glycidyl methacrylate, TEGDMA: triethylene glycol dimethacrylate

Table 2. Details of tested whitening mouth rinses

WMR	Composition	Company
Crest 3D White	Water, glycerin, hydrogen peroxide, propylene glycol, sodium hexametaphosphate, poloxamer 407, sodium citrate, flavor, sodium saccharin, citric acid	Procter & Gamble, Cincinnati, OH, USA.
Listerine Advance White	Aqua, Alcohol, Sorbitol, Tetrapotassium Pyrophosphate, Pentasodium Triphosphate, Citric Acid, Poloxamer 407, Sodium Benzoate, Eucalyptol, Thymol, Menthol, Sodium Saccharin, Sodium Fluoride, Tetrasodium Pyrophosphate, Propylene Glycol, Sucralose, Aroma, Disodium Phosphate.	Johnson& Johnson, Pomezia, Italy

WMR: Whitening Mouth Rinse

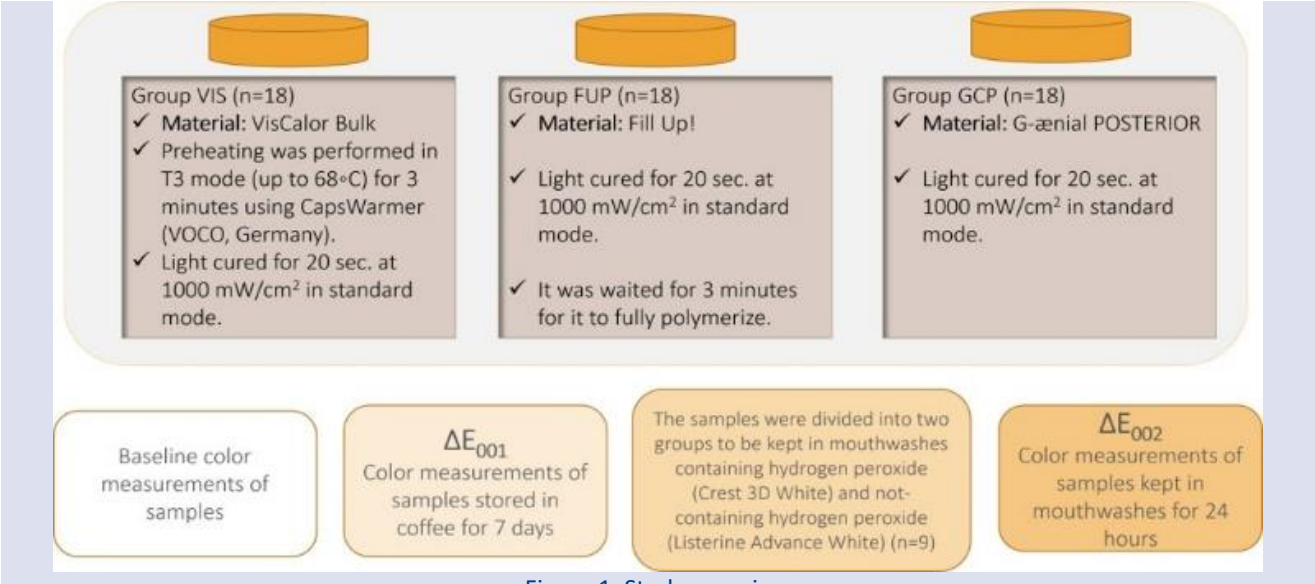

Figure 1. Study overview

Following the color measurement, the samples were kept in coffee (2 g sachet contents were dissolved in 200 mL boiled water that did not contain sugar or milk. (Nescafé Classic, Single Bags; Nestlé)) in closed containers for 1 week. Coffee was refreshed daily. After the coloring process, the second color measurements of the samples were made (T1).

Washed and dried samples were kept in 2 mouthwashes (Crest Crest 3D White, Procter & Gamble and Listerine Advance White, Johnson& Johnson) with different contents for 24 hours (n=9). The samples extracted from the solutions were washed under running water and dried before the third color measurement (T2). The flow chart of the study is shown in Figure-1.

Color changes were evaluated according to the formula CIEDE2000 (ΔE_{00}) between T1 and T0, between T2 and T0. The ΔL, ΔC, and ΔH in the formula describe

the differences in lightness, chroma, and hue between two measurements. 'S' stands weight functions for chroma and hue. In this study, K_L, K_C and K_H were accepted as "1".[13]

$$\Delta E_{00}=\sqrt{\left(\frac{\Delta L}{K_L S_L}\right)^2+\left(\frac{\Delta C}{K_C S_C}\right)^2+\left(\frac{\Delta H}{K_H S_H}\right)^2+R_T\left(\frac{\Delta C}{K_C S_C}\right)\left(\frac{\Delta H}{K_H S_H}\right)}$$

Statistical analyzes of this study were performed using the SPSS 21.0 (SPSS Inc. Chicago, IL, USA) program. The normality of data was checked with the Shapiro-Wilk test, and then statistical analysis was completed using one-way analysis of variance (ANOVA) and post hoc tukey test. Statistically significant level of $p<0.05$ was accepted.

Results

ΔE_{001} values of the samples after immersion in coffee are given in Figure 2. Statistically, the highest color change was obtained in the GCP group (7.30) ($p<0.05$). There was no statistically significant difference in discoloration between VIS (3.30) and FUP (3.01) ($p>0.05$).

50:50% acceptability threshold value was reported to be DE00= 2.25 by Ghinea et al.[18] Accordingly, clinically acceptable color changes were not observed in all groups evaluated in coffee immersion.

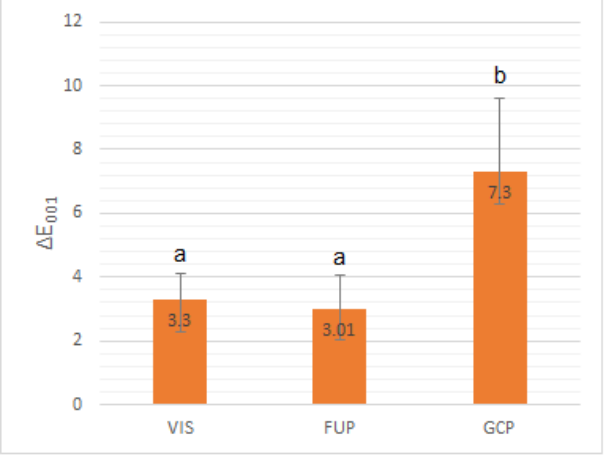

Figure 2: The mean and standard deviations of ΔE001 (color measurements of stored in coffee) values.

Table 3. The mean and standard deviations of ΔE002 values

ΔE_{002}	Crest 3D White	Listerine Advance White	p
VIS	1.51±0.45a	1.07±0.57a	0.428
FUP	1.51±0.63a	1.19±0.20a	0.284
GCP	5.15±2.32b	4.63±1.55b	0.012
p	0.000	0.000	

The superscript lowercases indicate the statistical differences within lines. The effect of mouthwashes on the material does not difference significantly ($p<0.05$).

The color change values (ΔE_{002}) obtained after the groups were immersed in whitening mouthwashes are shown in Table 3. In immersed both mouthwashes, VIS and FUP bulk-fill composite resins showed higher color stability than GCP. Statistically significant color reduction was observed in VIS and FUP samples in both mouthwashes ($p<0.05$). When ΔE_{001} and ΔE_{002} values were examined, there were significant difference in whitening in VIS and FUP groups in both mouthwashes, but no statistically significant difference was observed in the GCP group. Only in GCP, clinically acceptable color change (ΔE_{00} >2.25) was not observed after immersed in Listerine (ΔE=4.63) and Crest (ΔE=5.15).

Discussion

In the study, bulk-fill composite resins colored by immersed in coffee showed significantly higher color stability than the microhybrid composite. Therefore, the first hypothesis was rejected.

In this study, the CIEDE2000 color system was used to determine the color differences. The studies stated that color differences are determined more accurately in this system.[19-21] CIEDE2000 (ΔE_{00}) provides a better harmony than CIELAB, as it better distinguishes slight color differences in terms of threshold values during the evaluation of color differences.[19] Also, the DE00 formula changes the a* coordinate of the CIELAB and can include these special coordinates for non-uniform interactions between hue and chroma that specifically affect low chroma color.[22] Composite resin materials can absorb water as well as other liquids and pigments. This results in coloring of the composite resins.[23] The human eye is limited in observing color differences. In this study, the ΔE threshold detectability and acceptability was evaluated as 2.25.[18] In the current study, clinically unacceptable discoloration was observed in all tested composite resins in coffee immersion (ΔE_{00} >2.25). The color stability of resin composite restorations is affected by several factors, including the resin matrix, filler size, and the photoinitiator system of the composites.[24] Due to the hydrophilic characteristic of the resin matrix, the resin monomers and the degree of water absorption of these monomers can affect color stability. Higher water absorption can cause the resin matrix to absorb not only water but also other coloring liquids that cause discoloration.[23] The Bis-GMA based resin matrix has higher water absorption and therefore less stain resistance than UDMA.[19] In addition, increasing the ratio of TEGDMA in the resin matrix caused an increase in the water uptake of Bis-GMA based resins.[19] However, in this study, lower color change was observed in FUP samples in spite of containing Bis-GMA and TEGDMA. This difference can be attributed to the fact that the FUP material contains different resin monomers (such as TMPTMA). In a study, FUP material showed lower color change than other composite resins containing Bis-GMA.[25]

The chemical formulations, ratios and degree of crosslinking of composite resin materials differ from each other. These compositions of the resins that compose the matrix, which vary according to the brands, can show great differences in their color behavior. As a result, due to the polar structure of the resin matrices, it can also allow the penetration of color-changing agents, causing discoloration.[23] In this study, effective color reduction was observed in all composite resins evaluated after bleaching in mouthwashes. However, the color reduction in VIS and FUP samples was statistically significant. Therefore, the second null hypothesis, which stated that whitening mouthwashes would not provide an effective color change on colored composite resins, was rejected. The increased susceptibility of GCP to staining compared to bulk fill composite resins could be attributed to the filler size. VIS contains silicon dioxide nanoparticles (20-40 nm) and glass ceramic fillers (1µ). The presence of these nanofillers provides improved resistance to color changes, improving the material's smoother surface formation, gloss and polishing ability.[26-28] FUP contains 2 µ glass, amorphous silica fillers, while GCP's average filler size (16-17 µ) is larger than the tested bulk-fill composites (Table 1). With increasing infill size, the material can be easily eroded by the effects of coloring agents, resulting in rougher surfaces that are prone to staining.[24] In the literature, it has been reported that composite resin specimens in soaking mouthwash for 12 hours is equivalent to gargling once a day for 2 minutes for a year.[29] To use mouthwash and antiseptics is recommended 2 times a day for 2 minutes in accordance with the manufacturer's instructions. Considering this situation, the samples were kept in solutions for 24 hours and it was aimed to provide an effect equivalent to the 1-year exposure of the solutions.

Whitening products, which can be used without the supervision of a physician, are easy to use and can be easily obtained from markets, pharmacies and the internet. These products, which are reported to be safe to use, show less whitening effect compared to professional whitening systems applied by the physician, due to their low concentration of whitening agent and short application time.[30] Whitening mouthwashes contain hydrogen peroxide, sodium hexametaphosphate, pyrophosphate, sodium citrate and various enzymes as a whitening agent. Hydrogen peroxide is a common bleaching agent used in both professional physician-applied whitening and self-applied products.[14,31] It is a very strong oxidizing agent and causes bleaching by breaking down long-chain organic pigment molecules into short-chain compounds. However, peroxide application in whitening mouthwashes is more difficult due to the short application time and safety restrictions. In general, whitening mouthwashes contain low concentrations of hydrogen peroxide.[12] Crest 3D White used in this study contains hydrogen peroxide.

There are studies evaluating the bleaching efficiency of hydrogen peroxide in the literature.[14,32,33] Researchers reported that 6% and 35% hydrogen peroxide application had a bleaching effect against coffee discoloration in enamel, dentin and composite resin samples.[32] In a study was reported that 10% concentration of hydrogen peroxide provides bleaching in composite resin samples that could be noticed with the naked eye.[33]

Increasing the percentage of hydrogen peroxide in whitening mouthwashes may result in more effective whitening. However, the use of these agents at home carries some risks due to their uncontrolled application. It easily penetrates the cell membrane, inducing broad-spectrum DNA lesions and transforms into hydroxyl radicals that can interact with DNA. In fact, oxygen reagents derived from H_2O_2 have been reported to be involved in DNA damage, which is considered a major mechanism of chemical carcinogenesis.[15]

In the present study, the efficacy of mouthwashes with and without hydrogen peroxide were evaluated. There was no difference between the whitening efficacy of mouthwashes in the evaluated materials. Therefore, the tested 3rd hypothesis was accepted. The low pH of hydrogen peroxide whitening mouthwashes and their potential risks have motivated manufacturers to develop hydrogen peroxide-free whitening mouthwashes due to their uncontrolled application.[12,15,34] These mouthwashes contain alternative whitening agents such as sodium hexametaphosphate, tetrasodium pyrophosphate, and phthalimido-peroxy-caproic acid.[15] It is thought that Listerine Advance White used in this study provides as effective whitening as mouthwashes containing hydrogen peroxide thanks to its Tetrasodium Pyrophosphate content. The results of this study are in accordance with previous studies. In a study, it was stated that the color change of the colored microhybrid composite resin of mouthwashes with and without hydrogen peroxide varies according to the mouthwash brand, not according to the hydrogen peroxide content.[13] Lee et al. investigated the color stability of composite resins of different mouthwashes and found no significant difference between different composites and different mouthwashes.[35]

In daily use, factors such as the washing effect of saliva, mouth water intake, food-beverage variety and their interactions may affect the color change after mouthwash. The effect of mouthwash in daily use should also be examined clinically, and the effect of these solutions on the color stability of composite restorations should always be considered.

Conclusion

Based on this study, the following conclusions could be found:

- The tested bulk-fill composite resins were more resistant to coloring beverage than the microhybrid composite resin.
- Both bleaching mouthwashes evaluated were an effective factor in color recovery on colored bulk-fill composite resins.
- Hydrogen peroxide in whitening mouthwashes did not create any significant difference in whitening composite resins.

Acknowledgements

N/A

Conflicts of Interest Statement

The authors declare that they have no conflict of interest.

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Cumhuriyet Dental Journal, 25(Suppl): 114-118, 2022
DOI: https://doi.org/10.7126/cumudj.1032447

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Assessment of Youtube™ Videos as a Parent Information Source for Teething Symptoms#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 05/12/2021
Accepted: 13/03/2022

ABSTRACT

Objectives: The aim of the study was to evaluate the quality of information provided by YouTube™ for parents searching information about teething symptoms.

Materials and Methods: To simulate access to information from the parents' perspective, the terms "teething symptoms and teething signs" were searched on YouTube™. To obtain a total of 60 acceptable videos, a total of 100 videos were screened. Irrelevant videos, advertisements, non-English videos, duplicates, videos lasted greater than 15 min were excluded. General video assessment included ownership, video age, number of comments, purpose and references. Local and systemic symptoms of teething, duration of teething, and treatment options were also examined in the videos. Global Quality Scale(GQS), DISCERN, viewers' interaction, and viewing rate were calculated. Statistical analysis was performed using the SPSS Version 26.

Results: Sixty three videos were included. The videos had a mean video interaction index of 1.36±3.39. The mean viewing rate was 6915±18125 with a range of 0.7 to 115498. The mean score for GQS was 2.98±1.1, for DISCERN was 1.03±0.89. The mean DISCERN score of layperson was lesser than healthcare professionals ($p<0.05$). Local symptoms were mentioned in 85.7% of the videos and systemic symptoms in 58.7% of them. Treatments were mentioned in 61.9% of the videos.

Conclusions: The quality of information about teething symptoms on YouTube™ was variable, but the quality of videos from non-health professionals was particularly poor. Reliable YouTube™ videos published by childhealth professionals will be a good resource, especially for parents who cannot reach health institutions due to various reasons such as pandemic.

Keywords: Youtube™, Teething Symptoms, Teething Signs.

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How to Cite: Güçyetmez Topal B, Tıraş M, Tanrıkulu. (2022) Assessment of Youtube™ Videos as a Parent Information Source for Teething Symptoms, Cumhuriyet Dental Journal, 25(Suppl):114-118.

Introduction

The eruption of primary teeth is a physiological process that starts with the eruption of the mandibular incisors when babies are 4-8 months old and continues until the eruption of the primary second molars between 30-36 months.[1,2] Local and systemic symptoms such as general irritability, sleep disturbances, crying, nasal discharge, flushed cheeks, fever, diarrhea, loss of appetite, hypersalivation, ear rubbing, gingival inflammation on the erupting teeth, in this period of time when primary teeth erupt can be seen.[3-8]

Some studies have not found any causal relationship between tooth eruption and symptoms such as fever, diarrhea, rash, or infection in infants.[3,4,9] During the eruption period, pharmacological methods such as many teething gels are recommended to reduce the symptoms of babies, and non-pharmacological methods such as teething rings, cooled or frozen fresh vegetables and fruits for babies to bite and relieve by scratching the relevant area.[7] In this difficult period for babies and parents, parents can get information about the symptoms of tooth eruption from pediatric dentists, pediatricians, family physicians and other health institutions. In addition, parents are increasingly using the internet to get more information about infant health.[10-12] While healthcare professionals remain the most important source of information in guiding a patient's decisions, the impact of information on the internet is evident.[13] YouTube™ is one of the most visited websites by patients who want to access medical information and is the second most popular website in the world after Google on the Internet. YouTube™ was founded as a video sharing site in 2005 and approximately 5 billion videos are watched per day.[14] YouTube™ videos are not reviewed by an expert due to the nature of this platform and videos can be uploaded from various sources in varying quality.[15]

In the available literature, it has been observed that there is no study examining the information content of YouTube™ videos about teething symptoms. In this study, it was aimed to evaluate YouTube™ videos as a parent information source for teething symptoms.

Materials and Methods

In this study, we searched for the most frequently searched terms "teething symptoms and teething signs" from the Google Trends on YouTube™ to simulate access to information from a parent's perspective. 100 videos were analyzed to get 60 videos with default settings and no filters. To avoid variations in the analyses, a playlist was created. Irrelevant videos, commercials, non-English videos, duplicates, videos lasting longer than 15 minutes are excluded. The videos were independently evaluated by two calibrated pediatric dentistry research assistant (Kappa value was 0.86). General video evaluation included ownership, the job of the person who shared it, the type of video channel, the age of the video, the number of likes and dislikes, the number of comments, the purpose of the video and references. Local and systemic symptoms of teething, teething process and treatment options were also examined in the videos. Interaction index and viewing rate of the videos were calculated and evaluated according to the Global Quality Scale (GQS) and DISCERN.

Interaction Index=[number of likes − number of dislikes] / total number of views × 100%
Viewing rate = number of views/number of days since upload × 100% [16]

The Global Quality Scale (GQS), preferred for quality assessment, was used to evaluate the quality of each video based on the scope of scientifically accurate information about its content.[17] Videos were rated for streaming, usability, and overall quality on the Global Quality Scale. According to this;

- Low quality, poor flow and not helping patients.
- Generally poor quality, poor flow, offered some information and limited use to patients
- Moderate quality, poor flow, provided some important information, did not cover other important issues and useful to some extent for patients
- Good quality, good streaming, covers the most important topics, useful for patients, but videos may contain minor shortcomings.
- Excellent quality, excellent flow, detailed, valid and accurate information presented and very beneficial for patients.

The reliability of the content of the videos was evaluated with the DISCERN scale.[18] This assessment consists of five questions with 'yes' or 'no' answers:

- Are the objectives clear and achieved?
- Are reliable sources of information used?
- Is the information presented balanced and unbiased?
- Are additional sources of information listed for patient reference?
- Are areas of uncertainty mentioned?

Each question was given 1 point for a "yes" answer and 0 for a "no" answer. The total score ranges from 1 to 5 points.

Statistical analysis of the study was performed with SPSS Version 26 (IBM SPSS® Statistics, IBM Corp., London: UK). Categorical data were given as percentage (%) and number (n), and Pearson chi-square test was used for comparison. Mean and standard deviation values were used for parametric numerical data; median, minimum and maximum values were used for non-parametric numerical data. The significance level will be set to $p<0.05$.

Results

63 videos out of 100 videos reviewed on YouTube™ were included in this study. Of the 37 videos excluded from the evaluation, 11 videos were excluded because they were not in English, 5 videos did not have sound, 10 videos did not have video content, 7 videos were irrelevant to the topic, and 4 videos were repetitive. Descriptive statistics of the demographics of the 63 videos included are shown in Table 1.

Table 1. Descriptive statistics of YouTubeTM videos with "Teething symptoms and Teething signs"

	Mean (SD)*	Median(Min-Max)*
Number of Views	66933.17 (128611.44)	9295 (20-723368)
Number of Likes	319.89 (721.15)	71 (0-4800)
Number of Dislikes	33.62 (60.72)	6 (0-299)
Number of Comments	29.65 50.49)	2.5 (0-245)
Age of Video	2152.35 (1505.16)	1975 (90-4745)
Interaction Index	1.36 (3.39)	0.34 (0.026-17.8)
Viewing Rate	6915 (18125)	1.36 (0.7-115498)

*SD:Standard Deviation, Min:Minimum, Max:Maximum

The mean GQS score of the analyzed videos was 2.98±1.1, and the DISCERN mean score was 1.03±0.89. While association between the GQS value and the interaction index was found statistically significant ($p=0.006$), there was no significant association between the GQS and the viewing rate ($p<0.05$). The videos of layperson have a lower average DISCERN score (0.81) than healthcare professionals (1.93; $p<0.05$).

According to purpose of videos; 55 (87.3%) videos were for informational purposes, 5 (7.9%) for transferring personal experiences, and 3 (4.8%) for product promotion (Figure 1). Occupational distribution, number and percentages of those who shared videos on the subject are shown in Figure 2.

The most frequently discussed issue regarding eruption was local symptoms (85.7%). Local symptoms were mentioned in 85.7% of the videos and systemic symptoms in 58.7% of them. Also, nappy rash (in 1 video), constipation (in 1 video), and nasal discharge (in 1

video) were mentioned among symptoms of teething. The percentages of local and systemic symptoms in the videos are shown in Table 2.

The treatment of the teething symptoms was evaluated in 61.9% of the Youtube™ videos. 57.1% of these treatments are non-pharmacological, and 30.2% are pharmacological treatments. In the two videos, teething necklaces which mislead the parents, was adviced for teething symptoms. References were included in only 3 (4.8%) of the videos.

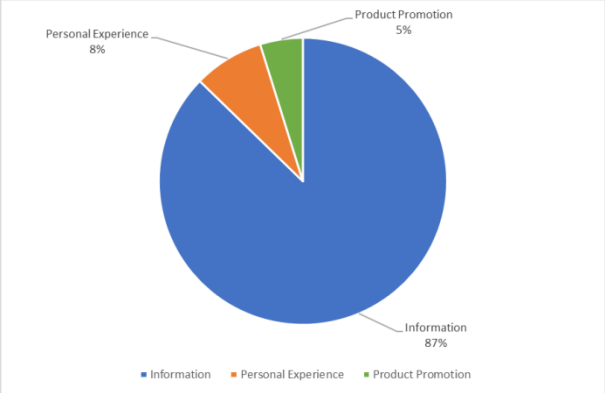

Figure 1. Percentages of the purpose of shared the videos

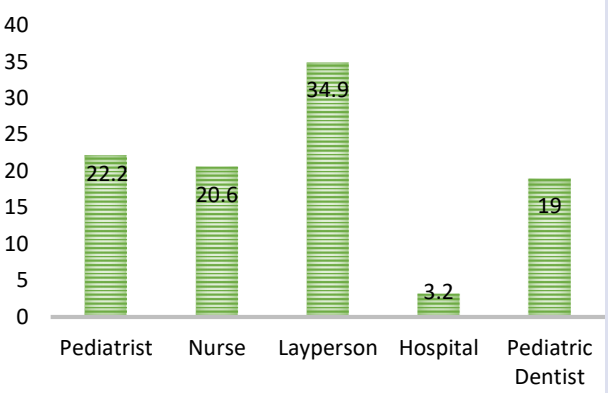

Figure 2. Occupational distribution of the people who shared the videos

Table 2. Percentages of videos that mentioned about the presence and absence of local symptoms

Local Symptoms		
	Absence	**Presence**
Gingival inflammation	20.6%	79.4%
Hypersalivation	20.6%	79.4%
Chewing	15.9%	84.1%
Ear Rubbing	57.1%	42.9%
Eruption Cyst	100%	0%
Flushed Cheeks	69.8%	32%
Ulcer in the Mouth	95.2%	4.8%

Table 3. Percentages of videos that mentioned about the presence and absence of systemic symptoms

Systemic Symptoms		
	Absence	**Presence**
Vomiting	79.4%	20.6%
Loss of Appetite	30.2%	69.8%
Cough	87.3%	20.6%
Rush	81%	19%
Stomachache	93.7%	6.3%
Crying	39.7%	60.3%
Pain	19%	81%
Unrest	15.9%	84.1%
Fever	25.4%	74.6%
Degree of Fever	61.9%	38.1%
Restless Sleep	28.6%	71.4%
Diarrhea	54%	46%

Discussion

Parents seek information on websites such as Youtube™ to learn more about their baby's health. Healthcare professionals are the most important source of information about the health of babies, but the ease of obtaining medical information on the internet and the need for remote health care due to COVID-19 increase the popularity of Youtube™ videos with medical content.[19] Within the scope of pediatric dentistry, Youtube™ videos were evaluated in many subjects such as oral hygiene, early childhood caries, fluoride use.[20-22] In the available literature, it has been seen that there is no study examining the information content of Youtube™ videos about teething symptoms in babies, and it is aimed to examine them in present study. Due to the increasing popularity of the internet and social media in recent years, it is seen that both healthcare professionals and layperson share videos about tooth eruption symptoms on platforms such as Youtube™. In

this study, layperson shared videos about tooth eruption symptoms at a rate of 34.9%. This rate was followed by pediatricians (22.2%), nurses (20.6%) and pediatric dentists (19%). Since different professional groups and layperson share Youtube™ videos on this subject, different parameters were used in the current study to evaluate the reliability of the videos.

The mean GQS score, which was used to evaluate the general quality of the videos examined, was calculated as 2.98±1.1. According to this average value, the videos that are of medium quality, provide poor flow, but provide some important information, do not mention other important issues, but still provide useful information, albeit limited for patients. In this study, the fact that the videos about eruption symptoms were mostly shared by layperson affected the mean GQS. Studies have reported that many of the videos on Youtube™ are uploaded by layperson and are of low quality.[22,23] In this study, association between the GQS value and the interaction index was found statistically significant. In a study, a statistical significance was found between the video interaction index and the quality of the videos, as same with this present findings.[24]

According to the DISCERN analysis, which evaluates the quality of consumer health information, the average score of the videos examined in this study is 1.03±0.89. The mean DISCERN score of layperson video sharers was found to be lower than that of healthcare professionals. These values highlight the low reliability of the videos according to DISCERN analysis. One study states that sharers of Youtube™ videos are not a reliable source for patients, consistent with this present findings.[25] Since Youtube™ videos adhere to the principle of freedom of expression and are mostly not editable, there may be situations such as misinformation sharing.[26] Studies agree that Youtube™ videos contain scientifically misleading or incorrect information.[27,28] Due to the dynamic nature of Youtube™, it should be taken into account that the watching rate of the videos, the values such as likes, dislikes and comments may change over time and these variables can be manipulated.

In this study, 87.3% of the videos examined were shared for informational purposes, 7.9% for personal experiences and 4.8% for product promotion. Parents can have limited information on their baby's teething symptoms, the situations they may encounter in this process, experience videos where they can compare their babies with their peers, and symptomatic treatments of brands, albeit to a limited extent.

In this study, local symptoms were mentioned in 85.7% and systemic symptoms in 58.7% of the examined Youtube™ videos. While the most frequently mentioned local teeth eruption symptom was chewing (84.1%), it was followed by gingival inflammation (79.4%) and hypersalivation(79.4%). Among the systemic symptoms, irritability (84.1%) was the most frequent, followed by fever (74.6%) and restless sleep (71.4%). Haznedaroğlu et al.(2016) evaluated websites as a source of information on teething symptoms in Turkey and reported that the most included symptoms were drooling, restless sleep, gingival inflammation and chewing.[29] HajiAhmadi et al.(2020) examined websites about teething symptoms, it was reported that the most common symptoms mentioned on the websites were increased drooling, gingival inflammation, chewing, irritability, crankiness, crying and decreased appetite, in parallel with this study.[30]

Many pharmacological and non-pharmacological methods are often recommended for the treatment of these existing teething symptoms in infants. Although there is no evidence to support the effectiveness of pharmacological preparations, parents and healthcare professionals continue to use pharmacological treatments widely.[2] In this study, 61.9% of the evaluated Youtube™ videos were included the treatment of the symptoms seen during the eruption period. 57.1% of these treatments are non-pharmacological, and 30.2% are pharmacological treatments. In the two videos, the use of teething necklaces was adviced.[31] In a study , it was found that the use of soft and cold teething rings and gum massage for non-pharmacological management on their website, and oral analgesics for pharmacological management of symptoms. It has been noticed that pharmacological treatment is not widely recommended on professional websites and on websites belonging to pediatricians.[30] It can be thought that not recommending pharmacological treatments on social media and the internet is to prevent uncontrolled drug use and drug cytotoxicity by parents without consulting healthcare professionals.

References were included in only 3 (4.8%) of the videos. In a study, it was reported that less than 50% of the sites did not have an author or reference.[29] The reliability of non-referenced information is doubtful, and people who seek information on the internet should be warned by healthcare professionals that such information may be misleading.

In the present study, parents were directed to consult different health institutions regarding symptoms. In worldwide studies, the rate of visiting the health institutions for teething symptoms was between 16-86.4%.[32-36] In another study which conducted in Turkey, it was reported that 44.4% of mothers applied to medical doctors for teething symptoms, and only 3% to dentists.[37] The preference of families to visit medical doctors may be associated with the fact that systemic symptoms cause more anxiety in families.[38] In this study, while parents were mostly directed to pediatricians about their babies; the most referrals directed to pediatric dentists were again by another dentists.

Conclusions

The quality of information about teething symptoms on YouTube™ was variable, but the quality of videos from layperson was particularly poor. Reliable YouTube™ videos published by childhealth professionals will be a good resource, especially for parents who cannot reach health institutions due to various reasons such as pandemic.

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Cumhuriyet Dental Journal, 25(Suppl): 119-123, 2022
DOI: https://doi.org/10.7126/cumudj.1031443

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Effect of Modeling Liquid Use on Color and Whiteness Index Change of Composite Resins#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 02/12/2021
Accepted: 16/03/2022

ABSTRACT

Objectives: Composite resins are widely used in the restoration of teeth. The aim of this study is to examine the effect of modeling liquid use on the color and whiteness index changes of composite resins.
Materials and Methods: In the study, samples were prepared using different composite resins (Clearfil Majesty Esthetic, Estelite Asteria, G-aenial A'Chord and Omnichroma). Before polymerization of the prepared samples, modeling liquid was applied to one group with a composite brush, while modeling liquid was not applied to the other group. After the polymerization process, the samples were polished using the finishing and polishing system (Clearfil Twist Dia). Color measurement of samples kept in coffee was measured at the beginning, at 7th and 30th days using spectrophotometer. CIEDE2000 (ΔE_{00}) and whiteness index (WI_D) formulas were used to calculate color changes. Statistical analysis of the data was performed with one-way analysis of variance (ANOVA) and Tukey tests.
Results: There was a statistically significant difference between the color and whiteness index change values of the composite resins on the 7th and 30th days. There was no statistically significant difference between the color and whiteness index change values of the composite resins with and without modeling liquid. The control group, which did not undergo finishing and polishing, showed the statistically highest color change.
Conclusions: Composite resins showed change in color (ΔE_{00}:1.8) and whiteness index (ΔWI_D:2.6) above the acceptable threshold value (AT) in coffee. The use of modeling liquid did not affect the color and whiteness index changes of the composite resins.

Keywords: Composite Resin, Whiteness Index, Modeling Liquid, Color Change.

Modelleme Sıvısı Kullanımının Kompozit Rezinlerin Renk ve Beyazlık İndeksi Değişimine Etkisi#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 02/12/2021
Kabul: 16/03/2022

ÖZ

Amaç: Kompozit rezinler dişlerin restorasyonunda yaygın bir şekilde kullanılmaktadır. Bu çalışmanın amacı; modeling likit kullanımının kompozit rezinlerin renk ve beyazlık indeks değişimine etkisini incelemektir.
Gereç ve Yöntemler: Çalışmada farklı kompozit rezinler (Clearfil Majesty Esthetic, Estelite Asteria, G-aenial A'Chord ve Omnichroma) kullanılarak örnekler hazırlandı. Hazırlanan örneklerin polimerizasyondan önce bir gruba kompozit fırçası ile modeling likit uygulanırken, diğer gruba modeling likit uygulanmadı. Polimerizasyon işleminden sonra örnekler bitirme ve cila sistemi (Clearfil Twist Dia) kullanılarak polisaj yapıldı. Kahve içerisinde bekletilen örneklerin renkleri başlangıçta, 7. ve 30. günde spektrofotometre kullanılarak ölçüldü. Renk değişim değerlerinin hesaplamasında CIEDE2000 (ΔE_{00}) ve beyazlık indeks (WI_D) formülleri kullanıldı. Verilerin istatiksel analizi tek yönlü varyans analizi (ANOVA) ve Tukey testleri ile yapıldı.
Bulgular: Kompozit rezinlerin 7. ve 30. gündeki renk ve beyazlık indeks değişim değerleri arasında istatiksel olarak anlamlı farklılık görüldü. Kompozit rezinlerin modeling likit kullanılan ve kullanılmayan gruplarının renk ve beyazlık indeks değişim değerleri arasında istatistiksel anlamlı farklılık görülmedi. Bitirme ve polisaj işlemi yapılmayan kontrol gurubu istatistiksel olarak en fazla renk değişimi gösterdi.
Sonuçlar: Kompozit rezinler kahve içerisinde kabuledilebilir eşik değeri (AT) üzerinde renk (ΔE_{00}:1,8) ve beyazlık indeks (ΔWI_D:2,6) değişimi gösterdi. Modeling likit kullanımı kompozit rezinlerin renk ve beyazlık indeks değişimi etkilemedi.

Anahtar Kelimeler: Beyazlık İndeks, Kompozit Rezin, Modeling Likit, Renk Değişikliği

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How to Cite: Aydın N, Karaoğlanoğlu S, Ersöz B. (2022) Effect of Modeling Liquid Use on Color and Whiteness Index Change of Composite Resins, Cumhuriyet Dental Journal, 25(Suppl):119-123.

Introduction

Composite resins, whose mechanical and optical properties have been improved, are widely used in the restoration of teeth as they provide color match with dental tissues.[1,2] Despite many positive properties of composite resins, the viscous resin monomers in their structures and the increase in inorganic filler ratios make the manipulation of materials difficult. Adhesion of the composite to the application tool during layered placement is a common problem.[3] Therefore, various modeling agents and equipment have been proposed to improve the adaptation and manipulation of composite resins.[2,4]

The use of modeling liquids, which are used in shaping composite restorations, has become widespread as the material facilitates manipulation. Less adhesion of the composite brush, which is wetted with modeling liquid, to the composite allows easy and fast application of the composite in the mouth. Using the brush moistened with modeling liquid in the last composite layer allows a smoother surface to be obtained.[5] However, it is stated that the modeling liquids used in the final restoration layer may interact with the beverages during feeding and adversely affect the optical properties and color stability of the composite material.[6]

Acceptable surface roughness and color stability are essential for clinical success in composite resins. Color changes in material were associated with water absorption, degree of polymerization, diet, and surface roughness of the restoration.[7] It is stated that the color sensitivity of the material to external factors has a direct effect on the polishing and finishing procedures as well as the composition of the material.[8] The rough surface of the restoration may be stained by external factors such as coffee, tea or red wine, causing the material to become discolored.[9,10]

Spectrophotometers used in the measurement of color change in dental materials measure the amount and spectral composition of the light reflected from the object and convert it into numerical data.[11] Despite the use of CIELAB (ΔE_{ab}) and CIEDE2000 formula (ΔE_{00}) over L*, a* and b* values in calculating the color change in dental materials[12], a new whiteness index (WI_D) has started to be used.[13] In the CIEDE2000 system, perceptibility threshold values (PT) are specified as ΔE_{00}>0.8 and the acceptability threshold value (AT) as ΔE_{00}≤1.8.[14] In the whiteness index, PT value is specified as ΔWI_D: 0.72 and AT value as ΔWI_D: 2.6.[14]

Although modeling liquids are widely used, their effects on the physical and surface properties of composite resins are limited in the literature. The aim of the *in vitro* study is to examine the effects of modeling liquid use on the color change and whiteness index of composite resins. Our first null hypothesis is that using modeling liquid will not affect the color change of composite resins. Our second null hypothesis is that using liquid modeling will not affect the whiteness index change of composite resins.

Materials and Methods

In our study, Omnichroma (Tokuyama Dental, Tokyo, Japan), Estelite Asteria A2B (Tokuyama Dental, Tokyo, Japan), Clearfil Majesty Esthetic A2 (Kuraray Noritake, Tokyo, Japan) and G-aenial A'Chord A2 (GC Corporation, USA) composite resins used (Table 1). Samples of 8 mm in diameter and 2 mm in height were prepared from the composite resins using a silicone mold. In the preparation of the samples, composite resins were placed in the space above the silicone mod with a mouth spatula. Then, one group was polymerized by placing a 1 mm thick glass (lamel) on the mylar strip, while the other group was smoothed with a brush (Composite Brush, GC, Japan) on which the top layer of modeling liquid (Modeling Liquid, GC, Japan) was applied, and then it was polymerized by placing 1 mm thick glass (lamel) on the mylar strip. In the polymerization of composite samples, the LED light device (DTE LUX E, Germany) was used as for 20 seconds at 1000 mW/cm² power. A total of 96 samples were prepared, as 24 from each material (n:8).

Table 1 Properties of composite resin materials used in the study

Materials	Composition		Filler content (w/w)	Lot Number
	Matrix	Filler		
Clearfil Majesty Esthetic A2 (Kuraray Noritake, Tokyo, Japan)	Bis-GMA	Barium glass filler, micro glass filler (1.5 µm), nano glass filler (20 nm), pre-polymerized organic filler	78/66	870033
Estelite Asteria (Tokuyama Dental, Tokyo, Japan)	Bis-EMA TEGDMA UDMA	Supra-nano spherical filler, Composite filler (260 nm spherical SiO_2-ZrO_2)	%82	200912A
G-aenial A'Chord A2 (GC Europe, Tokya, Japon)	Bis-EMA TEGDMA UDMA	Barium glass filler (300 nm), fumed silica (16 nm), silica glass (3 nm)	%82	200912A
Omnichroma (Tokuyama Dental, Tokyo, Japan)	TEGDMA UDMA	Supra-nano spherical filler, Composite filler (260 nm spherical SiO_2-ZrO_2)	79/68	00E639
Modeling Liquid (GC Europe, Tokya, Japon)	UDMA, 2-hydroxyethyl methacrylate,3 dimethacryloxy propane, 2-hydroxy-1		-	2102161

*BisGMA: Bisfenol diglisidilmethacrylate, UDMA: üretan dimethacrylate, TEGDMA: trietilenglikol dimethacrylate, Bis-EMA, bisphenol A ethoxylate dimethacrylate.

Two-step finishing and polishing systems (Clearfil Twist Dia, Kuraray, Japan) were used in the finishing and polishing of the prepared samples. The finishing and polishing of the samples of composite resins was carried out for 20 seconds under water cooling at 10.000 rpm. Finishing and polishing was not used to the control group. After finishing and polishing processes, composite samples were kept in incubator (FN 500, Nüve, Turkey) for 24 hours in distilled water at 37°C.

After the composite samples were kept in distilled water for 24 hours, the initial color (L *, a * and b * values) of the samples belonging to each group were measured using a spectrophotometer device (Vita Easyshade V; VITA Zahnfabrik, Germany) under D65 lighting conditions. Color measurements of composite samples were made with three measurements from the center point of the same sample.

After determining the initial color of the composite samples, they were kept in coffee (Nescafe Classic, Turkey) in the incubator (FN 500, Nüve, Turkey) for 30 days at 37°C. Color measurements of the samples on the 7th and 30th days were made with a spectrophotometer device (Vita Easyshade V; VITA Zahnfabrik, Germany) and L*, a* and b* values were recorded. The coffee solution was prepared by dissolving 2 grams of coffee powder and 200 ml of boiled distilled water in line with the manufacturer's recommendation. The prepared coffee solution was added to the samples at 37 °C. It was also replaced with a new coffee solution every 24 hours. The CIEDE2000 formula (ΔE_{00}) and whiteness index (WI_D) was used to calculate color changes in composite resins based on L*, a* and b* parameters.

Statistical data analysis was performed using SPSS 22.0 Statistical Program (SPSS Inc., Chicago, IL, USA). Color change and whiteness index change values of composite resins at the end of 7th and 30th days were evaluated using one-way analysis of variance (ANOVA) and Tukey multiple comparison test ($p<0.05$).

Results

A statistically significant difference was observed between the color change values of composite resins at the end of 7th and 30th days ($p<0.05$). One-shade composite resin (Omnichroma) showed the most color change at the end of the 7th and 30th days ($p<0.05$). The least color change was seen in supranano composite (Estelite Asteria). One of the nanohybrid composite resins, G-aenial A'Chord showed more color change than the other nanohybrid composite resin (Clearfil Majesty Esthetic) ($p<0.05$), (Table2).

There was no statistically significant difference between the color change values of the composite resin groups, with and without use of modeling liquid on the 7th and 30th days ($p>0.05$). The control group, which was not applied finishing and polishing procedure, showed the statistically highest color change ($p<0.05$).

Table 2. Color change values of composite resins at 7th and 30th days

Composite Resin	Model liquid use	7th day ΔE_{00}	30th day ΔE_{00}
Clearfil Majesty Esthetic	No	2.95 ± 0.3^{a}	3.93 ± 0.3^{a}
	Yes	3.13 ± 0.2^{a}	3.96 ± 0.2^{a}
	Control (No Polishing)	4.05 ± 0.3^{b}	6.05 ± 0.6^{b}
Estelite Asteria	No	2.50 ± 0.2^{c}	2.92 ± 0.2^{c}
	Yes	2.57 ± 0.2^{c}	3.30 ± 0.2^{c}
	Control (No Polishing)	3.52 ± 0.2^{b}	4.50 ± 0.3^{d}
G-aenial A'Chord	No	4.91 ± 0.4^{d}	6.06 ± 0.4^{b}
	Yes	5.09 ± 0.4^{d}	6.28 ± 0.4^{b}
	Control (No Polishing)	5.88 ± 0.5^{e}	7.58 ± 0.5^{e}
Omnichroma	No	14.23 ± 0.6^{f}	15.25 ± 0.6^{f}
	Yes	13.58 ± 0.5^{f}	15.42 ± 0.6^{f}
	Control (No Polishing)	14.51 ± 0.4^{f}	15.78 ± 0.8^{f}
P		0.000	0.000

*Statistical significance difference between rows (a-f). $p<0.001$

Table 3. Whiteness index change values of composite resins on the 7th and 30th days

Composite Resin	Model liquid use	Basaline WI_D	7th day ΔWI_D	30th day ΔWI_D
Clearfil Majesty Esthetic	No	8.02 ± 0.5^{a}	4.21 ± 0.5^{a}	5.48 ± 0.5^{a}
	Yes	7.50 ± 0.5^{a}	4.08 ± 0.3^{a}	4.97 ± 0.5^{a}
	Control (No Polishing)	9.82 ± 0.4^{b}	8.72 ± 0.4^{b}	13.35 ± 0.9^{b}
Estelite Asteria	No	4.58 ± 0.3^{c}	4.59 ± 0.3^{a}	5.26 ± 0.4^{a}
	Yes	4.28 ± 0.4^{c}	4.49 ± 0.3^{a}	4.96 ± 0.4^{a}
	Control (No Polishing)	5.72 ± 0.5^{d}	7.86 ± 0.5^{c}	11.79 ± 0.8^{c}
G-aenial A'Chord	No	4.44 ± 0.5^{c}	5.95 ± 0.9^{d}	7.14 ± 0.6^{d}
	Yes	4.23 ± 0.5^{c}	6.69 ± 0.8^{d}	7.37 ± 0.8^{d}
	Control (No Polishing)	4.19 ± 0.5^{c}	9.09 ± 0.9^{b}	12.49 ± 0.6^{b}
Omnichroma	No	44.08 ± 1.2^{e}	26.89 ± 2.5^{e}	32.37 ± 0.8^{e}
	Yes	42.32 ± 1.3^{e}	25.96 ± 1.8^{e}	32.33 ± 1.1^{e}
	Control (No Polishing)	41.37 ± 0.8^{e}	27.86 ± 1.4^{e}	34.88 ± 1.4^{e}
P		0.000	0.000	0.000

*Statistical significance difference between rows (a-f). $p<0.001$

A statistically significant difference was observed between the whiteness index change values of composite resins at the end of 7th and 30th days ($p<0.05$). One-shade composite resin (Omnichroma) showed the highest whiteness index change at the end of the 7th and 30th days ($p<0.05$). There was no statistically significant difference between the whiteness index change values of the supranano composite (Estelite Asteria) and the nanohybrid composite (Clearfil Majesty Esthetic) at the 7th and 30th days (Table 3).

Composite resin groups with and without use of modeling liquid did not show statistically significant difference between the whiteness index change values on the 7th and 30th days ($p>0.05$). The control groups in all composite resins, which did not used finishing and polishing processes showed statistically the highest whiteness index change ($p<0.05$).

Color and whiteness index change values of composite resins increased over time. The color and whiteness index change values of the composite resins at the end of the 7th and 30th days exceeded the AT value (ΔE_{00}:1.8, WI_D:2.6).

Discussion

The use of composite resins with modeling liquid in the restoration of teeth facilitates the finishing procedure of the restoration and provides a significant time saving for the dentist. However, doubts have arisen about the changes that may occur in the color stability of composite restorations over time due to the compounds of modeling liquids.[15,16] In this *in vitro* study, the effect of modeling liquid used with a brush on the color and whiteness index changes of composite resins was studied. As the modeling liquid did not affect the color and whiteness index changes of the composite resins, our first and second null hypotheses were accepted.

Although the many properties of composite resins, which are widely used in the restoration of teeth, have been improved, the surface roughness obtained after finishing and polishing affects the clinical success of the material. Low surface roughness increases the esthetic appearance and success of composite resins, while rough surfaces cause plaque accumulation, recurrent caries and discoloration of the restoration.[17] It has been reported in the literature that the diamond-containing finishing and polishing system creates less color change on composite resins.[18,19] For this reason, a two-step diamond finishing and polishing system was used in our study.

Color changes in dental materials are related to many internal and external factors.[20] Although beverages show different color changes on dental materials, red wine, coffee and tea cause the most color changes.[21] As a result of the yellow coloring pigment in coffee, it is effective in the color change of composite resins.[22] In our study, coffee was preferred in the examination of the color change of composite resins.

Due to the difference in the refractive index of the composite resins before and after polymerization, the translucency of the material increases after polymerization. Increasing the translucency made possible the composite resin structure that responds to light waves at a certain frequency and reflects a certain wavelength in it.[23] It is reported that single shade composite resins with increased translucency match a wide range of colors in a one-shade and are compatible with all tooth tones.[24,25] The very high initial WI_D value of the one-shade composite resin in our study can be explained by their translucency. However, after being kept in coffee, it was observed that the ΔE_{00} and WI_D value decreased more than the composite resins in the multi-shade system. It is considered that this decrease in the WI_D value causes single shade composites to show more color changes.

As a result of the increase in the amount of resin contained in dental materials, the amount of water absorption increases, creating hydrolytic degradation in the material. Substances separated from the structure of the material by hydrolytic degradation can cause physical and optical properties to change. Water absorbed by the polymer matrix has been reported to increase coloring by causing the bond between the matrix and the filler to break or hydrolytic decomposition of the filler itself.[26] In addition, as Bis-GMA causes rigid network formation, it is reported that composites whose main monomer content is Bis-GMA shows less water absorption than composites containing TEGDMA and more than composites containing UDMA and Bis-EMA.[27] There is UDMA monomer in the structure of the modeling liquid we used in our study.

It has been reported in the literature that modeling liquids can be successful in increasing the adaptation between the composite layers and preventing the coloration of the composites.[28,29] Bayraktar et al. reported that modeling agents reduce the surface microhardness of composite resins, but Modeling Liquid (GC, Japan) can be used as a safer wetting agent in terms of surface microhardness.[6] The modeling liquid (Modeling Liquid, GC) we used in our study did not make a statistical difference on the color and whiteness index changes of the composite resins.

The acceptability threshold value (AT), which is an important factor for evaluating the color stability of dental materials, has been specified as 50:50% AT value ΔE_{00}:1.8 and ΔWI_D:2.6 in the literature.[14] Sulaiman et al. reported in their study on the color stability of composite resins (in coffee and grape juice) that all composite resins showed a color change over 50:50% AT.[30] Composite resin groups in our study with and without modeling liquid showed a color and whiteness index change over 50:50% AT.

This study is an *in vitro* study inducing stains on both sides of the restorative material. In clinical use, only the outer surface of the restored tooth is exposed to beverages. In addition, consumed drinks can be diluted in the mouth with saliva. Although it was observed that the use of modeling liquid in our study did not affect the color and whiteness index change of the material, it is considered that it would be beneficial to conduct clinical studies on this subject.

Conclusions

According to the results of our *in vitro* experiment in which we examined the effect of composite modeling liquid on the color stability of composite resins;

- One-shade composite resin in coffee showed more color and whiteness index changes than composites with multiple color system.
- The use of modeling liquid did not affect the color and whiteness index changes of the composite resins.

Although the composite resins were shaped with modeling liquid, the color and whiteness index change values were above the AT value.

Acknowledgements

The study was not funded by any grants or external funding.

Conflicts of Interest Statement

The authors declare that they have no conflict of interest.

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Cumhuriyet Dental Journal, 25(Suppl): 124-129, 2022
DOI: https://doi.org/10.7126/cumudj.1032472

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Comparison of Four Different Endodontic Rotary Systems in Terms of Cyclic Fatigue#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 04/12/2021
Accepted: 17/03/2022

ABSTRACT

Objectives: The aim of this study was to compare four endodontic rotary systems in terms of cyclic fatigue.
Material and Methods: 25/08 Twisted File (TF), TF Adaptive, Reciproc and WaveOne rotary files were used to test the cyclic fatigue strength in this study. Four different artificial canals, compatible with the file size and taper, were created, with the curvature angle and radius of 45°-2 mm, 60°-2 mm, 45°-5 mm and 60°-5 mm, respectively. The front surface of the artificial canals was covered with a removable glass plate. The files were operated in the canals according to their own working principles until they fractured. The fracture time was determined by using a chronometer with 1/100 second accuracy and the cyclic fatigue strength was evaluated according to the time until fracture occurs. A total of 40 files, 10 in each canal, were used in each group. SPSS program was used for statistical analysis. Mann-Whitney U test was applied for pairwise comparisons. Bonferroni correction was applied and P< .008 was considered as statistically significant.
Results: In all canals, fracture time was the highest for Reciproc files, followed by WaveOne, TF Adaptive and TF files, respectively. For the canal curvature of 45°-2 mm, the Reciproc files were significantly more resistant to fracture than the others. While there was no significant difference between TF Adaptive and TF, WaveOne was significantly more resistant than both groups. In canals with the curvature of 60°-2 mm and 45°-5 mm Reciproc and WaveOne were significantly more resistant to fracture than TF Adaptive and TF. In addition, TF Adaptive was significantly more resistant than TF. For the curvature of 60°-5 mm, the difference between all groups was significant.
Conclusions: Regardless of the canal curvature, the Reciproc exhibited the highest cyclic fatigue strength, while the TF showed the lowest fatigue strength.

Keywords: Rotary File, Cyclic Fatigue, Continuous Rotation, Reciprocation, Adaptive Motion.

Dört Farklı Endodontik Döner Eğe Sisteminin Döngüsel Yorgunluk Açısından Karşılaştırılması#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 04/12/2021
Kabul: 17/03/2022

ÖZ

Amaç: Bu çalışmanın amacı dört endodontik döner eğe sisteminin döngüsel yorulma dayanımının karşılaştırılmasıdır.
Gereç ve Yöntemler: Çalışmamızda döngüsel yorulma dayanımını test etmek üzere 25/.08 Twisted File (TF), TF Adaptive, Reciproc ve WaveOne eğeler kullanıldı. Eğe boyutunu ve taperını taklit edecek şekilde, eğrilik açısı ve yarıçapı sırasıyla 45°-2 mm, 60°-2 mm, 45°-5 mm ve 60°-5 mm olan 4 farklı yapay kanal oluşturuldu. Yapay kanalların ön yüzeyi takılıp çıkarılabilir cam bir levha ile örtüldü. Eğeler kanallar içerisinde kendi çalışma prensiplerine göre kırılana kadar çalıştırıldı. 1/100 saniye hassasiyetinde bir kronometre yardımıyla kırılma süresi tespit edildi ve döngüsel yorulma dayanımı kırılma oluşana kadar geçen süreye göre değerlendirildi. Her grupta, her kanalda 10 adet olmak üzere toplam 40 eğe kullanıldı. İstatistiksel analiz için SPSS programı kullanıldı. İkili karşılaştırmalar için Mann-Whitney U testi yapıldı. İstatistiksel anlamlılık için Bonferroni düzeltmesi uygulandı ve P<0.008 istatistiksel olarak anlamlı kabul edildi.
Bulgular: Bütün kanallarda kırılma süresi Reciproc eğelerde en yüksek olup bunu sırasıyla WaveOne, TF Adaptive ve TF eğeler izledi. 45°-2 mm eğimli kanalda Reciproc eğeler kırılmaya karşı diğerlerine göre anlamlı derecede daha dayanıklıydı. TF Adaptive ile TF arasında anlamlı fark bulunmazken (P= .041), WaveOne her iki gruba göre anlamlı derecede daha dayanıklıydı. 60°-2 mm ve 45°-5 mm eğimli kanallarda Reciproc ve WaveOne, kırılmaya karşı TF Adaptive ve TF'ye göre anlamlı derecede daha dayanıklıydı (P< .001). Ayrıca TF Adaptive da TF'ye göre anlamlı derecede daha dayanıklıydı. 60°-5 mm eğimli kanalda ise bütün gruplar arasındaki fark anlamlıydı.
Sonuçlar: Kanal eğimine bağlı olmaksızın en yüksek döngüsel yorulma dayanımını Reciproc eğeler sergilerken, TF eğeler en düşük yorulma dayanımını gösterdi.

Anahtar kelimeler: Döner Eğe, Döngüsel Yorulma, Devamlı Rotasyon, Resiprokasyon, Adaptif Hareket

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How to Cite: Şanal Çıkman A, Ceyhanlı KT. (2022) Comparison of Four Different Endodontic Rotary Systems in Terms of Cyclic Fatigue, Cumhuriyet Dental Journal, 25(Suppl):124-129.

Introduction

Nickel titanium (NiTi) rotary instruments has benefited endodontic practice by increasing speed and quality with reduced procedural errors in chemomechanical root canal preparation.[1,2] However, despite its obvious advantages, NiTi rotary instruments carry a high risk of fracture during use, especially in curved root canals, which adversely affects the prognosis of the treated tooth.[3]

The main causes of file fracture are cyclic fatigue and torsional fatigue. Cyclic fatigue occurs as a result of the repetitive compressive and tensile stress that the file is subjected, at the point of curvature while continuing to rotate freely in the canal. Torsional fatigue occurs when the tip of the file is locked in the root canal while the body of it continues to rotate.[4] Torsional fatigue can be predicted by signs of plastic deformation, whereas cyclic fatigue fractures occur with little or no plastic deformation.[5,6]

With the technological developments, new production techniques, different kinematics and advanced alloys that increase the cyclic fatigue resistance of NiTi files have come to the fore. [7] NiTi files produced with M-wire and R-phase technology have been shown to have higher cyclic fatigue resistance compared to conventional NiTi files.[8,9] It has also been suggested that reciprocating motion extends the life of files by increasing cyclic fatigue resistance compared to continuous rotation.[10,11]

Reciproc (VDW, Munich, Germany) is a single file system made of M-wire alloy, and works with reciprocation, 150° counterclockwise (CCW) and 30° clockwise (CW). It has three different sizes, R25, R40 and R50, the tip diameters and apical tapers of which are 25/.08, 40/.06 and 50/.05, respectively. These files have an S-shaped cross-section, a non-cutting tip, and sharp cutting edges.[12]

WaveOne (Dentsply Maillefer, Ballaigues, Switzerland) is another file system made of M-Wire alloy, that works with reciprocation (170° CCW-50° CW). It has three different sizes, Small, Primary and Large, with the tip diameters and tapers of 21/.06, 25/.08 and 40/.08, respectively.[13] The files have a modified convex triangular cross-section with radial areas in the apical, and a convex triangular cross-section without radial areas in the middle and coronal sections.[14]

Twisted File (TF; SybronEndo, Orange, CA, USA) system is produced by R-phase technology and shaped by bending. In addition, electrochemical surface polishing is applied to the surfaces of the files. TF system works with continuous rotation movement, and offers multiple file possibilities with different tip diameters and tapers. In addition, the cross-section of these files is triangular and they have a safe tip design.[15]

TF Adaptive file system (SybronEndo, Orange, CA, USA) works with adaptive motion. It performs interrupted continuous rotation (600°-0) when the file is subjected to little or no stress in the root canal. Depending on the stress that occurs during shaping, the system changes into reciprocation mode, reducing the risk of intra-canal failure. The reciprocation angles are not constant, and they vary from 600°-0 to 370°-50° depending on the anatomical difficulty and the intracanal stress on the file.[16] There are two file groups in this file system, SMALL (SM) and MEDIUM/LARGE (ML). The SM group includes files 20/.04, 25/.06 and 35/.04. The ML group consists of files numbered 25/.08, 35/.06 and 50/.04.

The aim of this study was to compare TF, TF Adaptive, WaveOne and Reciproc systems in terms of cyclic fatigue in curved root canals and to contribute to clinical practice in determining a reliable system for root canal shaping. The null hypothesis was that there was no difference in cyclic fatigue strength between file groups.

Materials and Methods

In the present study, TF 25/.08, Twisted File Adaptive ML-1, Reciproc R25 and WaveOne Primary files, each with 0.25 mm tip diameter and 8% taper, were used to test the cyclic fatigue strength. A custom-made static test device and artificial canals were prepared for this study by Karadeniz Technical University, Department of Mechanical Engineering.

Four different artificial canals imitating the size and taper of the files were prepared in a stainless steel block with the curvature angle and radius of 45°-2 mm, 60°-2 mm, 45°-5 mm and 60°-5 mm. The working length was 19 mm and the point of maximum curvature was 7 mm from the apex. The front surface of the artificial canals was covered with a removable glass plate so that the fracture of the file can be seen and the fractured piece can be removed easily (Figure 1).

Figure 1. The artificial root canals with the curvature angle and radius of 45°-2 mm, 60°-2 mm, 45°-5 mm and 60°-5 mm, respectively.

A total of 40 files, 10 for each canal, were used from each file group. WaveOne and Reciproc files were used with VDW Reciproc Silver (VDW GmbH, Munich, Germany) in WAVEONE ALL and RECIPROC ALL programs, respectively. TF and TF Adaptive files were used with Elements Motor (California, USA) in continuous rotation and adaptive programs, respectively. Each file was adjusted to the working length and placed in the test device. The artificial canal was filled with glycerine prior to insertion of each file to reduce friction and associated heat during testing. The file was operated in the artificial canal

according to the manufacturer's instructions until the fracture occurred (Figure 2). A chronometer with an accuracy of 1/100 seconds was operated simultaneously with the endodontic motor and it was stopped as soon as the file fractured, and the fracture time was recorded.

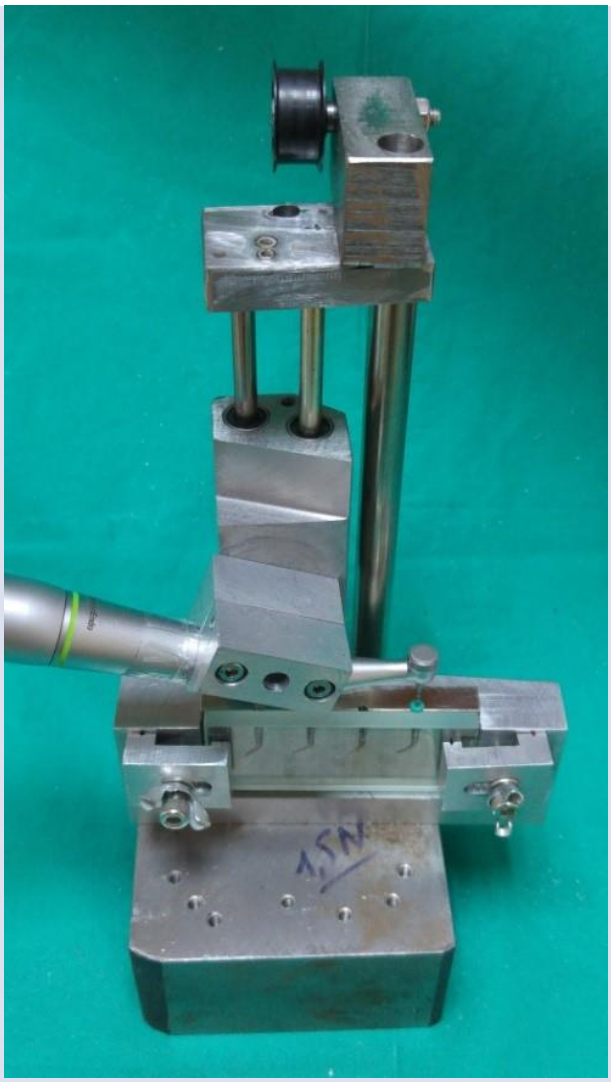

Figure 2. The cyclic fatigue test device

Statistical Analysis

SPSS (SPSS version 21.0; SPSS, IBM; Chicago, IL, USA) program was used in the statistical analysis. The distribution of the data was analyzed by applying the Shapiro-Wilk test. As the data weren't normally distributed, the Kruskal-Wallis test was applied. Mann-Whitney U test was used for pairwise comparisons. P<0.05 value was considered statistically significant. Bonferroni correction was applied for pairwise comparisons (P<0.008).

Results

The fracture time of the file groups for each artificial canal were given as mean, standard deviation, minimum and maximum values in Table 1-4.

In the artificial canals with the curvature angle and radius of 45°-5 mm and 60°-2 mm there was no significant difference between Reciproc and WaveOne (P=0.034 and P=0.070, respectively), and they exhibited significantly higher fatigue strength compared to TF Adaptive and TF groups (P<0.001). In addition, the TF Adaptive group was significantly more resistant to cyclic fatigue compared to the TF group (P<0.008) (Table 1, 2).

In the artificial canal with the curvature angle and radius of 45°-2 mm, the Reciproc group exhibited significantly the highest fracture time, thus the highest cyclic fatigue strength (P<0.008). This was followed by WaveOne, TF Adaptive and TF groups, respectively. The WaveOne group exhibited significantly higher fatigue strength than the TF Adaptive and TF groups (P<0.001). There was no significant difference between TF Adaptive and TF groups (P=0.041) (Table 3).

In the artificial canal with the curvature angle and radius of 60°-5 mm, the Reciproc group exhibited the highest fracture time (P<0.001). This was followed by WaveOne, TF Adaptive and TF groups, respectively. The difference was statistically significant between all groups (P<0.008) (Table 4).

Discussion

While it is ideal to perform cyclic fatigue test on curved canals of extracted human teeth, each file should be tested on a different tooth as the root canal shape will change during preparation. For this reason, standardization of the experimental conditions is difficult because the canal structure of each tooth is different from each other.[17] Therefore, artificial canals imitating the size and taper of the file have been used instead of human teeth.[18] These allow the files to follow a constant and repeatable path in accordance with the determined curvature values, and to be compared with each other under standard conditions.[19] So, in the present study the cyclic fatigue test was performed on artificial canals reflecting file size and taper.

There is a positive correlation between file fractures caused by cyclic fatigue and the curvature angle of the root canal.[20] The root canals with a curvature angle of more than 30° are considered difficult.[21] To date, different values of curvature radius, such as 2 mm, 5 mm or 10 mm used for cyclic fatigue test, and it has been reported that the radius of curvature also affects the cyclic fatigue of NiTi files. The cyclic fatigue strength of the files decreases as the radius decreases.[20,22-24] In addition, in most of the studies in the literature, the center of the curvature was determined at a distance of 5-7 mm from the file tip.[4] Considering these literature data, the curvature angles of the artificial canals were determined as 45° and 60°, and the curvature radii were determined as 2 mm and 5 mm in the present study. Thus, we used four different artificial canals, from the most difficult to the easiest, with the curvature angle and radius of 60°-2 mm, 60°-5 mm, 45°-2 mm and 45°-5 mm, respectively. And it was found that as the severity of the canal increased, the time to fracture of the files was decreased in all experimental groups.

Table 1. Fracture time values in the canal with the curvature of 45°-5 mm (sec)

Groups	Mean	Standard Deviation (±)	Minimum	Maximum
Reciproc	402.03[a]	74.51	265.05	518.32
WaveOne	319.78[a]	59.64	254.38	453.61
TF daptive	113.30[b]	15.08	93.89	144.28
Twisted File	81.66[c]	9.38	66.98	99.09

Superscripts with different letters indicate statistical significance (P<0.008)

Table 2. Fracture time values in the canal with the curvature of 60°-2 mm (sec)

Groups	Mean	Standard Deviation (±)	Minimum	Maximum
Reciproc	154.28[a]	33.03	98.55	200.15
WaveOne	131.41[a]	30.90	89.11	199.45
TF Adaptive	66.28[b]	11.52	43.97	82.71
Twisted File	51.88[c]	7.63	43.27	71.31

Superscripts with different letters indicate statistical significance (P<0.008)

Table 3. Fracture time values in the canal with the curvature of 45°-2 mm (sec)

Groups	Mean	Standard Deviation (±)	Minimum	Maximum
Reciproc	285.49[a]	56.43	232.83	395.04
WaveOne	217.15[b]	33.60	174.92	267.67
TF Adaptive	86.29[c]	13.45	67.32	108.73
Twisted File	71.31[c]	14.50	53.24	93.23

Superscripts with different letters indicate statistical significance (P<0.008)

Table 4. Fracture time values in the canal with the curvature of 60°-5 mm (sec)

Groups	Mean	Standard Deviation (±)	Minimum	Maximum
Reciproc	208.62[a]	19.99	171.14	252.34
WaveOne	156.80[b]	25.44	110.25	188.68
TF Adaptive	77.67[c]	15.09	56.23	107.06
Twisted File	58.44[d]	13.60	37.11	73.77

Superscripts with different letters indicate statistical significance (P<0.008)

To date, in cyclic fatigue studies, the time to fracture or the number of cycles until fracture (NCF) is used for the evaluation of fatigue resistance.[25,26] The NCF is calculated by multiplying the time to fracture (seconds) by 1/60 of the rotation per minute (NCF= time x rpm/60) However, in adaptive motion it is difficult to calculate the NCF accurately, as the operating mode and rpm value is modified according to the canal anatomy and the stress on the file.[27] Therefore, in the present study, the cyclic fatigue was compared according to the time to fracture.

The studies evaluated cyclic fatigue strength of NiTi rotary files have revealed that kinematics significantly affects the cyclic fatigue. Completing 360° rotations in 1 cycle in continuous rotation movement leads to increased stress on the file and further expansion of the surface cracks. The tensile stresses concentrate at a certain point of the file and cause the file to fracture.[28] In the reciprocating motion, since the full rotation is completed with more than one cycle, the stress is distributed to different points on the working part of the file and reduces the opening of surface cracks.[29] In addition, since the progression angle of each reciprocating system is determined not to exceed the elastic limit of the file, this movement increases the resistance against torsional and cyclic fractures.[30]

Castello-Escriva *et al.* compared the cyclic fatigue strength of 25/.08 size ProTaper F2, WaveOne and TF files and concluded that reciprocating WaveOne files exhibited higher fatigue strength than TF and ProTaper files with continuous rotation.[31] In addition, Kim *et al.* evaluated the cyclic fatigue of ProTaper F2, Reciproc and WaveOne files, and reported that Reciproc files exhibited the highest fatigue strength and both reciprocation systems were significantly more resistant to cyclic fatigue compared to ProTaper F2.[13] Consistent with these studies, it was revealed in the present study that Reciproc and WaveOne groups exhibited significantly higher cyclic fatigue strength compared to TF group in all artificial canals, supporting that cyclic fatigue strength is higher in reciprocating motion than in rotational motion. Thus, the null hypothesis was rejected.

Pedulla *et al.* evaluated the cyclic fatigue of Reciproc R25, WaveOne Primary, Mtwo (25/.06) and TF (25/.06) files used with Reciproc ALL, WaveOne ALL and continuous rotation mode, in an artificial canal with the curvature angle and radius of 60°-5 mm.[32] It was determined that both reciprocation modes significantly increased the fatigue strength compared to the rotation mode, in line with other studies. However, when each system was used with its own movement, it was found that TF group with rotation movement exhibited the greatest fatigue strength, followed by Reciproc, Mtwo and WaveOne files, respectively. While there was no significant difference between TF, Reciproc and Mtwo,

cyclic fatigue strength was found to be significantly lower in the WaveOne group compared to the others. These findings contradict our study. The difference between the two studies can be attributed to the taper of the files used. In the study of Pedulla *et al.*, 06 tapered TF files were compared with 08 tapered WaveOne and Reciproc files, while all files compared in the present study were 08 tapered. The files with smaller cross-sections are expected to show greater resistance to cyclic fatigue because they are more flexible.[17] So, the longer fatigue life of TF files despite their rotational motion might have been due to their smaller cross-sectional area.

The progression angle of reciprocation also affects the cyclic fatigue of NiTi files. An increase in the progression angle decreases the cyclic fatigue strength.[33,34] In the present study, Reciproc and WaveOne groups exhibited reciprocation movements of 150° CCW-30° CW and 170° CCW-50° CW, respectively, and both had a progression angle of 120°. As the adaptive movement adapts automatically to the stress that occurs in the root canal during preparation, no clear information can be obtained about the progression angle in TF Adaptive group. However, as the angle of adaptive motion varies from 600°-0 to 370°-50°, in the present study the progression angle of TF Adaptive group was expected to be higher than that of the Reciproc and WaveOne groups. Therefore, the lower fatigue strength of the TF Adaptive group compared to the Reciproc and WaveOne groups may be attributed to the higher progression angle.

Higuera *et al.* compared the cyclic fatigue strength of TF Adaptive M-L1, Reciproc R25 and WaveOne Primary files in a stainless steel artificial canal with the curvature angle and radius of 60°- 5 mm, using each group with its specific kinematic. [35] According to the findings of this study, the TF Adaptive M-L1 group exhibited the highest fatigue strength and followed by the Reciproc R25 group, with no significant difference between them. The WaveOne Primary group, on the other hand, exhibited significantly lower fatigue strength than the other groups. Our findings are not compatible with the findings of this study. The difference in the results of these two studies can be attributed to the evaluation parameter used. While fracture time values were used for analysis in the present study, NCF was used in Higuera *et al.*'s study. In addition, there is no information about the location of the curvature center, showing the maximum stress point, in Higuera *et al.*'s study. In the artificial canals used in the present study, the center of curvature was adjusted to be 7 mm away from the apex. The location of the center of curvature is an important parameter for cyclic fatigue, as the fatigue strength decreases as the file diameter at the maximum stress point increases.[24]

Özyürek *et al.* also compared the cyclic fatigue strength of TF Adaptive ML-1, Reciproc R25 and WaveOne Primary files according to NCF in an artificial canal with a curvature angle and radius of 60°- 5 mm.[36] During the test, they detected the real rpm values of the files by recording a slow-motion video with a high speed camera, and these values were used for calculating NCF. In conclusion, unlike Higuera *et al.* they obtained similar results with our study.

In a study on Reciproc and WaveOne files, Plotino *et al.* found that Reciproc files exhibited significantly greater cyclic fatigue strength and stated that this result could be associated with the smaller metal mass of Reciproc files at the maximum stress point. [37] Kim *et al.* compared Reciproc R25, WaveOne Primary and ProTaper F2 files, and they reported that both reciprocating systems were more durable than ProTaper, and Reciproc R25 files showed higher fatigue strength compared to WaveOne files. As a further evaluation, the authors measured the cross-sectional area of each file at the D5 level and found that WaveOne files had the highest cross-sectional area (323,000 μm^2), and Reciproc files the lowest (275,000 μm^2). In line with these findings, they attributed the high fatigue strength of Reciproc files to their S-shaped design and small cross-sectional area at the point of maximum curvature.[13] Additionally, Sekar *et al.* examined the effect of cross-sectional design on fatigue strength in files used with reciprocating motion, and found that S-shaped Mtwo files exhibited higher fatigue strength compared to Revo-S SU with triple helical cross-section, and OneShape with the cross section of triple helical in apical and S-shaped in coronal.[38] Consistent with these studies, the higher fatigue strength of Reciproc group compared to WaveOne, can be attributed to their S-shaped cross-section and smaller cross-sectional area at the point of maximum curvature.

Conclusions

Within the limitations of our study; reciprocation (Reciproc, WaveOne) was found to be related with higher fatigue strength compared to rotational motion (TF), and files with higher progression angle (TF Adaptive) exhibited lower fatigue strength. It was also determined that the cross-sectional design of the files, as well as the kinematics, could be effective on their cyclic fatigue strength.

Acknowledgement

This study was supported by the Scientific Research Fund of Karadeniz Technical University in Rize/Turkey. (No: TDK-2015-5185). The all authors have contributed significantly and authors deny any conflicts of interest.

We would spesifically like to thank Prof. Dr. Tevfik Küçükömeroğlu for great contribution of preparing test device and artificial canals.

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Cumhuriyet Dental Journal, 25(Suppl): 130-133, 2022
DOI: https://doi.org/10.7126/cumudj.1061217

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

The Effect of Dental Anxiety Levels of Medical Faculty Students on Oral Hygiene Behaviors#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History
Received: 05/12/2021
Accepted: 16/03/2022

ABSTRACT

Aims: Aimed to evaluate the effect of dental anxiety levels of students at Sivas Cumhuriyet University Faculty of Medicine on oral hygiene behaviors.

Materials and Methods: It is descriptive, cross-sectional study and carried out between September-October 2021. It was applied online to 216 volunteers from class I-V students. Students were asked about their sociodemographic characteristics, oral hygiene behaviors and Corah Dental Anxiety Scale (C-DAS). The C-DAS questionnaire is in 5-point Likert type consisting of 4 questions (Min: 4-max: 20 points). Analyzes were made with the SPSS 25 program. Descriptive statistics, independent sample T-test were performed.

Results: 50% (n=108) of the students were women. 78.2% (n=169) had never smoked. 33.3% (n=72) of them started brushing regularly before age of six. 58.8% (n=127) were brushing their teeth at least twice a day. The rate of brushed their teeth correctly was 49.5% (n=107). Only 24.5% (n=53) of the students changed their toothbrush every three months. Students' use of additional dental hygiene tools other than toothbrushes respectively; toothpick (37.5%, n=81), dental floss (32.4%, n=70), mouthwash (26.9%, n=58), interface brush (6%, n=13), miswak (3.7%, n=8). The mean C-DAS score was 8.8±3.7 (min:4-max:20). The mean score was significantly higher for female students (9.5±3.7) than the males (8.0±3.5) and those who had a toothache (9.5±4.1) in the last year than the others (8.1±3.2). There was no significant difference between C-DAS score and brushing teeth twice a day or more. There was no significant difference between the use of additional dental hygiene tools and C-DAS score.

Conclusion: Dental anxiety was found to be higher in women and those who had toothache in the last year. It was determined that anxiety did not affect the dental hygiene behavior.

Key Words: Dental Anxiety, Medical Students, Oral Hygiene Behaviors.

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How to Cite: Karahan S, Agadayı E. (2022) The Effect of Dental Anxiety Levels of Medical Faculty Students on Oral Hygiene Behaviors, Cumhuriyet Dental Journal, 25(Suppl): 130-133.

Introduction and Aim

Anxiety about the dentist and treatment is considered to be one of the common anxieties that people have. Dental anxiety includes fears of different severity, such as not liking going to the dentist, worrying, excessive fear, showing symptomatic symptoms (excessive sweating or feeling unwell as if she has a physical illness).[1] Dental anxiety negatively affects the quality of life of individuals by creating physiological, intellectual and behavioral differences in the patient and creating negative effects on both oral health and general health. Fear of dentistry; Many factors such as age, gender, characteristics of the planned treatment procedure, and education level are related.[2] In general, it is seen that the anxiety levels of women and low-income individuals are higher than other segments of the society.[3] Different results have been obtained in studies examining the effects of dental fear and anxiety on oral hygiene behaviors of individuals.[4] While Ay et al. reported that dental anxiety had no effect on individuals' brushing habits and use of dental hygiene tools such as dental floss, toothpicks and miswak [5,6] in a different study, it was reported that these individuals brushed their teeth less frequently.[7] When we examined the results of studies investigating whether dental fear and anxiety have an effect on oral health, it was found that individuals with high anxiety had fewer teeth, had more decayed teeth and missing teeth, and had more dental pathology in these patients.[8,9]

In our study, we aimed to evaluate the effect of dental anxiety levels of students studying at Sivas Cumhuriyet University Faculty of Medicine (SCUTF) on oral hygiene behaviors.

Materials and Methods

It is a descriptive, cross-sectional study. Our research was applied to class 1-5 students who were studying at SCUTF in the 2020-2021 academic year and accepted to participate in the study. The research was conducted between September and October 2021.The research questionnaire was sent to the participants online from the student communication platform. First of all, information about the study was given from the platform. Informed consent of the participants was obtained from the page opened before the survey.

The data form used in the study consisted of 21 questions in total. The first 17 questions were about socio-demographic information and oral hygiene behaviors of students. The next 4 questions were the Corah Dental Anxiety Scale (C-DAS).[10] This scale measures how much anxiety people feel about dental treatment related interventions. Seydaoğlu et al. A Turkish validity study was conducted by in 2006.[11] Chronbach's alpha value was found to be 0.81. It is a 5-point Likert type scale (Min:4-max:20 points). Those with 12 points and above were considered anxious, and those with 15 points and above were considered high anxiety. Analyzes were made with the SPSS 25 program. Frequencies for categorical variables and measures of central tendency (Mean ± Standard Deviation) for continuous variables were calculated. For data with normal distribution, the independent T test was used to compare two independent groups. A p-value of less than 0.05 was considered for statistical significance, with a 95% confidence interval.

Ethical Approval

The ethics committee of the Sivas Cumhuriyet University Non-Interventional Clinical Research approved this protocol (Approval date/number: 17.11.2021/E2021-11/42).

Results

216 students volunteered to participate in the study. 50% (n=108) of the students were women. 62.5% (n=135) of the participants were studying basic sciences and 37.5% (n=81) were studying clinical sciences. 81.9% (n=177) lived in the city center and 18.1% (n=39) lived in the county. 78.2% (n=169) of the students had never smoked, 19.0% (n=41) were currently smoking, and 2.8% (n=6) had quit. The oral hygiene behaviors of the students are shown in Table 1.

80.1% (n=173) of the students pay attention to features when selecting a new toothbrush. Content (76.4%; n=165), brand (68.1%; n=147), price (38.9%; n=84), taste (18.5%; n=40) and odor (6.5%; n=14) are the features they look for, respectively.

70.4% (n=152) of the students ate 3 or more meals a day. 14.4% (n=31) always consumed sugary foods and acidic beverages between meals, 21.3% (n=46) occasionally, 64.4% (n=139) rarely.

47.7% (n=103) of the participants had experienced toothache within the last year. The mean C-DAS score of the participants was 8.8±3.7 (min:4-max:20). When categorized 79.2% (n=171) did not have dental anxiety, 20.8% (n=45) of them had dental anxiety and 8.3% (n=18) had a high level of dental anxiety. The mean score of female students (9.5±3.7) was significantly higher than that of males (8.0±3.5) (p=0.004). The mean score of those who had a toothache in the last year (9.5±4.1) was also significantly higher than the others (8.1±3.2) (p=0.007). There was no significant difference between the C-DAS score and brushing teeth twice or more a day (p=0.556). There was no significant difference between the use of additional dental hygiene tools and the C-DAS score (p=0.280).

The answers given by the students to the C-DAS scale are shown in Table 2.

Table 1. Oral hygiene Behaviors of Students

	n	%
Age to start brushing teeth		
6 years and older	72	33.3
After 6 years	144	66.7
Tooth brushing frequency		
Not everyday	15	6.9
Once a day	74	34.3
Two or more per day	127	58.8
Toothbrush change frequency		
Quarterly	53	24.5
Once in a six month	129	59.7
Once a year or less	34	15.7
The state of brushing the teeth correctly (from the gingiva to the tooth at a 45-degree angle)		
Brushing the right way	107	49.5
Brushing the wrong way	109	51.5
Toothpaste usage amount		
Chickpea size	133	61.6
Along the brush	51	23.6
Random	32	14.8
Use of additional dental hygiene tools		
Floss	70	32.4
İnterfacial brush	13	6.0
Mouth rinse water	58	26.9
Miswak	8	3.7
Toothpick	81	37.5
Nothing	63	29.2

Table 2. Students' answers to the Corah Dental Anxiety Scale (C-DAS)

	Relaxed	A little uneasy	Tense	Anxious	So anxious**
If you had to go to the dentist tomorrow, how would you feel about it? *	21 (9.7%)	79 (36.6%)	75 (34.7%)	24 (11.1%)	17 (7.9%)
When you are waiting in the dentist's office for your turn in the chair, how do you feel?	88 (40.7%)	70 (32.4%)	31 (14.4%)	13 (6.0%)	14 (6.5%)
When you are in the dentist's chair waiting while he gets his drill ready to begin working on your teeth, how do you feel?	72 (33.3%)	81 (37.5%)	29 (13.4%)	24 (11.1%)	10 (4.6%)
You are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments which he will use to scrape your teeth around the gums, how do you feel?	96 (44.4%)	76 (35.2%)	22 (10.2%)	16 (7.4%)	6 (2.8%)

*Options; 1. I would look forward it as a reasonably enjoyable experience, 2. I wouldn't care one way or the other, 3. I would be a little uneasy about it, 4. I would be afraid that it would be unpleasant and painful, 5. I would be very frightened of what the dentist might do. ** So anxious that I sometimes break out in a sweat or almost feel physically sick.

Discussion

Our study is the first known study in the literature investigating the effect of dental anxiety levels on oral hygiene behaviors in medical students. Fear of dentistry; Many factors such as age, gender, and education level are related.[2] In different studies conducted on students in the literature, the level of dental anxiety in women was found to be higher than in men.[12,13] This situation is similar to our research.

In the study conducted by Bulut et al. on dentistry students, the mean C-DAS score of the participants (8.05±2.99) and the mean score of the students in our study (8.8±3.7) were similar (6). In our study, 20.8% of the students had dental anxiety. 8.3% had a high level of dental anxiety. In a study evaluating the dental anxiety level of university students in the USA, they found that 19% of the students had high dental anxiety at a rate similar to our study.[14]

In different studies in the literature, it has been determined that the level of dental anxiety in students is effective on the frequency of going to the dentist and tooth brushing habits.[15,16] In our study, we found that dental anxiety had no effect on students' oral hygiene behaviors.

Conclusions

Dental anxiety was found to be higher in women and those who had a toothache in the past year. It was determined that anxiety did not affect the dental hygiene behavior.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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Cumhuriyet Dental Journal, 25(Suppl): 134-140, 2022
DOI: https://doi.org/10.7126/cumudj.1061217

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Investigation of Preventive Measures Taken by Faculty of Dentistry Students in Clinical Practices and Perceived Stress Levels During the Pandemic Period#

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Research Article

Acknowledgment
#This study was presented as an oral presentation at the ''Sivas Cumhuriyet University 1st International Dentistry Congress'' held between 23-25 November 2021.

History

Received: 05/12/2021
Accepted: 18/03/2022

ABSTRACT

Aims: Aimed to evaluate the effect of dental anxiety levels of students at Sivas Cumhuriyet University Faculty of Medicine on oral hygiene behaviors.

Materials and Methods: It is descriptive, cross-sectional study and carried out between September-October 2021. It was applied online to 216 volunteers from class I-V students. Students were asked about their sociodemographic characteristics, oral hygiene behaviors and Corah Dental Anxiety Scale (C-DAS). The C-DAS questionnaire is in 5-point Likert type consisting of 4 questions (Min: 4-max: 20 points). Analyzes were made with the SPSS 25 program. Descriptive statistics, independent sample T-test were performed.

Results: 50% (n=108) of the students were women. 78.2% (n=169) had never smoked. 33.3% (n=72) of them started brushing regularly before age of six. 58.8% (n=127) were brushing their teeth at least twice a day. The rate of brushed their teeth correctly was 49.5% (n=107). Only 24.5% (n=53) of the students changed their toothbrush every three months. Students' use of additional dental hygiene tools other than toothbrushes respectively; toothpick (37.5%, n=81), dental floss (32.4%, n=70), mouthwash (26.9%, n=58), interface brush (6%, n=13), miswak (3.7%, n=8). The mean C-DAS score was 8.8±3.7 (min:4-max:20). The mean score was significantly higher for female students (9.5±3.7) than the males (8.0±3.5) and those who had a toothache (9.5±4.1) in the last year than the others (8.1±3.2). There was no significant difference between C-DAS score and brushing teeth twice a day or more. There was no significant difference between the use of additional dental hygiene tools and C-DAS score.

Conclusion: Dental anxiety was found to be higher in women and those who had toothache in the last year. It was determined that anxiety did not affect the dental hygiene behavior.

Key Words: COVID-19, Dentistry Students, Stres

Pandemi Döneminde Diş Hekimliği Fakültesi Öğrencilerinin Klinik Uygulamalarda Aldıkları Korunma Önlemleri ve Algılanan Stres Düzeylerinin İncelenmesi#

Bilgi
#Bu çalışma 23-25 Kasım 2021 tarihleri arasında düzenlenen 'Sivas Cumhuriyet Üniversitesi 1. Uluslararası Diş Hekimliği Kongresi'nde sözlü bildiri olarak sunulmuştur.
**Sorumlu yazar*

Süreç

Geliş: 05/12/2021
Kabul: 18/03/2022

ÖZ

Amaç: Bu çalışmanın amacı COVID-19 salgını sırasında diş hekimliği öğrencilerinin çeşitli değişkenlere göre klinik şartlarda uyguladıkları korunma önlemlerinin ve algıladıkları stres düzeylerinin incelenmesidir.

Gereç ve Yöntemler: Çalışma RTEÜ Diş Hekimliği Fakültesinde öğrenim gören 4. ve 5. sınıf öğrencileri üzerinde gerçekleştirilmiştir. Araştırmada tam sayım yöntemine gidilmiş ve 168 öğrenciden çevrimiçi anket yoluyla veri toplanmıştır. Anket, demografik bilgiler, klinik uygulamalarda alınan korunma önlemleri ile ilgili sorular ve algılanan stres ölçeği sorularından oluşmuştur. Verilere normallik testi (Shapiro-Wilk) uygulanmış olup istatistiksel analizlerde T-Testi ve Ki-Kare Analizi kullanılmıştır. Anlamlılık, p<0.05 olarak belirlenmiştir.

Bulgular: Kadın öğrencilerin algılanan stres düzeyleri erkek öğrencilere göre; 5. sınıf öğrencilerinin algılanan stres düzeyleri, 4. sınıf öğrencilerine göre anlamlı bir şekilde yüksek bulunmuştur. Rubber dam kullanan öğrencilerin kullanmayan öğrencilere göre; klinikte sosyal mesafeye dikkat eden öğrencilerin sosyal mesafeye dikkat etmeyenlere göre; COVID-19 şüpheli hasta ile karşılaşıp hangi kurumla iletişime geçeceğini bilen öğrencilerin, bilmeyen öğrencilere göre algılanan stres düzeyleri anlamlı bir şekilde düşük bulunmuştur.

Sonuçlar: Klinik uygulamalarda korunma önlemleri alınmasının öğrencilerin algıladıkları stres düzeyleri üzerinde etkili olduğu belirlenmiştir. Ayrıca öğrencilerin algıladıkları stres düzeyinin cinsiyet ve sınıf düzeyine göre farklılaştığı görülmüştür.

Anahtar Kelimeler: COVID-19, Diş Hekimliği Öğrencileri, Stres.

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How to Cite: Maraş E, Arıcıoğlu B. (2022) Investigation of Preventive Measures Taken by Faculty of Dentistry Students in Clinical Practices and Perceived Stress Levels During the Epidemic Period, Cumhuriyet Dental Journal, 25(Suppl): 134-140.

Introduction

The COVID-19 pandemic period has caused students to experience some changes in their socio-cultural and psycho-social lives.[1] These changes can also affect important areas of students' lives such as academic performance and social life.[2] Students studying dentistry have continued their education processes with clinical applications as well as theoretical courses.[3] It is essential for the students (4th and 5th-grades) who are in the final stages of their education, to have high levels of knowledge and awareness about COVID-19 processes, especially in clinical practice, in terms of their health and public health.[4]

The high amount of aerosol generated during dental procedures due to proximity to the patient and operative instrumentation poses a serious risk for the spread of COVID-19 infection for dental students.[5] Dentistry students should know what extra protective measures to take during clinical practice to prevent transmission of COVID-19 infection.[6]

On the other hand, dentistry students who both try to protect themselves as individuals and work for the protection and treatment of patients had to adapt to these changes brought about by the epidemic. This has undoubtedly made the experiences of the students very valuable.[7]

Many negative situations experienced during the epidemic process may cause students to perceive the events as more stressful, so it can be expected that the epidemic will create some effects on the performance of the students.[8] In the literature review, it has been seen that many studies have been conducted on the stress levels of students or dentists during the COVID-19 pandemic process.[3,9,10,11] However, no study has been found in the literature that determines the protection measures taken by dental students in clinical practice and their perceived stress levels. In this context, it is thought that this study will contribute to the literature by examining the stress levels of students working in clinical practices in dentistry during the COVID-19 pandemic process.

Based on all these points of view, this study mainly aimed to determine the precautions taken by the 4th and 5th-grade students of dentistry faculty in clinical practice and their perceived stress levels. The sub-objectives of the research are to reveal the stress levels of the students according to the measures they take in clinical practices, and to determine whether some variables make a difference in the measures taken in clinical practices and perceived stress levels.

Materials and Methods

All procedures conducted were approved by the Ethical Committee of Recep Tayyip Erdoğan University (No. 2021/209).

The quantitative research method was used in the study. The research was designed following the cross-sectional approach. The population of the research consisted of 173 students studying in the 4th and 5th-grades of the RTEU Faculty of Dentistry. Çoşkun *et al.*[12] stated that sample sizes larger than 30 and smaller than 500 were sufficient for many studies. The sampling method was not preferred in the study and data were collected from the students voluntarily with the full enumeration method. The data were collected through an online survey due to the epidemic period. After explaining the aim and importance of the research to the students, the data collection phase was started.

The personal information form prepared by the researchers consisted of questions about independent variables such as gender and class level according to the study, as well as the precautions were taken by the students in clinical practices (Ex: Do you question each patient's travel history before starting dental treatment?) and COVID-19 histories (Ex: Have you been vaccinated against COVID-19?).

The Perceived Stress Scale (PSS) was developed by Cohen, Kamarck, and Mermelstein (1983).[13] Moreover, Turkish adaptation was performed by Eskin *et al.*[14] (2013). The PSS, consisting of 14 items in total, was designed to measure how stressful some situations in one's life are perceived. Participants evaluate each item on a 5-point Likert-type scale ranging from "Never (0)" to "Very often (4)". Seven of the items with positive expressions were scored in reverse. In this study, the analysis performed over the total score and the Cronbach Alpha reliability coefficient of the scale was determined as 0.774.

The Jamovi program (Version 1.0.4) (https://www.jamovi.org) was used for statistical analysis. The comparison of the answers to the questions asked about COVID-19 according to gender and class was examined with the chi-square test. Moreover, the comparison of the mean score obtained due to the perceived stress scale according to gender and class (normal distribution was observed in the Shapiro-Wilk test) was measured by Chi-Square analysis. According to the measures taken in clinical practices, the students' perceived stress levels were measured with the independent sample t-test, again considering the normality distribution. Significance was determined as $p<0.05$.

Results

The demographic information of the participants was presented in Table 1. Of the total 168 participants, 89 were female and 79 were male students. Besides, it was seen that 101 students from the 4th-grade students and 67 students from the 5th-grade students participated.

Table 1. Demographic information of dentistry students

Demographic information		f	%
Gender	Female	89	52.9
	Male	79	47.1
Grade level	4.Grade	101	60.1
	5.Grade	67	39.9

Chi-square analysis was conducted to reveal the relationship between the answers given by the students studying at the Faculty of Dentistry to the questions asked about COVID-19, gender, and grade level. The results were shown in Table 2 and Table 3.

Table 2. Comparison of the answers given to the questions about COVID-19 by gender (Chi-square test)

COVID-19 Questions	Female (N=89)	Male (N=79)	Total (N=168)	p value
A1				0.4441
Yes	69.0(77.5%)	65.0(82.3%)	134.0(79.8%)	
No	20.0(22.5%)	14.0(17.7%)	34.0(20.2%)	
A2				0.2571
Yes	88.0(98.9%)	76.0(96.2%)	164.0(97.6%)	
No	1.0(1.1%)	3.0(3.8%)	4.0(2.4%)	
A3				0.7591
Yes	29.0(32.6%)	24.0(30.4%)	53.0(31.5%)	
No	60.0(67.4%)	55.0(69.6%)	115.0(68.5%)	
A4				0.3341
Yes	74.0(83.1%)	61.0(77.2%)	135.0(80.4%)	
No	15.0(16.9%)	18.0(22.8%)	33.0(19.6%)	
A5				0.2711
Yes	47.0(52.8%)	35.0(44.3%)	82.0(48.8%)	
No	42.0(47.2%)	44.0(55.7%)	86.0(51.2%)	
A6				0.0771
Yes	56.0(62.9%)	39.0(49.4%)	95.0(56.5%)	
No	33.0(37.1%)	40.0(50.6%)	73.0(43.5%)	
A7				0.1811
Yes	70.0(78.7%)	55.0(69.6%)	125.0(74.4%)	
No	19.0(21.3%)	24.0(30.4%)	43.0(25.6%)	
A8				**0.0111***
Yes	71.0(79.8%)	49.0(62.0%)	120.0(71.4%)	
No	18.0(20.2%)	30.0(38.0%)	48.0(28.6%)	
A9				**0.0331***
Yes	12.0(13.5%)	21.0(26.6%)	33.0(19.6%)	
No	77.0(86.5%)	58.0(73.4%)	135.0(80.4%)	
A10				0.5131
Yes	66.0(74.2%)	55.0(69.6%)	121.0(72.0%)	
No	23.0(25.8%)	24.0(30.4%)	47.0(28.0%)	
A11				0.3131
Yes	81.0(91.0%)	68.0(86.1%)	149.0(88.7%)	
No	8.0(9.0%)	11.0(13.9%)	19.0(11.3%)	
A12				0.0911
Yes	70.0(78.7%)	53.0(67.1%)	123.0(73.2%)	
No	19.0(21.3%)	26.0(32.9%)	45.0(26.8%)	
A13				0.9911
Yes	54.0(60.7%)	48.0(60.8%)	102.0(60.7%)	
No	35.0(39.3%)	31.0(39.2%)	66.0(39.3%)	
A14				0.9381
Yes	23.0(25.8%)	20.0(25.3%)	43.0(25.6%)	
No	66.0(74.2%)	59.0(74.7%)	125.0(74.4%)	
A15				0.0781
Yes	77.0(86.5%)	60.0(75.9%)	137.0(81.5%)	
No	12.0(13.5%)	19.0(24.1%)	31.0(18.5%)	
A16				0.2531
Yes	85.0(95.5%)	72.0(91.1%)	157.0(93.5%)	
No	4.0(4.5%)	7.0(8.9%)	11.0(6.5%)	
A17				0.4941
Yes	85.0(95.5%)	77.0(97.5%)	162.0(96.4%)	
No	4.0(4.5%)	2.0(2.5%)	6.0(3.6%)	
A18				0.8821
Yes	69.0(77.5%)	62.0(78.5%)	131.0(78.0%)	
No	20.0(22.5%)	17.0(21.5%)	37.0(22.0%)	
A19				0.4291
Yes	38.0(42.7%)	29.0(36.7%)	67.0(39.9%)	
No	51.0(57.3%)	50.0(63.3%)	101.0(60.1%)	

Table 3. Comparison of the answers given to the questions about COVID-19 according to Grades (Chi-square test)

COVID-19 Questions	4th grade (N=101)	5th grade (N=67)	Total (N=168)	p value
A1				0.0741
Yes	76.0(75.2%)	58.0(86.6%)	134.0(79.8%)	
No	25.0(24.8%)	9.0(13.4%)	34.0(20.2%)	
A2				0.5381
Yes	98.0(97.0%)	66.0(98.5%)	164.0(97.6%)	
No	3.0(3.0%)	1.0(1.5%)	4.0(2.4%)	
A3				<0.0011*
Yes	47.0(46.5%)	6.0(9.0%)	53.0(31.5%)	
No	54.0(53.5%)	61.0(91.0%)	115.0(68.5%)	
A4				<0.0011*
Yes	69.0(68.3%)	66.0(98.5%)	135.0(80.4%)	
No	32.0(31.7%)	1.0(1.5%)	33.0(19.6%)	
A5				<0.0011*
Yes	66.0(65.3%)	16.0(23.9%)	82.0(48.8%)	
No	35.0(34.7%)	51.0(76.1%)	86.0(51.2%)	
A6				<0.0011*
Yes	73.0(72.3%)	22.0(32.8%)	95.0(56.5%)	
No	28.0(27.7%)	45.0(67.2%)	73.0(43.5%)	
A7				<0.0011*
Yes	85.0(84.2%)	40.0(59.7%)	125.0(74.4%)	
No	16.0(15.8%)	27.0(40.3%)	43.0(25.6%)	
A8				0.0321*
Yes	66.0(65.3%)	54.0(80.6%)	120.0(71.4%)	
No	35.0(34.7%)	13.0(19.4%)	48.0(28.6%)	
A9				0.2601
Yes	17.0(16.8%)	16.0(23.9%)	33.0(19.6%)	
No	84.0(83.2%)	51.0(76.1%)	135.0(80.4%)	
A10				0.1891
Yes	69.0(68.3%)	52.0(77.6%)	121.0(72.0%)	
No	32.0(31.7%)	15.0(22.4%)	47.0(28.0%)	
A11				0.0751
Yes	86.0(85.1%)	63.0(94.0%)	149.0(88.7%)	
No	15.0(14.9%)	4.0(6.0%)	19.0(11.3%)	
A12				0.7081
Yes	75.0(74.3%)	48.0(71.6%)	123.0(73.2%)	
No	26.0(25.7%)	19.0(28.4%)	45.0(26.8%)	
A13				<0.0011*
Yes	74.0(73.3%)	28.0(41.8%)	102.0(60.7%)	
No	27.0(26.7%)	39.0(58.2%)	66.0(39.3%)	
A14				<0.0011*
Yes	37.0(36.6%)	6.0(9.0%)	43.0(25.6%)	
No	64.0(63.4%)	61.0(91.0%)	125.0(74.4%)	
A15				<0.0011*
Yes	73.0(72.3%)	64.0(95.5%)	137.0(81.5%)	
No	28.0(27.7%)	3.0(4.5%)	31.0(18.5%)	
A16				0.6961
Yes	95.0(94.1%)	62.0(92.5%)	157.0(93.5%)	
No	6.0(5.9%)	5.0(7.5%)	11.0(6.5%)	
A17				0.1721
Yes	99.0(98.0%)	63.0(94.0%)	162.0(96.4%)	
No	2.0(2.0%)	4.0(6.0%)	6.0(3.6%)	
A18				0.0021*
Yes	87.0(86.1%)	44.0(65.7%)	131.0(78.0%)	
No	14.0(13.9%)	23.0(34.3%)	37.0(22.0%)	
A19				0.1681
Yes	36.0(35.6%)	31.0(46.3%)	67.0(39.9%)	
No	65.0(64.4%)	36.0(53.7%)	101.0(60.1%)	

In terms of genders, there was a significant difference between the answers given to the questions “Do you think a surgical mask is sufficient to prevent COVID-19 cross-infection?" (A8) and "Should N-95 masks be routinely worn in dentistry?" (A9) due to the current epidemic ($p<0.05$). There was no significant difference

between the answers given to the other questions in terms of gender (p>0.05). More female answered yes to the question "Do you think the surgical mask is sufficient to prevent COVID-19 cross infection?", compared to male (p<0.05). More male answered yes to the question "Should N-95 masks be routinely worn in dentistry due to the current epidemic?", compared to female (p<0.05).

There was a significant difference between the answers given to the questions (p<0.05);

(A3), Do you question each patient's travel history before starting dental treatment?

(A4), Do you measure each patient's body temperature before starting dental treatment?

(A5), Do you question the vaccination history of the patient while taking the anamnesis?

(A6), Do you question the history of COVID-19 while taking anamnesis from the patient?

(A7), Do you postpone dental treatment of patients showing suspicious symptoms?

(A8), Do you think surgical mask is sufficient to prevent covid-19 cross-infection?

(A13), Do you routinely follow universal infection control precautions for each patient?

(A14), Do you use a rubber dam in every patient?

(A15), Before treatment do you ask each patient to rinse their mouth with an antibacterial mouthwash?

(A18), Do you pay attention to the social distance in the clinic (extra staff, patient relatives)?

When the results were examined in terms of classes; a significant difference was found between the answers given to the questions shown above (p<0.05). Significantly more 5th grade students said yes to the 4th, 8th and 15th questions compared to the 4th-grade students. (p<0.05). On the other hand, significantly more 4th-grade students said yes to the 3rd, 5th, 6th, 7th, 13th, 14th, and 18th questions compared to the 5th-grade students (p<0.05).

To determine the perceived stress levels of the students according to gender, an independent sample t-test was conducted at the significance level of 0.05. Results have shown that female students' stress levels (X=2.33±0.66) were significantly higher than male students (X=2.07±0.57). When the results according to the class level were examined; it was observed that the stress levels of the 5th-grade students (X=2.41±0.67) were significantly higher than the 4th-grade students (X=2.08±0.57). (Table 4)

To determine the perceived stress levels of the students according to the rubber dam usage situation, an independent sample t-test was conducted at the significance level of 0.05. The results were showed that the stress levels of the students using rubber dam (X=28.29±5.79) were significantly lower than the students not using rubber dam (X=30.59±8.04).

To determine the perceived stress levels of students according to the status of paying attention to social distance in the clinic, an independent sample t-test was conducted at the significance level of 0.05. The results showed that the stress levels of the students paying attention to social distance (X=29.21±7.03) showed a significantly lower level than those not paying attention to social distance (X=32.83±8.80).

An independent sample t-test was conducted at the significance level of 0.05 to determine the perceived stress levels of the students according to their knowledge of the institution to be contacted in case of infection. The results showed that the stress levels of the students with communication knowledge (X=28.65±6.76) were significantly lower than the students who did not have communication information (X=32.12±8.30). (Table 5)

Table 4. Comparison of Perceived Stress Scale mean score by gender and class with independent sample t-test

	N	Mean	SD	SE	p- value
Gender					
Female	89	2.33	0.66	0.07	0.009
Male	79	2.07	0.57	0.06	
Class					
4th grade	101	2.08	0.57	0.06	0 .001
5th grade	67	2.41	0.67	0.08	

Table 5. Perceived stress levels of students according to the protection measures taken in clinical practices

Variables	N	Mean	SD	SE	p- value
Using Rubber Dam					
Yes	44	28.29	5.79	0.87	0.045
No	124	30.59	8.04	0.72	
Paying Attention to Social Distancing					
Yes	132	29.21	7.03	0.61	0 .011
No	36	32.83	8.80	1.46	
Having Contact Information When Encountered with Infection					
Yes	103	28.65	6.76	0.66	0.004
No	65	32.12	8.30	1.03	

Discussion

This research was designed to determine the precautions taken in clinical practice and perceived stress levels of students studying in the 4th and 5th-grades of the faculty of dentistry during the epidemic period. The results of the research showed that taking preventive measures in clinical practices reduced the students' perceived stress levels. Moreover, it was determined that the perceived stress level of male students and 4th-grade students was lower during the COVID-19 process.

The results indicated that male students perceived this process as less stressful than female students. Wang *et al.*[16] (2020) examined the psychological reactions and related factors in the first phase of the COVID-19 epidemic and found that women have experienced higher levels of stress than men. These results were consistent with the results of our study. In general, it can be said that the fact that women have a more stressful lifestyle than men is reflected in the clinical management during the epidemic process.

The reason why the stress levels of the 5th-grade students were higher than the 4th-grade students can be seen as the 4th-grade students' inexperience in the treatment of infected patients in the clinic and their less familiarity with the clinical environment. In the study of Lingawi and Afifi (2020) on the anxiety levels of dental students, no significant difference was found between students in different classes in terms of stress levels.[9] Although the concepts of anxiety and stress were known as different concepts in terms of severity and duration, it is known that they are used interchangeably in the literature. In this respect, it can be said that the results of the study did not match the results of the present study.

It was found that the stress levels of the students who use a rubber dam in each patient, pay attention to social distance in the clinic and have the knowledge of the institution to be contacted in case of infection were lower. This situation can be interpreted as students who can take the right protection measures can feel safer. In other words, it was observed that the stress levels of the students who were sensitive to taking clinical precautions during the COVID-19 period and who can manage the process more positively were lower. In their study, Polat and Coşkun (2020) examined the relationship between the use of personal protective equipment and depression, anxiety, and stress levels, it was determined that the depression, anxiety, and stress scores of the health workers who stated that they used their equipment appropriately when necessary, were low.[17]

According to our results, it was found that 4th-grade students were more sensitive when questioning the patient's anamnesis. The reason for this can be shown as the fact that 4th-grade students have just left the theoretical education and have just started the clinical practice. It was observed that 5th-grade students attached more importance to relatively routine practices such as using antiseptic mouthwash and measuring body temperature before the procedure, rather than the patient's anamnesis.

In our study, male students gave more importance to the necessity of using N95 masks than female students. No studies have been found in the literature that can be compared with this result. This can be seen as a limitation of the study. Another limitation of this study is that it was conducted only in the RTEU sample. The content of the research can be expanded by including students from other public and private universities.

Conclusions

The results of the research showed that taking preventive measures in clinical practices reduced the students' perceived stress levels. In addition, it was determined that the perceived stress level of male students and 4th-grade students were lower during the COVID-19 process. We hope that the results of the research can reduce the perceived stress levels of dental students with the development of personal protection measures in the COVID-19 pandemic and contribute to the development of support strategies.

Acknowledgements

None to declare.

Conflicting of Interests

All authors declare no conflict of interest.

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