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ARAŞTIRMA / RESEARCH

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TREATMENT OF A HUGE ODONTOGENIC FIBROMA WITH ANTERIOR ILIAC CREST AND IMPLANT SUPPORTED FIXED PROSTHESIS: A CASE REPORT

Büyük Boyutlu Odontojenik Fibromanin Anterior İliak Kret ve İmplant Destekli Sabit Protez ile Tedavisi: Olgu Sunumu

Emrah SOYLU [1], Erdem KILIÇ [2], Mustafa ZORTUK [3], Alper ALKAN [2]

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ABSTRACT

Purpose: Odontogenic fibroma (OF) is a rare benign odontogenic neoplasm and classified as central (COF) and peripheral (POF) type and COF has two sub groups; epithelium-poor (simple) type and epithelium-rich (WHO or complex) type. Treatment modality of OF is surgical excision. However, after large-scaled excision, reconstruction of the defect may be required.

Case Report: 39 years old male patient referred with complain of a painless swelling in anterior maxilla. Incisional biopsy showed that the lesion is simple type OF. Under general anesthesia, lesion enucleated and defect reconstructed with anterior iliac graft. After 8 months, 3 dental implants were placed and final reconstruction was done with implant supported fixed prosthesis.

Discussion: OF is a benign and very rare odontogenic neoplasm accounting for 0.5 - 5% of odontogenic tumors. Treatment modality of OF is enucleation and curettage, but after enucleation of huge OF, reconstruction may be challenging by the size of the defect. Anterior iliac graft is a gold standard among all autologous bone graft sources and it also provides adequate bone for the reconstruction of the maxillofacial defects, otherwise it is possible to place implants with acceptable resorption rates.

Conclusion: Reconstruction of the jaw defects with anterior iliac graft and implant supported fixed prosthesis after enucleation of huge size tumors such as COF, is a feasible method.

Key Words: Odontogenic Fibroma, Reconstruction, Dental Implant, Anterior Iliac Graft, Fixed Prosthesis

ÖZ

Giriş: Odontojenik fibroma (OF) çenelerin benign odontojenik tümörleri içerisinde yer almaktadır. Periferal (POF) ve santral (SOF) olmak üzere iki tipi bulunmaktadır. SOF tipi ise epitelden zengin (Kompleks) ve epitelden fakir (Basit) olmak üzere iki alt tipe ayrılmaktadır. OF nin tedavisi cerrahi eksizyondur, ancak büyük ölçekli bir eksizyon sonrasında defekt onarımı gerekebilmektedir. Bu vaka raporunun amacı, basit tip SOF eksizyonu sonrasında oluşan geniş defektin anterior iliak greft ve dental implantlarla yapılan tedavisini sunmaktır.

Vaka Raporu: 39 yaşındaki erkek hasta anterior maksilladaki ağrısız şişlik şikâyeti ile kliniğimize başvurdu. Yapılan insizyonel biopsi sonucunda lezyonun basit tip SOF olduğu anlaşıldı. Genel anestezi altında lezyon eksize edildi ve oluşan defekt anterior iliak kemikten alınan otojen greft ile greftlendi. Anterior maksillaya 8 ay sonra 3 adet dental implant yerleştirildi. 3 ay sonra implant destekli sabit protez ile hastanın tedavisi tamamlandı.

Tartışma: OF nadir görülen iyi huylu odontojenik bir tümördür ve tüm odontojenik tümörler içinde %0,5 - %5'lik görülme oranına sahiptir. OF nin tedavisi cerrahi eksizyon ve takiben kavitenin küretajını içermektedir fakat büyük ölçekli eksizyonlarda oluşan defektin tamiri zor olabilmektedir. Anterior iliak greft, yeterli miktarda kemik sağlayabilmesi ve implant yerleştirilmesine imkân sağlaması nedeniyle maksillofasiyal defektlerin tamirinde altın standart olarak kabul edilmektedir.

Sonuç: SOF gibi geniş boyutlara ulaşabilen lezyonların eksizyonu sonucunda oluşan çene defektlerin tamirinde anterior iliak greftle beraber dental implant uygulanması başarılı bir tedavi yöntemidir.

Anahtar Kelimeler: Odontojenik Fibroma, Rekonstrüksiyon, Dental İmplant, Anterior İliak Greft, Sabit Protez

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INTRODUCTION

Odontogenic fibroma (OF) is a rare benign odontogenic neoplasm[1] and originated from the dental mesenchymal tissues.[2] World Health Organization (WHO) classified the odontogenic fibroma as central and peripheral type and central odontogenic fibroma (COF) has two sub groups; epithelium-poor (simple) type and epithelium-rich (WHO or complex) type.[1-3] Clinically OF usually grows slowly and shows a persistent growing behavior and is more frequently found in women.[2] It can be related with the crown of a impacted tooth, therefore OF can be seen in most frequently in maxilla anterior and mandibula posterior. Clinically, it appears with different size of painless swelling and radiological appearance of OF can be as a uni or multilocular shape with well-defined borders. Treatment modality of the OF is conservative surgical excision and curettage of the remaining bone walls. However, after large-scaled excision, reconstruction of the defect may be required.

Reconstruction of the jaws especially after tumor resection, trauma or enucleation of the large cyst or tumor is a challenging procedure, due to amorf type of the remnant tissue. Main purpose of the reconstruction procedure is to obtain the continuity of the jaws and similar contour of the anatomical shape of the jaws and dental rehabilitation of the reconstructed and also edentulous jaws. Nowadays dental implants are the most popular treatment alternative for the rehabilitation of the partial or total edentulous patients. During the period from the first application of the dental implant to present, many articles have been published on the success of the dental implant in edentulous jaws or even in atrophic jaws. In addition, Chipasco *et al.*[4] and Bowen *et al.*[5] showed that the dental implants are as successful as in jaws that reconstructed with iliac graft, symphysis graft or with fibula flaps compared with the healthy jaws.

The aim of this report is to present the enucleation of a huge OF and reconstruction of the alveol defect with anterior iliac crest graft and implant supported fixed prosthesis.

CASE REPORT

A 39 years old male patient referred to Erciyes University Department of Oral and Maxillofacial Surgery clinic with complain of a painless and large swelling in anterior maxilla. Intra-oral examination showed a large and expansive swelling which lies from right retro-molar region to left premolar region. (Figure 1)

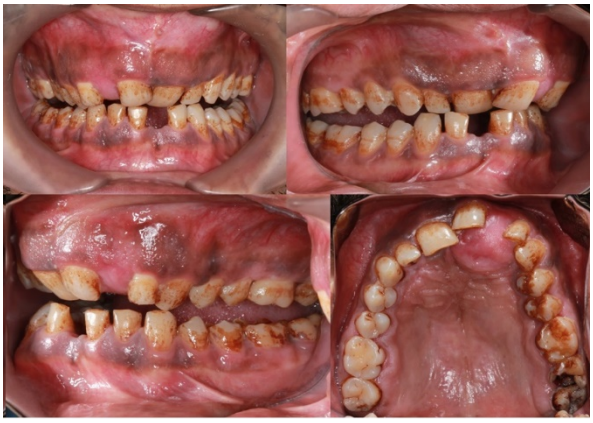

Figure 1. Intra-oral views of the lesion.

Intra-oral examination showed that upper anterior teeth were mobile and lesion was ruptured the mucosa between central insicors. Extra-oral examination showed a facial asymmetry cause of the swelling in the right face and also we noticed that lesion elevated the right nasal mucosa and right nostril and also nasal mucosa can be seen through extra orally (Figure 2). Panoramic radiograph and cone beam dental tomographic (CBCT) examination showed a huge unilocular lesion from inferior border of the right orbit cavity and right second molar to left second premolar region (Figure 3). An incisional biopsy was performed through the extracted part of the lesion between upper central insicors under local anesthesia with 2cc articane HCl

(Ultracaine DS Forte, Sanovi Aventis, İstanbul, Turkey) and lesion was diagnosed as simple type OF. Patient was informed about the treatment protocol and informed consent form was obtained.

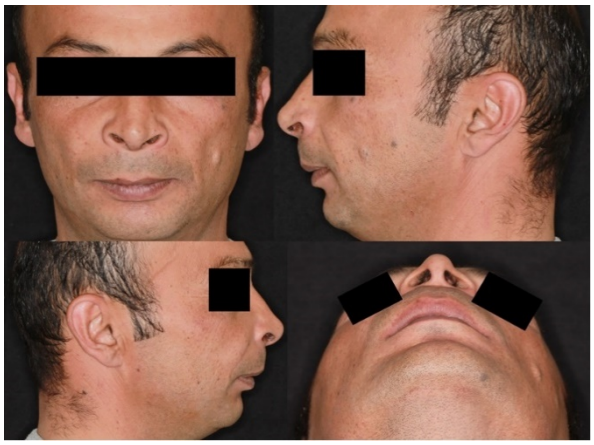

Figure 2. Extra-oral views of the patient.

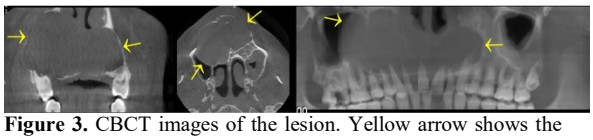

Figure 3. CBCT images of the lesion. Yellow arrow shows the borders of the lesion.

Under general anesthesia, affected teeth (11,12,13,14,21,22 and 23) were extracted. A full-thickness mucoperiosteal flap elevation was done with a horizontal incision through the extraction sockets and 2 vertical releasing incisions in left and right molar region. Lesion and the borders became visible after flap elevation. Lesion enucleation was done with the maximum attention to the neighbor anatomical structures. (Figure 4 a, b, c) Simultaneously with lesion enucleation, another surgical team harvested corticocancellous iliac graft via anterior approach (Figure 4d). Grafts were placed as the cortical sides of the grafts faced to outside and cancellous sides faced to inside and grafts were fixed with each other and also to the maxilla with mini fixation plates and fixation screw (Figure 4 e, f). Reconstructed area washed with rifampicin (RIF, Koçak Farma Drugs, Tekirdağ, Turkey) and the mucosa closed with 3/0 vicryl suture. Ampicilin+sulbactam 2x1000 mg, paracetamol and methylprednisolone (1mg/kg) were administered intravenously for the prevention of infection and edema. Mouth wash with chlorhexidine was done immediately after oral feedings. After two days of hospitalization patient was free of infection and pain and he can walk properly without any numbness.

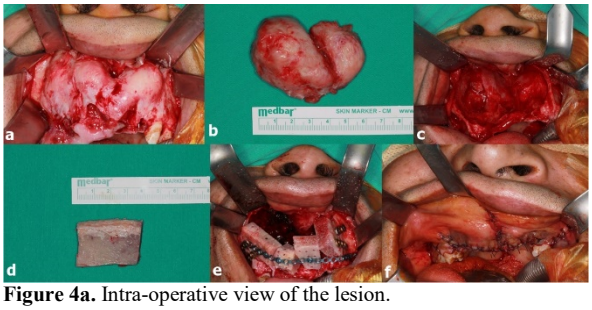

Figure 4a. Intra-operative view of the lesion.
Figure 4b. Enucleated lesion.
Figure 4c. Defect of the anterior maxillar after tumor enucleation.
Figure 4d. Anterior iliac graft (one of the pieces).
Figure 4e. Fixation of the grafts to the maxillar with mini fixation plates. Intra-operative view.
Figure 4f. Wound closure with 3/0 vicryl suture.

He was discharged from the hospital and Ampicilin+sulbactam 2x375mg, dexketoprofen trometamol 2x25mg and mouth was with chlorhexidine were prescripted. 7 days after surgery, sutures were removed and clinically mucosa and donor side was completely healthy. 8 months after reconstructive surgery mini fixation plates were removed (fixation screw couldn't removed and left inside) and 3 dental implants (4.2x11.5mm, 4.2x11.5mm, 4.2x10mm, Dyna Implants, Holland) were placed simultaneously with two-staged protocol (Figure 5). 3 months later of the implant surgery, healing caps of the implants were inserted and final reconstruction was done with fixed prosthesis. A panoramic radiograph was taken 32 months after first surgery (21 months after prosthetic load), and radiographic examination showed that the patient was free of recurrence and peri-implant bone resorption was in acceptable limits, relatively (Figure 6).

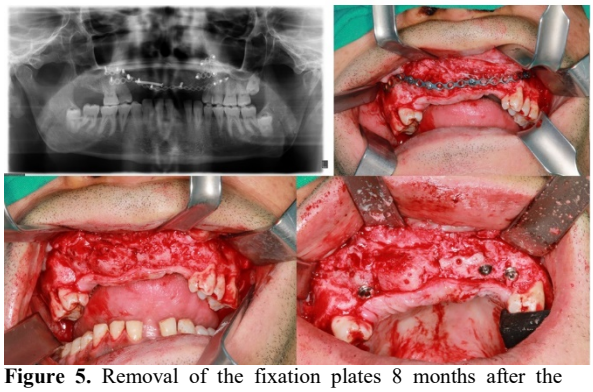

Figure 5. Removal of the fixation plates 8 months after the surgery and simultaneously placement of the dental implants.

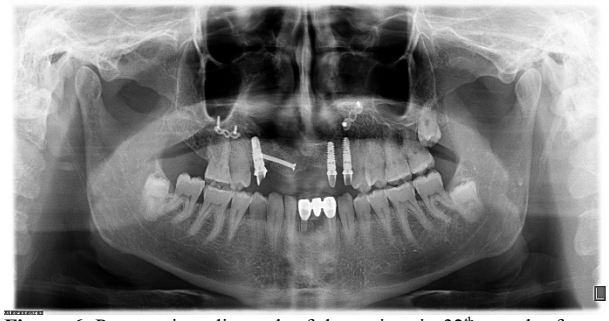

Figure 6. Panoramic radiograph of the patient in 32th month of the surgery. (21 months after prosthetic load)

DISCUSSION

OF is a benign and very rare odontogenic neoplasm accounting for 0.5-5% of odontogenic tumors.[3] ChhaBra *et al.*[6] defined the treatment modality of OF as enucleation and curettage and also reported that recurrence is uncommon. Dunlap and Barker[7] reported two cases of maxillary odontogenic fibroma treated by curettage with follow-up of 9 years and 10 years with no evidence of recurrence. However some reports showed recurrence. Heimdal *et al.*[8] reported a case that recurred 9 years after surgery. Svirsky *et al.*[9] have reported a 13% (2 out of 15 cases) rate of recurrence. Jones *et al.*[8] reported a case which recurred 16 months after surgery. In this case, during the 20 months follow up, recurrence was not observed. Surgical treatment of OF is conservative surgical excision and curettage of the remaining bone walls, but after enucleation of huge OF, reconstruction may be challenging by the size of the defect, such as in our case.

Main challenging point in the oral and maxillofacial surgery is the reconstruction of the bone defects. Different types of reconstructive procedures are required due to site, dimension, and the type of the defect.[17,18] Autologous bone substitutes are the first choice with the osteoinductive, osteoconductive and nonimmunogenic properties and also with financial advantages.[11] There are different autologous graft sources depending on the required amount of the graft including iliac crest, tibia, mandibular symphysis, calvarium and rib.[11] Anterior iliac graft is a gold standard among all autologous bone graft sources[11-14] and also has advantages; it can provide great amounts of cancellous bone, it is easy to access, and it has a high ratio of cancellous to cortical bone and a high concentration of pluripotent or osteogenic precursor cells that support osteogenesis.[13,15] The corticocancellous properties of the anterior iliac graft also allows to fixation with miniplates and has an excellent graft-host healing potential.[17] In this case, graft was divided into the pieces to obtain the contour of maxilla, and graft pieces were easily fixed with mini fixation plates and fixation screw. Graft worked very well and healed uneventfully with acceptable maxillary contour and let us to provide the proper shape of the anterior maxilla that we desired before the surgery.

Therefore anterior iliac crest is usually the first choice in most centers.[11] It also provides adequate bone for the reconstruction of the maxillofacial defects and facial contour, otherwise it is possible to place implants with acceptable resorption rates due to long term results in the literature.[4,16] Chiapasco *et al.*[4] compared behavior of the implants in bone grafts which were placed after reconstruction of the resected mandibles. They found similar peri-implant bone resorption in autogenous grafts (anterior iliac crest or fibula) and revascularized iliac or fibula flaps, 24 months after prosthetic load. Bowen *et al.*[5] retrospectively analyzed the reconstruction of the atrophic mandible with anterior iliac crest onlay graft and dental implants. They found that the 5 year implant survival is 98.7% and

peri-implant bone loss was 0.6mm. In our case, with the 21 months of follow-up period, loss of marginal bone around implant is in acceptable limits, relatively.

Defect reconstruction of the jaws that occurs after enucleation of huge size tumors, trauma or even after resection is a challenging situation. However, anterior iliac graft has advantages; such as; ease of access, a great source for corticocansellous bone graft and compatible with dental implants.[11]

As a conclusion, as this report shows, reconstruction of the maxillary defects with anterior iliac graft and implant supported fixed prosthesis after enucleation of huge size tumors such as COF, is a feasible method.

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A RARE CASE OF HYPO-HYPERDONTIA WITH THYROID DISORDER

Tiroid Hastalığı ile Birlikte Görülen Nadir Bir Hipo-Hiperdonti Vakası

İlkay PEKER[1], Songul YAPICI[1], Zeynep Fatma ZOR[2], Erdal BOZKAYA[3]

Makale Kodu/Article code *: 86233*

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ABSTRACT

Hypo-hyperdontia is an extremely rare mixed numerical dental abnormality with the presence of supernumerary teeth and absence of the teeth concomitantly in the same individual.

Although its etiology is unknown, hypo-hyperdontia may appear as a result of genetic or possible environmental factors. This report presents the first case for posterior hypo-hyperdontia with distodens and absent premolar. Furthermore, it is the second case report in the literature for hypo-hyperdontia with a thyroid disorder.

Keywords: Hypo-hyperdontia; thyroid disorder; distodens; missing premolars; posterior teeth

ÖZ

Hipo-hiperdonti aynı kişide diş eksikliği ile birlikte süpernümerer dişlerin bulunduğu, oldukça nadir görülen diş sayı anomalisidir. Etiyolojisi bilinmemekle birlikte, genetik veya çevresel etkenler nedeniyle ortaya çıkabilir. Bu vaka raporunda distodens ve eksik premolar diş ile birlikte meydana gelmiş ilk posterior hipo-hiperdonti vakası sunulmuştur. Aynı zamanda, bu vaka literatürdeki tiroid hastalığı ile birlikte görülen ikinci hipo-hiperdonti vakasıdır.

Anahtar kelimeler: Hipo-hiperdonti, tiroid hastalığı, distodens, eksik premolarlar, posterior dişler

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INTRODUCTION

Tooth number abnormalities are known as hypodontia and hyperdontia. Hypodontia is defined as congenitally missing of one or more teeth, excluding third molars while hyperdontia is the abnormality in the number of teeth which is more than 20 for deciduous teeth, and/or 32 for permanent dentition.[1] Simultaneous occurrence of hypodontia and hyperdontia in the same individual is an extremely rare situation. Various names such as concomittant hypo-hyperdontia[2], oligopleodontia[3] and hypo-hyperdontia[4] have been used in the literature by different authors. In recent years, this condition has been commonly called as hypo-hyperdontia with a reported prevalence between 0.002% and 3.1%.[5]

This abnormality can be classified into three cathegories in accordance with the location of occurrence in the dental arches: anterior only, posterior only, and antero-posterior (simultaneous occurrence in both anterior and posterior regions).[6] In the literature, hypo-hyperdontia cases have been reported in only anterior and antero-posterior regions of the jaws. According to the best of our knowledge, there is no published hypo-hyperdontia case occurred only in posterior regions of the jaws. Although its exact etiology is unknown, hypo-hyperdontia may appear as a result of possible genetic and environmental factors. This abnormality can be seen in conjunction with several syndromes such as Ellis-Van Creveld, Marfan and Down Syndromes. Additionally, hypo-hyperdontia with subclinical hypothyroidism has been reported in only one published case report.[7]

This article is the first case report for the posterior hypo-hyperdontia in a patient with multinodular thyroid disease.

CASE REPORT

A 27-years-old male applied to Gazi University Faculty of Dentistry, Department of Dentomaxillofacial Radiology with a complaint of cracked filling. Systemic anamnesis of the patient revealed multinodular hyperplasic thyroid disorder without any drug usage. Thyroid hormon levels of him were within the normal limits. He reported to have two siblings with no abnormality in their teeth. He also reported a supernumerary and wisdom teeth extraction in the right posterior maxilla two years ago. There was no abnormality in extraoral examination. In intraoral examination, bilateral missing mandibular second premolars (each one in the quadrants), a persistent primary molar with infraocclusion in the right mandible (Figure 1) and bilateral dens invaginatus in maxillary lateral insicors (Figure 2), also cracked filling in the right mandibular first molar and caries in the right maxillary first molar were observed.

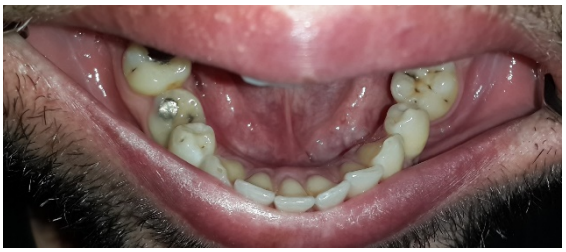

Figure 1. A persistent primary molar with infraocclusion and missing second premolar on the left side of mandible. Missing second premolar on the right side of the mandible.

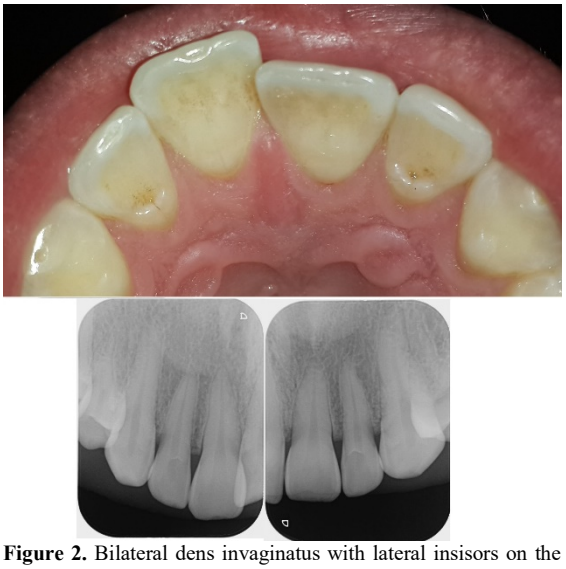

Figure 2. Bilateral dens invaginatus with lateral insisors on the anterior maksilla.

In panoramic radiographic examination, there were no impacted permanent premolars in mandible, and a distodens was present in the left posterior maxilla (Figure 3). Another maxillary distodens in the right side was observed in panoramic radiographic image obtained two years ago (Figure 4). No missing and supernumerary teeth or hypohyperdontia were observed in clinical and radiographic examinations of his parents. However, his siblings couldn't be examined. Restorative treatment of cracked filling and carious tooth, extraction of persistent primary molar and orthodontic treatment were planned. However, the patient didn't continue to the further treatments.

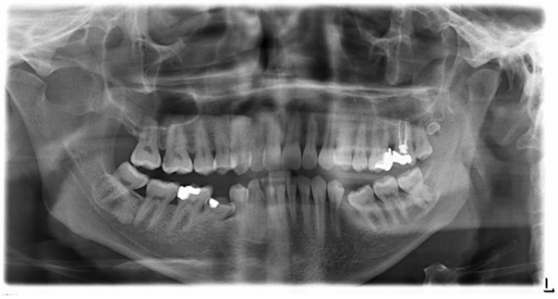

Figure 3. A persistent primary molar with infraocclusion and missing second premolar on the left side of mandible. Missing second premolar on the right side of the mandible. Distodens on the left side of maxilla (The image was taken in 2015).

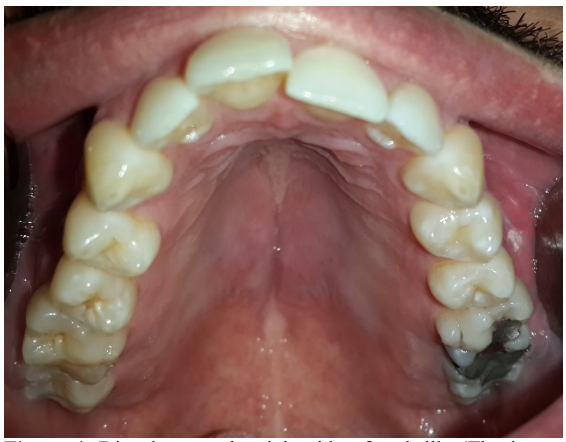

Figure 4. Distodens on the right side of maksilla (The image was taken in 2013)

DISCUSSION

In a recent comprehensive review, it has been reported that hypo-hyperdontia was more common in males (58%) than in females, with a ratio of 1.3:1.[6] This abnormality was classified into various cathegories by several authors. Based on the affected jaws, hypo-hyperdontia has been divided into three categories: the maxillary type (the maxillary arch alone), the mandibular type (the mandibular arch alone) and the bimaxillary type (both the maxillary and mandibular arches).[6] In the literature, the most common hypo-hyperdontia has been reported as bimaxillary type (65%) followed by the maxillary (21%) and mandibular types (14%), respectively.[6] According to the location of dental arches, it was cathegorized as anterior, posterior and antero-posterior.[6] In the literature, it is reported that 57% of the cases were in the anterior regions whereas 43% of the cases were in the antero-posterior regions of the jaws.[6] However, there was no reported hypo-hyperdontia case in the posterior regions up to date. In this report, bimaxillary type and posterior hypo-hyperdontia was observed in a 27-year-old male. This is the first case of posterior hypo-hyperdontia in the related literature.

In cases of hypo-hyperdontia, hyperdontia was commonly observed in maxillary mesiodens whereas hypodontia commonly affected to the second premolars.[5] No distodens has been reported in hypo-hyperdontia cases.[4,8] Two missing mandibular premolars and maxillary distodens were observed in this case.

Hypo-hyperdontia may cause several pathologic conditions including delayed or uneruption of teeth, eruption of supernumerary teeth and crowding in dental arches, etc.[5,9,10]

The majority of published hypo-hyperdontia cases was diagnosed during mixed dentition period.[4,6] Taurodontism[11,12], dens invaginatus[13] and double teeth[14] have been reported in the patients with hypo-hyperdontia. Panoramic radiographic examination is useful in early detection of several dental abnormalities. In the present case, panoramic

radiograhic examination revealed hypo-hyperdontia and maxillary lateral incisors with dens invaginatus.

Etiology of hyphyperdontia is unclear, it has may have a genetical origin or can be a part of various syndromes.[6,15-17] In this case, his siblings couldn't be examined and no abnormality was observed in his parents. Deficiency of thyroid hormones can lead to delayed and prolonged proliferation of cells of the nervus trigeminus and the rate of neuron production is decreased. Trigeminal nerve fiber growth and pattern are strictly integrated with tooth morphogenesis. Failure of the nerve to establish the lingual branch can cause absence of the mesenchymal dental follicle.[7,18] There is only one published report regarding a case of hypo-hyperdontia with subclinical hypothyroidism. In the present case, his systemic anamnesis revealed multinodular hyperplasic thyroid disorder without any drug usage.

According to the best of our knowledge, this is the first case report for posterior hypo-hyperdontia with distodens. Furthermore, it is the second case report in the literature for hypo-hyperdontia with a thyroid disorder. Although hypo-hyperdontia is an extremely rare numerical dental abnormality, careful clinical and radiographic examinations and multidisciplinary treatment protocol are essential.

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MAKSİLLER SİNÜSÜ İÇİNE ALAN GENİŞ VE ENFEKTE RADİKÜLER KİST: VAKA RAPORU

A Wide Infected Radicular Cyst Invading Maxillary Sinus: Case Report

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ÖZ

Radiküler kist, çenelerde görülen en yaygın lezyonlardan biridir. Çürük veya travma sonucu gelişen pulpal nekrozu takiben, devital olan dişin apeksinde oluşur. Radiküler kistlerin çoğu genellikle asemptomatik ve küçüktür, nadiren büyük boyutlara ulaşabilir. Bu makalenin amacı; maksillar sinüsü kaplayan, orbita tabanına ve burun yan duvarına kadar ulaşmış bir radiküler kist vakasının, lokal anestezi altında cerrahi olarak enükleasyonunu sunmaktır.

Anahtar kelimeler: Enükleasyon, maksiller sinüs, radiküler kist

ABSTRACT

Radicular cysts are among the most common lesions of the jaws. They develop around the apex of the devitalized root following pulp necrosis or trauma. Mostly radicular cysts are asymptomatic and small, they rarely reach large sizes. The purpose of this article is to present the enuclation of a radicular cyst case invading the maxillary sinus and reaching to orbital floor and the lateral nasal wall.

Keywords: Enucleation, maxillary sinus, radicular cyst

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GİRİŞ

Maksillofasiyal bölgeyi pek çok kist etkiler. Kistler kemik ya da yumuşak doku içinde semptomlu ve semptomsuz olabilirler. Kemikte olursa santral kist, yumuşak dokuda olursa periferal kist olarak adlandırılır. Genel olarak enflamatuvar ve nonenflamatuvar kaynaklı odontojenik ve nonodontojenik kist şeklinde sınıflandırılır.[1] Enflamatuvar odontojenik kistleri radiküler ve lateral periodontal kistler oluşturur.[2] Radiküler kist, enflamatuvar kaynaklı odontojenik kistlerden en yaygın olanıdır ve diş pulpasındaki nekroz ve enfeksiyondan kaynaklanır.[3] Enflamasyona sekonder olarak periodontal ligamentteki *Malassez* epitel artıklarından köken alırlar.[1]

Radiküler kist çenelerin en sık görülen kistidir (%38-68).[4-6] Rutin periapikal filmlerde teşhis edilebilirler ve bir dişin köküyle ilişkili yuvarlak ya da oval, uniloküler ya da multiloküler, iyi sınırlı radyolusensi olarak gözlenirler.[7] Pek çok radiküler kist 0,5-1,5 cm arası küçük boyutlardadır fakat 5 cm'yi aşacak büyüklüğe ulaşabilir.[8] Maksiller arkı, mandibular arktan daha çok etkiler[9] ve en sık maksiller anterior bölgede ortaya çıkar.[10] Çoğunlukla hayatın 3. ve 6. dekatları arasında ve daha sık erkeklerde görülür. Klinik olarak, lezyon küçük ve asemptomatiktir fakat bazen perküsyonda hafif ağrı ve hassasiyet izlenebilir.[3] Hastalar genelde yavaşça gelişen şişlikten şikâyetçidir. Tedavi seçenekleri, kist lokalize ve küçükse kanal tedavisi olabilirken lezyon büyükse enükleasyon gibi cerrahi tedavi yapılabilir.[11] Tedavi edilmeyen kistler, lokal doku yıkımı ve deformitelere sebep olarak genişleyebilirler.[12]

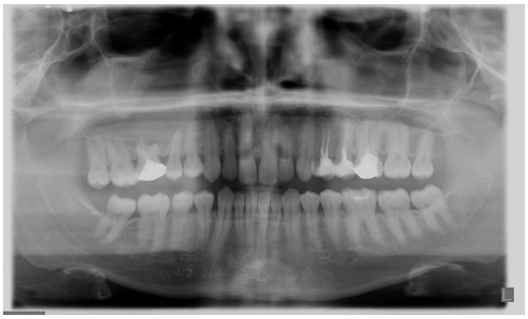
Bu makalede, maksiller sinüsü de içeren ve Caldwell-luc yaklaşımı ile tamamen rezeke edilen geniş bir radiküler kist olgusu sunulmuştur.

VAKA RAPORU

Yüzünün sağ tarafında şiddetli ağrı ve şişlik şikâyeti ile Sivas Ağız ve Diş Sağlığı Merkezine birkaç kez başvuran 25 yaşındaki yetişkin erkek hastaya, apse sebebiyle antibiyotik ve analjezik reçete edildiği öğrenildi. Hasta, iyileşme olmadığı için Cumhuriyet Üniversitesi Diş Hekimliği Fakültesi Ağız, Diş ve Çene Cerrahisi kliniğimize 25.03.2016 tarihinde başvurdu. Ekstraoral klinik muayenede sağ maksiller posterior bölgede fasiyal asimetri, şişlik mevcuttu ve bu bölge hassastı. Hastaya göre, yüzündeki şişliğin 1 yıldır ağrısız olarak devam ettiği öğrenildi (Resim 1). İntraoral muayenede ise posterior dişlerin vestibüler sulkusunu dolduran, iyi tanımlanmış, lokalize, düzgün yüzeyli, diffüz, yumuşak ve fluktuan şişlik izlendi. Şişlik 4×4 cm boyutlarındaydı. Üzerindeki mukoza ülsere değildi ve rengi normaldi. Palatinal mukoza sağlamdı. Hastanın oral hijyeni iyiydi. Baş-boyun bölgesi muayenesinde başka bir semptom izlenmedi ve lenf bezleri normaldi. Muayene sırasında hastanın genel ve fiziksel sağlığının iyi olduğu izlendi.

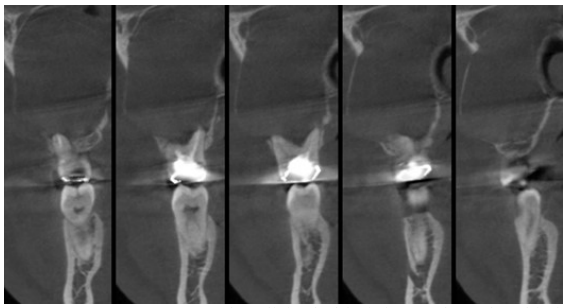
Resim 1. Preoperatif maksiller vestibüler sulkustaki ekspansiyon.

Panoramik röntgende sağ maksiller sinüsün normal görünümünden daha bulanık bir radyolüsentliğe sahip olduğu, birinci büyük azı dişinin kanal tedavili ve maksiller sinüsle ilişkili olduğu izlendi (Resim 2).

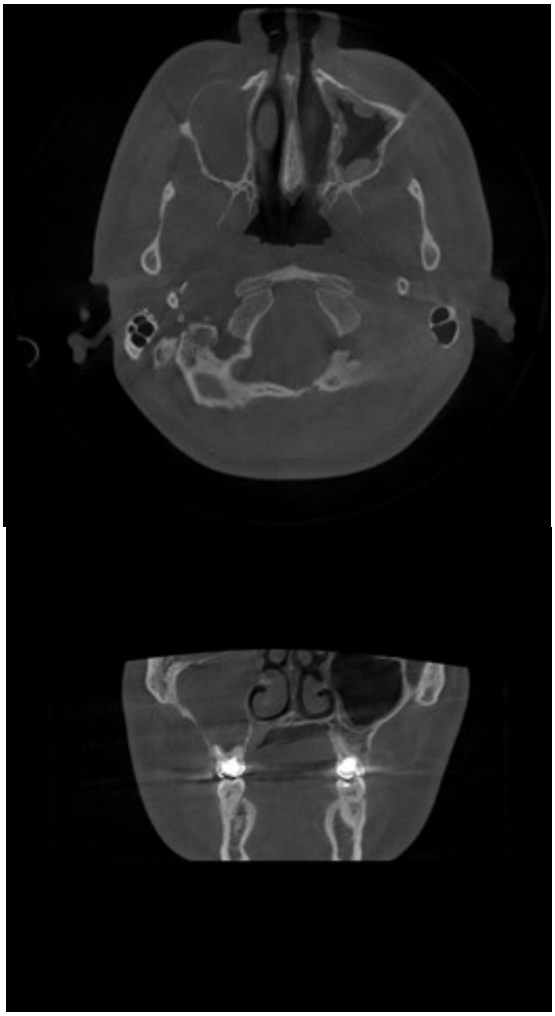


Resim 2. Hastanın preoperatif panoramik radyografik görüntüsü

Yapılan ponksiyonda, enfekte kist sıvısı aspire edildi. Alınan dental volumetrik tomografide lezyonun tüm sağ maksiller sinüsü kapladığı ve burun yan duvarını rezorbe ettiği ayrıca orbita tabanına kadar ulaştığı gözlemlendi (Resim 3,4). Tomografi, lezyonun 4×4 cm boyutlarında ve 1. molar dişin kökleriyle ilişkili olduğunu gösterdi.

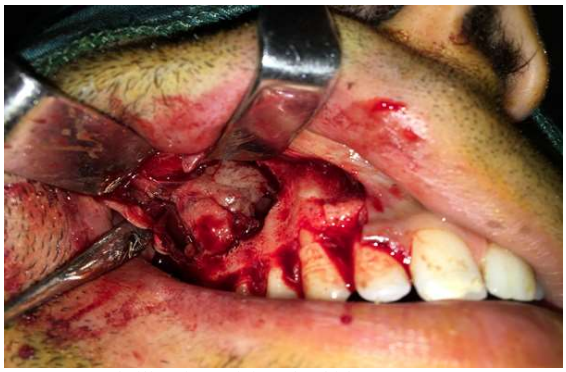


Resim 3. Sağ üst 1. molar dişin köklerini rezorbe eden kistin sagittal CBCT görüntüsü



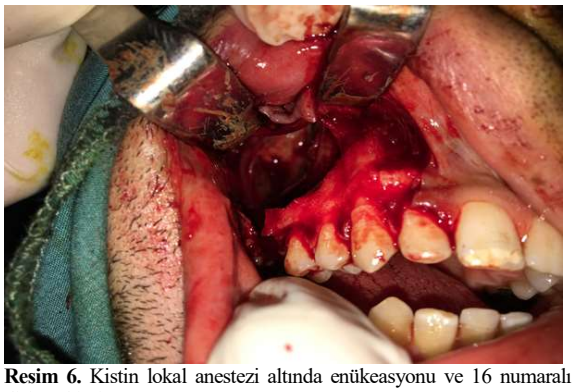
Resim 4. Maksillar sinüsü kaplayan radiküler kistin aksiyal ve koronal CBCT görüntüsü

İlgili dişe daha önceden kanal tedavisi yapıldığı için vitalite testi yapılamadı fakat bölgedeki 12, 13, 14, 15, 17 ve 18 nolu dişler vitaldi. Tüm dişlerde perküsyona hassasiyet gözlenmedi. Hastanın rutin laboratuvar testleri normal sınırlar içindeydi. Hastadan alınan anamnez, klinik ve radyolojik muayene sonucunda radiküler kist ön tanısı konuldu. Hastanın asker olması sebebiyle marsüpyalizasyon tedavisi için yeterli zamanı olmadığı için kistin cerrahi enükleasyonu tercih edildi. Hastanın bilgilendirilmiş onamı alındı. Hastanın, tedavi prosedürünü ve prognozunu etkileyecek önemli bir medikal hikâyesi yoktu. %2'lik adrenalinli (1:200000) lokal anestezi ve antibiyotik profilaksisi altında Caldwell-Luc operasyonu uygulandı. Operasyonda tüber, infraorbital, infiltratif,ve palatinal anestezileri takiben öncelikle sağ lateral dişinin hemen distalinden üçüncü büyük azı dişinin distaline kadar sirküler insizyon atılarak başlandı ve insizyonun başlangıç ve bitiş bölgelerinden vestibülden vertikal insizyonlar ile insizyon bitirildi. Devamında bölgeden zarf flep kaldırıldı ve lateral kortikal kemiğin rezorpsiyonundan dolayı doğrudan kist membranına ulaşıldı (Resim 5).



Resim 5. Maksiller sinüsü içine alan kitle.

Kist kapsülüyle birlikte enükle edildi ve kavite kürete edildi ayrıca bölgedeki kistle ilişkili birinci büyük azı dişi çekildi (Resim 6).



Resim 6. Kistin lokal anestezi altında enükeasyonu ve 16 numaralı dişin çekimi

Betadin ve serum fizyolojik ile irrigasyon yapıldı. Kemik kenarları düzeltildi ve kanama kontrolü yapıldı. Flep 3/0 ipekle primer olarak süture edildi (Resim 7). Hastaya postoperatif talimatlar verildi, analjezik ve antibiyotik ilaçlar reçete edildi. Süturlar bir hafta sonra alındı. Operasyonu takiben 14. gündeki kontrolde herhangi bir komplikasyon izlenmedi. Çıkartılan dokular histopatolojik olarak incelendi ve enfekte radiküler kist ile uyumlu olduğu rapor edildi. Hastanın postoperatif seyri sorunsuzdu ve 6 ay sonra rekürrens belirtisi yoktu.

Resim 7. Flebin primer olarak kapatılması

TARTIŞMA

Odontojenik kistler maksillofasiyal bölgenin yaygın görülen lezyonlarıdır. Etyolojilerine göre, gelişimsel ve enflamatuvar olmak üzere ikiye ayrılırlar. Gelişimsel kistler; primordial, dentijeröz kist, erüpsiyon kisti ve gingival kistlerdir. Enflamatuvar kistler; radiküler ve lateral periodontal kistlerdir.[13]

Radiküler kistler, odontojenik kistler içinde en yaygın olanıdır ve bu kistlerin %52,3-70,7'sini oluşturur.[14,15] Çenelerin dişli olan tüm bölgelerinde görülmekle birlikte; maksiller anterior bölgede görülme oranı yüksektir.[1] Erkeklerde kadınlardan daha fazla görülür.[16] Bu vakada, 25 yaşındaki erkek hastada maksiller posterior bölgede, sağ üst 1. molar diş kaynaklı, maksiller sinüsü kaplayan radiküler kist olgusu sunulmuştur.

Radiküler kistler, travmatik yaralanma veya çürük sonucu gelişen pulpal nekrozu takiben oluşurlar. Devital dişle ilişkili olup, *Malassez* epitel artıklarının proliferasyonu sonucu gelişen unilokuler radyolusent lezyonlardır.[1,12] Bu lezyonlar genellikle epitelle döşelidir. Ekspansif büyürler, çapı genellkile 1 cm'den küçüktür ve ince bir kortikal kemikle sınırlandırılmışlardır.[17] Büyük boyutlardaki radiküler kistler nadiren ortaya çıkarlar ve odontojenik keratokist, dentigeröz kist gibi patolojileri düşündürebilirler.[18] Bu vakada radiküler kistin sinüsü tamamen kapladığı, çapının 4x4 cm olduğu ve bukkal kortekste perforasyon oluşturduğu görülmüştür.

Radiküler kistler, maksiller posterior bölgede daha az görülür. Bu bölgede görüldüklerinde kiste sebep olan devital dişin sinüse yakınlığı, kistin maksiller sinüse yayılmasında önemli rol oynar.[12] Bu vakada radiküler kistin, kökleri maksiller sinüsle ilişkili olan sağ üst 1. molar diş kaynaklı oluştuğu düşünülmektedir.

Radiküler kistler yavaş büyürler ve genellikle çok büyük boyutlara ulaşmazlar. Kist kavitesi enfekte olduğunda ağrı ve şişliğe yol açar ve hastalar genellikle bu şikâyetlerle kliniğe başvururlar. Geniş kistlerde dişte mobilite, kök rezorpsiyonu, yer değiştirme ve vitalite kaybına neden olurlar.[19] Bizim vakamızda sağ üst 1. molar dişte kanal tedavisi mevcut olduğundan devitaldir ve köklerde rezorpsiyon mevcuttur. Kistle ilişkili olduğu düşünülen diğer dişlere (12, 13, 14, 15, 17 ve 18) yapılan elektrikli pulpa testi sonucunda dişlerin vital olduğu tespit edilmiştir. Dişlerde mobilite, yer değiştirme veya kök rezorpsiyonu gözlenmemiştir.

Radiküler kist teşhisinde radyografik incelemeler erken tanıda büyük önem taşır. Radyografik olarak radiküler kist; iyi sınırlı, sıklıkla radyoopak görünümlü sklerotik bir sınırla çevrili, uniloküler radyolusent lezyon şeklinde görülür.[20] Maksiller sinüsü kaplayan büyük patolojilerin teşhisi, boyutunun ve sınırlarının belirlenmesi, konvansiyonel radyografik yöntemlerle zor olmaktadır. Bilgisayarlı tomografi ile kistler; solid tümörler ve fibroosseoz lezyonlar gibi çeşitli patolojilerden ayırt edilebilir.[21] Bu vakada hastadan alınan panoramik radyografi ile maksiller sağ bölgedeki lezyonun sınırları tam olarak tespit edilememiş, dental volumetrik tomografi çekilerek radyografik inceleme desteklenmiştir.

Dentigeröz kist, odontojenik keratokist gibi diğer odontojenik kistler ve odontojenik tümörler (ameloblastoma, Pindborg tümörü, odontojenik fibroma, sementoma); radiküler kistlerle aynı radyografik özellikleri paylaşırlar. Bu tür lezyonların teşhisinde histopatolojik değerlendirmenin önemi büyüktür.[20] Bu vakada lezyon bölgesinden alınan örnekte yapılan histopatolojik incelemede, lezyonun enfekte radiküler kist olduğu doğrulanmıştır.

Radiküler kistler için önerilen tedavi seçeneği endodontik tedaviyle kombine olarak kist içeriğinin boşaltılması veya ilgili dişin ekstraksiyonu ile birlikte kistin cerrahi olarak enükleasyonudur.[22] Lezyon 1cm'den küçük olduğunda çoğu klinisyen endodontik tedaviyi tavsiye etmektedir; ancak büyük lezyonlar için cerrahi yöntem olarak marsupyalizasyon veya enükleasyon tercih edilmektedir.[7] Endodontik tedaviyi takiben iyileşmenin değerlendirilmesi için en az bir yıl beklenilmesi gerektiği görüşü bildirilmiş, bu sürenin sonunda iyileşme gözlenmediği takdirde cerrahi yöntemin tercih edilmesi gerektiği savunulmuştur.[23] Bazı araştırmacılar, kistik lezyonun çapı 3 cm'den küçük olduğunda kistin epiteliyle birlikte tamamen enükleasyonunu önerirken, 3 cm'den büyük lezyonlar için marsüpyalizasyonu önermektedirler.[24] Fakat marsüpyalizasyonun; uzun sürmesi, iki aşamalı cerrahi gerektirmesi ve kist epitelinin in situ karsinomaya prolifere olma riski gibi dezavantajları vardır.[25] Bu vakada kistin enfekte olması, hastanın ağrısının olması, mesleği nedeniyle hastanın rutin kontrollere gelememesi gibi nedenlerle kistle ilişkili sağ üst 1. molar dişi çekilip, kist kapsülüyle birlikte enükle edilmiştir.

Sonuç olarak, radiküler kist oral kavitede yaygın görülen bir durumdur. Maksiller sinüs kitlelerinin ayırıcı tanısında göz önünde bulundurulmalıdır. Bu vakada, maksiller sinüsü kaplayan, göz tabanına ve burun yan duvarına kadar ulaşan radiküler kistin cerrahi olarak enükleasyonu sunulmuştur. Bu tür lezyonların varlığında doğru teşhisi koymak için, iyi bir klinik ve radyografik inceleme ile birlikte, histolojik değerlendirme gereklidir.

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EVALUATION OF THE CONDYLAR SHAPE AND POSITION IN PATIENTS WITH TEMPOROMANDIBULAR JOINT DISORDERS USING CONE BEAM COMPUTED TOMOGRAPHY

Konik Işınlı Bilgisayarlı Tomografi Kullanılarak Temporomandibular Eklem Bozukluğu Olan Hastalarda Kondiller Şekil ve Pozisyonunun Değerlendirilmesi

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ABSTRACT

Background: Temporomandibular joint (TMJ) disorders are common and often self-limited in the adult population. In epidemiologic studies, up to 75 percent of adults show at least one sign of joint dysfunction on examination and as many as one third have at least one symptom. The present study was conducted to investigate the position and shape of the condyle in patients with TMD divided into two groups (a group with disc displacement and a group with osteoarthritis) and based on their Cone Beam Computed Tomography (CBCT) images.

Materials: The present study was conducted on 45 patients (5 men and 37 women) aged 13 to 82 (with a mean age of 37.5) known by their clinical examinations to have TMD type II (disc displacement) and type III (osteoarthritis). To investigate the shape and position of the condyle and the slope of the articular eminence in the sagittal, coronal and axial planes, CBCT images were taken from the patients' TMJ on both sides at maximum dental occlusion.

Results: The result of this study showed the lack of a normal distribution of the data in the quantitative analysis of the horizontal condylar position with the mouth closed (post+ante/post-ante). The compare this indicator in the RDC and the TMD groups, revealing a significant difference between the two (p=0.002). In group II, the condyle showed a greater tendency toward the posterior position. A significant relationship was found between the mediolateral condylar position (central, medial and lateral positions) and the RDC or TMD group type (p=0.02), and the condyle showed a greater tendency toward the lateral position in both groups. However, a significant relationship between the sagittal shape of the condyle and the RDC or TMD group type (p=0.02).

Conclusion: The results obtained indicate that adolescent disc displacement and osteoarthritis can cause the condyle to change its position and shape in the fossa.

Key words: Temporomandibular joint disorder (TMD), CBCT, condyle, toothache

ÖZ

Amaç: Temporomandibular eklem (TME) rahatsızlıkları sıklıkla görülmektedir ve erişkin popülasyonunda sınırlıdır. Epidemiyolojik araştırmalarda yetişkinlerin %75'inde muayene sırasında en az bir adet eklem disfonksiyonu belirtisi görülürken, üçte birinin en az bir semptomu vardırBu çalışma, iki gruba ayrılan TMD'li hastalarda (disk yer değiştirmeli bir grup ve osteoartritli bir grup) kondilin yerini ve şeklini Konik Işınlı Bilgisayarlı Tomografi (CBCT) görüntülerine dayalı olarak araştırmak için yürütülmüştür.

Gereç ve Yöntem: Bu çalışma, klinik muayene ile TMD tip II (disk yer değiştirmesi) ve tip III (osteoartrit) olduğu saptanan 13 ila 82 yaşları arasındaki (Ort. 37.5) 45 hastada (5 erkek ve 37 kadın) gerçekleştirildi. Kondil şekli ve pozisyonu ile birlikte artiküler eminensin sagital, koronal ve eksenel düzlemlerde eğimini araştırmak için, hastaların maksimal dental oklüzyonunda temporomandibular eklemden her iki taraftan CBCT görüntüleri alındı.

Bulgular: Ağız kapalı (post+ante/post-ante) yatay kondil pozisyonunun kantitatif analizinde verilerin normal dağılımının olmamasını gösterdi. RDC ve TMD gruplarındaki bu göstergenin ikili karşılaştırılmasında iki grup arasında istatistiksel olarak anlamlı bir fark vardı (p = 0,002). Grup II'de, kondil posterior pozisyona doğru daha büyük bir eğilim gösterdi. Mediolateral kondüler pozisyon (merkez, medial ve lateral pozisyonlar) ile RDC veya TMD grup tipi arasında anlamlı bir ilişki bulundu (p=0,02) ve kondil her iki grupta lateral pozisyona daha büyük bir eğilim gösterdi. Bununla beraber kondilin sagital şekli ile RDC veya TMD grubu tipi arasında anlamlı bir ilişki görüldü (p = 0,02) .

Sonuç: Elde edilen sonuçlar ergen disk yer değişikliği ve osteoartritin kondilin fossa içindeki yerini ve şeklini değiştirmesine neden olabileceğini göstermektedir.

Anahtar Kelimeler: Temporomandibuler eklem bozukluğu (TMD), CBCT, kondil, diş ağrısı

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INTRODUCTION

Temporomandibular joint (TMJ) disorders are common and often self-limited in the adult population. In epidemiologic studies, up to 75 percent of adults show at least one sign of joint dysfunction on examination and as many as one third have at least one symptom.[1,2] However, only 5 percent of adults with TMJ symptoms require treatment and even fewer develop chronic or debilitating symptoms[3] and involve muscular pain, joint pain, limited mandibular range of motion and joint clicks as their clinical symptoms based on the type of disorder presenting. A clinical examination does not suffice for making an accurate diagnosis of the variety of diseases that affect the TMJ.

In most cases, the etiology and treatment of the condition can be ascertained using imaging examinations. A series of clinical examinations and TMJ imaging are therefore essential in the diagnosis of TMD.

As a major part of the TMJ, the condyle takes a variety of shapes in different ages and in different individuals. These variations are affected by evolutionary variations, malocclusion, trauma and other developmental disorders and diseases.[4,5] In its superior view, the condyle can be flat, round or substantially convex, while in its mediolateral view, it is often slightly convex and symmetrical. Radiographic studies classify the condylar shape into five main categories, including the concave, convex, angled, flattened and round shape categories.[6]

The articular eminence is located in the anterior glenoid fossa and its posterior slope varies in different people and is affected by masticatory and developmental forces and the displacement of the articular disc.[7-9] The articular eminence is 90-94% developed by age 20.[10] Many studies examined the morphological and slope variations in the articular eminence, showing the largest part of the morphological variations to be associated with aging, often manifested in the form of flattening.[9,11]

In addition to morphological studies, the examination of the TMJ requires the superior articular space of the condyle to be carefully examined in TMJ imaging. Different studies have used CBCT imaging to estimate the size of the articular space in normal individuals who had already had their size confirmed in an MRI. Learning the size of these articular spaces is essential, as studies have shown that disc displacement can also occur in the absence of clinical symptoms.[12,13] With the increasing use of MRI, disc displacement has been shown to not be a very rare phenomenon and is reported to occur more than previously imagined, even in children.[14] Tomography and MRI studies have demonstrated that, in the anterior displacement of the disc, condyles move in the posterior direction[15,16] and tend more toward the medial or lateral positions of the glenoid fossa. An examination of the CBCT images and the measurement of the articular spaces can help estimate potential disc displacement and the onset of degenerative articular diseases.[17,18]

As the early diagnosis and treatment of TMD is crucial to the successful control of bone degradation,[19] the present study was conducted to investigate the position and shape of the condyle in patients with TMD in two groups, a group with disc displacement and a group with osteoarthritis, based on their CBCT images.

MATERIALS AND METHODS

It was a cross sectional study approved by the Research Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran (540).

The present study was conducted on 45 patients (5 men and 37 women) aged 13 to 82 (with a mean age of 37.5) known in their clinical examinations to have TMD type II (disc displacement) and type III (osteoarthritis). To investigate the shape and position of the condyle and the slope of the articular eminence in the sagittal, coronal and axial planes, CBCT

images were taken from the patients' TMJ on both sides and at maximum dental occlusion using a Dental CBCT PLANMECA PROMAX in the radiology department of Mashhad School of Dentistry. The classification proposed by Kinzinger *et al.*[20] was used in investigating and classifying the condylar shape in the three planes. The mediolateral position of the condyle (the coronal plane) was classified into the central, lateral and medical groups based on the study conducted by Ikeda *et al.*[18] To calculate the superior, posterior and anterior spaces, the condylar position in the sagittal plane was assessed qualitatively and quantitatively based on a study conducted by Tsiklakis.[21] Moreover, the slope of the articular eminence was measured based on the study by Zabarovi *et al.*[22] All the images were ultimately examined by an oral and maxillofacial radiologist.

RESULTS

As shown in table 1 and according to the Chi-squared test, the qualitative assessment of the condylar position with the mouth closed in all the three central, anterior and posterior positions in group types II and III showed a significant relationship between the horizontal condylar position with the mouth closed and the RDC or TMD group type (p=0.004).

Table 1. Horizontal condylar position with the mouth closed in the RDC and TMD groups (types II and III).

Horizontal condylar position with the mouth closed	RDC/TMD Groups				Total	
	Disc Displacement (Group II)		Osteoarthritis (Group III)			
	Number	Percentage	Number	Percentage	Number	Percentage
Central	11	26	16	34	27	30
Anterior	4	9	15	33	19	21
Posterior	28	65	15	33	43	49
Total	43	100	46	100	89	100
P-Value = 0.004			Pearson's Chi-square = 11.136			

The Kolmogorov-Smirnov test showed the lack of a normal distribution of the data pertaining to the quantitative indicator of the horizontal condylar position with the mouth closed (post+ante/post-ante); (p=0.009). The Mann-Whitney test was thus used to compare this indicator in the RDC and TMD groups, suggesting a significant difference between the two (p=0.002), as the condyle showed a greater tendency toward the posterior position in group II.

The Kolmogorov-Smirnov test was also used to assess the normal distribution of the data pertaining to the superior articular space. As the test showed that p=0.002, the non-parametric Mann-Whitney test was used to compare the superior space in the RDC and TMD groups, suggesting no significant differences between the two groups (p=0.42) and showing the superior space to not be affected by group type.

A significant relationship was found between the mediolateral position of the condyle (central, medial and lateral positions) and group type (p=0.02) and the condyle was found to have a greater tendency toward the lateral position in both the RDC and TMD groups.

The Chi-squared test showed a significant relationship between the sagittal shape of the condyle and the presence or absence of joint clicks and crepitus (p=0.02) and the condylar shape tended more toward anterior flattening in both groups (Figure 1).

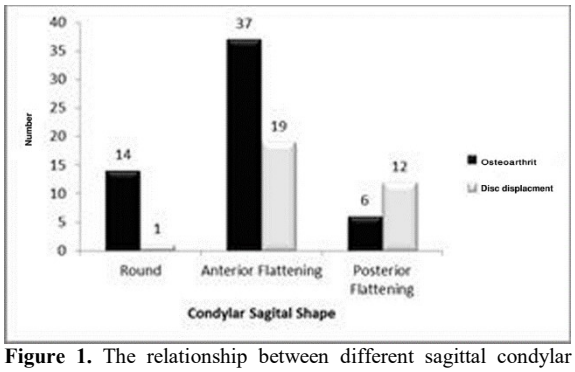

Figure 1. The relationship between different sagittal condylar shapes and the presence or absence of clicks and crepitus

A significant relationship was found between different condylar shapes in the coronal plane and group type, as angled condylar shape was more commonly observed in both groups; however, the relationship between condylar shapes and group type was not significant in the axial plane.

The independent *t*-test showed no significant differences in the mean slope of the

articular eminence (p=0.31) between the RDC and the TMD groups. The ANOVA showed no significant relationships between the mean slope of the articular eminence and different sagittal condylar shapes (p=0.31). No significant relationships were found between the slope of the articular eminence and gender or age in either of the two groups. The mediolateral condyle has three positions, including central, internal and external positions. The Kruskal-Wallis test showed significant relationships between different mediolateral condylar positions and age (p=0.02) and also showed that the lateral position is more common in older ages. The Kruskal-Wallis test showed no significant relationships between the vertical or horizontal condylar positions with the mouth closed and age (p=0.07). The ANOVA showed no significant differences between the mean age in different condylar shapes in the sagittal, axial and coronal planes (p=0.19), and the assessment of the different condylar shapes by gender showed no significant differences between the two groups in either of the three planes (p=0.05).

DISCUSSION

The accurate diagnosis of morphological variations in different parts of the TMJ and condylar position in the glenoid fossa enables the early diagnosis of joint disorders and subsequently a successful treatment; all of these diagnoses rely on having ample knowledge about normal and abnormal joint anatomy.

A study conducted by Ikeda *et al.*[23] reported a significantly larger anterior space in patients with disc displacement and a significantly smaller posterior space in both full and partial disc displacements. The superior space was significantly smaller in cases of full disc displacement compared to in normal cases and a thinning was visible; that is, a superior posterior shift was observed in the condyle in the glenoid fossa. In the coronal sections, the lateral space was significantly larger in cases of lateral disc displacement compared to in normal cases and the central and medial spaces were significantly smaller than in normal cases. In cases of medial disc displacement, the condylar position was the exact opposite of the previous position. In the present study, the condyle was more inclined toward a posterior position in group II (disc displacement) compared to in normal cases.

Hongchen *et al.*[24] studied the variations in the position of the condyle in the glenoid fossa and the variations in the superior, anterior and posterior articular spaces and found condyle to have a significant disposition to move in the posterior direction. In the present study, a posterior condylar position was more frequently observed in the disc displacement group compared to in the osteoarthritis group.

In the present study, compared to the fossa, the condyle was seen with equal frequencies in the central (34%), anterior (33%) and posterior (33%) positions in group III (osteoarthritis). One of the reasons for the lack of a relationship between the horizontal condylar position with the mouth closed and the osteoarthritis group was the effect of chronic displacements on the position and shape of the disc in this group, which could not be investigated due to the unavailability of MRI images.

Reportedly, discs react to improper positions by an obvious increase or reduction in thickness, which undoubtedly affects the condylar position and the articular spaces.[20]

No significant relationships were observed between the superior articular space and the RDC and TMD group types with the mouth closed (p=0.42), which was inconsistent with the results obtained by Alexiou *et al.*[25], who reported a reduced articular space as the most common complication in patients with osteoarthritis observed markedly in 50% of the joints and a bone contact between the condylar head and the glenoid fossa observed markedly in 22% of the joints. The disparity of findings can be attributed to the cited study's larger

sample size and/or the severe type of osteoarthritis observed in its patients.

Ikeda *et al.*[18] studied the condylar position in the axial, coronal and sagittal planes in normal cases and concluded that articular spaces are not affected by age. They also found that the lateral articular space is smaller compared to the medial and central articular spaces and attributed it to the variations in disc thickness in normal people in response to functional diversities. In the present study, the condylar position in the coronal plane had a greater tendency toward lateral positioning and was unaffected by age in both groups.

In the present study, the condylar shape was significantly different between the two groups in the coronal and sagittal planes and was affected by group type. In the coronal plane, the condyle had a greater tendency toward the angular shape; in the sagittal plane, it showed an anterior flattening. In one study, Katsavrias *et al.*[26] concluded that the condylar shape is significantly different in patients with osteoarthritis compared to in asymptomatic individuals and is smaller in all the planes except in the anterior plane compared to in the control group. The flattening bone change was more evident than all other changes in the condylar head, which could be associated with the findings of the present study in that the condylar shape has a greater tendency toward anterior flattening in the sagittal plane and toward the angular shape in the coronal plane in both disc displacement and the osteoarthritis groups.

Previous study[26] on condylar morphology have shown that variations in the condylar shape can be closely associated with the slope of the condylar head, variations in the shape of the glenoid fossa and the slope of the articular eminence; however, the present study found no significant relationships between the condylar shape and the slope of the articular eminence.

The slope of the articular eminence is 90-94% developed by age 20. Several studies conducted in the past have shown morphological variations of the eminence structure to be linked with age, mostly manifested in the form of flattening.[9,11] Dilhan *et al.*[27] and several other researchers, however, found no significant differences in the variations in the slope of the articular eminence with age, which is consistent with the results of the present study in that no relationships exist between articular slope and age.

In the study by Dilhan *et al.*[27], the slope of the articular eminence was assessed in relation to gender and was found to be significantly greater in men than in women. However, the present study found no significant relationships between the two, which may be attributed to the study's smaller number of male subjects compared to female subjects.

Osteoarthritis is an age-dependent disease, and previous studies found morphological and bone variations of the condyle and the glenoid fossa to increase with age[25]; however, the present study found morphological and bone variations of the condyle and the articular eminence to not be affected by age, which may be attributed to its small sample size and the failure to categorize participants by age.

CONCLUSION

The results obtained indicate that adolescent disc displacement and osteoarthritis can cause the condyle to change its position and shape in the fossa.

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Doi: 10.7126/cumudj.307284 *RESEARCH ARTICLES*

PREVALENCE OF VERTICAL ROOT FRACTURE IN EXTRACTED ENDODONTICALLY TREATED TEETH: A PROSPECTIVE STUDY

Endodontik Tedavi Görmüş Çekim Endikasyonu Olan Dişlerde Dikey Kök Kırığı Görülme Sıklığı: İleriye Dönük Bir Çalışma

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ABSTRACT

Objectives: Vertical root fracture (VRF) is one of the complications of endodontic treatment which results extraction of the related tooth. The purpose of this prospective study was to evaluate prevalence of VRF in extracted endodontically treated teeth.

Materials and Methods: During a 1 year period 241 teeth were observed. All of the cases were from extracted teeth after endodontic treatment. Clinical signs, symptoms, the informations about patient and related tooth were recorded.

Results: A total of 17 (7.02%) cases of VRF occurring among 241 cases were observed. The VRF occurred most frequently in the mesial roots of the mandibular first molars (23.5%) and they were the most frequently extracted teeth (35.2%). The VRF prevalence of maxillary first molars was 23.5%, maxillary first and second premolars with a same frequency (11.7%) were the following most fractured teeth. The fractures were predominantly buccolingual and were more frequent in female patients (58.8%). The mean patient age was 36 years and the mean time to VRF was 45 months. Most of the teeth which undergo VRF had a composite restoration (41.1%). 23.5% of the teeth had a post restoration and from among these posted teeth 75% were fully crowned. VRF was found similar frequency in mandibular teeth and in maxillary teeth ($p>0.05$).

Conclusions: After average of 45 months from endodontic treatment, mandibular first molar teeth were found most frequently prone to extraction due to VRF. Further investigation is necessary to determine the possible causes and evidence of fracture development.

Key Words: Endodontically treated teeth, vertical root fracture, tooth extraction, failure.

ÖZ

Amaç: Dikey kök kırığı (VRF), ilgili dişin çekimini gerektiren, endodontik tedavinin komplikasyonlarından biridir. Bu ileriye dönük çalışmanın amacı, çekim endikasyonu bulunan endodontik tedavi görmüş dişler arasında VRF görülme sıklığını değerlendirmektir.

Gereç ve Yöntem: 1 yıllık bir süre boyunca 241 diş gözlendi. Tüm vakalar çekim endikasyonu bulunan endodontik tedavi görmüş dişler arasından seçildi. Hasta ve ilgili diş ile ilgili klinik belirtiler, işaretler ve bilgiler kaydedildi.

Bulgular: 241 vaka arasında toplam 17 (%7,02) VRF vakası gözlendi. VRF, en sık alt çene birinci büyük azı dişlerin mesial köklerinde (% 23,5) meydana gelmiş ve bu dişlerin en sık çekilen dişler olduğu bulunmuştur (%35,2). Üst çene birinci büyük azı dişlerde VRF görülme sıklığı % 23,5; takiben, üst çene birinci ve ikinci küçük azı dişler aynı oranla (% 11,7), en sık kırılan dişler olmuştur. Kırıklar ağırlıklı olarak bukko-lingual idi ve kadın hastalarda daha sıktı (% 58,8). Ortalama hasta yaşı 36 idi ve VRF oluşana dek geçen ortalama sure 45 ay idi. VRF görülen dişlerin çoğunda kompozit onarım (% 41,1) vardı. Dişlerin % 23,5'inde post restorasyon vardı ve bu postlu dişlerin % 75'inde tam kron vardı. VRF alt çenedeki dişlerde ve üst çenedeki dişlerde benzer frekansta bulundu ($p>0,05$).

Sonuç: Endodontik tedaviden ortalama 45 ay sonra, alt çene birinci büyük azı dişler VRF nedeniyle sıklıkla çekime daha yatkın bulundu. Kırık gelişiminin olası nedenlerini ve kanıtlarını belirlemek için daha ileri araştırmalar gereklidir.

Anahtar Kelimeler: Endodontik olarak tedavi edilmiş dişler, dikey kök kırığı, diş ekstraksiyonu, başarısızlık.

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INTRODUCTION

VRF is a complication that may occur after endodontic treatment.[1,2] It has unfavourable prognosis[3] and results in extraction of the tooth or root amputation.[2,4,5] Reasons for VRF include:

a) overzealous widening of the root canal for biomechanical preparation or post placement[6], especially when the root canal has been widened by 40% or more;[7]
b) particularly when step back techniques were used;[8]
c) compromised tooth integrity as a result of large carious lesions or trauma;[9]
d) excessive force during compaction of root filling material, particularly when lateral or lateral-vertical forces are applied[10] and
e) lack of sufficient periodontal support, the presence of internal resorption, or both[11] can also lead VRF.

A local deep pocket, dual sinus tracts, and a halo type of lateral radiolucency are the symptoms and radiographic features of VRF [12]. Clinical signs, radiographic features, and symptoms observed in VRF are similar to a failed root canal treatment and periodontal disease. This similarity makes accurate diagnosis difficult.[3,5,8,13,14]

The prevalence of vertical root fracture was reported as 2-5% in previous studies.[8,15] Song *et al.*[16] reported the percentage of prevalence of VRF in endodontically treated teeth as 1.2% and Zadik *et al.*[17], Fuss *et al.*[18] and Toure *et al.*[19] reported levels of 8.8%, 10.9% and 13.4%, respectively.

The purpose of this study was to investigate the prevalence of VRF in extracted endodontically treated teeth prospectively.

MATERIALS AND METHODS

A total of 241 endodontically treated teeth were extracted between January to December 2011. The patients were referred to the Department of Endodontics, Faculty of Dentistry, and Selcuk University, Turkey by different dental clinics. All of the patients had complained about their endodontically treated teeth. The decisions for extraction was made by specialists (K.O. and S.B.) from totally 1000 failed endodontically treated teeth and 241 teeth were decided for extraction. From these teeth, only 17 were suspected of VRF and referred to an oral surgeon for extraction (H.A.). The questionnaires were filled out via question and answer at the time of extraction for all patients (K.O.); data included information about the patient (age, gender, level of education). Examination of the extracted teeth took into consideration tooth type, status of coronal restoration, root canal filling, radiographic findings, presence of periodontal defects, signs, and the time elapsed from root canal treatment to VRF. After extraction, each tooth was cleaned of external remnants and washed for VRF verification. The diagnosis of VRF was made based on the findings from the extracted tooth. Other extracted teeth were classified by reason for extraction, which included according to prosthetic reasons, periodontal reasons, endodontic failure, nonrestorable caries, nonrestorable cusp/tooth fracture, perforation/ stripping, and teeth extracted because of patient request.

The data were analyzed by using SPSS 17.0 (SPSS, Chicago, IL). The associations between patients' gender and levels of education were examined using a chi-square test. The differences about age of patients were analyzed with Mann Whitney U test. $p<0.05$ was accepted as the level of significance.

RESULTS

VRF was observed in all of the 17 teeth that were referred to an oral surgeon on suspicion of VRF. When these 17 teeth were evaluated, it was observed that 35.2% were mandibular first molars, 23.5% were maxillary first molars, and 11.7% were maxillary first and second premolars (Figure 1). Mesial roots of the

mandibular molars were the most frequently extracted because of VRF. The fractures were predominantly buccolingual and were more frequent in female patients (58.8%). The mean patient age was 36 years, and the mean time to vertical root fracture was 45 months. The elapsed time between root canal treatments to VRF is shown in (Figure 2).

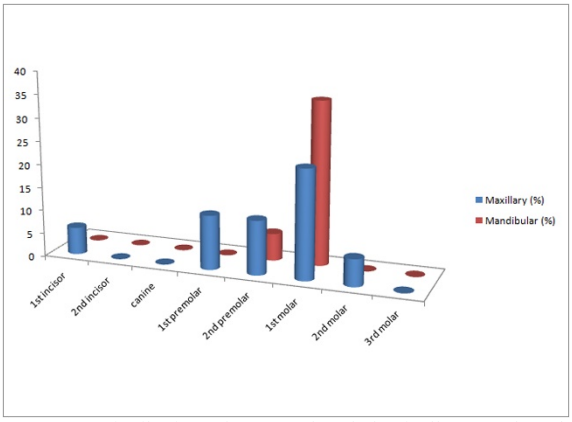

Figure 1. Distribution of extracted endodontically treated teeth due to vertically root fracture

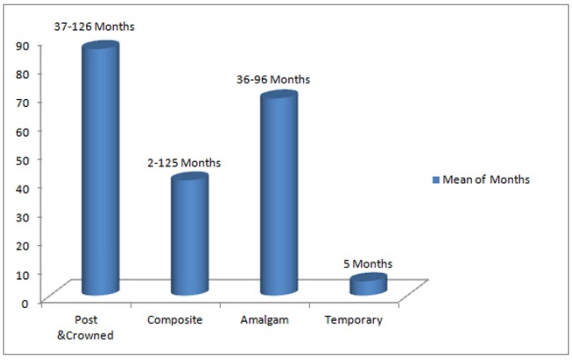

Figure 2. Restorative materials used in 17 teeth with VRF and the mean of elapsed time between root canal treatments to VRF

Most of the teeth that undergo vertical root fracture had a restorative adhesive techniques (41.1%). 23.5% of the teeth had a post restoration, and among these posted teeth, 75% were fully crowned. There is a significant difference among the coronal restorations of teeth (p=0.000) and distrubution of percentages is shown in (Figure 3). None of the posts ended at the coronal third, but all ended at the middle third of the root. All the posts used were prefabricated posts. The frequency of VRF in mandibular teeth and in maxillary teeth was found to be similar (p=0.417).

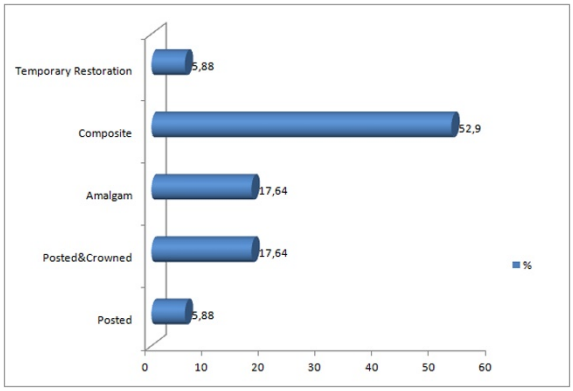

Figure 3. Distribution of coronal restoration of extracted endodontically treated teeth due to vertically root fracture

The most prevalent clinical observations in this study were the presence of periodontal pocket (17.6%) and painful and/or draining fistula (23.5%) on the buccal side of the tooth. Radiographically, a halo type of lateral radiolucency was observed in 3 of the 17 cases.

DISCUSSION

The diagnosis of VRF is problematic and easily misdiagnosed as periodontal disease or endodontic failure.[5,8,13] In the present study, the prevalence of VRF was 7.02%, which was close to the 8.8% found by Zadik *et al.*[17] and 10.9% by Fuss *et al.*[18] Some clinical retrospective articles had previously reported lower percentages such as 4%[20], 3.7%[21], and 1.2% Song *et al.*[16] The lower percentages of VRF in these studies might be because of the difficulties in the clinical diagnosis of VRF. A prospective study by Toure *et al.*[19] reported the percentage of prevalence of VRF in endodontically treated teeth as 13.4%. A study by Sjögren *et al.*[22] reported the highest percentage of the VRF in endodontically treated at 30.8%. The differences among these studies might have occurred because of the study periods.

In our study, the ages of patients ranged from 16 to 61. Most of the VRF in endodontically treated teeth were recorded in patients 30 to 50 years of age as in some previous reports.[8,12,15,18] Based on this finding, we can speculate that after endodontic treatment, teeth become more prone to fracture in younger patients.

Fuss *et al.*[5], Testori *et al.*[15] and Tamse *et al.*[3] reported that premolars have more frequency of VRF in endodontically treated teeth; however, our results, like those of Chan *et al.*[12] and Llena-Puy *et al.*[4], showed that the most extracted teeth were mandibular molars. Also, we found that the mesial roots of mandibular molars are more prone to fracture than distal roots, as reported by Fuss *et al.*[5], Tamse *et al.*[3], and Chan *et al.*[12]. The higher percentage of VRF observed in mesial roots of mandibular molars can be explained by the thin or flat structure of mesial roots, especially after root canal treatment and/or heavier masticatory force associated with first molars.

In Llena-Puy *et al.*[5] study; the mean time from root canal therapy to vertical root fracture was reported as 54 months. According to our results, it is 45 months. For most teeth, using of a restorative adhesive restoration did not appear to prolong the time between restoration and VRF. In contrast the study of Llena-Puy *et al.*[4], in the present study teeth that had a post restoration and full crown provided the longest average time elapsed to VRF. Based on this finding, the posted and fully crowned teeth may extend the time elapsed to VRF in endodontically treated teeth.

In the present study, painful and/or draining fistula appearing in the attached gingiva was the most frequent clinical sign. As opposed to the cases of failed endodontic therapies, it was located <4 mm from the gingival margin. Unlike our study (23.5%), this type of fistula was found by Tamse *et al.*[3] in 35% and by Testori *et al.*[15] in 42%. Following the painful and/or draining fistula, periodontal pocket was the second clinical sign observed in our study. Tamse *et al.*[3] reported that 13% of cases of endodontically treated teeth failed because of VRF; there was no periapical or lateral radiolucency. But in our study, 52.9% of teeth had no periapical or lateral radiolucency, and a halo type of lateral radiolucency was observed only in 3 cases.

Limitations of this study include the fact that, the patients investigated in the present study were treated at different clinics, not our clinic. Because of this, we do not know what sealers or other materials were used during treatment. A preoperative evaluation of the frequency of a VRF in endodontically treated teeth was investigated in the present study. Further investigations need to investigate frequency of a VRF in a larger sample of patients.

CONCLUSIONS

The results of this study showed that the use of posts and fully crowns for reconstruction of endodontically treated teeth does extend the elapsed time to VRF, but use of adhesive restorative techniques does not shorten the elapsed time to VRF.

ACKNOWLEDGMENTS

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Doi: 10.7126/cumudj.307293 *RESEARCH ARTICLES*

STORAGE CONDITION AND PERIOD EFFECT ON THE DIMENSIONAL STABILITY OF IRREVERSIBLE HYDROCOLLOID IMPRESSION MATERIALS

Saklama Şartlarının ve Sürelerinin İrreversible Hidrokolloid Ölçü Maddelerinin Boyutsal Stabilitesi Üzerine Etkileri

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ABSTRACT

The aim of this study was to evaluate the effects of brand, holding solution and storage periods on dimensional stability of irreversible hydrocolloid impression materials.

Impressions were taken from a master maxillary typodont, using a newly designed device and five different irreversible hydrocolloid impression materials. A total of 245 impressions were taken and divided into a control group, two main groups and three subgroups through storing procedure and time. Stone models were obtained for each model and five different dimensions were measured and compared to each other.

Comparison of the groups according to brand of irreversible hydrocolloid impression materials showed statistically significant differences. While the storage period was statistically important at all distances, storage condition was significant only at some distances.

Irreversible hydrocolloid impression materials can be stored in holding solution or sealed plastic bags up to two weeks. Type of the impression material, storage condition and storage period may affect dimensions.

Key words: Alginate impression, Dimensional stability, Holding solution, Orthodontic Model

ÖZ

Bu çalışmanın amacı marka, bekletme solüsyonu ve saklama süresinin irreversible hidrokolloid ölçü maddelerinin boyutsal stabilitesi üzerine etkilerinin incelenmesidir.

Ölçüler, yapay üst çene modelinden oluşturulmuş yeni bir cihaz yardımıyla beş farklı irreversible hidrokolloid ölçü maddesi kullanılarak alındı. Toplamda 245 adet ölçü saklama şartları ve süreleri dikkate alınarak kontrol grubu, iki ana grup ve üç alt gruba ayrıldı. Her bir ölçüden alçı modeller elde edildi, beş farklı uzunluk ölçüldü ve birbiri ile karşılaştırıldı.

İrreversible hidrokolloid ölçü maddesinin markasına göre yapılan gruplar arası karşılaştırma istatistiksel olarak anlamlı farklılıklar gösterdi. Saklama süresi tüm mesafe ölçümlerinde istatistiksel olarak anlamlı etki yaratırken iken saklama koşulları bazı mesafe ölçümlerinde anlamlı etkiye sahipti.

İrreversible hidrokolloid ölçü maddeleri bekletme solüsyonunda veyahut kilitli plastik torbalarda iki haftaya kadar bekletilebilir. Ölçü maddesinin tipi, saklama şartları ve saklama süresi boyutsal stabilite üzerinde etkilidir.

Anahtar kelimeler: Aljinat ölçü, Boyutsal stabilite, Bekletme solüsyonu, Ortodontik Model

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INTRODUCTION

Orthodontic treatment begins and ends with taking records such as patient history, photographs, radiographs and impressions. Impression is one of the most important pretreatment and post treatment records. At the beginning of the treatment, essential evaluations and measurements are performed on orthodontic models. Factors such as amount of crowding, arch shape, teeth relationship, molar relationship, jaws relationships, asymmetries and teeth shapes are determined on orthodontic models. Stone models are also used for making orthodontic appliances.[1] Although computer aided impression taking methods have been begun to use at last decade, most of the clinicians still prefer or use traditional method, as taking orthodontic impressions with irreversible hydrocolloids and using stone models.[1-3]

Irreversible hydrocolloid impression material is made from seaweed. When the powder of the material is mixed with water a gel formation is occurred and this reaction acts in an irreversible manner. The characteristics of irreversible hydrocolloid impression materials that produced by different commercial companies are important on clinical usage. Main clinical advantages of irreversible hydrocolloid materials are low cost, easy usage and good patient tolerance.[1-3] However, its low dimensional stability is main disadvantages of the material in clinical conditions. Water absorption and water release that occurs over time can cause dimensional distortions and hence inaccurate models.[1] Some factors such as type of impression material[4] and impression tray, storage condition and storage period can affect the dimensional stability of irreversible impression materials and hence the accuracy of diagnostic stone models. Quality of diagnostic stone models has a critical role in the orthodontic treatment plan and evaluation of the treatment results.[4,5]

The aim of this study was to evaluate the dimensional stability of five irreversible hydrocolloid impression materials according to the different storage condition and periods. The null hypothesis of this study was that the storage conditions and periods would not affect the dimensional stability of irreversible hydrocolloid impression materials.

MATERIALS AND METHODS

In the current study for the standardization of some main factors such as jaw, position of jaw, stable position of impression tray and pressure; a device named Dento that simulates the mouth was designed and produced by combining a maxillary typodont and carpenter equipment (BM1 Professional, Bosch, Germany). Position of the impression tray was stabilized with the help of two screws (Figure 1). Some reference points were made with a round bur on maxillary typodont (Figure 2).

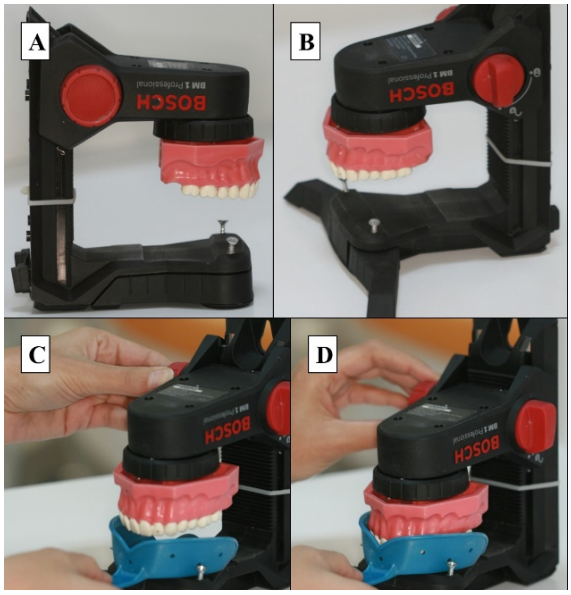

Figure 1. A) and B) Dento, C) and D) Imression process.

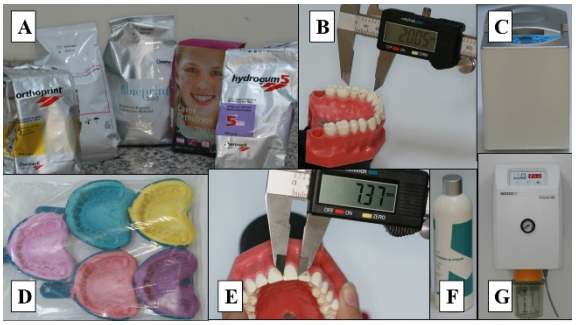

Figure 2. A)Irreversible hydrocolloid impression material brands, B) Digital caliper and Typodont, C) Irreversible hydrocolloid impression material mixing machine, D) Impressions, E) Measurement of dimensions, F) Holding solution, G) Gypsum mixing machine.

Five distances were determined based on developing previous studies.[6] These are;

1. Distance: Between mesiobuccal cusp tip of upper right molar and cusp tip of upper right canine.

2. Distance: Between distobuccal cusp tip of upper left molar and buccal cusp tip of upper left first premolar.

3. Distance: Between cusp tip of upper right canine and buccal cusp tip of upper left first premolar.

4. Distance: Between mesiobuccal cusp tip of upper right molar and distobuccal cusp tip of upper left molar.

5. Distance: Mesiodistal width of upper left central incisor.

Five different brand of alginate were included in this survey. Hydrogum 5(Zhermack, Badia Polesine, Italy), Palgat Plus Quick (3M ESPE, Seefeld, Germany), Blueprint (Dentsply Ltd., Weyhridge, England), Orthoprint (Zhermack, Rovigo, Italy), Orthorace (Cavex Holland BV, Haarlem, Netherlands) were tested at laboratory conditions (Figure 2). All of the impressions were taken with the same type and size of impression tray (O-Tray impression tray, Dentaurum, Germany) (Figure 1C and D). Alginates were prepared with an automatic alginate mixing machine (A.H.T.C.- MIX, Gulsa, Turkey) according to the manufacturers' instructions (Figure 2C and D). In this study, 245 alginate impressions (49 from each brand of alginate) were taken and 35 impressions (7 from each brand of alginate) were used as control group and poured within 20 minutes. Pouring procedure of impressions is standardized by using the same brand of gypsum and an automatic gypsum mixing machine (Motova 100, Bego, Bulgaria) (Figure 2G). Other 210 impressions were divided into two main groups. First group was stored in a holding solution (Extend a pour solution, Dux dental, USA) and second group was stored in sealed plastic bags like previous study.[5] Each groups included equal number of impressions from each brands of impressions. Then main two groups were divided into three subgroups according to storage periods. All of subgroups were named and names were given at Table 1.

Table 1. Subgroups and their abbreviations used in Tables 2-8.

	Control	One day storage in sealed plastic bag	Five days storage in sealed plastic bag	Two weeks storage in sealed plastic bag	One day storage in holding Solution	Five days storage in holding Solution	Two weeks storage in holding Solution
Orthoprint (Zhermack)	OZ	OO	OF	OT	OSO	OSF	OST
Palgat Plus Quick (3M Espe)	PZ	PO	PF	PT	PSO	PSF	PST
Cavex Orthotrace (Cavex)	CZ	CO	CF	CT	CSO	CSF	CST
Blueprint X-rex (Densplay)	BZ	BO	BF	BT	BSZ	BSF	BST
Hydrogum 5 (Zhermack)	HZ	HO	HF	HT	HSO	HSF	HST

These storage periods were 24 hours, 120 hours and 336 hours. The subgroups were poured in gypsum in order to compare the dimensional changes of alginate impression materials[7] at the end of the storage periods. Pouring of impressions is standardized by using same brand of gypsum (Amberok Model Stone, ADD, Turkey) with control group and automatic gypsum mixing machine. All of the stone models were divided in 35 groups and given numbers. Five distances were determined between reference points and measured on all of the stone models.

At the end of the study, all of stone models of a subgroup and maxillary typodont was

scanned with digital scanner (3Shape TRIOS® Ortho, 3Shape, Denmark). These digital models were prepared and analyzed with proper computer program(Ortho Analyzer™ Software, 3Shape, Denmark). All measurements were repeated on these models and results were compared (Figure 3).

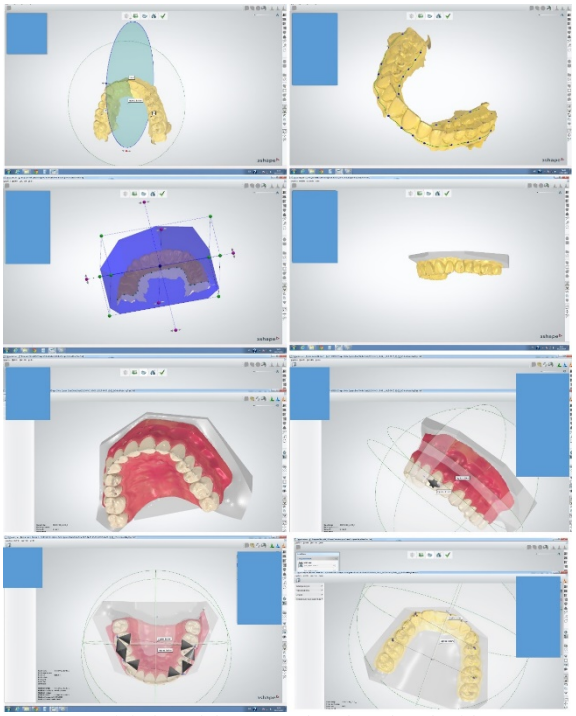

Figure 3. Digital models prepared and analyzed with computer program.

Research data were statistically analyzed and computational works were performed using statistical software (SPSS 17.0 V; SPSS Inc., Chicago, IL, USA). Statistical tests were made using three way ANOVA and significance was evaluated at $p<0.05$.

RESULTS

The measurements of distances on the master model and on control groups were shown at Table 2. All of the measurements made on control groups were very close to master model dimensions.

Table 2. Mean values of distances of control groups (mm).

Group			Mean value		
	First Distance	Second Distance	Third Distance	Fourth Distance	Fifth Distance
Model	19,48	16,52	37,38	51,16	8,09
OZ	19,23	16,32	37,36	51,12	8,03
PZ	19,32	16,38	37,26	50,84	7,98
CZ	19,38	16,25	37,39	50,91	7,92
BZ	19,45	16,48	37,32	50,89	8,05
HZ	19,44	16,51	37,20	51,05	7,98

Evaluation of the measurements of one day, five day and two weeks storages in sealed plastic bag groups and holding solution groups were showed that the all of the brands of the alginate materials were contracted at different amounts (Table 3-8).

Table 3. Mean values of distances of One day storage in sealed plastic bags groups (mm).

Group			Mean value		
	First Distance	Second Distance	Third Distance	Fourth Distance	Fifth Distance
Model	19,48	16,52	37,38	51,16	8,09
OO	19,07	16,07	37,18	50,60	7,82
PO	19,17	16,21	36,60	49,51	7,59
CO	19,12	16,27	36,91	50,32	7,90
BO	19,18	16,09	37,46	50,51	7,90
HO	19,06	16,01	37,15	50,56	7,84

Table 4. Mean values of distances of five days storage in sealed plastic bags groups (mm).

Group			Mean value		
	First Distance	Second Distance	Third Distance	Fourth Distance	Fifth Distance
Model	19,48	16,52	37,38	51,16	8,09
OF	19,05	16,26	36,93	50,51	7,86
PF	19,30	16,10	37,21	50,69	7,45
CF	19,06	16,01	37,01	50,47	7,87
BF	19,22	15,91	37,24	50,81	7,54
HF	19,25	16,20	37,35	50,80	7,47

Table 5. Mean values of distances of two weeks storage in sealed plastic bags groups (mm).

Group			Mean value		
	First Distance	Second Distance	Third Distance	Fourth Distance	Fifth Distance
Model	19,48	16,52	37,38	51,16	8,09
OT	19,06	16,02	37,18	50,65	7,29
PT	19,12	16,05	37,05	50,45	7,39
CT	19,30	16,02	36,87	50,55	7,69
BT	19,16	16,10	36,83	50,32	7,36
HT	18,91	15,84	36,91	50,38	7,83

Table 6. Mean values of distances of one day storage in holding solution groups (mm).

Group	First Distance	Second Distance	Mean value Third Distance	Fourth Distance	Fifth Distance
Model	19,48	16,52	37,38	51,16	8,09
OSO	18,93	15,96	36,90	50,17	7,61
PSO	19,07	15,98	36,35	50,28	7,85
CSO	19,18	16,19	37,02	50,40	7,88
BSO	19,17	16,04	37,36	50,70	7,66
HSO	19,10	15,95	37,10	50,46	7,92

Table 7. Mean values of distances of five days storage in holding solution groups (mm).

Group	First Distance	Second Distance	Mean value Third Distance	Fourth Distance	Fifth Distance
Model	19,48	16,52	37,38	51,16	8,09
OSF	19,07	16,31	37,06	50,65	7,80
PSF	19,19	15,95	36,79	50,07	7,88
CSF	19,12	16,24	36,90	50,33	7,89
BSF	19,28	16,27	36,80	49,99	7,86
HSF	19,27	16,07	36.97	50,72	7,49

Table 8. Mean values of distances of two weeks storage in holding solution groups (mm).

Group	First Distance	Second Distance	Mean value Third Distance	Fourth Distance	Fifth Distance
Model	19,48	16,52	37,38	51,16	8,09
OST	19,05	16,29	36,99	50,49	7,82
PST	19,07	15,99	36,69	50,27	7,68
CST	19,10	16,16	37,11	50,51	7,80
BST	19,06	15,97	36,83	50,37	7,85
HST	19,11	16,03	36,83	50,45	7,45

Tests of between-subjects effects showed that the effects of brands and storage periods on first, second, third, fourth and fifth distance are statistically significant ($p<0.05$). In addition, storage condition is statistically significant in all dimensions except second distance ($p<0.05$) (Table 9).

Table 9. Tests of Between –Subjects Effects

Tests of Between –SubjectsEffects	DependentVariable				
	First Distance	Second Distance	Third Distance	Fourth Distance	Fifth Distance
	P valu	P value	P value	P value	P value
Brands of Irreversible Hydrocolloid Impression Materials	,000	,030	,000	,000	,000
Storage Conditions	,024	,408	,000	,000	,000
Storage Periods	,010	,001	,013	,000	,000
Brands of Irreversible Hydrocolloid Impression Materials * Storage Conditions	,002	,000	,000	,001	,000
Brands of Irreversible Hydrocolloid Impression Materials * Storage Periods	,000	,000	,000	,000	,000
Storage Conditions * Storage Periods	,027	,000	,078	,019	,000
Brands of Irreversible Hydrocolloid Impression Materials * Storage Conditions * Storage Periods	,000	,000	,016	,000	,000

*P<0,05 indicates significant difference.

When the Pairwise Comparisons of brands of Alginate materials were evaluated, following statistical results were identified (Table 10);

Table 10. Pairwise Comparisons of Brands

Pairwise Comparisons of Brands	First Distance	Second Distance	Third Distance	Fourth Distance	Fifth Distance
Groups	P value	P value	P value	P value	P value
Control(Model) Orthoprint	,000	,000	,006	,000	,000
Palgat Plus	,000	,000	,000	,000	,000
Orthorace	,002	,000	,000	,000	,000
Blueprint	,000	,000	,034	,000	,000
Hydrogum	,000	,000	,003	,000	,000
Orthoprint Control	,000	,000	,006	,000	,000
Palgat Plus	,003	,042	,000	,000	,033
Orthorace	,000	1,000	1,000	,545	,000
Blueprint	,000	,624	1,000	1,000	1,000
Hydrogum	,018	,019	1,000	1,000	,938
Palgat Plus Control	,000	,000	,000	,000	,000
Orthoprint	,003	,042	,000	,000	,033
Orthorace	,474	,144	,000	,000	,000
Blueprint	1,000	1,000	,000	,000	,050
Hydrogum	1,000	1,000	,000	,000	1,000
Orthorace Control	,002	,000	,000	,000	,000
Orthoprint	,000	1,000	1,000	,545	,000
Palgat Plus	,474	,144	,000	,000	,000
Blueprint	1,000	1,000	,284	1,000	,000
Hydrogum	,126	,071	1,000	,107	,000
Blueprint Control	,000	,000	,034	,000	,000
Orthoprint	,000	,624	1,000	1,000	1,000
Palgat Plus	1,000	1,000	,000	,000	,050
Orthorace	1,000	1,000	,284	1,000	,000
Hydrogum	1,000	1,000	1,000	,262	1,000
Hydrogum Control	,000	,000	,003	,000	,000
Orthoprint	,018	,019	1,000	1,000	,938
Palgat Plus	1,000	1,000	,000	,000	1,000
Orthorace	,126	,071	1,000	,107	,000
Blueprint	1,000	1,000	1,000	,262	1,000

*p<0.05 indicates significant difference.

-Dimensional differences between model and all subgroups were statistically significant at all five distances ($p<0.05$).

-Measurements on first distance showed that Orthoprint subgroups' dimensions showed statistically significant differences from other brands of Alginate ($p<0.05$).

-There are statistically significant differences between Orthoprint and other two brands of Alginate (Palgat Plus Quick and Hydrogum) according to measurements on second distance ($p<0.05$).

-Statistical comparison of third and fourth distances' measurements indicated that the differences between Palgat Plus Quick and other brands of Alginates are significant ($p<0.05$).

-Hydrogum subgroups' distances did not show statistically significant changes ($p>0.05$) although comparison of other subgroups show statistically significant changes ($p<0.05$).

Pairwise Comparisons of storage periods showed following results (Table 11);

Table 11. Pairwise Comparisons of Storage Periods

Pairwise Comparisons of Storage Periods					
	First Distance	Second Distance	Third Distance	Fourth Distance	Fifth Distance
Groups	P value	P value	P value	P value	P value
Control Oneday Fivedays Twoweeks	,000 ,000 ,000	,000 ,000 ,000	,000 ,000 ,000	,000 ,000 ,000	,000 ,000 ,000
Oneday Control Fivedays Twoweeks	,000 ,015 1,000	,000 ,078 1,000	,000 1,000 ,530	,000 ,000 ,000	,000 ,000 ,000
Fivedays Control Oneday Twoweeks	,000 ,015 ,518	,000 ,078 ,001	,000 1,000 ,019	,000 ,000 ,439	,000 ,000 ,000
Twoweeks Control Oneday Fivedays	,000 1,000 ,518	,000 1,000 ,001	,000 ,530 ,019	,000 ,000 ,439	,000 ,000 ,000

*p<0.05 indicates significant difference.

-Control groups' results are statistically significant than other storage periods (one day and five days) ($p<0.05$).

-On first distance, statistically significant differences were identified between one day and five day storage periods ($p<0.05$).

-There are significant differences between 5 days and two weeks storage periods on second, third, fourth and fifth distances ($p<0.05$).

-Differences between all three storage periods are statistically different on fifth distance measurements ($p<0.05$).

Pairwise Comparisons of Storage conditions showed following results (Table 12);

Table 12. Pairwise Comparisons of Storage Conditions

Pairwise Comparisons of Storage Conditions					
	First Distance	Second Distance	Third Distance	Fourth Distance	Fifth Distance
Groups	P value	P value	P value	P value	P value
Control Plastic bag Solution	,000 ,000	,000 ,000	,000 ,000	,000 ,000	,000 ,000
Plastic bag Control Solution	,000 ,071	,000 1,000	,000 ,000	,000 ,000	,000 ,000
Solution Control Plastic bag	,000 ,071	,000 1,000	,000 ,000	,000 ,000	,000 ,000

*p<0.05 indicates significant difference.

-Comparisons of control groups (poured within 20 minutes) and other storage conditions' groups (sealed plastic bag and holding solution) showed statistically significant differences on all distances ($p<0.05$).

-Comparison of sealed plastic bag groups and holding solution groups did not show statistical differences on first and second dimension. On the other hand other three distances show statistical differences ($p<0.05$).

Comparison of digital and manual measurements' results showed than there are not statistically significant differences between these two methods.

DISCUSSION

The null hypothesis of this study was rejected since the storage conditions and periods were effective on the dimensional stability of irreversible hydrocolloid impression materials.

Type of impression trays and shape of the impression can affect the dimensional stability and the dimensional changes.[8,9] In previous studies artificial models were used as a master model in order to produce more accurate points for measurement and evaluation.[10,11] In the present study, sizes of impressions and master model were identical because same typodont and same impression trays were used.

It was known that mixing method has significant effect on mechanical properties of

alginate impression materials.[12] In the present study mixing method was standardized and the manufacturers' recommendations were followed. Stabilization of impression trays were ensured with two screws positioned on the base of the Dento. Equal pressure was applied while taking all impressions due to the appliance design. Stone models of all groups were produced with using same brand of gypsum and gypsum-mixing machine. Distances measured on all of the stone models were same and reflect the impressions' dimensions well. Storage conditions of the impressions were appropriate to study parameters. Storage periods were convenient to the clinical applications and results of study were beneficial for clinicians. Plaster study models were found reproducible.[13] Moisture and dry can affect the dimensions but they are not adverse effective factors on the dimensional stability of irreversible hydrocolloids.[14] In the present study, storing conditions of all stone models were the same.

As a result, proper comparisons of dimensional changes of the impressions were made. Study parameters were also suitable for use of orthodontic models. Statistical analysis was proper for study parameters and compatible with other studies made on this subject.

All of the measurements on control groups were very close to master model dimensions. This result was inevitable because it is recommended that the impressions should be poured within 30 minutes for best copy of the master model or mouth. Present study's results were also supported by literature.[15] In a study that evaluates the relationship between pouring time and dimensional accuracy, it was found that the hydrocolloid impression materials can be stored up to an hour without significant dimensional changes.[15] In same study, impressions were poured after 12 minutes, 30 minutes and an hour storage periods.[15] On one hand, some authors recommend pouring alginate within ten minutes. On the other hand, other study results presented that it can be poured within 30 minutes without significant dimensional changes.[16]

In the comparisons of effects of brand of alginate impression materials on dimensions of orthodontic models at first, second, third, fourth and fifth distances were showed that there are some statistically significant differences between groups. But the results were not uniform. Literature supports these results; there is a non-uniform relationship between alginate brand and storage time and also is significant effects of alginate brand on model dimensions.[17,18] However some studies opposed with this result; all types of irreversible hydrocolloids were dimensionally stable over a extended period.[19] In addition a study about the dimensional stability of alginate was concluded that the extended storage periods affects the dimensions but the effect is not statistically significant.[20,21]

In the present study, one day storage in sealed plastic bag caused contraction of all impressions on different amounts but this contraction was approximately 0.5 mm. This contraction can affect the model dimensions but the quality of the orthodontic models was proper for evaluation of patients. Coleman *et al*.[22] evaluated the effects of immediate pour, 10 minutes storage, 30 minutes storage, 1 hour storage and 24 hour storage on dimensions of hydrocolloid impressions and stated that one day storage caused bad effects on the dimensions of impressions. In another study, Nassar *et al.*[23] stated that four hours of storage period caused under 0.5% dimensional changes on impressions.

According to the present study's results; storage of impressions in plastic bags during five days caused dimensional changes on impressions in which the maximum dimensional contraction was less than 1 mm. This maximum value can disrupt some results of detailed orthodontic evaluation like Bolton analysis but general stone model quality may be enough for diagnostic examination. When the

literature was evaluated, some studies showed that longer storage time can cause unstable impression dimensions.[24] However, another study results showed that storage periods up to 5 days did not change the dimensions of impression at statistically significant level.[25] In addition, in a study which evaluated that the relationship between model accuracy and storage time, it was concluded that the four days storage period in sealed plastic bags did not differ the accuracy of models.[6] On the other hand, another study showed that statistically significant dimensional differences were determined between one day storage, three days storage and five days storage groups. So storage time is a determinant on the dimensional changes of alginate.[26]

According to present study's results; two weeks storage period affect the model quality badly on sealed plastic bag group but the maximum dimensional deviation from the original master model was less than 1 mm like five day storage period. Longer storage period provoked more contraction of impressions. However quality of the stone models were almost alike five days storage periods. There is no study at the literature about two week's storage period so this is the first result about two weeks storage of Alginate impressions.

In present study, comparison of the storage condition (sealed plastic bag via holding solution) showed statistically significant differences between groups on third, fourth and fifth dimension. One day, five days and two weeks storage in holding solution were resulted in varying amounts of contractions of impressions. However, contractions were around 0.5 mm.

Storage temperature may have an effect on dimensions of impressions.[19] In present study, impressions were stored same place and the temperature at room temperature. So the effect of temperature was eliminated.

In an experimental study, It was shown that the weight of alginate increased initially maximum and then decreased. It means alginates take the water or other liquid inside firstly, then give them to outside. Alginate firstly expanded by external liquid then contracted by reversed thermodynamic potential.[27] This study's results are compatible with present study's result which shows that alginate impression materials contractions are not uniform.

Present study's results showed that the alginate is not a uniform material and should be used carefully. Storage time, storage condition and alginate brand can affect the dimensional stability of impressions. On the other hand these effects are at small level and mostly may not change the orthodontic model accuracy.

Comparison of digital and manual impression taking methods showed no statistically significant differences. Digital measurements of five distances gave similar results with manual method at which digital caliper was used. Computer aided digital impression taking methods can reduce the chair time and increase patient comfort. Clinicians do not use gypsum, alginate or impression and do not need a technician and storage area due to digital impression technology. These are main advantages of digital impressions. On the other hand quality of work in the limit of study parameters are not more than conventional ones.

This study has some limitations. Under the same experimental conditions the effects of different factors on dimensional changes of irreversible hydrocolloid impression materials should be made in future investigations.

Today, despite new impression taking technologies being available especially in developed countries, many of clinicians mainly working in private practice are continuing to use Alginate for taking impressions and sending them to orthodontic laboratories. Day by day new brands of Alginate with new characteristics are been developing and producing. New products like holding solution also are taking in

market. So researchers should test them and present the results to help clinicians.

CONCLUSIONS

- Extended storage time may cause dimensional changes on the alginate impressions.
- Alginate impressions can be stored in holding solution or sealed plastic bags up to two weeks without too much clinically effective stability problems.

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RETROSPECTIVE ANALYSIS OF MANDIBULAR FRACTURES CASES IN CENTER OF THE EASTERN ANATOLIA REGION OF TURKEY

Türkiye'nin Doğu Anadolu Bölgesi Merkezinde Mandibula Kırıklarının Retrospektif Analizi

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ABSTRACT

Objectives: The aim of this retrospective study is to evaluate the etiology of mandibular fractures, the distribution of the age and gender of mandibular fracture patients, the anatomical regions where these fractures are located, and the treatment modalities used in mandibular fracture cases.

Materials and Methods: This study employed data obtained via clinical records and the files of patients diagnosed with a mandibular fracture who were treated from 2011 to 2015 at the Department of Oral and Maxillofacial Surgery, Ataturk University. The etiology of these patients' mandibular fractures, the distribution of these patients' age and gender, the anatomical regions where these patients' fractures were located, and the treatments applied to these patients were recorded by analyzing the obtained data. Descriptive statistical analysis was performed using Microsoft Excel software.

Results: 137 mandibular fracture sites were seen in 103 patients. Of these patients, 81 (79%) were male and 22 (21%) female, making the male-to-female ratio 3.7:1. The patients' ages ranged between 4 and 78 years, and the mean age was 31.4. Of the various etiologies of mandibular fractures, traffic accident (42 patients, 41%) was most frequent, followed by violence (28 patients, 27%), fall (24 patients, 23%). Of the various anatomical sites where mandibular fractures occurred, the condylar site (36 patients, 26%) was the most common, followed by the body (24%), symphysis and parasymphysis (23%), angle (18%). 58 patients (56%) were treated with closed reduction 42 patients (41%) were treated with open reduction. Three patients (3%) did not receive any treatment.

Conclusions: Traffic accidents are the most common etiologic factor of mandibular fracture cases in center of the Eastern Anatolia Region of Turkey. Males and young individuals are the most affected. The condylar site is the most common anatomical site. Both closed and open reduction methods are commonly used for the treatment of mandibular fractures.

Key words: Mandibular fracture, etiology, treatment

ÖZ

Amaç: Bu retrospektif çalışmanın amacı, mandibula kırıklarının etiyolojisini, hastaların cinsiyet ve yaş dağılımlarını, bu kırıkların oluştuğu anatomik bölgeleri ve tedavi yöntemlerini değerlendirmektir.

Gereç ve Yöntem: Bu çalışma da kullanılan veriler, 2011-2015 yılları arasında Atatürk Üniversitesi, Dişhekimliği Fakültesi Ağız, Diş ve Çene Cerrahisi Anabilim Dalı'nda mandibula kırığı teşhisiyle tedavi edilen hastaların dosyaları ve klinik kayıtlarından elde edilmiştir. Bu veriler üzerinden, mandibula kırıklarının etiyolojisi, yaş ve cinsiyet dağılımı, kırıkların anatomik bölgeleri ve uygulanan tedaviler analiz edilerek kaydedildi. Verilerin yüzdeleri, ortalamaları ve standart sapmaları Microsoft Excel yazılımı kullanılarak hesaplandı.

Bulgular: 103 hastada 137 mandibula kırığı görüldü. Bu hastalardan 81'i (% 79) erkek, 22'si (% 21) kadın, erkek-kadın oranı 3,7:1'dir. Hastaların yaşları 4 ile 78 yıl arasında değişiyordu ve ortalama yaş 31,4'tür. Mandibula kırıklarının çeşitli etyolojileri arasında trafik kazaları (42 hasta, %41) en sık olarak görülmekle birlikte, bunu şiddet (28 hasta, %27) ve düşme (24 hasta, %23) izledi. Mandibula kırıklarının meydana geldiği çeşitli anatomik bölgeler arasında kondil bölgesi en sık görülmekle birlikte (36 hasta, %26), bunu korpus (%24), semfiz ve parasemfiz (%23) ve angulus (%18) izledi. 58 hasta (%56) kapalı redüksiyonla ve kırk iki hasta (% 41) açık redüksiyonla tedavi edildi. Üç hasta (%3) herhangi bir tedavi görmedi.

Sonuç: Trafik kazaları, mandibula kırıklarında en sık görülen etyolojik faktör olmakla birlikte erkekler ve genç bireyler en fazla etkilenmektedir. Kondiler bölge kırığın meydana geldiği en yaygın anatomik bölgedir. Mandibula kırıklarının tedavisinde hem kapalı hem de açık redüksiyon tedavi yöntemleri yaygın olarak kullanılmaktadır.

Anahtar Kelimeler: Mandibular kırık, etyoloji, tedavi

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INTRODUCTION

Mandibular fractures are an important part of maxillofacial traumas.[1] These fractures account for 36-59% of all maxillofacial fractures.[2] Various functional and aesthetic disorders can result from mandibular fractures.[3] Many factors can be involved in the etiology of these fractures, with traffic accidents being the most common of these factors.[4,5] Fractures can occur in different anatomical regions of the mandible depending on the mechanism of the trauma.[6] Different treatment approaches can be applied in the mandibular fractures depending on various factors, such as patient characteristics, fracture type and localization, and the preference of the surgeon treating the patient.[5,7] The type and etiology of fractures and the anatomical region where mandibular fractures are reported occur at different rates in studies conducted on different populations or in different geographic locations.[4,6,8]

The aim of this retrospective study is to evaluate the etiology of mandibular fractures, the distribution of the age and gender of mandibular fracture patients, the anatomical regions where these fractures are located, and the treatment modalities used in mandibular fracture cases in center of the Eastern Anatolia Region of Turkey.

MATERIALS AND METHODS

This study employed data obtained via clinical records and the files of patients diagnosed with a mandibular fracture who were treated from 2011 to 2015 at the Department of Oral and Maxillofacial Surgery, Ataturk University. The etiology of these patients' mandibular fractures, the distribution of these patients' age and gender, the anatomical regions where these patients' fractures were located, and the treatments applied to these patients were recorded by analyzing the obtained data. The etiology of mandibular fractures was divided into six categories: traffic accident, violence, fall, sports accident, work accident, and other. The anatomical location of the fractures was divided into six regions: the symphysis and parasymphysis, the body, the angle, the condyles, the alveolar, and the ramus. The treatment methods used to treat mandibular fractures were divided into closed and open reduction. The percentage, mean, and standard deviation of the data were calculated using Microsoft Excel software. This study has local ethics committee approval.

RESULTS

During the five-year period covered by this study, 137 mandibular fractures were seen in 103 patients. Of these patients, 81 (79%) were male and 22 (21%) female, making the male-to-female ratio 3.7:1. The patients' ages ranged between 4 and 78 years, and the mean age was 31.4 (Figure 1 shows the patients' age distribution).

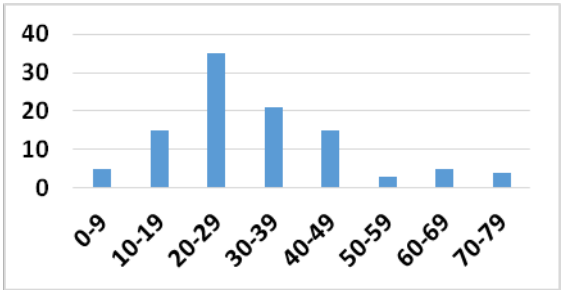

Figure 1. Distribution of Patients' age

Of the various etiologies of mandibular fractures, traffic accident (42 patients, 41%) was most frequent, followed by violence (28 patients, 27%), fall (24 patients, 23%), sports accident (4 patients, 4%), work accident (3 patients, 3%) and other (2 patients, 2%) (Figure 2 shows the distribution of the etiology of mandibular fractures). Of the two types of mandibular fractures, 70 (68%) patients had one fracture site and 33 (32%) had multiple mandibular fracture sites. Of the various anatomical sites where mandibular fractures occurred, the condylar site (36 patients, 26%) was the most common, followed by the body (24%), symphysis and parasymphysis (23%), angle (18%), alveolar (8%), and ramus (1%)

(Figure 3 shows the distribution of the anatomical sites of mandibular fractures). Of the two types of treatment methods, 58 patients (56%) were treated with closed reduction via intermaxillary fixation (IMF) with arch bars (54 patients) or circummandibular wires with an acrylic splint (4 patients). 42 patients (41%) were treated with open reduction via internal rigid fixation with miniplates and screws with short-term IMF. Three patients (3%) did not receive any treatment; they were only given recommendations.

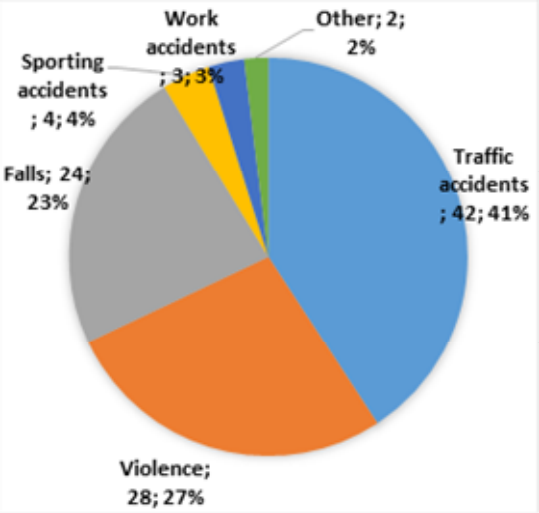

Figure 2. Distribution of etiologies of mandibular fractures.

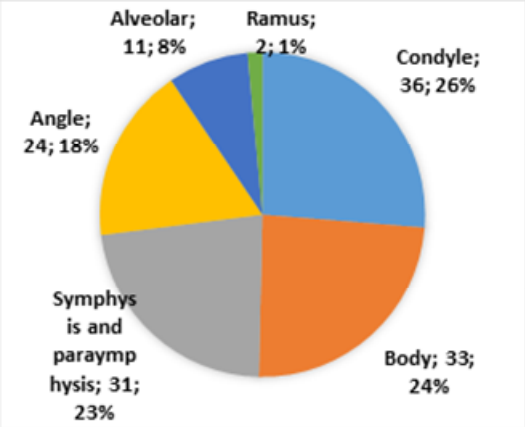

Figure 3. Distribution of mandibular fractures sites.

DISCUSSION

In this study, most patients were male (the male-to-female ratio was 3.7:1) and the peak incidence of mandibular fractures was in the 20-29-year-old group (see Figure 1). These results confirm the findings of other studies, which indicated that young people and males suffer more mandibular fractures than other groups.[2,4,5,9-11]

The most common etiologies of mandibular fractures described in the literature are traffic accidents, violence, falls, sports accidents, work accidents, and gunshot and explosion injuries.[4,6,7,12] The results of this present study indicate that the most frequent etiologies were traffic accidents, followed by violence and falls. This same distribution is observed in the findings of various other studies.[4,6,11,13] Some studies[14-16] have reported violence as the most common etiology. These varied results may be caused by the differences in socioeconomic status or motor vehicle use rate between different populations.[8] Traffic accidents are the most common etiology of mandibular fractures in developing countries, but sports accidents are the most common cause in developed countries.[4,17] Fights (violence) are the most common cause of mandibular fractures in rural and farming populations and in various ethnic groups.[8,13] Alan *et al.*[2] reported that interpersonal violence and the use of motor vehicles are more common among men than women may cause men to be more affected by this type of trauma.

The most commonly observed anatomical sites of mandibular fractures have varied between the results of different studies. Several studies have reported that the most common fracture sites are the angle,[18,19] body,[9,11] symphysis and para symphysis,[7,10] condylar[4,6,12,13] sites. In this study, the most common sites were the condylar site, followed by the body, symphysis and parasymphysis, and angle sites. The same distribution of fracture sites is reported in two other studies.[4,5] Additionally, the distribution of the etiologies of mandibular fractures found by this study are similar to the findings of these same two studies.[4,5] The similarities between this study and the other two studies suggest that the

etiology of a mandibular fracture affects the anatomical site of the fracture.

When treating mandibular fractures, clinicians intend to establish a stable occlusion, maintain normal mandibular arch form, regain the symmetry of the face and mandible, restore mandibular function, and avoid the progression of a developmental disorder.[3,7] There are many treatment options for mandibular fractures, and there is a general agreement on the best treatment options. Treatments generally vary according to clinician preferences, patient characteristics, and fracture type, number, and location.[5,7] Two basic treatment methods have been proposed: open and closed reduction.[3,4,7] The management of cases that involve a stable occlusion, a favorable fracture, and a greenstick fracture should consists ofwatchfull waiting, aliquid diet, and limited physical activity. Andersson *et al.*[3] presented that if occlusal discrepancies or other signs of fracture displacement develop, then either closed or open reduction techniques should be implemented early. In this study, only three cases (3%) were recorded as giving advice to patients without any administering treatment.

Despite technological advances in plating systems and the widespread availability of these systems, most mandibular fractures can be successfully treated with closed technics.[1,3] This technique consists of an IMF procedure, which uses arch bars. IMF is simple and conservative. Erol *et al.*[1] demonstrated that in the cases with preferable characteristics, clinical outcomes are quite good. In children, the best option for the treatment of most mandibular fractures is the closed approach. In younger children, mandible fractures can be successfully treated using acrylic splints attached to the mandible by circummandibular wires, avoiding the necessity of IMF.[1,3,20] In the present study, 56% of cases were treated with closed reduction methods, which included IMF with arch bars or acrylic splints attached to the mandible by circummandibular wires.

Open reduction with internal fixation methods is an appropriate option for patients who are intolerant to IMF and exhibit excessive displacement, unfavorable fractures, or multiple fractures.[1,3,7] In recent years, open reduction and internal fixation methods performed with miniplates and screw systems have become quite popular for the treatment of mandible and other facial fractures. An open method entails a number of advantages, such as optimal visualization of fracture segments, stable anatomical reduction, and early return of function for the patient.[4,6] In this study, 41% of patients were treated with open reduction and internal fixation with miniplates and screws. The findings of this study are compatible with the findings of other reports indicating that closed reduction methods are more preferable.[1,9,11] However, other studies reported that the open methods are more preferable.[4,7,10,13] The differences between these results may be due to variability of factors affecting treatment options or the variety of preferences of different clinicians.

CONCLUSIONS

This study indicated that traffic accidents are the most common etiologic factor of mandibular fracture cases in center of the Eastern Anatolia Region of Turkey. Males and young individuals are the most affected by these fractures. The condylar site is the most common anatomical site of mandibular fractures. Both closed and open reduction methods are commonly used for the treatment of mandibular fractures.

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Doi: 10.7126/cumudj.307301 *RESEARCH ARTICLES*

A HISTOMORPHOMETRIC EVALUATION OF THE EFFECTS OF PLATELET-RICH FIBRIN AND RIFAMYCIN IN COMBINATION WITH AN ALLOGRAFT ON BONE AUGMENTATION WITH SIMULTANEOUS IMPLANT PLACEMENT IN RABBIT TIBIA

Trombosit Zengin Fibrin ve Rifamisinin Bir Allogreft ile Kombinasyonda Kemik Büyütme Üzerindeki Etkilerinin Tavşan Tibiasında Eşzamanlı İmplant Yerleştirmesiyle Histomorfometrik Olarak Değerlendirilmesi

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ABSTRACT

Objective: To evaluate the potential of platelet-rich fibrin (PRF) and rifamycin to enhance guided bone augmentation with simultaneous high-profile dental implant placement in a rabbit tibia model.

Materials and Methods: Dental implants protruding 2 mm were covered with dome-shaped stiff occlusive titanium barriers filled with demineralized freeze-dried bone allograft (DFDBA)+saline (7 rabbits), DFDBA + rifamycin (8 rabbits), or DFDB +PRF (8 rabbits). After 4 weeks, the animals were sacrificed, and undecalcified histomorphometric examination with toluidine blue staining was performed.

Results: The bone-to-implant contact (BIC) was 58.43 ± 1.92% in the saline group, 68.3 ±20.37% in the rifamycin group, and 80.70±2.55% in the PRF group, and the percentage of new bone formation was 36.90 ± 0.94%, 45.26±0.60%, and 51.82±0.82%, respectively. Conclusions: Both PRF and rifamycin have potential to enhance GBA, and using DFDBA + PRF or DFDBA+rifamycin beneath a stiff occlusive titanium barrier next to a high-profile implant may enhance both BIC and new bone formation.

Keywords: Guided bone augmentation, platelet-rich fibrin, rifamycin, allograft, high-profile dental implants

ÖZ

Amaç: Yüksek profilli dental implant yerleştirilmesinde yönlendirilmiş doku augmentasyonunu geliştirmek için plateletten zengin fibrin (PRF) ve rifamisin uygulamasının potansiyelinin değerlendirilmesi.

Materyal ve metod: İki mm'lik koronal kısmı kemik dışında kalan dental implantlar kubbe şeklinde sert kaplayıcı titanyum membran ile kapatılmış ve membranın içi demineralize dondurularak kurutulmuş kemik allogrefti (DFDBA)+salin (7 tavşan), DFDBA+rifamisin (8 tavşan) veya DFDBA+PRF (8 tavşan) ile doldurulmuştur.

Bulgular: Kemik implant kontağı (KİK) salin grubunda 58,43±1,92%, rifamisin grubunda 68,34±20,37% ve PRF grubunda 80,70±2,55% olarak tespit edilmiştir. Sırasıyla yeni kemik oluşum yüzdesi de 36,90±0,94, 45,26±0,60 ve 51,82±0,82 olarak bulunmuştur.

Sonuç: Hem PRF hem de rifamisinin yönlendirilmiş doku augmentasyonunu geliştirici potansiyeli olduğu ve yüksek profilli dental implant uygulamalarında sert kaplayıcı titanyum membran altında DFDBA + PRF veya DFDBA + rifamisin kullanılmasının hem KİK değerini hem de yeni kemik oluşum yüzdesini artırabileceği görülmüştür.

Anahtar Kelimeler: Kemik Takviyesi, Trombosit bakımından zengin fibrin, rifamisin, Yüksek profilli diş implantları

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INTRODUCTION

Vertical bone insufficiency is still a challenging problem in oral surgery for dental implant placement.[1] Conventionally, a therapeutic method known as guided bone regeneration/ augmentation (GBR/GBA) is used to solve this problem. The basic principle of GBA involves placement of a mechanical barrier to protect the blood clot and to isolate the bone defect from the surrounding connective tissue. This allows osteoprogenitor cells to proliferate and differentiate without competition from overlying soft tissue cells.[2-4]

For vertical ridge augmentation with GBA, barriers have been used alone or in combination with bone grafts. It may be possible to enhance the bone healing obtained with grafts by combining regenerative therapies.[5] Platelet-rich fibrin (PRF) is a second-generation autologous platelet concentrate (APC) that is easy and inexpensive to prepare. It is a fibrin meshwork in which platelets, leukocytes, cytokines, and growth factors are trapped during centrifugation.[6,7] Clinically, PRF enhances bone healing in dentistry.[8,9] In this study, PRF was combined with graft material based on the hypothesis that two distinct wound-healing processes would occur together and promote bone regeneration.

Antibiotics combined with bone autografts and allografts have been used clinically to treat infections.[10] Bone grafts can be soaked in an antibiotic solution or combined with antibiotic powder. Rifamycin is a semisynthetic macrocyclic antibiotic derived from natural rifamycin B that has been combined with bone grafts and has positive effects on bone healing and graft incorporation. Kaya *et al.*[11] showed that topical rifampin can accelerate the bone repair process. Taşdemir *et al.*[12] combined rifamycin with autogenous bone grafts and found earlier revascularization and osteogenesis in the experimental group; there was also significantly more BMP-2 in the experimental group than in the controls. Therefore, we combined rifamycin with grafts to enhance bone healing.

Investigators continue to search for optimal bone augmentation strategies to achieve predictable results and precise bone formation. This study used tissue engineering to enhance bone formation during GBA. In an animal experiment, a stiff occlusive titanium barrier was placed over supracrestally placed high-profile dental implants with demineralized freeze-dried bone allograft (DFDBA)+saline, DFDBA+PRF, or DFDBA+rifamycin to evaluate whether bone formation was enhanced.

MATERIALS AND METHODS

The study protocol was approved by the ethics committee of Cumhuriyet University. All experiments were performed according to the Cumhuriyet University Guidelines for the Care and Use of Laboratory Animals.

Study Design

This study used 23 adult male New Zealand white rabbits, weighing 3.0-3.5 kg. In the experimental model, 23 3-mm-diameter, 10-mm-long implants were placed in the rabbit tibia, leaving the threads exposed by 2 mm in coronal section. The exposed threads were covered with a custom-made dome-shaped stiff occlusive titanium barrier with a diameter of 8 mm, height of 4 mm, and thickness of 0.3 mm. The 3-mm-diameter holes at the top of each barrier were closed with a Teflon cover. All of the barriers were cleaned in an ultrasonic bath and sterilized in an autoclave before use. The titanium barriers were filled with DFDBA (Maxxeus Community Tissue Services, Ohio, USA) combined with saline (seven rabbits), DFDBA combined with PRF (1:1 ratio) (eight rabbits), or DFDBA combined with rifamycin (250 mg; Koçak Farma, Istanbul, Turkey) (eight rabbits). The rabbits were assigned randomly to the three groups.

PRF Preparation

For each of the experimental animals, PRF was prepared before surgery. Five milliliters of blood were withdrawn under sedation from the central auricular artery of each animal into a blood-collection tube without anticoagulant. The blood was centrifuged immediately after collection at 3000 rpm for 12 minutes. This produced a fibrin clot that was removed from the tube using forceps under sterile conditions. The PRF clot was cut into small pieces and combined with graft material.

Surgical procedures

All operations were completed under general anesthesia, achieved with 2% xylazine (Rompun 2%; Bayer, Istanbul, Turkey) and 1% ketamine (Ketalar; Eczacibasi Warner Lambert, Istanbul, Turkey). The experimental side was shaved and cleaned with povidone–iodine. After the incision was made, the tibia bone was exposed with subperiosteal dissection.

Implant beds 3 mm in diameter and 8 mm deep were prepared, and an implant (Adin Dental Implant Systems, Toureg–NP 3.0×10 mm; Afula, Israel) was inserted with primary stability. Healing caps were screwed on the implants. This left the implants exposed by 2 mm (Figure 1). Six small holes were drilled with a 1-mm-diameter round burr to induce bleeding from the marrow space. All implants were covered with a titanium barrier, and the barriers were filled with DFDBA+saline, DFDBA+PRF, or DFDBA+rifamycin. The tissues were sutured tightly in two layers using absorbable sutures (Pegelak, poly (glycolide-co-lactide) (PGLA); Doğsan, Trabzon, Turkey). Postoperatively, the rabbits were given ceftriaxone 50 mg/kg (Rocephin; Deva, Istanbul, Turkey) and carprofen 4 mg/kg (Rimadyl; Pfizer, New York, IL, USA) intramuscularly once daily for 3 days.

The animals were sacrificed 4 weeks after implantation. The implants were dissected with the bone, and any signs of unusual healing were documented (Figure 2).

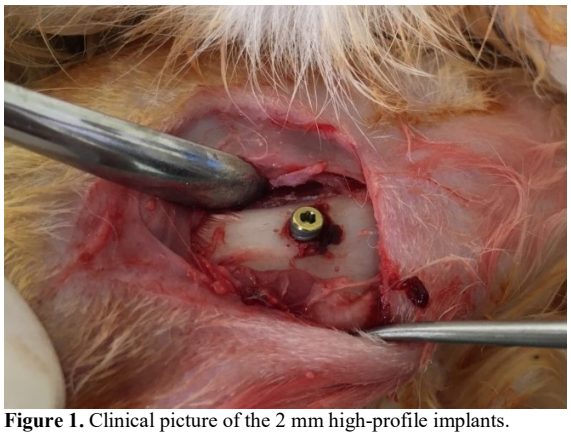

Figure 1. Clinical picture of the 2 mm high-profile implants.

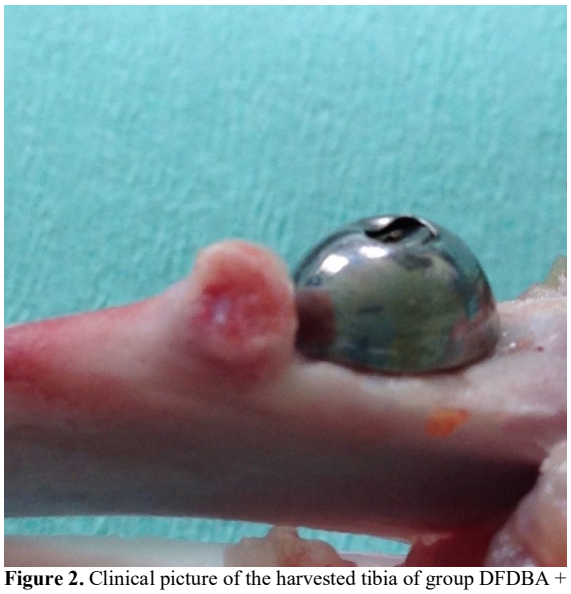

Figure 2. Clinical picture of the harvested tibia of group DFDBA + PRF with the removed titanium barrier.

Specimen preparation

The bone with the implant was removed *en bloc* and immersed in 4% neutral buffered formaldehyde for histological assessment. Dehydration with increasing percentages of ethanol was followed by embedding in a methyl methacrylate-based resin (Technovit 7200 VLC; Kulzer&Co, Wehrheim, Germany). Undecalcified

ground sections from the implants and surrounding bone were prepared according to the method described by Donath and Breuner.[13] Sections of all implants were taken through the same longitudinal plane and reduced to a thickness of 50 µm with diamond grinding. Four sections were prepared from each specimen and stained with toluidine blue.

Bone histomorphometry

All sections were evaluated histomorphometrically. Images were captured using a light microscope (Olympus BX50; Olympus Optical, Tokyo, Japan) with an attached digital camera system (Olympus DP 70; Olympus Optical, Tokyo, Japan). All images were downloaded to a personal computer and evaluated using BIOQUANT Osteo II (BIOQUANT Image Analysis Corporation, Nashville, TN, USA) image-analysis software. The percentages of bone-to-implant contact (BIC) and new bone formation were calculated.

Data analysis

Analysis of variance, Tukey's range test, and *t*-tests to examine differences between pairs were used for the statistical evaluation. SPSS 14.0 for Windows (SPSS, Chicago, IL, USA) was used for the statistical analysis. A difference was considered statistically significant if the *p*-value was less than 0.05.

RESULTS

All animals had uneventful recoveries. At sacrifice, no clinical signs of adverse tissue reactions were seen. All implants were still *in situ* at sacrifice, and all tissue specimens were available for analysis.

Figure 3 shows regenerated tissue representing healing. The area of newly formed bone and the BIC were increased in the PRF and rifamycin groups compared with the saline group. The results of the histomorphometric analysis are shown in Table 1. Morphometric measures of BIC differed significantly between the DFDBA+PRF and DFDBA+saline groups and between the DFDBA+rifamycin and DFDBA+saline groups ($p<0.05$). In terms of new bone formation, the DFDBA+PRF and DFDBA+rifamycin groups differed significantly from the DFDBA+saline group ($p < 0.05$).

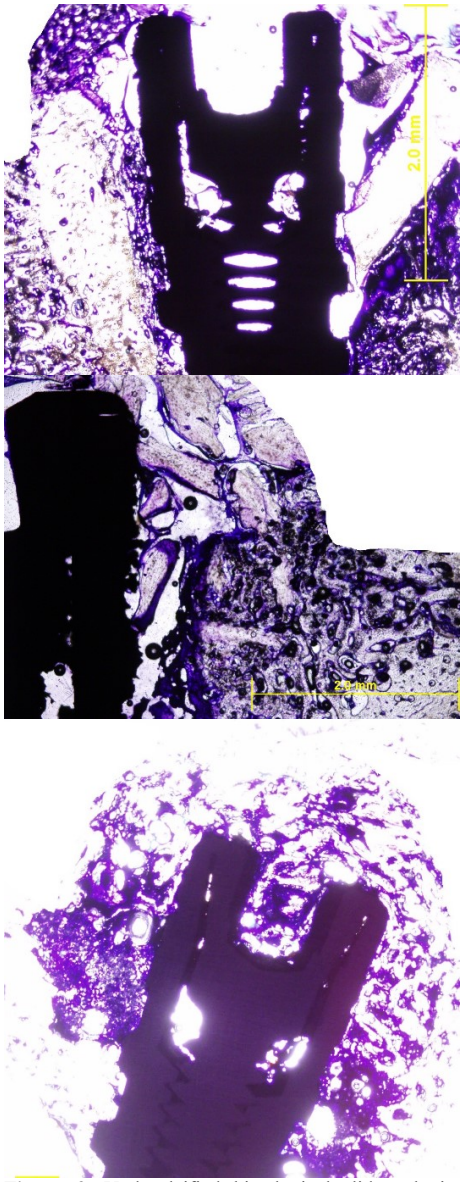

Figure 3. Undecalcified histological slides obtained from the specimens. A, Sample from DFDBA+saline group (Scale bar = 2 mm). B, Sample from DFDBA+rifamycin group (Scale bar = 2 mm). C, Sample from DFDBA+PRF only group (Scale bar = 1 mm). (Toluidine blue)

Table 1: Percentage of direct bone-to-implant contact and new bone formation.

	BIC	New Bone Formation
DFDBA+saline	58.43 ± 1.92 [a b]	36.90 ± 0.94 [d e]
DFDBA+rifamycin	68.34 ± 20.37 [a c]	45.26 ± 0.60 [d f]
DFDBA+PRF	80.70 ± 2.55 [b c]	51.82 ± 0.82 [e f]
P value	.001	.001

Same superscript letters indicate statistically significant difference ($p<0.05$). BIC = Bone-to-implant contact, DFDBA= Demineralized freeze-dried bone allografts, PRF=Platelet-rich fibrin

DISCUSSION

Previous studies[14,15] have used GBA with a dome-shaped stiff occlusive titanium barrier successfully for bone regeneration. Although bone is generated under the titanium barrier membrane with only a blood clot, this procedure has a limited potential. Sites with fewer surrounding osseous walls and more pronounced atrophy are more demanding and require materials or techniques that offer greater biological activity and regenerative capacity.[16,17] To enhance bone formation with GBA, tissue engineering procedures are used. Casap *et al.*[18] used recombinant human bone morphogenetic protein-2 (rhBMP-2) with a titanium occlusive barrier over high-profile dental implants for vertical ridge augmentation, and found more bone formation in the experimental group. Marx *et al.*[19] used a composite graft of rhBMP-2/collagen sponge, freeze-dried allogeneic bone, and platelet-rich plasma within a titanium mesh, and found that this method was successful for large vertical ridge augmentations. Misch *et al.*[17] evaluated the use of a composite graft of rhBMP-2 and bone allograft under a titanium mesh for vertical augmentation, and suggested that this technique leads to favorable vertical bone gains. The stimulation of bone regeneration is important, and topically applied growth factors may augment bone formation at GBA. However, growth factors are expensive.

In recent years, PRF has been shown to affect bone regeneration significantly. Ozdemir *et al.*[20] evaluated the effects of PRF alone when used with GBA and found that PRF under a titanium barrier enhanced new bone formation. Biologically active bone graft materials are needed to improve bone regeneration, and PRF is combined with bone grafts for this reason. Shah *et al.*[21] grafted periodontal intrabony defects with a combination of PRF with DFDBA and concluded that the combination produced better results than DFDBA alone. Agarwal *et al.*[22] grafted intrabony periodontal defects with DFDBA combined with PRF and found that combining PRF with DFDBA significantly enhanced bone regeneration compared with a bone graft alone. In the present study, the DFDBA+PRF sites showed significant increases in BIC and new bone formation compared with the DFDBA+saline group. Our results are in agreement with previous reports. Therefore, adding PRF to DFDBA may enhance bone formation during GBA. In this study, PRF upregulated the growth factors necessary for enhancing bone formation during GBA, and this technique was cost-effective.

Bone graft materials are combined with various antibiotics for different purposes, and the effects of these combinations on graft healing have been studied. The results of these studies have varied, which might have resulted in part from the potential toxic effects of various antibiotics and their localized concentrations.[23] Mabbry *et al.*[24] reported that the combination of gentamycin and tetracycline mixed with freeze-dried bone allografts increased osseous regeneration. Masters *et al.*[25] grafted intrabony periodontal defects using DFDBA with tetracycline HCl and found greater bone filling and defect resolution in the experimental group. Tabrizi *et al.*[26] evaluated the periodontal regenerative capacity of DFDBA alone and combined with local lincomycin. DFDBA with or without lincomycin did not offer predictable

benefits. The literature contains little information on the combined effects of DFDBA and rifamycin in bone healing. Kaya *et al.*[11] showed that topical rifampin can accelerate bone healing, but when they combined rifamycin with allogeneic bone grafts, they found that this combination reduced new bone formation in osseous defects. By contrast, our results showed that DFDBA + rifamycin significantly enhanced BIC and new bone formation compared with DFDBA + saline.

In this study, the samples were collected after 4 weeks, which represents the end of acute bone healing in rabbits. Rossi *et al.*[27] described the healing of marginal defects around dental implants in an experimental study and showed that these defects regenerate in 20~30 days.

CONCLUSION

Within the limitations of this study, the placement of DFDBA + PRF or DFDBA + rifamycin beneath an occlusive titanium barrier next to a high-profile implant resulted in significantly increased bone formation and BIC compared with DFDBA+saline. Additional research is required to fully explore the newly formed bone obtained using a stiff occlusive titanium barrier when high-profile implants are placed. Evidence supporting the use of antibiotic agents with bone grafts to enhance bone healing is presently insufficient. To determine the full potential of rifamycin in bone regeneration, further studies must examine the effects of rifamycin in bone healing.

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*Doi:*10.7126/cumudj.307315 *REVIEWS*

CLEAR CELL ODONTOGENIC CARCINOMA OF THE MANDIBLE WITH PERINEURAL INVASION: A REVIEW

Perinöral İnvazyon Gösteren Alt Çene Berrak Hücreli Odontojenik Karsinom: Bir Derleme

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ABSTRACT

Objectives: Clear cell odontogenic carcinoma (CCOC) is a rare aggressive cancer of the oral cavity. Diagnosis is mainly by excluding other pathologic lesions containing clear cells. Perineural invasion may be an important feature in this lesion.

Methods: We performed a literature review. We paid attention to the CCOC and perineural invasion in the search of English language literatures in the Pubmed.

Results: Analysis of previously reported cases of CCOC showed that up to 2014 there were 74 reported CCOC cases in English articles, cited in PubMed. There was only one previous report of perineural invasion. A new case is also presented in this article.

Conclusion: Clear cell odontogenic carcinoma needs a special immunohistochemical protocol and complete workup to reach a correct diagnosis. Perineural invasion should be considered in central lesions of the mandible.

Key words: Clear cell odontogeniccarcinoma, Submentalflap, Mandible, Perineuralinvasion.

ÖZ

Amaç: Berrak hücreli odontojenik karsinom (BHOK), oral kavitede nadir bulunan agresif bir kanserdir. Tanı esas olarak berrak hücreler içeren diğer patolojik lezyonları dışlar. Bu lezyonda perinöral invazyon önemli bir özellik olabilir. Yöntem: Literatür derlemesi yapıldı. Pubmed veri tabanındaki İngilizce makalelerden BHOK ve perinöral invazyon terimleri araştırıldı.

Bulgular: Daha önce rapor edilen BHOK vakalarının analizi, PubMed'de taranan İngilizce makalelerde, 2014 yılına kadar 74 tane BHOK vakası bulunduğunu gösterdi. Perinöral invazyona ilişkin sadece bir önceki rapor vardı. Bu makalede de yeni bir vaka sunulmuştur.

Sonuçlar: BHOK, tanıya ulaşmak için özel bir immünohistokimyasal protokole ve doğru tanıya ulaşmak için eksiksiz bir çalışmaya ihtiyaç duyar. Perinöral invazyon mandibulanın orta lezyonlarında düşünülmelidir.

Anahtar Kelimeler: Berrak hücreli odontojenik karsinom, submental flep, alt çene, perinöral invazyon

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INTRODUCTION

Clear cell odontogenic carcinoma (CCOC) is a rare aggressive carcinoma of the oral cavity.[1] There are no net pathologic criteria to distinguish this carcinoma from the other clear cell carcinomas.[2] Good workup to rule out the metastasis of clear cells to the oral cavity, mainly from the kidney, and an appropriate immunohistochemical plane to reach a correct diagnosis are necessary.[3] Clear cell odontogenic carcinoma was first described by Hansen *et al.*[4] in 1985.

Table 1: Historical look at clear cell odontogenic carcinoma

Year	Authors	Number of patients in review of the literature
1985	Hansen,*et al*[4]	Introduction of the lesion
1996	Muramatsu,*et al*[9]	18
2004	Siriwardena,*et al*[10]	35
2005	Ebert,*et al*[11]	43
2009	werle,*et al*[12]	59
2013	Swain,*et al*[13]	74

CCOC often involves the mandible and most often occurs in female patients.[5] Recurrence and metastasis can occur years after the excision of the primary lesion.[6,7]

Diagnosis is often challenging because there are no pathognomonic histopathologic criteria. In this stage, the pathologist confronts a clear cell neoplasm.[8]

In this article, workup and surgical management are discussed with a case report.

PATIENT & METHODS

Patient

The patient was a 42-year-old female who was referred by her dentist for "loose teeth in the left mandible". On panoramic radiographic examination there was a radiolucent lesion in the mandible with hanging tooth appearance and ill-defined borders; spiked root resorption of mandibular premolar teeth was apparent (Figure 1).

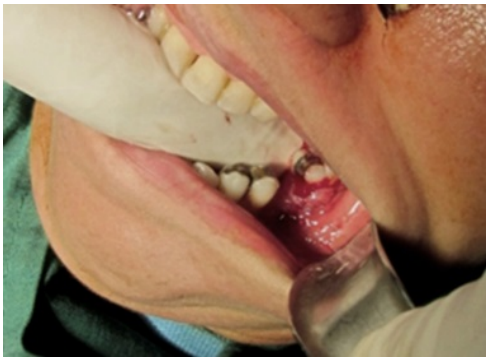


Figure 1a. Intraoral photograph of the lesion;

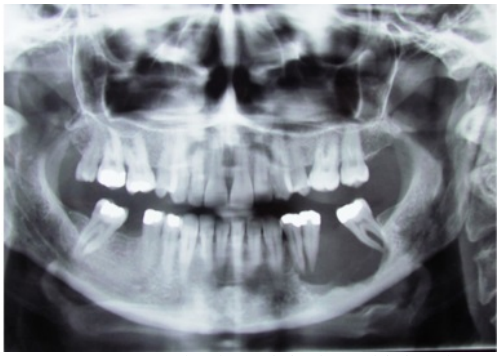


Figure 1b. Panoramic view of the jaw with hanging tooth (left mandibular premolar and first permanent molar) and ill-defined borders;

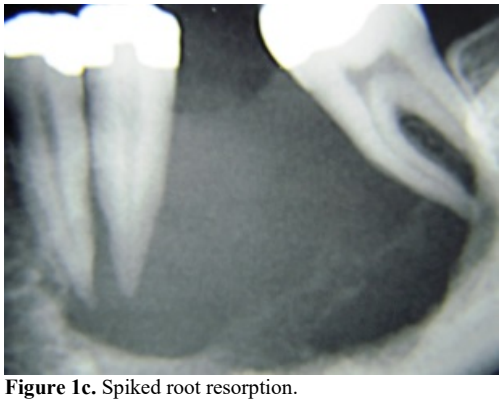


Figure 1c. Spiked root resorption.

Intraoral examination revealed good oral hygiene, with loose mandibular left premolar teeth. On physical examination, there were no enlarged neck lymph nodes. There were no systemic diseases, with a negative history of cigarette smoking and alcohol intake. There was no alteration in lower lip sensation. Incisional biopsy was performed under local anesthesia.

Histopathologic examination: Mononuclear cells with clear cytoplasm, hypochromic centrally located nucleolus and some cellular atypia were present in hematoxylin and eosin (H&E) staining.

Hyperchoromatic epithelial nest including cluster of cells with abundant clear cytoplasm (Figure 2).

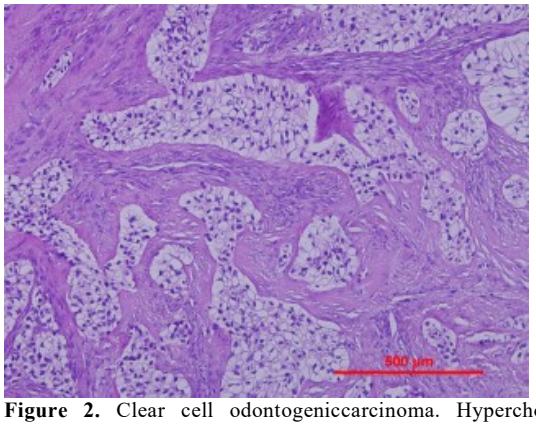


Figure 2. Clear cell odontogeniccarcinoma. Hyperchoro-maticepitjelial nest including cluster of cells with abundant clear cytoplasm.

Clear cells were arranged in nests and cords. Hyalinized connective tissue was separately evident between clear cell nests. The tumoral cells presented a degree of nuclear pleomorphism with perineural invasion. Necrosis was seenin tumor islands and areas of calcification were present. Immunohistochemical analysis revealed that clear cells were positive for CK 7 and none were positive for CD 10, vimentin, and CK 20 (Figure 3).

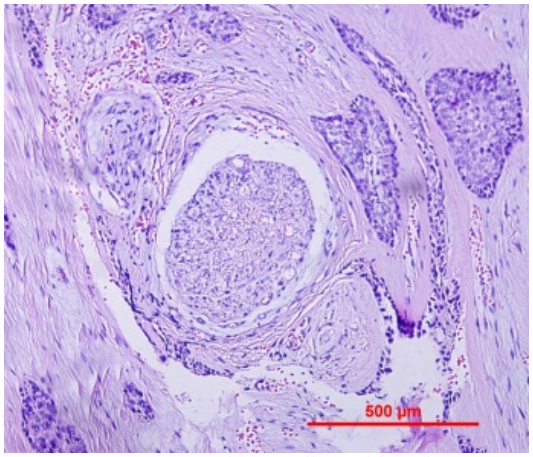


Figure 3a. Mononuclear cells with clear cytoplasm withhypochromiccentrally located nucleus and some cellular atypia with perineural invasion (H&E ×10).

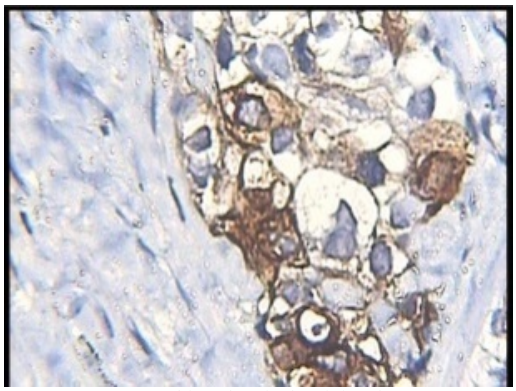


Figure 3b. Immunohistochemical staining for CK7 was positive.

Workup: Abdominal sonography was carried out to evaluate the possibility of metastasis from kidney. Mammography was ordered to rule out any possibility of occult primary breast cancer. Chest x-ray was ordered to evaluate lung metastasis from the intraoral carcinoma and/or detection of primary lung cancer with probable metastasis to the oral cavity. Contrast enhanced neck CT scan was carried out to evaluate neck lymph nodes and also thyroid and parathyroid endocrine glands (Figure 4).

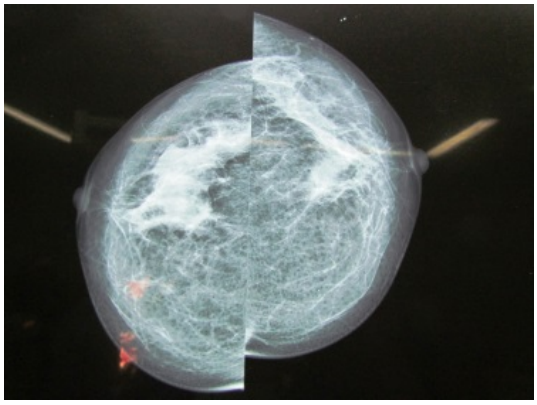


Figure 4. Workup: **a.** Mammography.

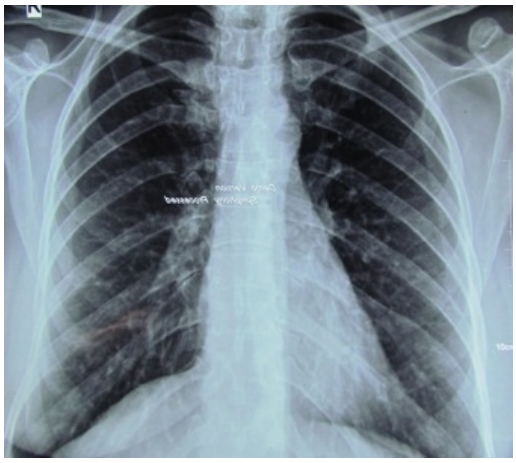
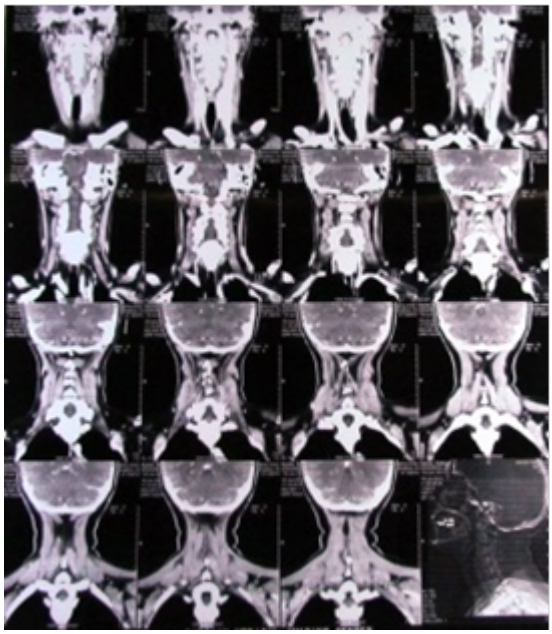


Figure 4b. Chestx-ray;c,contrast-enhanced CT scan of the neck



Surgical management

A decision was made in consultation with Oncology Department to carry out mandibulectomy with continuity defect and 1.5-cm safe margins. Realignment of the resected bone was carried out with titanium reconstruction plate and replacement of resected soft tissues with orthograde submental flap and neck management with supraomohyoid neck dissection (SOHND) during the operation. Patel modification of submental flap with subplatysmal dissection in non-pedicled side and inclusion of anterior belly of digastric and myelohyoid muscles was considered for soft tissue reconstruction (Figure 5).

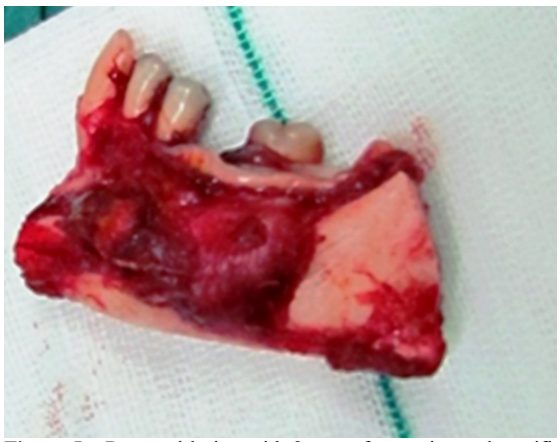


Figure 5a. Resected lesion with 2-cm safe margins and sacrifice of the inferior alveolar nerve;the buccal cortical plate is destroyed

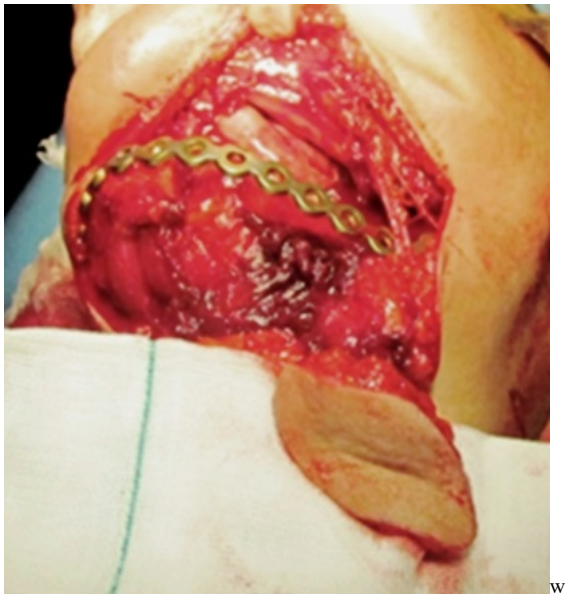


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Figure 5b. Reconstruction plate in place and orthograde submental flap

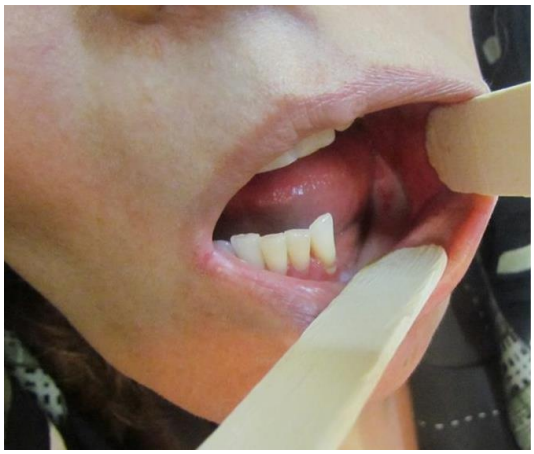

Figure 5c. Flap covered the reconstruction plate and replaced the resected mucosa (4 weeks after operation)

The lesion was centrally located in the mandible in posterior region. Potentialof perineural invasion around the inferior neurovascular bundle was probable; therefore, safe margins for this nerve were also considered in surgical treatment planning.

The surgical specimen was subjected to detailed histopathological examination. The surgical margins were negative and perineural invasion was present. The patient underwent a course of radiotherapy, and has remained asymptomatic in the first-year follow-up.

Methods: We performed a literature review. We paid attention to the CCOC and perineural invasion in the search of English language literatures in the Pubmed.

RESULTS

Analysis of previously reported cases of CCOC revealed that Up to 2014 there were 74 reported CCOC cases in English articles cited in PubMed.[4,9-13] There was only one previous report of perineural invasion.[14] The present case is the second report.

DISCUSSION

Three microscopic patterns have been described for clear cell odontogenic carcinoma. The biphasic pattern consists of epithelial cells admixed with eosinophilic polygonal epithelial cells. The second pattern that is similar to the case reported in this article is monophasic, characterized by clear cells that are arranged in nests or cords. The third pattern has a resemblance to ameloblastoma: cells with a clear cytoplasm in peripheral islands demonstrate palisading.[15]

Clear cell variants of odontogenic tumors (Pindborg tumor and ameloblastoma), salivary gland origin (acinin cell carcinoma, mucoepidermoid carcinoma, Epithelial-myoepithelial carcinoma, Myoepithelial carcinoma, Myoepithelioma and oncocytoma), vascular derived (Perivascular endothelial cell tumor) and metastatic carcinoma to the jaws (renal, adrenal, parathyroid, thyroid and breast adenocarcinoma) should be considered in histopathologic differential diagnosis of CCOC.[16-27]

Table 2: Clear cell neoplasms in oral cavity

Tumor origin	Clear cell variant	Reference
Odontogenic	Pindborg tumor	16
	Ameloblastoma	17
Salivary gland	Acinic cell carcinoma	18
	Mucoepidermoid carcinoma Epithelial- myoepithelial carcinoma Myoepithelial carcinoma	19
	Myoepithelioma	20
	Oncocytoma	21
Vascular	Perivascular epithelial cell tumor	22
metastatic	Renal	23
	Adrenal	24
	Parathyroid	25
	Thyroid	26
	Breast adenocarcinoma	27

On immunoprofile evaluations, clear eosinophilic cells shows positive reactivity for cytokeratins 8, 13, 14, 18, and 19 and epithelial membrane antigen, but a negative reaction to vimentin, S-100 protein, desmin, smooth muscle actin, HMB-45, alpha (1)-chymotrypsin, CD45, CD31, and glial fibrillary acidic protein.[11]

But in the present case, Immuno stains for cytokeratin 7 showed strong positivity, and none were positive for CD 10, vimentin, and CK 20.

Submental flap was introduced by Martin in 1993.[28] After that many modifications of this flap have been presented.[29-31] The presented case; submental flap was a suitable option for soft tissue reconstruction. It has appropriate hairless skin paddle (in females) for coverage of reconstruction plate and replacement of resected mucosa. It is not bulky so the need for flap revision and plate exposure is not a concern. Bridging the mandibulectomy segment in the lateral region of the mandible by reconstruction plate without bone grafting in malignant lesion is asimple and acceptable method.[32]

The resultant skin scar is the same length as necessaryfor placement of reconstruction plate even if the flap is not in the plane. Removal of excess submental chin by this flap also has esthetic beneficial effects. Skin flap incision allows concomitant access to the neck for SOHND.

Perineural invasion (PNI) is one of the established prognostic factors for adenoid cystic carcinoma (ACC) and squamous cell carcinoma (SCC).[33]

PNI is tropism of tumor cells for nerve bundles in surrounding tissues. It is a form of metastatic tumor spread that leads to more local recurrence, increasing the probability of neck lymph node metastasis. PNI has a negative effect on surveillance rate.[34,35] The concept of PNI has beena known entity for more than 150 years but its clinical significance has been noticed from

three decades ago.[36] There are two famous definitions for PNI; at the first is Batsaki definition in 1985:"Tumor cell invasion in, around and through the nerve" and Liebig *et al*'s definition in 2009: "The finding of tumor cells within any of the three layers of the nerve sheath."[37,38]

Accepted pathologic mechanism for neural extension is secretion of certain growth factors by cancer cells and the presence of receptors in nerve sheath.[39] Neurotropic malignancies are melanoma, polymorphous low grade adenocarcinoma of salivary glands (PLGA), adenoid cystic carcinoma, prostate and pancreatic cancers.[40]

When the cancer has central position in the mandible and in close proximity to the inferior alveolar nerve, then involvement of this nerve should be considered by the surgeon. Ina study by Ariji *et al.*[41,42] on 5 patients with central SCC of the mandible, there were perineural invasions in 4/5 of patients, which is much higher than PNI in mucosal SCC (27%).

Extension of carcinoma via this route (PNI) to the CNS is possible. In the presence of PNI related to the inferior alveolar nerve, involvement of the mandibular branch of trigeminal nerve and extension to the cranium through the oval foramen should be considered.[43] MRI that shows nerve enlargement and CT scan that shows enlargement and/or destruction of oval foramen are useful aids.[44, 45]

Anatomical location (proximity to the inferior alveolar nerve) is related to increased incidence of PNI; therefore, intraoperative control with nerve biopsy and frozen section is necessary in such situations.[46]

Lip sensation alteration, such as numbness (paresthesia, tingling, formication and pain) is a warning sign for the potential involvement of the inferior alveolar nerve in central mandibular lesions, located in bone between the mental and mandibular foramina.[47,48] However, it should be considered that perineural invasion is a process with slow progression and it is possible that despite extensive PNI, there is no sign of lip numbness (like the case presented here). Review of literature for PNI and CCOC revealed just only a histopathologically proven PNI.[32] The importance of PNI in the case presented and the effect on treatment planindicate the need for more radiographic investigation of the nerve canal, an increase in the extent of surgery, incorporation of radiotherapy to the protocol and the need for more attention to neck dissection.

CONCLUSION

Clear cell odontogenic carcinoma needs a special immunohistochemical protocol and complete workup to reach a correct diagnosis. Combination of titanium reconstruction plate and orthograde submental flap is a good choice for reconstruction of the lateral mandibular segment and provision of soft tissue coverage after wide surgical resection. Perineural invasion should be considered in central lesions of the mandible.

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Doi: 10.7126/cumudj.307312 *REVIEWS*

ANIMAL STUDIES IN FIELD OF PERIODONTOLOGY: EXPERIMENTAL PERIODONTAL AND PERIIMPLANT DISEASE INDUCTION

Periodontoloji Alanında Hayvan Çalışmaları: Deneysel Periodontal ve Periimplant Hastalığın İndüksiyonu

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ABSTRACT

Preclinical studies are crucial in studying the etiology and pathogenesis of human diseases especially diseases with multifactoriel etiology such as diabetes, cardiovascular diseases and periodontitis. Studies in animal models are complementary to in vitro experiments prior to clinical trials. Every model has its own advantage and disadvantage and there is not any model suitable for all kinds of studies. To find the optimal experimental model and animal species is a major issue for researchers. In this mini-review I aimed to review the animal models used in the field of periodontology and a relatively novel field implantology and though very little, to provide guidance for researchers.

Key words: Experimental model, animal study, animal model.

ÖZ

Preklinik araştırmalar, özellikle diyabet, kardiyovasküler hastalıklar ve periodontitis gibi multifaktoriyel etiyolojiye sahip insan hastalıklarının etiyoloji ve patogenezinin araştırılması için oldukça önemlidir. Hayvan modellerinde yapılan araştırmalar, in vitro deneylerle birlikte klinik araştırmalardan önce gerçekleştirilmelidir. Her deney modelinin kendine özgü avantaj ve dezavantajı bulunmaktadır ve hiçbir model, tüm araştırma konularının hepsi için tek başına elverişli değildir. En uygun deneysel modeli ve hayvan türünü belirleyebilmek, araştırıcılar için zor bir durumdur. Bu mini derlemede, Periodontoloji alanında ve nispeten daha yeni bir alan olan İmplantoloji alanında kullanılan hayvan modellerinin derlenmesi ve çok az da olsa, araştırıcılara rehber olabilmek amaçlanmıştır.

Anahtar kelimeler: Deneysel araştırmalar, Hayvan çalışmaları, Hayvan modelleri.

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INTRODUCTION

Preclinical studies are crucial in studying the etiology and pathogenesis of human diseases especially diseases with multifactoriel etiology such as diabetes, cardiovascular diseases and periodontitis. Animal studies are complementary to in vitro experiments prior to clinical trials. In addition, experimental animal models of human diseases allow us to investigate individual factors contributing pathogenesis of the disease and discovery of new therapeutic approaches. The first example of the animal studies available online was written by Wakeman[1] in 1905 and was about phosphorus poisoning in dogs. Forty two years after, the first animal study in field of periodontology was published in 1947 by Sognnaes[2] and it was the very first study of experimental periodontal disease. Since then, numerous papers were published and so many animals were used in diverse kinds of studies.

Different animal species were used in experimental study models in periodontology including rats, hamsters, rabbits, ferrets, dogs, pigs and primates. All of these animals were used in order to mimic human periodontal diseases in an attempt to reveal pathogenetic mechanisms of periodontal disease and find cure. However, not every animal is suitable for studying periodontal disease as both the anatomy and physiopathology of animals are different from those of humans. There are some important aspects to be considered in finding the best way of reflecting human periodontal diseases. These are standardization, reproducibility and common characteristics with human disease such as anatomy, etiology and pathophysiology. Furthermore, availability, simplicity of handling, ethical issues and cost are also important factors. Therefore, selection of the appropriate animal model is important and depends on not only the similarity of the nature of the disease to that of humans but also aforementioned criteria. In this mini-review I aimed to review the animals used in experimental models in field of periodontology beginning from the small-sized animals to large-sized ones.

Rats and mice

Rodents have been used in periodontal research due to their advantages such as their small size, low cost, availability, handling and housing and detailed knowledge about their genetic structure. Rats are the most extensively studied animals for the pathogenesis of periodontal diseases. Rats have 1 incisor and 3 molars in each quadrant and incisors are rootless.[3] One of the most successful study approaches, germ-free or gnotobiotic rats, made it possible to study dental plaque and bacterial biofilm in periodontal research. Gnotobiotic rats of the Spraque-Dawley strain have been very useful in the understanding of periodontopathogenic bacteria.[4] There are a few ways of inducting periodontal diseases in rats. These are

- Ligation model
- Bacterial infection and/or inoculation models
- Lipopolysaccaride injection model
- Calvariel model
- Critical size defect model

Ligation Model

Ligature-induced periodontal disease is the most common way of inducting periodontal disease in animals. Many different types of animals ranging from rats to nonhuman primates were used in this model. In rats molar teeth are suitable for induction and evaluation of periodontal disease, both mandible and maxilla can be used but it must be considered that there might be some problems in histological or morphological evaluation of the jaw selected. Mostly silk ligature but any retentive ligature type can be used. Placement of a ligature causes an accumulation of dental plaque and ulceration in the sulcular epithelium facilitating the bacterial invasion into connective tissue. Alveolar bone and attachment loss occur in 7 days after ligation.[5]

In wild-type rats ligation could induce periodontal disease alone but in gnotobiotic rats ligation without bacteria is not enough.[6]

Bacterial infection and/or inoculation models

As periodontitis is an infectious disease, bacterial colonization around teeth and subsequent bacterial invasion into the soft tissues is an important aspect of periodontal disease especially in experimental procedures. A limitation of the infection/inoculation model is that rodents are not natural hosts for many human bacteria and the bacterial infection process in the oral cavity is transient. Different periodontopathogenic bacterial strains have been used such as *Porphyromonas gingivalis.*[7,8] *A. actinomycetemcomitans,*[9] *Tannerella forsythia*[10] and *Treponema denticola.*[11] There is an exception of transient infection in rats. Wild-type *A. actinomycetemcomitans* is a common inhabitant of rice rats. Rice rat (*Oryzomys palustris*), is a native American species that is highly susceptible to periodontal disease, beginning as early as 2 weeks of age.[12]

In infection/inoculation model, typically 10^9 CFU bacteria in a viscous suspension (2% carboxymethylcellulose) are administered orally every other day for 1 week. PCR has frequently been used for detection of bacteria but a limitation of PCR is that PCR does not specify living or dead bacteria. Prophylactic antibiotic use before infection/inoculation and repeating inoculation enhance the chance of inducing periodontal infection. In addition, some strains of mice have different degree of susceptibility to infection.[13]

Lipopolysaccharide Injection Model

The lipopolysaccharide (LPS) is a major component of the cell wall of microorganisms that contributes to inflammatory process in the host. Injection of LPS causes an innate immune response and induces inflammation to stimulate osteoclastogenesis and bone loss. Therefore LPS injection is a good model of inducing periodontal disease in rodents.[13]

Calvarial Model

Calvarial model is not particularly an experimental periodontitis model but was first designed and developed to study the effect of cytokines on osteoclastogenesis.[14] In this model, the soft tissue above the calvaria is stimulated by an injection and with a rapid expansion of pro-inflammatory cytokines in 24 hour, inflammatory process leads to bone destruction.[15]

Rat Critical Size Defect Model

Like calvarial model, the critical size defect model is also not an experimental periodontitis model. It was developed to study bone formation in the mandible and has been very useful in studying the efficacy of different materials such as barrier membranes[16], bone grafts[17], growth factors and hormones[18] in bone augmention procedures.[19]

Hamsters

The dentition formula of the hamsters is identical to rodents and periodontal disease does not occur spontaneously[20] but experimental periodontal disease can be achieved with a diet containing high concentrations of carbohydrates, particularly sucrose.[21] The albino hamster is disease-free but the golden Syrian hamster is the most commonly used for inducing periodontal disease. Keyes and Jordan demonstrated that infectious dental plaque inoculation in albino hamsters induced periodontal disease and this disease transmitted from generation to generation.[22] Diet-induced periodontitis model of hamsters have some similarities with rat model of experimental periodontitis. Both have similar bone destruction pattern with horizontal bone loss, therefore bone loss occurs mostly in horizontal dimension.[3] However, there are certain differences between these two rodent model of periodontitis. Firstly, despite the similarity of periodontal tissue structure, interdental septum is narrower than in rats. Secondly, alveolar bone loss in the buccal surface is lesser than the interdental surfaces.[23,24] In conclusion, this model of periodontal disease

causes a similar bone destruction pattern to those observed in rats infected with Gram-positive bacteria and the disease pattern is different from human periodontal disease.[24]

Rabbits

Rabbits are not the first choice of animal for experimental periodontitis models and mostly have been used to study surgically induced periodontal defect and periodontal regeneration. Critical-sized femoral defects are traditionally the most commonly used models in rabbits.[25] It has also been reported that rabbits were used in implant research.[26] Although not too much, there are some studies[27,28] demonstrating periodontal disease induction in rabbits. In these investigations ligation method along with bacterial inoculation were used to induce periodontitis in New Zealand type white rabbits. In addition, numerous pathogenic bacteria such as *F. nucleatum, P. heparinolytica, Prevotella spp., P. micros, S. milleri group, A. israelii,* and *A. haemolyticum* were found in oral flora of the rabbits.[24,29]

Ferrets

Ferrets (*Mustela putorius*) rarely have been studied in terms of periodontal disease. However, restricted studies have reported some similarities between human and ferret dentition and periodontal physiology.[30] Unlike rodents, ferrets naturally develop calculus and periodontal disease similar to humans regardless of the diet and have a deciduous and permanent dentition.[3,30] Because of spontaneously calculus development, ferrets were considered to be a suitable model for studying calculus. Research has shown that ferret calculus has a structure similar to hydroxyapatite and differs from human calculus in terms of degree of calcification.[31] Experimental periodontitis in ferrets could be induced by ligation within four weeks[31,32] and the ferret periodontitis model showed a similar pattern of periodontal destruction observed in humans with a small difference as 50-70% loss of attachment with ligation.[3,30] Ligation also caused large populations of PMNs, plasma cells and lymphocytes. Unlike periodontitis model, ferret model of gingivitis is almost identical to human gingivitis.[30] However, ferrets are difficult to handle and need special care and maintenance.

Dogs

Due to the naturally occurring gingivitis and periodontitis, dog model is quite suitable for periodontal research.[33] Periodontitis is the most prevalent disease in canines older than 2 year old with a percentage of 80%.[34] Periodontal tissues and the size of the teeth are similar to those observed in human. It is reported that, like human microflora, dogs have anaerobic gram negative cocci and rods, *P. gingivalis* and *F. nucleatum* in their subgingival flora.[35,36] The severity of the periodontal disease increases with age and frequently results in loss of tooth in dogs. The beagle is one of the most commonly used due to its size and its extremely cooperative temperament. Several studies have used dogs to evaluate the regenerative procedures, surgical manipulations and different treatment modalities including wound healing and regeneration in periodontal pockets.[35,37] However there are some limitations of studying in dogs. There are quite strict ethical policies regarding dog studies and dogs require special treatment such as exercise, maintenance, daily companionship and requirement of large space.

Pigs

Studies in miniature pigs have been increasing in recent years. Similarities between human and mini pig periodontal anatomy and physiology made it possible to evaluate pathogenesis and treatment outcomes of periodontitis. Like human, mini pigs have both deciduous and permanent dentition. Gingivitis and periodontitis occur spontaneously in mini pigs in early and middle terms of their life span (6 and 16 months respectively).[38,39] Pig model of gingivitis and

periodontitis have similar histopathological process manifested by inflammation and bleeding in gingival tissues, plaque and calculus accumulation and probing depth. However, additional procedures are recommended in order to shorten the time required for disease occurrence. Surgical removal of bone, bacterial inoculations of *P. gingivalis, S. mutans*, and *A. actinomycetemcomitans* and additional ligation of silk sutures are reported to reduce time without affecting course of the disease.[35,40,41]

Non-human primates

Non-human primates are considered to be the closest animal model mimicking human periodontal diseases due to their phylogenetic proximity. The reason is that human and non human primates share common anatomical and physiological features in periodontal tissues and periodontal diseases of both species present similar immunological and microbiological aspects.[3,4] Periodontal diseases in non human primates occur spontaneously in late period of their life span in some species. There are also some limitations of this model. These are the risk of cross infection with human, the diversity in the size of species, handling and housing issues, aggressive temperament and high cost.[3,42] Many studies carried out in monkeys were performed in order to evaluate implant surgery outcomes and periodontal regeneration.[4,43] There are also some ethical issues regarding the use of non human primates. The most preferred non human primates in periodontal research are macaques, baboons, chimpanzees and marmosets. First three have the same dental formula as human while marmosets have a different formula with 3 premolars and 2 molars in a quadrant. In most species, periodontal inflammation and destruction pattern are quite similar to human with plasma cell, lymphocyte and neutrophil infiltration in inflamed periodontium while small sized monkeys such as marmosets have very little inflammation restricting their use in periodontal research.[42] However, as in pig model of periodontitis, an intervention to increase plaque accumulation is necessary. In this regard, orthodontic ligatures, sutures, bone surgery could be used.[35,43]

Experimental periimplantitis models

In this section of this mini-review only the experimental periimplantitis models were discussed. Experimental periimplant mucositis which is characterized by an inflammatory lesion around the soft tissues surrounding implants caused by bacterial challenge is not included. The advantages and disadvantages of animal models used in experimental periodontitis are discussed above. Here, only the difference of experimental periimplantitis model from experimental periodontitis will be discussed.

Periimplantitis is the inflammatory disease of the soft and hard tissues surrounding implants and characterized by bleeding on probing, pus formation and alveolar bone loss.[44] Experimental periimplantitis models are relatively new and unlike periodontitis there is not any established animal model. The pathogenesis of periimplantitis is not fully understood and therefore putting these two diseases in same basket might mislead us in terms of investigating ethiopathogenesis, preventing the disease or finding new treatment modalities. Periimplantitis is a unique disease regarding to its anatomical and physiological structure for it is the disease of living tissues surrounding an inanimate object. Day by day the increase in implant numbers caused an increase in periimplantitis incidence. Because of its unrevealed pathophysiology, studies are rapidly increasing.

Experimental models of the periimplantitis were studied in mostly canine but also nonhuman primates and mini pigs.[39] As the most used big animal models in periodontology, dog, non-human primate and pig (mini-pig, micro-pig) has some advantages over small animal models. The biggest advantages of dog model are that periodontal diseases spontaneously develop and with a good plaque control periodontal health can

be maintained. Docile character, ease of management and maintenance and large size make dog a good animal model for periodontal disease. These also apply in terms of periimplantitis. Bone structure and remodeling process of dogs are quite similar to human and in addition plaque control and maintenance of periimplant lesions are easy.[45-47] Periimplantitis in dog model could be induced by ligature placement around implants and disrupting oral hygiene. The regions suitable for experimental periimplantitis are mandibulary premolars and first molar regions.[24,45]

On the other hand, non-human primate dentition closely resembles the human dentition as they have deciduous and permanent dentition such as humans and the anatomy of the periodontium and periodontal disease in non-human primates and humans share some similarities.[3,4] The advantages and disadvantages of experimental periodontal disease model in non-human primates also apply to experimental periimplantitis.[45] Mini pigs and micro pigs are relatively new in this field than dog and non-human primates. They eliminated disadvantages of the domestic pig model of experimental studies such as body weight, maintenance and management issues and made it easier to study this model in periodontology. Like dogs, pigs have a similar bone composition, structure and remodeling rate to human bone[47] allowing to study periimplant lesions effectively.

In experimental periodontitis, different experimental models are available for different animal models. However, in terms of experimental periimplantitis, regardless of the animal model, the most used method is ligature-induced periimplantitis model. Especially two models of ligature-induced experimental periimplantitis were studied, one of them is dog model[1,48,49] and the other is mini pig model.[45,50] Other than ligature-induced periimplantitis model, miniimplants in rabbits, rats and mice were also studied.[51-55] Small sized animals have a disadvantage of smaller oral cavity and implants replacing teeth are difficult to insert in small animal models.

Ligature-induced periimplantitis model has many discrepancies regarding the method used by the authors.[45,49,56,57] However the procedure can be summarized by following steps:

1. Tooth extraction and healing time (3-4 months),
2. Implant placement and healing time (2-4.5 months),
3. Ligature placement and active destruction period,
4. Some studies removed the ligature and allowed a passive destruction period[48,58] while some studies kept the ligatures in place.[57, 59, 60]

Besides a study reported implant removal and reimplantation.[49] In addition, in a recent study, ligature-induced periimplantitis model was achieved with *P.gingivalis* infiltration to ligatures.[61] With small or big modifications, this model is still being developed by researchers. The protocol is widely different from one to another. However the aim of ligature-induced periimplantitis is to induce periimplant bone destruction in a way seen in humans and establish an optimal treatment modality. Soft diet after implant placement is also suggested in order not to traumatize implants and to allow plaque accumulation.[39]

Other than ligature placement, a study in minipigs reported flapless implant placement and plaque accumulation in order to develop periimplant infection.[62] Not being a periimplantitis model, some researches induced surgical bone defects with or without implants to evaluate bone regeneration.[63]

Two recent studies suggested an immediate ligature-induced periimplantitis model, one in dogs[64] and the other in rabbits.[53] This new method of theirs was different from the

conventional method in terms of immediate implant placement and simultaneous insertion of ligatures.

Although many studies were performed in dogs, Becker *et al.*[65] for the first time described a mice model of periimplantitis. They inserted titanium implants in the median of the palate and induced periimplantitis with ligature placement. Recently, another mice model of ligature-induced periimplantitis was developed by Nguyen *et al.*[55] Their protocol is nearly same as dog or minipig model. Another study by Firih *et al.*[66] described a mice model of experimental peri-implantitis with *P.gingivalis* lipopolysaccaride injection delivered to periimplant soft tissues in the edentulous alveolar bone. A study in rats used *A. actinomycetemcomitans* inoculation around implants and inserted contaminated implants in rat hard palate.[67]

In conclusion, experimental periodontitis models are well established and documented in almost all animal models. Other than genetic innovations such as knock-out models, experimental periodontitis models are nearly same. On the other hand, lack of an established animal model and/or treatment protocol caused a rapid increase in periimplantitis research. Big animal models have their own advantages however cost, handling problems, ethical issues are major problems for their use. In addition, new models such as rat and mice may facilitate experimental procedures and accelerate improvements in this area.

Conflict of interest

There is no conflict of interest in this article.

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