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Original research

SHOULD WE USE THE DIGITAL MODELS IN PEDIATRIC DENTISTRY?

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ABSTRACT

Objectives: This study aims to compare the measurements of the extraction spaces in the plaster models and digital dental models and to investigate the usability of the digital models in preventive and interceptive appliances in pediatric dentistry clinics.

Materials and Methods: In the dental models of 56 patients whose first molar teeth were extracted in the early period, the dental arch length of the extraction spaces were measured with a digital caliper in the plaster model (Control Group), with computer software in the digital model (Experimental Group). Measured values were compared using a t-test and statistical significance levels were determined.

Results: In plaster models and digital models, the measured mean arc length of the extraction spaces were 6.94 mm and 6.83 mm, respectively. There was no statistically significant difference between the two measurement methods ($p>0.05$).

Conclusions: The use of digital models is recommended in pediatric dentistry clinics due to shorter chair time in pediatric patients, effective treatment planning/follow-ups, reducing treatment costs and other advantages.

Key Words: Dental model, dental occlusion, primary tooth.

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INTRODUCTION

Despite the increasing number of patients consulting to the pediatric dentistry clinics due to modern advances in dental caries prevention and the preservation of natural dentition; premature loss of primary teeth is still a common problem.[1-4] This is considered to be the most important cause of dental and skeletally malocclusion.[5,6] In these cases, it is necessary to use of space maintainers in order to keep the existing space in the dental arch and prevent the development of malocclusion by tilting the adjacent and opposite teeth.[7-14] The space maintainers or other orthodontic appliances should be specially designed considering the dental occlusion, condition of the existing teeth and future dental requirements for each case. Therefore, the preparation stage of these appliances and the quality of dental models are quite critical for the treatment planning and the follow-up procedures.[14]

Orthodontic and pedodontic archives are needed for the diagnosis and treatment planning of occlusion and space management in pediatric dental clinics and the models are considerable parts of these dental records. Especially in orthodontic treatment planning and space management, the measurement of dental spaces are required and the spaces can be measured using compasses, ruler or caliper.[15] The distance between the two dental points to be measured is determined by the compass and measured on the ruler. However, in these measurements, when the tip of the compass is placed on the ruler, the exact distance cannot be measured, causing the values to be rounded up to the nearest integer, therefore, measurements cannot be performed with great precision.[15] A digital caliper is also used in the dental plaster model in order to make more accurate measurements. In this method, when the caliper is placed between two points to be measured, the numerical distance is displayed digitally. However, the possibility of incorrect placement of the caliper makes it difficult to measure correctly. Additionally, the storage of the dental models can be troublous and if it is not properly maintained, its breakage can be a major disadvantage.[16] The conventional measurements cause the wear and tear of the dental models and these conditions affect the accuracy of the measurements.[17] Also, the risk of bacterial contamination and transportation of the models are the other disadvantages of conventional measurements.[18,19]

With the development of the technology, dental plaster models have been replaced by digital models that facilitate diagnosis and interdisciplinary planning, which is accelerating with the development of 3D scanners.[20,21] On the digital models created, the points to be measured can be determined more easily by enlarging and zooming the images, measurements can be made very precisely and the images can be used in all parts of the world by keeping them in the storage softwares.[22] The main advantages of the digital dental models are easy storage, accurate and precise measurement, access and sharing of digital files over the web, diagnosis and treatment planning to be completed in a shorter time and prevention of loss of information.[16,22,23] To date, different technologies have been developed to create 3D scanning devices and each has its own limitations, advantages and disadvantages. Today, digital orthodontic model forming systems are Cerec, Cadent Itero System, E4D, Lava COS and Trios.[23]

The digital models are obtained directly or indirectly by any of mentioned three-dimensional scanning systems.[21,23] The models created by directly mouth scanning provide many advantages on patients with cleft-palate-lip, gag reflex, mouth breathing, probable aspiration risk of the impression material, sedation requirements.[19,21] However, in case of the absence of a scanning device in the clinic, the digital model can be obtained indirectly by scanning previously obtained measurements or dental plaster models.[16,23-26] This study aimed to evaluate whether the indirectly obtained digital models are as reliable as dental plaster models and their utility in pediatric dental clinics. The null hypothesis tested in this study was that there would be no difference between the measurements of the extraction spaces in the plaster models and the digital dental models.

MATERIALS AND METHODS

The study protocol was approved by the Ethics Committee of Ankara University (36290600/24 21.03.2017). Fifty-six patients (30 male, 26

female) aged 7-8 who have lower (n=28) or upper (n=28) primary first molar tooth extraction (due to dental caries, excessive dentoalveolar abscess, periodontal defects, pathological root resorption, non-restorable tooth structure, etc) in early stages were included in the study. All the patients' occlusion had Class 1 molar relationship. One week after the extraction, the patients were recalled and a dental impression was obtained with hydrocolloid impression material -alginate- and disinfected with 5% NaOCl solution for 15 minutes. After disinfection procedures, the dental models are obtained by using hard dental plaster at the end of 30 min. setting period (Control Group). 3Shape Dental Scanner (Trios, 2017, Denmark) was used to create the digital models (Experimental Group) of the experimental group and the arc length of the extraction space was measured on these models. While the distance between the most convex point of the mesial proximal surface of the primary second molar tooth and the most convex point of the distal proximal surface of primary canine tooth was measured by 3Shape Orthoanalyser software (Figure 1), the same measurement was made using digital caliper in plaster models of the control group (Figure 2).

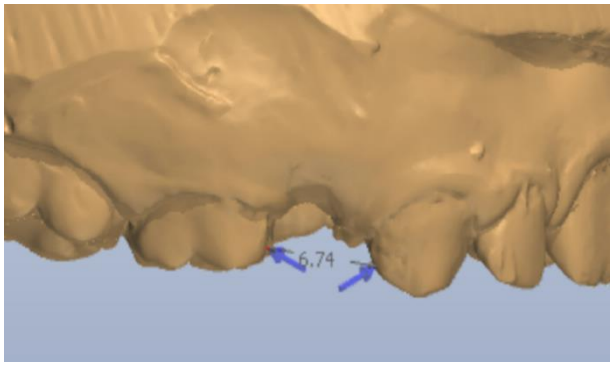

Figure 1: The measurement of the extraction space in the digital dental model with a computer software.

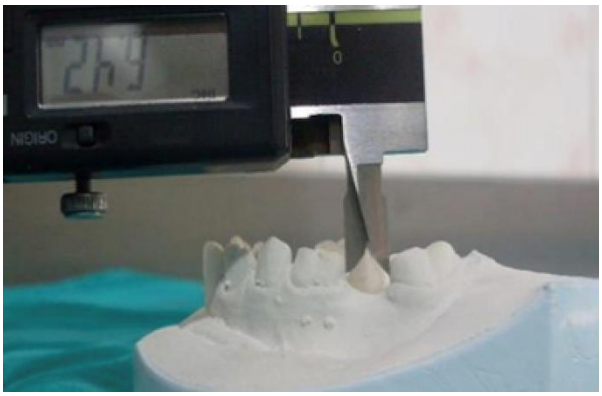

Figure 2: The measurement of the extraction space in the plaster dental model with a digital caliper.

Measurements were repeated one week later for both groups and the results were consistent with the kappa test (mean k value=0.90). For statistical analysis, *t-test* was used and p-value <0.05 was considered statistically significant.

RESULTS

The mean arc length of the extraction space was 6.83 mm for the experimental group and 6.94 mm for the control group. The difference between the two groups was not statistically significant (p=0.529) (Table 1).

Table 1. Mean arc length measurement values of the extraction space for the experimental and control groups.

	Experimental Group (Digital Models) (n=56)	Control Group (Plaster Models) (n=56)	p value* (t-test)
Mean arc length of the extraction spaces (mm)	6.83 ± 1.28	6.94 ± 0.85	0.529

*p value <0.05 was considered statistically significant.

DISCUSSION

In orthodontics and pediatric dentistry, the measurements of extraction spaces, arc length, interdental and other spaces are important steps in treatment planning and follow-up periods. To date, although these measurements mostly carried out by using plaster models, the use of digital models has to become widespread today.[15] However, disadvantages such as difficulties of storage of the plaster models, the possibility of fracture[16] and damage to the plaster model during measurements[17] made the digital models popular.[20,21] In the studies

used plaster models and digital models, it has been reported that digital models can be preferred due to accuracy and repeatability in the measurements of tooth dimensions and interdental spaces.[27-29] In this study, it was investigated whether the measurements made in digital models are as reliable as the plaster models and their utility. The effect of measurement differences in plaster and digital dental models on providing acceptable occlusion and ideal teeth alignment is not well-known, therefore, the differences between the two methods need to be investigated.

In the plaster dental models, spaces and diameters are usually measured by using compasses, calipers or rulers.[15] However, digital caliper measurements are known to be more reliable than the other techniques.[15,16] In digital models, the points to be measured can be determined more easily by enlarging and zooming the images, so that the measurements can be carried out more precisely. The created mesurement images can be stored and re-used in the computer software and shared with other clinicians or multidisciplinary departments.[22] In this study, while the measurements were performed with digital caliper and computer software in plaster dental models and the digital models, respectively.

In both plaster and digital models, interdental spaces, extraction spaces or distances between points including different dental structure can be measured.[27-29] On the other hand, in pediatric dentistry, it is valid that the space maintainers can be applied in case of loss of space instead of applying immediately in the extraction of first primary molars. In this regard, the models of the cases planned to be followed without applying the space maintainer were used and the measurements of the extraction spaces in the plaster and digital dental models were compared in this study. According to the results of this study, it was found that there was no statistical significance between the plaster and digital dental models ($p>0.05$).

Considering the advantages of digital scanning systems, the use of digital models in diagnosis, treatment planning and follow-ups is recommended in pediatric dentistry clinics. Pediatric dentistry clinics are the first departments where the treatment decisions regarding primary teeth extraction, space maintainers and other appliances and space management procedures are taken. Especially, digital scanners and models are beneficial for pediatric dentists and patients when patient monitoring is required to avoid unnecessary treatments and costs. Also, in pediatric dentistry clinics, intraoral 3D scanner devices should be used due to reducing chair time and lack of cooperation, especially in young children. In addition, the limitation of this study was the measurements of extraction space were performed extraoral on the dental models. Therefore, it is possible to conclude that there is need for further studies about intraoral scanning systems. The null hypothesis that there are no differences among the measurements of the plaster and digital dental models was accepted.

CONCLUSIONS

The use of digital scanning systems and models should be encouraged in pediatric dentistry clinics.

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CONFLICT OF INTEREST STATEMENT

No potential conflict of interest was reported by the authors.

Pedodontide Artık Dijital Modelleri Kullanalım mı?

ÖZ

Amaç: *Alçı modeller ile dijital dental modellerde yapılan çekim boşluğuna ait ölçümlerin karşılaştırılması ve dijital modellerin pedodonti kliniklerinde koruyucu ve durdurucu uygulamalarda kullanılabilirliğinin araştırılması amaçlanmıştır.* ***Gereç ve Yöntemler:*** *Süt 1. azı dişi erken çekilen 56 hastanın dental modellerinde, çekim boşluğuna ait dental ark boyunun alçı modelde (Kontrol Grubu) dijital kumpas ile, dijital modelde (Deney Grubu) ise bilgisayar yazılımı kullanılarak ölçümü yapılmıştır. Ölçüm değerleri t-test kullanılarak karşılaştırılmış ve istatistiksel anlamlılık düzeyleri saptanmıştır.* ***Bulgular:*** *Alçı modellerde ve dijital modellerde çekim boşluğuna ait ark boyu ortalaması sırasıyla 6.94 mm. ve 6.83 mm. olarak ölçülmüştür. İki ölçüm metodu arasında istatistiksel anlamlı bir farklılık saptanmamıştır ($p>0,05$).* ***Sonuçlar:*** *Pedodonti kliniklerinde çocuk hastalarda çalışma zamanını kısaltmak, efektif tedavi planı ve takibi oluşturmak, tedavi maliyeti azaltmak ve*

sağladığı diğer avantajlar nedeniyle dijital modellerin kullanımı önerilmektedir. ***Anahtar Kelimeler:*** *Diş modeli, süt dişi, diş oklüzyonu.*

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