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E-mail: neudentj@erbakan.edu.tr

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Effect of Scanbody Material and Mucosa Modification Technique on The Accuracy of Digital Impressions of Edentulous Arches with Multiple Implants

Görkem GÖKSOY[1*] Demet ÇAĞIL AYVALIOĞLU[2] Bilge GÖKÇEN-RÖHLIG[3]

[1] Dt., İstanbul University Health Sciences Institute Prosthetic Dentistry PhD, İstanbul, Türkiye, gorkemgoksoy@gmail.com

[2] Assist. Prof., İstanbul Health and Technology University Dentistry Faculty Department of Prosthodontics, İstanbul, Türkiye, demetayvalioglu@gmail.com

[3] Prof., İstanbul University Dentistry Faculty Department of Prosthodontics, İstanbul, Türkiye, bgokcen@istanbul.edu.tr

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ABSTRACT

Aim: The aim of current research is to evaluate the effect of scanbody material and additional reference markers in the form of artificial landmarks on the accuracy of digital impressions of edentulous arches with multiple implants.

Material and Methods: A model of an edentulous maxilla with six implants (BLT, RC, Institut Straumann, AG) was used as master model. PEEK and PMMA scanbodies were screwed on the implants and digital impressions were obtained with an intraoral scanner (TRIOS4, 3Shape). Reference markers made of flowable composite (C), gingival barrier material (GB), scannable silicone (S) were placed on the edentulous spaces and impressions were obtained. The master model was digitalized with an extraoral high-resolution reference scanner. Deviations of the predetermined points and inter-implant distances were calculated by using superimpositining technique.

Results: Inter-implant distance measurements showed that PEEK scanbodies demonstrated better precision than PMMA scanbodies, ($p<.001$). In the subgroups, also PEEK groups were more accurate than PMMA groups ($p<.001$). Kruskal-Wallis test also showed statistical difference in deviations of the predetermined points among the groups in precision ($p<.001$). Addition of markers did not influence the precision and trueness in PEEK groups but in PMMA groups both in distance measurements and predetermined point deviations.

Conclusion: Addition of reference markers does not make any significance in the accuracy of digital impressions when PEEK scanbodies are used. PMMA seems not to be an alternative material as scanbody material, addition of markers is needed.

Dijital Tarama Parçası Materyalinin ve Mukoza Modifikasyon Tekniğinin Çoklu İmplantlarla Dişsiz Arkların Dijital Ölçülerinin Doğruluğuna Etkisi

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Dijital Ölçü.

ÖZET

Amaç: Dental implantların dijital ölçüleri yaygın olarak kullanılmaktadır ve dişsiz çenelerin tam ark taramaları için tek ve kısmi dişsiz boşluklara göre daha düşük doğruluk sonuçları vermektedir. Mevcut araştırmanın amacı, çoklu implantlı dişsiz arkların dijital ölçülerinin doğruluğu üzerinde, tarama gövdesi malzemesinin ve ek referans alanlarının etkisini değerlendirmektir.

Gereç ve Yöntem: Ana model olarak altı implantlı (BLT, RC, Institut Straumann, AG) dişsiz bir maksilla modeli kullanılmıştır. PEEK ve PMMA tarama gövdeleri implantlara yerleştirilmiş ve bir ağız içi tarayıcı (TRIOS4, 3Shape) ile dijital ölçüler alınmıştır. Dişsiz boşluklara akışkan kompozit (C), dişeti bariyer materyali (GB), taranabilir silikondan (S) yapılmış referans işaretleyiciler yerleştirilmiş ve ölçüler alınmıştır. Ana model, yüksek çözünürlüklü bir referans tarayıcı ile dijitalleştirilmiştir. Önceden belirlenen noktaların sapmaları ve implantlar arası mesafeler çakıştırma tekniği kullanılarak hesaplanmıştır. Çoklu karşılaştırmaları belirlemek için Mann Whitney U ve Kruskal Wallis-H testi yapılmıştır.

Bulgular: İmplantlar arası mesafe ölçümleri, PEEK tarama gövdelerinin PMMA tarama gövdelerinden daha iyi hassasiyet gösterdiğini göstermiştir (Ortalama sapmalar; PEEK: 40±4 mμ, PMMA: 127±6 mμ, $p<.001$). Alt gruplarda da PEEK grupları PMMA gruplarına göre daha doğru sonuçlar vermiştir ($p<.001$). Kruskal-Wallis testi de kesinlikte gruplar arasında önceden belirlenmiş noktaların sapmalarında istatistiksel olarak farklılık göstermiştir ($p<.001$). Ek referans alanlarının eklenmesi, PEEK gruplarında ölçünün kesinliği ve doğruluğu etkilememiştir.

Sonuç: PEEK tarama gövdeleri kullanıldığında, referans işaretçilerin eklenmesi dijital ölçülerin doğruluğunda herhangi bir anlam ifade etmemektedir. PMMA, tarama gövdesi malzemesi olarak alternatif bir malzeme gibi görünmüyor, ek referans alanlarının eklenmesi gerekmektedir. Ancak farklı tarama teknolojileri ile daha ileri çalışmalar yapılmalıdır.

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***Corresponding Author:** Görkem GÖKSOY, *gorkemgoksoy@gmail.com*

INTRODUCTION

One of the critical criteria for the success of implant-supported prosthesis applications is the fabrication of prostheses with passive fit. To achieve prostheses with passive fit, it is crucial to accurately transfer the angles and positions of implants placed within the jawbone onto the working model, necessitating precise impressions of the implant superstructures.[1] Traditional and digital impression methods are used to obtain measurements for implant-supported prostheses. In recent years, digital impressions have gained popularity compared to conventional methods due to their clarity of data and ease of use, with intraoral scanners becoming widely used in clinical practice.

During digital impression-taking, it is vital to ensure that the scan bodies' surfaces are fully visible. Once adequate imaging is achieved, the scan bodies' images are matched with the digital libraries of implant manufacturers, facilitating accurate determination of implant analog positions. Today, major manufacturers produce scan bodies made from different materials, such as polyether ether ketone (PEEK), aluminum alloys, titanium alloys, and resins.[2-5] The impact of using scan bodies made from different materials on impression accuracy remains to be debated, with insufficient data currently available.[1]

The digital impression technique is highly sensitive when taking impressions in edentulous patients due to the absence of anatomical reference points like teeth. It has been noted that deviations during scanning increase with the rising number of implants placed in edentulous arches.[6] Therefore, the lack of sufficient anatomical structures that could serve as references complicates achieving accurate measurements in fully edentulous arches. Establishing additional reference points during imaging to prevent deviations in the images and ensure uninterrupted continuity of measurements during scanning is believed to contribute to measurement accuracy.[6]

Since natural teeth are absent in complete edentulism, discrepancies are also observed during the merging of obtained images within the software and during obtaining a virtual model. This study is designed based on the assumption that having reference points during scanning facilitates the alignment of scanned areas, thereby enhancing measurement accuracy. In addition to investigating the effect of added reference points in edentulous regions, the study aims to explore how differences in digital scanning materials and body design impact the digital measurement of multiple implants in fully edentulous arches. This study tests two hypotheses:

1. PEEK scan bodies provide more precise measurements than PMMA scan bodies.
2. The use of additional reference areas increases measurement accuracy.

MATERIALS AND METHODS

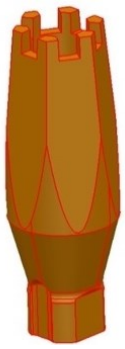
In this study, an upper jaw model mimicking complete edentulism was used as the primary model. The main model was produced using a 3D printer (Uniz NBEE 3d, 9400 Activity Rd Ste L San Diego, CA 92126, US) with pink-colored resin to mimic gum tissue color (Figure 1).

Figure 1: Master Resin Model

Six implants (bone level 4.1-10mm, BLT, RC, Institut Straumann, AG, Basel, Switzerland) were placed parallel to each other on the obtained model using a parallelometer. The implants were positioned in the regions of teeth numbered 16, 14, 12, 22, 24, and 26.

The design of the polymethyl methacrylate (PMMA) digital impression post was created using Powershape software (Autodesk 2021). Additional reference areas were incorporated into the design to enhance measurement accuracy and reduce deviation. Production was carried out using a 3D printer (Uniz NBEE 3d, 9400 Activity Rd Ste L San Diego, CA 92126, US) with PMMA resin (Uniz Z Dental Model, 9400 Activity Rd Ste L San Diego, CA 92126, US) (Figure 2).

Figure 2: CAD design of PMMA digital impression scan body



The study comprises 8 groups. Prior to the study, power analysis was conducted using SPSS software to determine the sample size of the research groups. Based on an effect size of 0.5 and a significance level of 0.05, it was determined that measurements should be taken from 40 points in each group.

During the placement of modification materials, soft tissue and palatal mucosa areas between implants were selected to create additional reference areas. The exact number and locations of modifications—gingival barriers, composite, and scannable silicone—were applied in all study groups (Figure 3). Polymerizations of reference materials were performed according to manufacturers' instructions, and measurements were taken after polymerization was completed. Details of materials used in group formations and modifications are provided in Table 1.

Figure 3: a) PEEK b) PEEK + GB c) PEEK + C d) PEEK + S

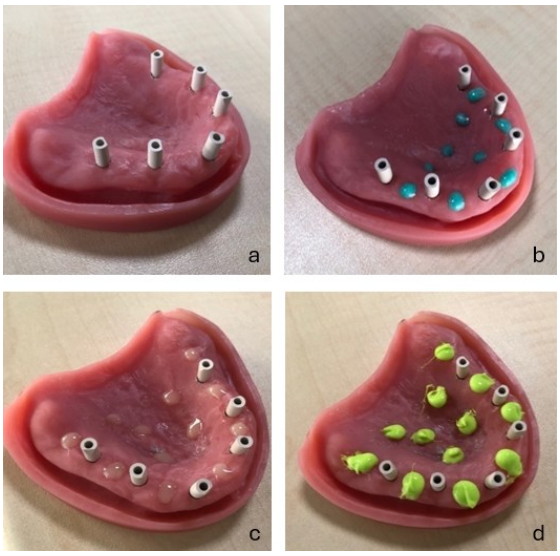


Table 1: The material list

Group	Modification	Firm
PEEK	----------	Institut Straumann, AG, Basel, Switzerland
PEEK+GB	Gingival Barrier(GB)	Scan Body: Institut Straumann, AG, Basel, Switzerland OpalDam Green Light Cured Gingival Barrier, Ultradent Products, Inc,USA
PEEK+C	Composite (C)	Scan Body: Institut Straumann, AG, Basel, Switzerland 3M ESPE Filtek Ultimate Flowable Restorative A2 Shade
PEEK+S	Scannable Silicone (S)	Scan Body: Institut Straumann, AG, Basel, Switzerland Aqium 3D Light Scannable, Müller Omicron Dental, Germany
PMMA	----------	----------
PMMA+GB	Gingival Barrier (GB)	OpalDam Green Light Cured Gingival Barrier, Ultradent Products, Inc,USA
PMMA+C	Composite (C)	3M ESPE Filtek Ultimate Flowable Restorative A2 Shade
PMMA+S	Scannable Silicone (S)	Aqium 3D Light Scannable, Müller Omicron Dental, Germany

In a prospective and double-blind study design, all digital measurements were taken by an assisting researcher (GG). An experienced CAD specialist at Mayıs Design conducted overlaps. Other researchers (BGR and DA) analyzed overlap results using coded data for group names. Following evaluations and statistical analyses, the researcher who performed the scans replaced these codes with actual group names.

The researcher who took digital measurements has worked with digital measurements for approximately 2 years as a clinician. However, to ensure standards, the researcher calibrated the study model by scanning it five times under the supervision of an expert familiar with the system before scans. Digital group measurements were obtained using an intraoral scanner (TRIOS4, 3Shape, Denmark). Five scans were conducted from each group, and data in STL format were saved. After each scan, the scan body was removed, replaced, and manually removed to eliminate errors due to improper seating. In PMMA groups, only the scan body was designed and produced, and the system's original screw was used to attach the measurement post to the implant.

After completing scans for one group, a 10-minute break was taken to rest the device and the clinician; no more than two groups were scanned daily. Scans were performed at room temperature and under daylight.

The digital master model was created by scanning the resin model using an industrial scanner (SOLUTIONIX, MEDIT Corp., 23 Goryeodae-ro 22 gil, Seongbuk-gu, Seoul, Korea). Scanning data from intraoral scanners for group scans and industrial scanners for reference model scans were saved as STL files and imported into Geomagic Control X (3D Systems, Rock Hill, SC, USA) software. Reference model data (digital master model) were loaded into the program for image alignment. Data for comparison areas on the program, soft tissue areas, and distances between implants were processed. Eight points were identified in soft tissue when selecting points, the implant distances were evaluated using seven different measurements, and the images were merged (Figure 5). Seven different measurements were taken to assess the distances between implants, and images were overlaid. During measurements, implants were numbered from 1 to 6, and the measurements were conducted as follows: (1-2), (2-3), (3-4), (4-5), (5-6), (1-6), and (2-5) (Figure 6).

Figure 4: a) PMMA b) PMMA+GB c) PMMA + C d) PMMA+ S

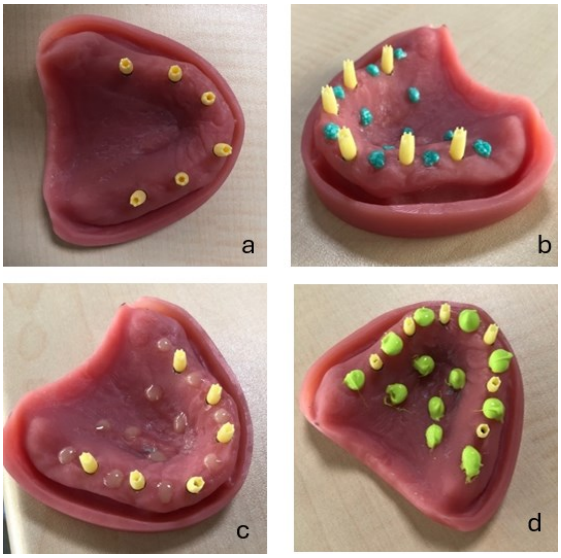


Figure 5: Calculation of soft tissue deviations

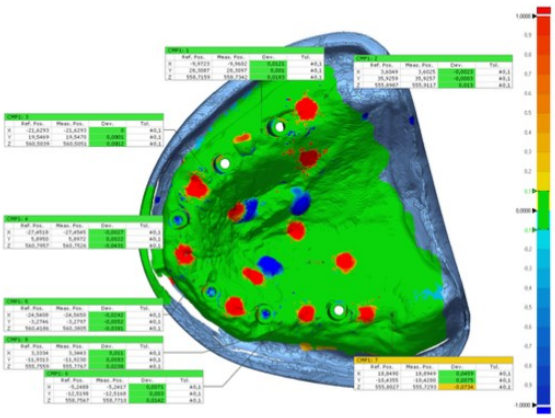
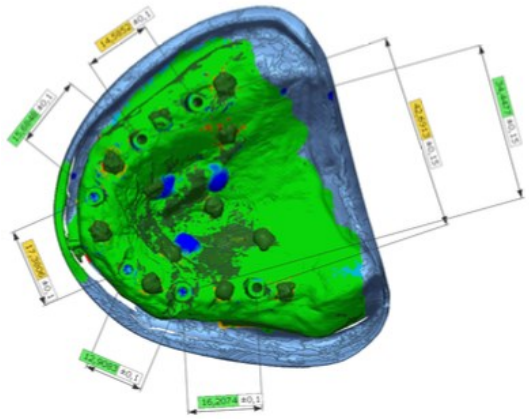


Figure 6: Measuring distances between implants



The data obtained in this study were analyzed using IBM SPSS 28 (MAC OS). Descriptive statistical methods such as mean, standard deviation, median, frequency, ratio, minimum, and maximum were employed to evaluate the study data. The normality of variables was assessed using histogram graphs and the Kolmogorov-Smirnov test. For variables that did not exhibit normal distribution, analyses were performed using the Kruskal-Wallis and Mann-Whitney U tests. Cases where the p-value was less than 0.05 were considered statistically significant.

RESULTS

In this study, a complete edentulous jaw model produced using a 3D printer was used to place 6 implants, aiming to investigate the in vitro impact of digital scanning material and modifications added to edentulous areas on the accuracy of digital measurements of multiple implants. During hypothesis testing, deviations at pre-defined points in soft tissue areas and deviations observed in the measurement of distances between implants were evaluated separately.

1) Evaluation of Inter-Implant Distance Measurements

The impact of added modifications on measurement accuracy was assessed by comparing distances between implants. It was observed that modifications significantly affected measurement accuracy at a statistically significant level ($p < 0.05$) (Table 2, Figure 7). The mean deviation values for groups were calculated as follows: 0.40 ± 0.35 mm for PEEK group, 0.51 ± 0.47 mm for PEEK + GB group, 0.51 ± 0.43 mm for PEEK + C group, 0.43 ± 0.38 mm for PEEK + S group, 0.12 ± 0.61 mm for PMMA group, 0.97 ± 0.64 mm for PMMA + GB group, 0.70 ± 0.49 mm for PMMA + C group, and 0.83 ± 0.52 mm for PMMA + S group.

Figure 7: Graphical comparison of group means

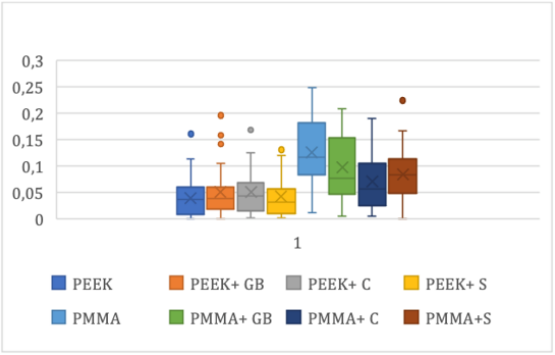


Table 2: Analysis of the Effect of Modification Addition on the Distance Between Implants

	Mean (mm)	SD	Median	Minimum	Maximum	Range	Test Statistics[a]	
PEEK	0,04	0,03	0,03	0,0006	0,16	0,16	Kruskal-Wallis H	65,604
PEEK-GB	0,05	0,04	0,03	0,0005	0,19	0,19		
PEEK-C	0,05	0,04	0,04	0,0017	0,17	0,16		
PEEK-S	0,04	0,03	0,03	0,0030	0,13	0,13	df	7
PMMA	0,12	0,06	0,11	0,01	0,24	0,23		
PMMA-GB	0,09	0,06	0,07	0,006	0,20	0,20		
PMMA-C	0,07	0,04	0,05	0,005	0,18	0,18	Asymp.Sig	<0,001
PMMA-S	0,08	0,05	0,08	0,001	0,22	0,22		

a: Kruskal Wallis Test , $p < 0.05$

The Mann-Whitney U test revealed statistically significant differences ($p < 0.001$) between several groups: PEEK-PMMA+S, PEEK-PMMA+GB, PEEK-PMMA, PEEK+S-PMMA+S, PEEK+S-PMMA+GB, PEEK+S-PMMA, PEEK+GB-PMMA+GB, PEEK+GB-PMMA, PEEK+C-PMMA, and PMMA+C-PMMA (Table 3).

Table 3: Intergroup analysis of the difference in the distance between implants

Pairwise Comparisons					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test St.	Sig.	Adj. Sig.[a]
(PEEK)-(PEEK+S)	-5,686	19,356	-0,294	0,769	1,000
(PEEK)-(PEEK+GB)	-16,343	19,356	-0,844	0,398	1,000
(PEEK)-(PEEK+C)	-21,157	19,356	-1,093	0,274	1,000
(PEEK)- (PMMA+C)	-51,129	19,356	-2,641	0,008	0,231
(PEEK)- (PMMA+S)	-70,186	19,356	-3,626	<0,001	0,008
(PEEK)- (PMMA+GB)	-81,071	19,356	-4,188	<0,001	0,001
(PEEK)-(PMMA)	-118,200	19,356	-6,107	<0,001	0,000
(PEEK+S)- (PEEK+GB)	10,657	19,356	0,551	0,582	1,000
(PEEK+S)- (PEEK+C)	15,471	19,356	0,799	0,424	1,000
(PEEK+S)- (PMMA+C)	-45,443	19,356	-2,348	0,019	0,529
(PEEK+S)- (PMMA+S)	-64,500	19,356	-3,332	<0,001	0,024
(PEEK+S)- (PMMA+GB)	-75,386	19,356	-3,895	<0,001	0,003
(PEEK+S)-(PMMA)	-112,514	19,356	-5,813	<0,001	0,000
(PEEK+GB)- (PEEK+C)	-4,814	19,356	-0,249	0,804	1,000
(PEEK+GB)-(PMMA+C)	-34,786	19,356	-1,797	0,072	1,000
(PEEK+GB)- (PMMA+S)	-53,843	19,356	-2,782	0,005	0,151
(PEEK+GB)-(PMMA+GB)	-64,729	19,356	-3,344	<0,001	0,023
(PEEK+GB)-(PMMA)	-101,857	19,356	-5,262	<0,001	0,000
(PEEK+C)-(PMMA+C)	-29,971	19,356	-1,548	0,122	1,000
(PEEK+C)-(PMMA+S)	-49,029	19,356	-2,533	0,011	0,317
(PEEK+C)- (PMMA+GB)	-59,914	19,356	-3,095	0,002	0,055
(PEEK+C)-(PMMA)	-97,043	19,356	-5,014	<0,001	0,000
(PMMA+C)-(PMMA+S)	-19,057	19,356	-0,985	0,325	1,000
(PMMA+C)-(PMMA+GB)	29,943	19,356	1,547	0,122	1,000
(PMMA+C)-(PMMA)	67,071	19,356	3,465	<0,001	0,015
(PMMA+S)-(PMMA+GB)	10,886	19,356	0,562	0,574	1,000
(PMMA+S)-(PMMA)	48,014	19,356	2,481	0,013	0,367
(PMMA+GB)-(PMMA)	37,129	19,356	1,918	0,055	1,000

The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Statistical analysis showed that the PEEK group exhibited less deviation compared to both PMMA and PMMA with modifications ($p < 0.05$).

When evaluating the intra-group differences in inter-implant distance measurements within PMMA and PEEK groups, no significant difference was found within PEEK groups ($p > 0.05$) (Figure 8). However, within PMMA groups, statistically significant differences were observed among groups ($p < 0.05$) (Figure 9 Table 4). Further analysis indicated that the significant difference within PMMA groups was primarily driven by the PMMA + C - PMMA comparison, where the difference was statistically significant at $p < 0.001$ (Table 4).

Table 4: Analysis of the difference in inter-implant distance measurements in PMMA groups

Pairwise Comparisons of PMMA Groups					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
(PMMA+C)- (PMMA+S)	-9,47	9,695	-0,97	0,329	1,000
(PMMA+C)- (PMMA+GB)	15,47	9,695	1,59	0,111	0,663
(PMMA+C)- PMMA	36,82	9,695	3,79	<0.001	0,001
(PMMA+S) -(PMMA+GB)	6,00	9,695	0,61	0,536	1,000
(PMMA+S) - PMMA	27,35	9,695	2,82	0,005	0,029
(PMMA+GB)- PMMA	21,35	9,695	2,20	0,028	0,166

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 5: Intergroup analysis of soft tissue deviations

	Descriptive Statistics				Test Statistics[a]	
	N	Minimum	Maximum	Mean ± SD		
PEEK	40	0,001	0,22	0,09± 0,05	Kruskal-Wallis H	3.94
PEEK-C	40	0,015	0,24	0,10± 0,06		
PEEK-S	40	0,005	1,86	0,29 ± 0,58	df	7
PMMA	40	0,0001	0,22	0,08± 0,05		
PMMA-GB	40	0,004	0,85	0,12 ± 0,16		
PMMA-C	40	0,008	0,28	0,10 ± 0,06	Asymp.Sig	0,78
PMMA-S	40	0,004	1,85	0,28 ± 0,50		
PEEK-GB	40	0,005	0,28	0,09 ± 0,06		

Figures 8: Intragroup evaluations of deviations in the distance between implants PEEK group

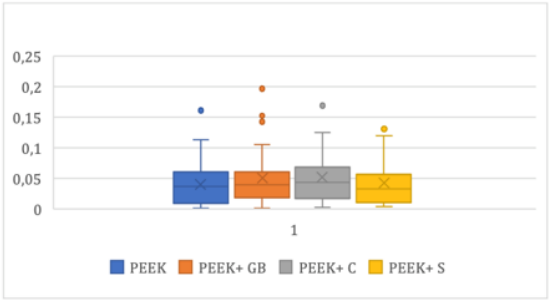
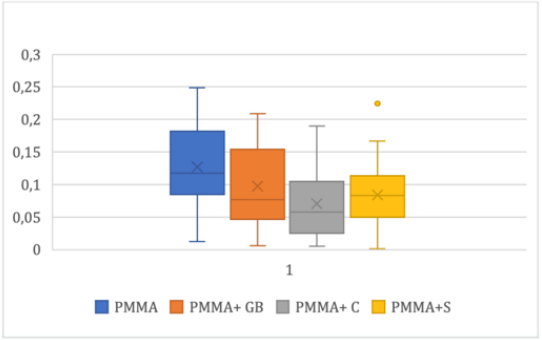


Figure 9: Intragroup evaluations of deviations in the distance between implants, PMMA group



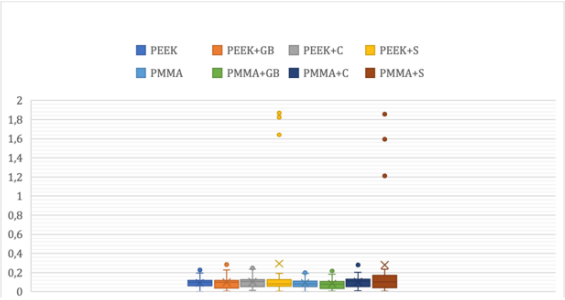
2) Analysis of Deviations in Soft Tissue

When analyzing deviations in soft tissue, there is no statistically significant difference between groups (Table 5, Figure 10). Similarly, intra-group analyses within the PMMA and PEEK groups did not yield statistically significant results (Table 6).

Table 6: Intragroup analysis of PEEK and PMMA groups

Test Statistics		
	PEEK	PMMA
Kruskal-Wallis H	1,120	2,702
df	3	3
Asymp. Sig.	0,772	0,44

Figure 10: Graphical examination of Soft Tissue deviation



DISCUSSION

This in vitro study aimed to investigate and compare the effects of different materials used in digital scan bodies and the design of digital scan bodies on the accuracy of measurements in edentulous areas and between implants, along with the potential impact of additional reference points. When evaluating the results of the study, the first null hypothesis that "PEEK scanning components provide clearer measurements compared to PMMA scanning components" was accepted, while the second null hypothesis that "the use of additional reference points improves measurement accuracy" was partially accepted. PEEK scanning components yielded significantly better results compared to PMMA scanning components. The use of additional reference points significantly improved measurement accuracy in the PMMA groups, while it did not affect the measurement accuracy in the PEEK groups.

In this study, different scan bodies and additional reference points were evaluated. Statistically, significant differences were found between the PEEK and PMMA groups regarding implant-to-implant distance measurements, with the PEEK group showing less deviation than the PMMA group. In the subgroups where additional reference points were added, generally, less deviation was observed in PEEK groups compared to subgroups consisting of PMMA modifications. PEEK and PMMA groups showed deviations in soft tissue and implant-to-implant distances within clinically acceptable levels. While implant-to-implant distance measurements varied between 0.46 ± 0.42 mm in the PEEK group and 0.94 ± 0.60 mm in the PMMA group, soft tissue deviations ranged from 0.14 ± 0.30 mm in the PEEK group to 0.15 ± 0.27 mm in the PMMA group. Deviations in digital measurements of multiple implants in partial edentulism averaged 11 µm, whereas deviations in complete edentulous arches were higher. Previous studies have reported distance deviation values ranging from 47-226 µm, consistent with findings in this study and current clinical practices.[1,7,8]

Traditional methods can achieve minimal error in measurements of multiple implants in complete edentulism. The open-tray impression technique, where implant impression copings are splinted to each other, is the most commonly used method and provides clinically acceptable results. However, achieving the desired accuracy in digital impressions of multiple implants in complete edentulism remains challenging, with controversial outcomes.[9,10] The low clarity observed in complete edentulism is attributed to the high number of overlaps performed by software algorithms for 3D image acquisition and the lack of fixed anatomical reference points. A systematic

review examining impression techniques used in implant-supported prostheses recommended using the interconnection of scanner components to enhance measurement accuracy.[11]

Conversely, Mizumoto et al. demonstrated in their study that adding additional reference points did not significantly affect the accuracy of scanning data; in fact, using dental floss to create additional reference points adversely affected results, increasing deviations.[12] Canullo et al. also conducted another study where scan bodies were splinted together using intermediate components with numerous reference points, yielding results similar to those in the literature, indicating that splinting scan bodies did not affect scanning accuracy and even had a negative effect in the presence of angular deviations.[13] Arıkan et al. further noted that while splinting scanning components improved scanning clarity, conventional impressions obtained by splinting measurement components yielded more precise results.[14]

The characteristics of scan bodies significantly affect scanning accuracy.[15] A systematic review concluded that scan bodies' surface, geometry, and material influence implant measurements.[16] Previous studies have predominantly used PEEK or titanium with aluminum alloys as scan body materials, with slight inclusion of PMMA materials in studies. Therefore, there are no other studies against which we can compare the results obtained using PMMA scan bodies. In this study, the low impression accuracy observed with PMMA scan bodies is thought to be more related to geometry than the surface characteristics of the scan bodies. The scan body must have a solid structure for intraoral scanners to capture images. The PMMA scan body produced in this study did not differ in color or surface gloss from PEEK scan bodies. However, the PMMA scan body designed for use in this study was manufactured in a sharper-edged form to create additional reference points during scanning. Compared to PMMA scan bodies, PEEK scan bodies had simpler shapes. Our findings indicated that scan bodies with simpler designs are more suitable for scanning accuracy, a conclusion supported by similar findings in a study by Muizomata et al., where scan bodies with shorter and less complex structures resulted in fewer angular and distance deviations.[12] Another study investigating the relationship between the body, geometry, and shape of two different scan bodies found significant differences in 3D positioning and angular deviations between the two scan bodies.[17]

In the context of PMMA groups, another reason for the observed low accuracy is the absence of this new design in the scanner software library. Images obtained from the scanner are first transferred to software where the model is created. During model creation, aligning the image converted by the CAD software from the scanner part in STL format, which is present in the CAD software library, helps reduce errors in the model.[18] In our study, since a new design was attempted, which is not present in the CAD library.

Previous studies in this field indicate that factors such as the distance between scanning components, the depth of the implant, visibility of scanning components, position within the scan, and the experience of the operator can affect the accuracy of digital implant scans performed with multiple scanning components.[19,20] For the most precise scanning, additional reference points on scanning bodies, as recommended by implant manufacturers, can facilitate soft tissue scanning, thereby reducing deviations during measurement, albeit not statistically significant.

The current study has several limitations. Only one scanner was used for model scanning in the study. Different intraoral scanners with varying technologies may yield different results, which is an important factor to consider when translating study findings into clinical practice. Moreover, the study is an in vitro

study, and the scanning environment differs from the oral cavity. Factors such as saliva and mobile mucosa movement were not considered. It should also be noted that a physical model made of material reflecting light differently was used for scans. The optimized scanning conditions raise the possibility that similar results may not be achieved under in vitro conditions.

CONCLUSION

In conclusion, the use of PEEK scan bodies in full-arch implant measurements results in low deviations. Additional modifications applied to edentulous areas do not affect measurement accuracy. Although PMMA material does not provide as high precision as PEEK, the study's findings are promising for its use. Evaluating the effect of material differences on scanning accuracy could be more objectively assessed by designing PMMA scan bodies to match the original geometry of manufacturers. Studies on this topic are quite limited. Therefore, more in-vitro and in-vivo research is needed.

Ethical Approval

This in-vitro study does not require ethics committee approval.

Financial Support

The authors declare that this study received no financial support.

Conflict of Interest

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

Author Contributions

Design: BGR, GG, DAŞ. Data collection or data entry: GG. Analysis and interpretation: BGR, GG, DAŞ. Literature search: GG, DAŞ. Writing: GG, BGR, DAŞ.

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Evaluation of Sella Turcica Bridging, Ponticulus Posticus Calcification and Sella Turcica Volume in Individuals with Different Malocclusions

Murat TUNCA[1] **Sema KAYA**[2*]

[1] Assist. Prof., Department of Orthodontics, Faculty of Dentistry, Kütahya Health Sciences University, Kütahya, Türkiye.
dtmurattunca@gmail.com

[2] Assist. Prof., Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Van Yuzuncu Yıl University, Van, Türkiye.
semakaya@yyu.edu.tr

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ABSTRACT

Aim: The aim of this study was to evaluate sella turcica bridging, ponticulus posticulus calcification and sella turcica volume in individuals with different skeletal malocclusions on cone beam computed tomography (CBCT) images.
Material and Methods: Sella turcica volume calculations were performed on a total of 84 individuals, 28 individuals in each class. Ponticulus posticus calcification and sella turcica bridging were performed on a total of 162 patients (27 male, 27 female) in each class. Sella turcica bridging and ponticulus posticulus calcifications were analyzed on sagittal sections of CBCT images and data were recorded as no bridging, partial bridging and complete bridging. Sella turcica volume calculations were performed with 3D-DOCTOR (Able Software Corp., Lexington, MA, USA) by manual segmentation method on KIBT sagittal sections.
Results: There was no statistically significant difference in ponticulus posticus calcification and sella turcica bridging according to skeletal malocclusions and gender. Sella tursica volume did not show a statistically significant difference between skeletal malocclusions, while sella tursica volume was found to be statistically significantly higher in female than in male individuals. ($p=0.004$, $p<0.005$).
Conclusion: Ponticulus posticus calcification, sella turcica bridging and sella turcica volume do not vary according to skeletal malocclusions. Sella turcica volume is statistically significantly higher in female individuals. It should be kept in mind that calcifications and shape changes in structures such as the sella turcica and atlas bone on lateral cephalometric radiographs may be a sign of certain diseases.

Farklı Maloklüzyonlara Sahip Bireylerde Sella Tursika Köprüleşmesi, Pontikulus Postikus Kalsifikasyonu ve Sella Tursika Hacminin Karşılaştırılması

Makale Bilgisi

Makale Geçmişi

Geliş Tarihi: 30.09.2023
Kabul Tarihi: 02.01.2024
Yayın Tarihi: 30.08.2024

Anahtar Kelimeler:
Sella turcica,
Pontikulus postikus,
Malokluzyon.

ÖZET

Amaç: Bu araştırmada farklı iskeletsel maloklüzyona sahip bireylerde sella tursika köprüleşmesi, pontikulus postikus kalsifikasyonu ve sella tursika hacminin konik ışınlı bilgisayarlı tomografi (KIBT) görüntülerinde değerlendirilmesi amaçlanmıştır.
Gereç ve Yöntemler: Sella tursika hacim hesaplamaları her bir sınıfta 28 birey; toplam 84 birey üzerinde yapılmıştır. Pontikulus postikus kalsifikasyonu ve sella tursika köprüleşmeleri her bir sınıfta 54 (27 kadın, 27 erkek) toplam 162 hasta üzerinde yapılmıştır. Sella tursika köprüleşmeleri ve pontikulus postikus kalsiifikasyonları KIBT görüntüleri sagittal kesitler üzerinde analiz edilerek; köprüleşme yok, kısmi köprüleşme ve tam köprüleşme şeklinde veriler kaydedilmiştir. Sella tursika hacim hesaplamaları KIBT sagittal kesitleri üzerinden manuel segmentasyon yöntemi ile 3D-DOCTOR (Able Software Corp., Lexington, MA, USA uygulaması ile yapılmıştır.
Bulgular: Pontikulus postikus kalsifikasyonu ve sella tursika köprüleşmesi açısından iskeletsel malokluzyonlara ve cinsiyete göre istatistiksel olarak anlamlı bir fark gözlenmemiştir. Sella tursika hacmi iskeletsel malokluzyonlar arasında istatistiksel olarak anlamlı bir fark göstermezken kadınlarda sella tursika hacmi istatistiksel olarak anlamlı bir şekilde erkeklere göre daha yüksek olduğu tespit edilmiştir ($p=0.004$, $p<0.005$).
Sonuç: Pontikulus postikus kalsifikasyonu, sella tursika köprüleşmeleri ve sella tursika hacmi iskeletsel malokluzyonlara göre değişiklik göstermemektedir. Sella tursika hacmi kadınlarda istatistiksel olarak anlamlı bir şekilde daha yüksektir. Lateral sefalometrik radyografilerde sella tursika ve atlas kemiği gibi yapılarda meydana gelen kalsifikasyonların ve şekil değişikliklerin bazı hastalıkların da habercisi olabileceği unutulmamalıdır.

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***Corresponding Author:** Sema KAYA, *semakaya@yyu.edu.tr*

INTRODUCTION

In lateral cephalometric radiographs, anatomical structures that can be observed are used for assessing an individual's growth and development and for orthodontic diagnosis purposes.[1,2] Genetic diseases in individuals can also affect the development of craniofacial structures, and changes in anatomical structures can be observed in these radiographs.[3] There are many studies in the literature that suggest that these diseases may also correlate with dental eruption disorders, shape abnormalities, and skeletal anomalies within the nasomaxillary complex. The relationship between orthodontic or dental anomalies and anomalies of the sella turcica and atlas bone has been a subject of particular interest for researchers.[3-13]

The sella turcica is an intracranial bony depression located anterior to the body of the sphenoid bone, housing the pituitary gland.[5] The two tuberculum sellae and two dorsum sellae form the shape observed sagittally in lateral cephalometric radiographs, protecting the pituitary gland.[4] The geometric center of the sella turcica is important for cephalometric analysis. However, based on the length, diameter, and depth of the sella turcica, it can be classified as J-shaped, double-contoured base, shallow, oblique anterior wall, irregular dorsum sella with a posterior wall, and pyramid-shaped dorsum sellae.[14,15] In some individuals, in addition to anatomical variations of the sella turcica, "bridging of the sella turcica" can be observed, characterized by the pronounced fusion of the anterior and posterior clinoid processes along with calcification of the interclinoid ligament.[16] The bridging of the sella turcica has been suggested to lead to dental and skeletal anomalies, with its cause possibly being neural crest cells, which have embryogenic origins and contribute to the formation of the nasomaxillary complex.[17,18]

Another bridging anomaly believed to correlate with dental and skeletal anomalies due to similar embryogenic reasons is the ponticulus posticus. It is a bony bridging of the canal where the vertebral artery passes through in the atlas bone, similar to the sella turcica.[3] Research examining the relationship of these anomalies with dental or skeletal anomalies has generally been evaluated on lateral cephalometric radiographs containing two dimensions.[3-12]

This study aims to evaluate the sella turcica bridging, ponticulus posticus calcification, and sella turcica volume in individuals with different skeletal malocclusions using cone-beam computed tomography (CBCT) images. The null hypothesis (H0) of the study can be expressed as "There is no difference in sella turcica bridging, ponticulus posticus calcification, and sella turcica volume among individuals with different skeletal malocclusions."

MATERIALS AND METHODS

This research received approval from the Non-Interventional Clinical Research Ethics Committee of Van Yüzüncü Yıl University (2023/05-21). This retrospective study was conducted in accordance with the principles outlined in the Helsinki Declaration, and informed consent forms were obtained from the individuals included in the research. The sample size for the study was determined to be a minimum of 84 individuals, with 28 individuals in each of the three groups, based on the effect size calculated for three groups using the G-Power statistical package (Version 3.1, Franz Faul, University of Kiel, Germany) with an effect size of 0.4, Type I error ($\alpha = 0.05$), and 90% power.

The study included individuals aged 14-35 who had not previously undergone orthodontic or orthognathic surgical treatment, had no craniofacial syndromes or obvious pathologies, and had clear visibility of both the first cervical vertebra and the sella turcica within the same Field of View (FOV) area. Patients who had previously undergone orthodontic or orthognathic surgical treatment, had a history of trauma or fracture in the maxillofacial region, or had significant skeletal asymmetry were excluded from the study if they had low-quality cone-beam computed tomography (CBCT) images with metal and motion artifacts.

For CBCT measurements, a KaVo 3D eXam (Biberach, Germany) tomography device, which undergoes routine maintenance and repairs at our Faculty of Dentistry's Department of Oral, Dental, and Maxillofacial Radiology, was used. All tomography imaging procedures were performed at 120 kVp, 5 mAs, 7 s scanning time, with a 0.4 mm voxel size and a 130 mm FOV. To reach the desired sample size, 162 CBCT images taken for diagnostic purposes between January 2018 and December 2022 at our Faculty of Dentistry's Department of Oral, Dental, and Maxillofacial Radiology were screened. Individuals were divided into three groups based on the skeletal class I ($0° \leq ANB \leq 4°$), skeletal class II ($4° < ANB$), and skeletal class III ($ANB < 0°$) values according to the ANB angle, which is the angle between Nasion, A, and B points. Cephalometric images in the content of all CBCT images were traced by an orthodontist with six years of experience using the NemoCeph NX 2005 (Nemotec, Madrid, Spain) package program.

Sella turcica bridging was analyzed on sagittal sections of CBCT images, and data were recorded as no bridging, partial bridging, and complete bridging (Figure 1). Similarly, ponticulus posticus calcifications were analyzed on sagittal sections, and data were recorded as no bridging, partial bridging, and complete bridging (Figure 2). Sella turcica volume calculations were performed using manual segmentation on CBCT sagittal sections with the 3D-DOCTOR (Able Software Corp., Lexington, MA, USA) application. The boundaries of the sella turcica were manually drawn on sagittal sections (Figure 3). All sections from the first section where the sella turcica was observed to the last section were included in the study with a section interval of 0.4 mm. The presence of ponticulus posticus, sella turcica bridging, and sella turcica volume calculations were performed by a five year experienced Oral and Maxillofacial Radiology specialist.

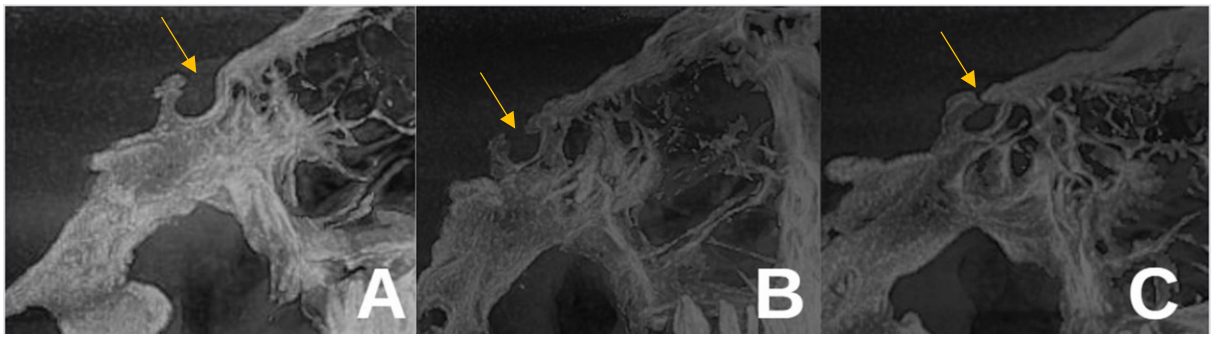

Figure 1. Sella Turcica bridging classifications: A - no bridging, B - partial bridging, C - complete bridging (yellow arrow).

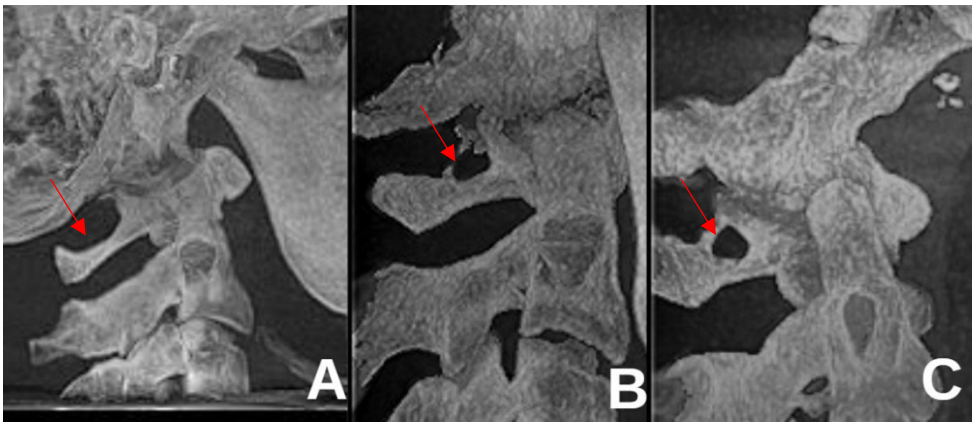

Figure 2. Ponticulus Posticus calcifications: A - no calcification, B - partial calcification, C - complete calcification (red arrow).

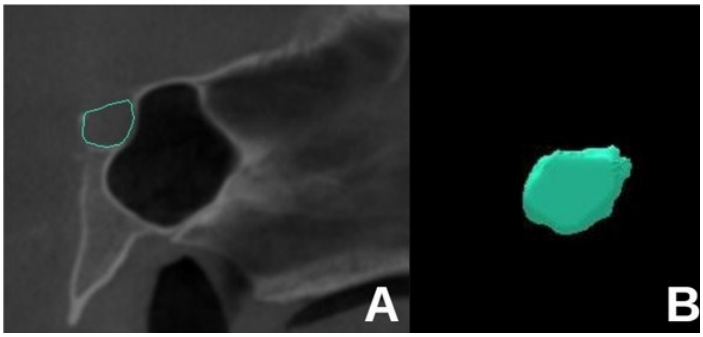

Figure 3. A - Manual segmentation of Sella Turcica volume on the sagittal section. B - Three-dimensional image of the calculated Sella Turcica volume.

Statistical Analysis

The data were analyzed using IBM SPSS v23 (IBM Co., Armonk, NY). Normality of the data was examined using the Kolmogorov-Smirnov test. As the data were normally distributed for three or more groups, one-way analysis of variance (ANOVA) was used. Chi-square analysis was used to evaluate categorical data such as ponticulus posticus calcification and sella turcica bridging. The relationship between sella turcica volume and gender was analyzed using the Student's t-test. The results of the analysis were presented as mean ± standard deviation for quantitative data and as median (minimum - maximum) for categorical data. The significance level was set at $p < 0.05$.

RESULTS

The demographic data of the individuals included in the study are presented in Tables 1 and 2. According to this, sella turcica volume calculations were performed on a total of 84 individuals, with 14 male and 14 female individuals in each class. The mean age of the individuals was found to be 22.7 in class I, 21.64 in class II, and 22.21 in class III. In addition, ponticulus posticus calcification and sella turcica bridging were performed on a total of 162 individuals, with 27 male and 27 female individuals in each class. The mean age of the individuals was 23.01 in class I, 23.54 in class II, and 23.3 in class III.

Table 1. Comparison of demographic data by classes for Sella Turcica volume.

Gender	Class I	Class II	Class III	Total
Female	14 (50)	14 (50)	14 (50)	42 (100)
Male	14 (50)	14 (50)	14 (50)	42 (100)
Age (M-SD)	22.07 ± 4.7	21.64 ± 6.3	.2,93 ± 6.3	22.21 ± 5.7

M-mean, SD: standart deviation.

Table 2. Comparison of demographic data by classes for Sella Turcica bridging and Ponticulus Posticus calcification.

Gender	Class I	Class II	Class III	Total
Female	27 (50)	27 (50)	27 (50)	54 (100)
Male	27 (50)	27 (50)	27 (50)	54 (100)
Age(M-SD)	23.01 ± 4.9	23.54 ± 6.5	23,3 ± 5.7	23.3 ± 5.6

M-mean, SD: standart deviation.

Table 3. Comparison of Ponticulus Posticus calsification and Sella Turcica bridging with respect to skeletal malocclusion and gender.

		Ponticulus Posticus calsification			Sella Turcica bridging		
		No	Partial	Total	No	Partial	Total
Class	I	48	5	1	15	27	12
	II	47	2	5	16	28	10
	III	44	7	3	17	23	14
p*			0.23			0.85	
Gender	Female	70	7	4	18	45	18
	Male	69	7	5	30	33	18
p*			0.93			0.11	

*Chi-Squared test, $p<0.005$

Comparisons based on skeletal malocclusion and gender for ponticulus posticus calcification and sella turcica bridging are shown in Table 3. According to this, no statistically significant difference was observed in terms of ponticulus posticus calcification and sella turcica bridging with respect to skeletal malocclusions and gender.

The comparison of sella turcica volumes based on skeletal malocclusions and gender is presented in Table 4. While sella turcica volumes showed no statistically significant difference with skeletal malocclusions, it was determined that the sella turcica volume in females was statistically significantly higher than in males (p=0.004, p<0.005).

Table 4. Comparison of Sella Turcica volume with respect to skeletal malocclusion and gender.

		Sella Turcica volume (M±SD)	***p***
Class	I	1906.11±617.23	0.756*
	II	1789.29±489.08	
	III	1837.57±639.57	
Gender	Female	1943.74±448.02	***0.004*****
	Male	1744.90±679.34	

* One-way analysis of variance (ANOVA).
** Student-t test, SD: Standart Deviation p<0.05

DISCUSSION

Sella turcica bridging has a prevalence of 1.1%-22%, while ponticulus posticus calcification ranges from 5.14% to 37.83%. These variations in sella turcica and atlas bone can be observed in routine orthodontic radiographs. These variations have been associated with conditions such as headaches, migraines, certain syndromes, cleft lip and palate, dental anomalies, and temporomandibular disorders. They can also vary with non-syndromic skeletal malocclusions.[3-7,9-12,19]

Current study, there was no statistically significant difference observed in sella turcica bridging and ponticulus posticus calcification concerning skeletal malocclusions and gender. However, sella turcica volume was found to be statistically significantly higher in females compared to males (p=0.004). According to the results of the present research, our hypothesis H0 is partially rejected.

In two-dimensional evaluations, sella turcica bridging and ponticulus posticus calcification can be misinterpreted due to superimpositions. Especially, false bridging, which is caused by the superimposition of anterior and posterior clinoid processes of the sella turcica and interclinoid processes, is completely eliminated in three-dimensional radiographic evaluations.[20]Therefore, in our study, we preferred cone beam computed tomography (CBCT) images for detecting sella and ponticulus ponticus bridging and calculating sella turcica volume.

When examining the literature, it is observed that both sella bridging and ponticulus posticus calcification are highly prevalent in normal individuals. However, the reason for often researching the correlation between these structures is their embryogenic origins.[12,18,21-23] The anterior wall of the sella turcica develops from different embryogenic structures than its posterior wall. The anterior wall, as well as the development of the neck, shoulder, and vertebrae, is develops neural crest cells. The posterior wall, on the other hand, develops from the mesoderm layer, which is closely related to the notochord.[3,4] The fact that the same cells play a role in the development of dental and craniofacial structures naturally strengthens the possibility of their correlation with dental and skeletal anomalies.

However, it should be noted that not every sella turcica bridging or ponticulus posticus calcification indicates an anomaly. Bavbek et al.[24] stated that it is observed in 65-80% of normal individuals and emphasized that not every sella turcica bridging points to an anomaly but also pointed out the high correlation with certain syndromes and diseases.

Studies that evaluate the correlation between dental anomalies and ponticulus posticus on cephalometric radiographs exist in the literature. For example, Dadgar et al.[5] found

a higher incidence of ponticulus posticus calcification in individuals with embedded canines compared to those with normal dentition. Kaya et al.[4] reported that Type I and Type II calcification of ponticulus posticus was more common in cases with embedded canines, tooth transposition, and third molar agenesis compared to control groups. Ghadimi et al.[3] found no significant relationship between ponticulus posticus calcification and palatally embedded canine teeth.

Current study, no statistically significant difference was observed in ponticulus posticus calcification among individuals with different malocclusions. The differences between our study and Bayraktar et al.'[25] study could be attributed to differences in age groups and classifications of ponticulus posticus.

When studies evaluating ponticulus posticus in terms of gender are examined, Dadgar et al.[5] and Ghadimi et al.[3] found no correlation, while Bayraktar et al.[25] reported that males had a higher incidence of calcification than females. In our study, no difference was observed in ponticulus posticus calcification among gender groups.

There are studies in the literature that suggest a correlation between sella turcica bridging and dental anomalies on lateral cephalometric radiographs. However, studies that assess sella turcica bridging and sella turcica dimensions based on skeletal malocclusions using two-dimensional radiographs have conflicting results. Afzal and Fida[26] and Sobuti et al.[27] reported that sella turcica bridging was more common in individuals with Class III malocclusion. Shresta et al.[28] stated that there was no difference in sella turcica bridging among individuals with different malocclusions. In our study, there was no difference in sella turcica bridging among individuals with different malocclusions.[28]

Sella turcica completes its development around the age of 15. Sella turcica's linear dimensions can vary from 5-16 mm in length and 4-12 mm in height.[24] The width, height, and length of sella turcica have generally been evaluated in two-dimensional radiographs, and some mathematical formulations have been developed to calculate its volume.[24] There are three studies evaluating the dimensions of the sella turcica using CBCT (Cone Beam Computed Tomography). Nadim[29] stated that the determination of sella turcica dimensions using CBCT was achieved with high accuracy. In Nadim's[29] research, as well as in the study by Chou et al.[31] no significant differences were observed in the linear measurement values of sella turcica among individuals with different sagittal malocclusions. However, Abdallah[30] reported that the depth of sella turcica is higher in individuals with a horizontal growth pattern compared to those with normal and vertical growth patterns. In our study, we aimed to calculate the volume of sella turcica using software programs instead of linear measurements on CBCT images, and no statistical differences were observed among individuals with different malocclusions. However, it was noted that sella turcica volume was higher in females compared to males.

The variables evaluated in the current study have been assessed not only for their association with sagittal skeletal malocclusions but also with transversal and vertical skeletal malocclusions. Seifeldin et al. have reported that there is no correlation between the morphology and bridging of the sella turcica and skeletal maxillary deficiency.[32] However, Yan et al. have associated the shape of the sella turcica with different skeletal vertical malocclusions. They have stated that in individuals with a low angle, the distance of the posterior clinoid is greater, the height of the posterior clinoid is less, and the incidence of sella turcica bridging is higher.[33] Recent literature has reported a positive correlation between individuals with cleft lip and palate and diseases such as migraine.[34,35] Sella turcica dimensions can vary by race, gender, and development, and the limited sample size and not evaluating them in vertical direction are limitations of our study.

CONCLUSION

Ponticulus posticus calcification, sella turcica bridging, and sella turcica volume do not differ based on skeletal malocclusions. Sella turcica volume is statistically higher in female individuals. It should be remembered that calcifications and shape changes in structures such as sella turcica and atlas bone can be indicators of certain diseases on lateral cephalometric radiographs. Moreover, it has been observed that having different malocclusions does not predispose to the genetic calsification of ponticulus posticus and bridging of sella turcica.

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Ethical Approval

The necessary ethical approval for this study was obtained from the Non-Interventional Ethics Committee of Van Yüzüncü Yıl University (2023/05-21).

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Conflict of Interest

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

Author Contributions

Design: SK, MT. Data collection or data entry: SK, MT. Analysis and interpretation: SK, MT. Literature review: SK, MT. Writing: SK, MT.

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Factors, Precautions and Solution Suggestions of Complication and Malpractice in Endodontic Treatment Practices

Mehmet Kutluhan UÇUK[1*] Asiye Nur DİNÇER[2]

[1] Assist. Prof., T.C. Altınbaş University School of Dentistry, Department of Endodontics, İstanbul, Türkiye, kutluhan.ucuk@altinbas.edu.tr

[2] Assoc. Prof., Private Practice Dentist, Endodontics, İstanbul, Türkiye, asiyedincer@yahoo.com

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ABSTRACT

Aim: The aim of this study is to investigate the level of knowledge of dentists performing endodontic treatment on complications, malpractice and legal liability, to reveal the causes of adverse cases and to obtain solution suggestions.
Material and Methods: The survey method was used in this study. 280 participants who were undergoing at least 3 endodontic treatments per week were asked 36 questions with content such as demographic characteristics, endodontic treatment procedures, questions about malpractice and complications, legal exposure, prepared on the Microsoft Forms platform. The statistical significance level was taken as p=0.05. Chi-square test, SPSS statistical package program were used in the analysis.
Results: Dental practitioners are mindful of concepts such as malpractice and complications, but a larger part of them consider themselves inadequate about lawful liability or about the lawful process that will be handled when complaints are made against them. Furthermore, the likelihood of filing a malpractice lawsuit due to the outcome of a hazardous procedure adversely affects the working conditions.
Conclusion: Institutions and managers should provide support and motivation for the lawful awareness and preparation of the dentists they employ.

Endodontik Tedavi Uygulamalarında Komplikasyon ve Malpraktisin Etkenleri, Önlemleri ve Çözüm Önerileri

Makale Bilgisi

Makale Geçmişi

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Anahtar Kelimeler:
Diş Hekimliği,
Endodonti,
İntraoperatif komplikasyonlar,
Kanuni Yükümlülük,
Malpraktis.

ÖZET

Amaç: Bu çalışmanın amacı endodontik tedavi uygulayan diş hekimlerinin komplikasyon, malpraktis ve hukuki sorumluluk üzerine bilgi düzeylerini araştırmak, istenmeyen olguların sebeplerini ortaya çıkartmak ve çözüm önerileri elde etmektir.
Gereç ve Yöntemler: Bu çalışmada anket yöntemi kullanılmıştır. Haftada en az 3 adet endodontik tedavi uygulamakta olan 280 adet katılımcıya demografik özellikler, endodontik tedavi prosedürleri, malpraktis ve komplikasyon üzerine sorular, hukuki maruziyet gibi içerikleri olan 36 adet soru Microsoft Forms platformunda hazırlanarak soruldu. İstatistik anlamlılık düzeyi p=0.05 olarak alındı. Analizde Ki-kare testi, SPSS istatistik paket programı kullanıldı.
Bulgular: Diş hekimleri komplikasyon, malpraktis gibi kavramlar hakkında bilinçlidirler, bununla birlikte büyük kısmı hukuki sorumluluklar hakkında veya şikâyete maruz kalındığında karşı karşıya kalacakları hukuki süreç hakkında kendilerini yeterli görmemektedirler. Ek olarak, riskli işlemin bir sonucu olarak malpraktis davası açılma ihtimali, çalışma koşullarını olumsuz etkilemektedir.
Sonuç: İşverenler ve kurumlar, çalıştırdıkları hekimlerin hukuki olarak bilinçlenmesi ve eğitilmesi hususunda destek ve teşviklerde bulunmalıdırlar.

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***Corresponding Author:** Mehmet Kutluhan UÇUK, *kutluhan.ucuk@altinbas.edu.tr*

INTRODUCTION

Dentists have interactions with their patients as a result of the treatments they perform. Treatments may include both medical and aesthetic concerns. The dentist has a number of responsibilities and rights in terms of ethics and law due to the treatment that is performed. Unwanted results in treatments can be considered as a complication or malpractice. This judgment is guided by many factors, from the care of the dentist to his experience, and also fromthe procedures to the attitude of the patient. The patient's ability to search for rights for the alleged harm, the situation of arguing with the patient or his relatives may cause a change in the treatment process, and the dentist may prefer less risky treatment methods. The dentist should make predictions about unwanted results in treatments, and in cases where a dentist cannot foresee, dentist should be able to make the necessary medical intervention for the superior benefit of the patient. Treatments should be carried out following medical standards with informed consent received from the patient. The existence of consent provides both the patient and the dentist with assurance and a legal basis.

In the patient-dentist relationship, the patient and the dentist are two integral parts of a team and work together for the same purpose.[1] Consent is one of the reasons that make medical intervention under the law.[2] In the treatment performed, the unwanted results that are predicted to occur before the treatment, so precautions are taken, but the occurrence of which cannot be avoided, is referred to as a 'complication'; the dentist's medically defective application is called 'malpractice'. Failure to notice the complication in a timely manner, failureto take the necessary measures despite being noticed, and failure to comply with the medical standards of the measures taken are considered malpractice.[3] Legal and ethical responsibilities are increasing day by day. The highest number of malpractice claims in dentistry are related to the specialty of Endodontics.[4] No dentist in our country is far from malpractice cases.[5] For this reason, this study was needed to reduce dentist victimization in legal exposures that are increasing today, to identify the causes of medical failures with dentists' legal knowledge levels, and to develop solutions

The legal duty of the dentist's medical intervention

Any intervention that minimizes unwanted effects, such as the treatment of a disease, the elimination of a deficiency, or the correction of an abnormality can be defined. To generalize, all kinds of interventions on human beings related to medical science are medical interventions.[6]The main factor that makes the interventions in compliance with the law is the consent of the patient.[7] The indication constitutes the justified reason for the dentist in the treatment or prevention. There are legal regulations that nothing can be done and requested about the indication without the purpose of diagnosis, treatment or prevention.[8-10] When a cause-and-effect relationship cannot be established in the indication, the indication is excluded, and this legally creates liability for violation of the contract established between the dentist and the patient, tort, intentionally causing injury. In addition, non-indication procedures do not complywith ethical values.[11]

Undesirable disadvantages may occur in medical applications. There is a possibility that unwanted adverse events occurring in the same case may be evaluated as both malpractice and complications. The determining factors are the care of dentists, and taking precautions against possible negativities. As mentioned earlier, one of the elements that makes the default contract between a dentist and a patient compliant with the law is the presence of informed consent from the patient.[5]

Complication-malpractice?

The damage caused as a result of the medical intervention by the dentist is a result of the intervention, if the care that a dentist should show under the same environmental conditions, at the same level of competence, taking into account the scientific and technical level that medical science has reached today, the conditions of the environment in which the interventionis performed, the educational level

of the intervener, and the state of expertise [12], does not result in the responsibility of the dentist.[13] If a complication is not detected early, if necessary measures are not taken despite being noticed, or if these measures are not evaluated in accordance with medical standards despite being noticed and taken, the dentist has not taken care in the management of complications; in this case, a case that can be considered a complication may turn into malpractice, and at this point, the responsibility of the dentist arises.[14] There is a regulation on this issue in a convention.[9] The possibility of unintended consequences, complications, and risks of the procedure should be notified to the patient in advance. If the patient has not been informed about the possibility of complications, the trusteedentist is held responsible for the fact that the provisions of the information have not been fulfilled.[15]

General scopes of malpractice

Malpractice is called a defect in medical practice. Although 'Medical Negligence' can also be used as an associated term, it is the careless verb of a healthcare professional who compromises health standards.[16] The word malpractice comes from the Latin term mala praxis.[17] Contracts ortorts form the basis of medical malpractice lawsuits. Any medical intervention should be performed under the established standards. The legal regulation on this issue is regulated under a convention.[18] In the same environmental conditions, the care and diligence expected of a dentist with the same level of competence is referred to as the standard of care.[19] Legislatures primarily want to reduce the incidence of dentist inattention and patient injuries.[20] Shortcomings in practice lead to deviations from the medical standard. The non-use of rubber dams is the most basic example of deviation from the medical standard and is an unacceptable situation.[21] The aspiration of files and materials used in treatment may cause serious enough consequences to require surgical intervention.[22] Although malpractice and complication are close concepts, malpractice is related to the defect and the dentist is responsible. Although the concept of complication is considered an accident-coincidence in the sense of criminal law, the dentist is not held responsible here.[3] The treatment standards brought by current science bring with them the need for up-to-date devices and equipment.

Examples of inadequacy in the level of knowledge of the dentist, errors in decision-making,inaccuracies in communication, lack of care and attention, intensity, inappropriate environmental factors, cyclicity, or inadequacy in medical devices can be given.[23]

Malpractice lights on dentistry

Among the causes of malpractice in dentistry, failure to meet the standard of treatment and dissatisfaction with the treatment outcome are the most frequently observed deficiencies.[24] While the various specialties may set the stage for scenarios tied to the nature of medical interventions, such as not fulfilling aesthetic expectations, incorrect tooth extraction, patient dissatisfaction with prostheses, and instrument breakage, it is the lack of meticulous and careful practice that underlines the core issues at hand. Lawsuits related to the endodontics department are the most common malpractice lawsuits filed in dentistry.[4] The patient may file a complaint against the dentist or initiate legal action on the grounds of having suffered harm. The number of lawsuits filed against dental medical interventions is increasing day by day, and changes are being observed in related medical interventions today.[25] Defensive medicine, in particular avoidance behavior, encompasses both everyday clinical decisions that affect individual patients and more systematic changes in the scope and style of practice.[26] Due tolegal regulations, dentists are concerned that they may experience problems due to errors in medical practice. This is observed in many countries around the world due to similar practices.[5] Although defensive medicine causes an increase in the level of anxiety, it also leads to an increase in the amount of medical expenses.[27]

MATERIAL AND METHODS

Survey preparation and target group

The study was initiated after obtaining ethical approval (27.10.2020-18/354). The questionnaire was created on the internet using the Microsoft Forms platform (Microsoft Windows operating, Albuquerque, NewMexico, USA) and the responses of the participants were accepted for about 8 months. In the research, which was a cross-sectional study type, the target group is dentists who routinely (at least 3 times a week) perform endodontic treatment. Dentists working in public and private have been reached. The survey questions and test solvability were first solved by 10 people asa pilot study, and the missing items were completed and presented to the participants as an online survey after revision.

Survey questions

The survey questions, numbered 1 to 8 include demographic characteristics, branch, professional experience, place of work and frequency of work, questions numbered 8 to 12 include the frequency of endodontic treatment, the time spent on treatment, the preference for single or multiple sessions, the adequacy of the treatment time, questions numbered 13 to 18 include the types of complications, the frequency of complications, the methods and time of obtaining consent, informing the patient, between questions 19 and 21, medical standard, complication, and malpractice information questions are included, between the questions numbered 22 and 28 are cases of complications, causes of malpractice, withdrawal of the dentist from treatment, questions numbered 28 to 36 include questions about the dentist's knowledge of the legal process, the status of receiving legal education, the status of exposure to legal sanctions or complaints, and the impact of complaints on working conditions.

1. What is your age range?

23-39/ 40-49/ 50+

2. What is your gender?

Male / Female

3. What is your specialty?

General Practitioner/ Endodontics/ Pediatric Dentistry/ Other specialty-PhD

4. What is your professional title?

Dentist/ Research Assistant Dentist/ Specialist Dentist-Dentist Dentist/ Assistant Professor/ Associate Professor/ Professor

5. How many years have you worked? (If you are not currently working, please answer according to the period you were employed)

0-5/ 6-10/ 11-25/ 26+

6. Where do you work?

Private practice-Private clinic/ State hospital-Public Oral Health Services Center/ University Hospital

7. How many days do you work in a week?

1-3 / 3-5 / 5-7

8. What is the frequency of endodontic treatments you perform in a week?

3-10 / 11-20 / 21

9. How much time do you allocate for root canal treatment, excluding permanent restoration, in multi-rooted symptomatic teeth?

0-1 hour / 1-2 hours / 2-3 hours / 3-4 hours

10. How much time do you allocate for root canal treatment, excluding permanent restoration, in single-rooted asymptomatic teeth?

0-1 hour / 1-2 hours / 2-3 hours / 4 hours+

11. What is your preference for choosing single-session or multiple-session treatments?

Single session under all conditions / Single session if the tooth is asymptomatic, multiple sessions if symptomatic / Multiple sessions under all conditions / Undecided

12. Is the session time you allocate for treatment sufficient?

Sufficient / Insufficient / Undecided

13. What are the two most common complications you encounter?

Perforation / Instrument breakage / Extrusion of irrigant through the apex

Flare-up / Complications related to anesthesia / Damage to the tooth-surrounding tissues / Non-healing post-treatment-tooth extraction / Other

14. What is the frequency with which you encounter complications?

Never-very rarely / 1-2 times a month / 1-2 times a week / 3+ times a week

15. What is your method of obtaining consent from the patient?

Written consent / Verbal consent / Both written and verbal consent / I do not obtain consent

16. If you obtain a pre-prepared written consent form, what is your method?

I give the consent form for them to sign / An assistant provides the consent form for signing/ In addition to the consent form, I have them write 'I have read, understood, and give my consent' / I do not obtain written consent

17. Do you provide additional information to your patients about the treatment or anticipated complications?

I provide additional information only if there is a high risk of complications /I provide additional information under all conditions/ I never provide additional information/ Undecided

18. At what stage of the treatment process is consent obtained from the patient?

Before examination / After examination, before treatment / After the first session of multi-session treatments / Normally I don't, but if a problem occurs during the procedure, I obtain it at the end of the session

19. What is the medical standard?

The rules generally accepted among medical science and dentists for the treatment performed/ The treatment varies according to dentists/ Treatment methods subject to recent research/ Practices in university hospitals

20. What is a complication?

An unexpected and unpreventable adverse action during treatment/ The result that displeases the patient after treatment due to a lack of necessary materials/ An adverse result anticipated before treatment but not prevented/ Harm that could not be avoided despite being anticipated and measures taken before treatment/ An adverse situation developing due to skipping sequential procedures due to lack of time

21. What is malpractice?

It is the dentist performing a medically faulty application/ The result of treatment not leading to complete healing/ The patient being harmed despite treatment adhering to medical standards and precautions taken/ Harm occurring despite the patient being adequately informed about the medical treatment

22. If a file breaks during treatment, would you inform the patient?

I always tell them/ I do not tell unless the prognosis is negatively affected/ I never tell/ Undecided

23. When a file seperation can be considered a complication rather than malpractice? (multiple options can be selected)

It is sufficient if instrument breakage is mentioned in the consent obtained from the patient/ Mentioning the possibility of instrument breakage in addition to the consent obtained, and it occurs during the use of sequentially used instruments without deformation in treatment with a rubber dam/ When the canal file breaks due to being used more than recommended

24. When can perforation at the pulp floor while searching for canal openings be considered malpractice?

If it occurs while cleaning decay with a steel bur at low speed/ Even if moving slowly, it occurs due to the patient suddenly turning their head/

While searching for the canal entrance at the pulp floor with an aerator after cleaning the decay/ If the possibility of perforation has been mentioned to the patient during the examination, informed consent has been obtained, and perforation occurs while working according to the standard

25. In your opinion, what are the most common causes of malpractice? (multiple options can be selected)

Allocating too little time for treatment/ Reusing materials that should be used a maximum of 2-3 times, multiple times/ Not keeping records or keeping incomplete records/ Insufficiencies in physical conditions, material problems/ Treating according to outdated schools of thought/ Proceeding without taking radiography/ Lack of professional experience/ Carelessness of staff / Insufficient communication with the patient.

26. When can a dentist discontinue a patient's treatment? (multiple options can be selected)

If the dentist goes on leave or becomes ill / If the patient insults the dentist / If the treatment fee is not paid / If the patient says they will complain if not healed / The dentist can discontinue treatment at any time without any special condition / The dentist can never discontinue treatment / Undecided

27. Can a dentist withdraw from treating a patient? (multiple options can be selected)

The dentist can withdraw when they decide they cannot use their medical knowledge as required and another competent dentist is available to apply the treatment/ The dentist can withdraw if the treatment prognosis is very low and the treatment will not respond/ The dentist can withdraw if the patient's infectious disease poses a risk to the dentist; themselves, their family, or other patients have a high probability of transmission/ The dentist can withdraw from treating a patient brought in for emergency intervention but has the potential to complain if a problem occurs/ The dentist can withdraw if a consultation is necessary but the patient refuses the consultation/ The dentist can never withdraw from treatment/ Undecided

28. Your patient claims to have been harmed due to a negative outcome of the treatment. Do you have knowledge about the legal and penal process?

I know / I don't know

29. How does the possibility of a malpractice lawsuit arising from a risky procedure affect your working conditions? (Multiple options can be selected)

It has a positive effect/ It has a negative effect/ Undecided

30. Have you received course on legal responsibility (seminar, symposium, etc.)?

Yes / No

31. Do you think you have sufficient knowledge about the distinction between malpractice and complications and the related legal process?

Yes/ No

32. Have you ever been subject to complaints or legal sanctions in your professional life as a result of treatment outcomes?

I have been complained about/ I have been subject to legal sanctions/ I have not experienced any complaints-sanctions

33. During your student years, were you ever subject to complaints or legal sanctions as a result of treatment outcomes?

I have been complained about/ I have been subject to legal sanctions/ I have not experienced any complaints-sanctions

34. If you have faced legal sanctions, what was the outcome? (If there are multiple cases, please specify separate outcomes)

It concluded in my favor/ It concluded against me/ The process is ongoing/ I have not been subject to legal sanctions/ Other

35. What impact has the complaint or legal sanction you experienced had on your professional life?

It had a wearing effect, but I can continue with

my daily life/ It was an opportunity for me to improve myself/ It had no impact/ I experienced a traumatic process, thought about quitting/left the profession/ I have not experienced any complaints/sanctions/ Other

36. After experiencing a complaint or legal sanction, how has it affected your evaluations regarding the diagnosis and treatment of the patients you apply medical intervention to? (multiple options can be selected)

I continue with the same techniques and treatment methods, no change/I continue with the same techniques and treatment methods but now inform the patient more about complications than before/I now apply treatments with fewer complications, in the slightest risk I either refer the patient to another physician or apply more problem-free treatment procedures/I have not experienced any complaints/sanctions/Other.

Statistical analyses

The sample width in the study is at least 200 people, additionally, the number of participants reached is 280. As a result of the power analysis, the power of the test was calculated at 92%.Descriptive statistics for the categorical variables in the study were expressed as numbers (n) percentages (%). The chi-square test was calculated to clear the relationships between categorical variables. The significance level was taken as 5% statistically in the calculations. For analysis, the SPSS (IBM SPSS for Windows, ver.25) statistical package program was used. In this study, the meaningful p-values obtained are calculated using the Chi-square method, taking into account all subcategories. Which specific subcategory contributes to the observed differences is indicated through lettering assigned by the Bonferroni method within individual subcategories. Here, individual p-values do not exist; rather, it is determined whether the result is meaningful or not. In essence, when the table is considered as a whole, a p-value is identified; however, if we delve into the categories, we can only examine the differences. Consequently, the relationships between parameters cannot be defined with absolute and definitive boundaries.

RESULTS

In the survey study applied to the participants in this study, the following data were obtained: 85.7% of the participants are between the ages of 23 and 29, the majority of them are women, 72.1%, and 35% are endodontics specialists. The second largest majority are general practitioners with 33.9%. The majority (61.8%), preferred a single session if the tooth is asymptomatic, and multiple sessions are preferred if it is symptomatic, 82.9% of dentists found the treatment time allocated to the patient sufficient. The first two most common complications were instrument fracture (67.85%) and flare-up (27.85%). The incidence of complications was 1-2 per month for 72.1% of the participants. The method of obtaining consent is written by 40% of the participants, and the time of obtaining consent is after examination, before treatment by 60%. The definitions of medical standards (91.4%), complications (80.7%), and malpractice (87.5%) are known. The rate of not giving information to the patient when the file was broken during treatment was 4.3%. When asked in which case thecase of file fracture can be considered a complication and not malpractice, most of the participants (82.49%) gave the correct answer that included receiving consent form the patient, mentioning the possibility of tool seperation, non-deformed tools that are used in order with all with rubber dam'. Situations caused by malpractice, according to participants: Taking a short time to treat patients (58.21%); repeatedly using materials that should be used 2-3 times 89.28%; not keeping records or incompletely keeping records (34.64%); inability in physical conditions, material problems 70.35%; appropriate treatment for outdated schools 53.57%; performing procedures without taking radiography 62.85%; lack of professional experience 59.64%; sloppiness of auxiliary personnel % 33.21; inadequate communication with the patient was selected by 31.07%. The

majority (75.35%) thinks that the dentist may leave the treatment unfinished if the patient insults. When asked about the withdrawal status, the majority (92.4%) thinks that the dentist may withdraw it is decided that the dentist cannot use the medical knowledgeproperly and in the presence of another dentist competent to administer the treatment. The majority of the participants do not have information about the civil and criminal process of claiming harm on the grounds that the patient's treatment resulted negatively (72.1%). The possibility of a malpractice lawsuit filed by dentists negatively affects working conditions (72.5%). The majority of the participants have not received legal liability training before (77.1%) and think that they do not have sufficient knowledge about malpractice, separation of complications and the related legal process (75.4%). 76.1% of the participants were not subjected to complaints or legal sanctions in their professional lives, and 88.6% did not experience any complaints or sanctions during their student years as a result of treatment.

DISCUSSION

The majority of the participants' ages were young dentists profile, and most of the participants were female dentists. In addition, 35% of the participants were endodontists. If the tooth was asymptomatic in the majority (61.8%), single-session treatment was preferred. Accordingto Greaves' review[28] when looking at recovery or success rates, there was no significant differencebetween single sessions or multiple sessions. In terms of the time allocated for treatments, 82.9% of theparticipants found the time allocated for treatment sufficient. According to Hayran et al.,[29] conducted on patients, the rate at which patients found the allotted time sufficient for themselvesis 56.4%. The most common complications were instrument fractures and flare-ups. According to the findings of our study, the incidence of complications was 1-2 times a month at 72.1%. More than 40% are written consent forms. Arican's research revealed that merely 63.1% of the participants acknowledged obtaining informed consent from their patients, with 74.5% acquiring written consent and 25.5% receiving verbal consent.[30] Obtaining consent increases the patient's confidence and participation in medical interventions.[31] In the information-only questions about medical standards and complications, 91.4% of the correct answers were received to the concept of medical standards, 80.7% to the definition of complications and 87.5% to the definition of malpractice. The patient should be informed if any negativity occurs during the treatment.[13] It is possible to distinguish the fact that a file fracture can be evaluated as a complication, not malpractice. When the situations that cause the most malpractice are asked with the multi-option, material and physical conditions are indicated. However, giving a short time for treatment to patients with two close results and a lack of professional experience are the next two causes of malpractice. According to Kiani and Sheikhazadi,[24] equipment problems account for 4.5% of the reasons for compensation. In a study conducted in Denmark,[32] technical complications and malpractice accounted for 28.4% of malpractice cases. For the question for withdrawing from treatment, the recieved correct answer rate was 92.14%. Withdrawal or discontinuation of treatment is subject to the HMEK (Hekimlik Meslek Etiği Kuralları) m.25 [33] with, the dentist's refusal of the patient, TDN (Tıbbi Deontoloji Nizamnamesi) was sentenced with m.18.[8] When asked about information about the legal process in case the patient is harmed as a result of treatment, 72.1% of the participants do not have information. According to Yıldırım et al.,[34] this number reflects as 60% result of a study conducted with 125 dentists. Morevover, the probability of filing a malpractice lawsuit as a result of a risky procedure, compared to 72.5%, negatively affects working conditions. In addition, the majority has not received legal responsibility training, however, they find their knowledge about malpractice, complication discrimination and the related legal process is insufficient. According to Saruhan et al.,[35] dentists mostly thinkthat the distinction between complications

and malpractice cannot be made clearly. When questioned about experiencing legal sanctions, most did not report exposure. According to a study conducted in Denmark,[32] dentists were prosecuted for malpractice in 43% of 3611 malpractice cases. A study revealed that from 1991 to 2000, the High Health Council (HHC) made a total of 1,548 decisions. Of these, 14 (0.9%) pertained to the field of dentistry, within which 8 cases identified dentists as being at fault.[36] In Iran, a study made inference that most of the dental malpractice complaints (86.9%) occurred in the private sector.[24] In another study from Turkey refers that Approximately 83.3% of lawsuits alleging dental malpractice against dentists arise within the context of private sector.[37] According to Saruhan et al.[35], 5.2% always and 11% never responded to avoiding patients with a high potential to sue dentists in order to protect themselves from malpractice claims. In a study conducted with 175 dentists [38], the proportion of individuals who responded "I am indecisive" to the question "Do you use defensive medicine to protect against verbal and physical violence by patients and their relatives?" exceeded those who answered "yes" or "no". Defensive medicine applications also increase their effect in dentistry. Dentists tend to stay away from complaints. The development of defensive medicine leads to an increase in the level of anxiety [27]. Dentists in Turkey should possess a deeper understanding of patient rights, the obligations of dentists, and the legal documents that can safeguard them from potential lawsuits.[30]

The frequency of facing complications is 1-2 per month, moreover, instrument fractures and flare-ups occur more often. The main reasons for the occurrence of malpractice have been negative effects on the use of tools and duration. Dentists consider their level of knowledge in terms of the legal dimension of medical interventions insufficient. They have not received anytraining on legal responsibility, and they do not know the exact limits under which treatment can be left unfinished or withdrawn. Courses should be increased, and legal training should be provided. Dentists should be motivated by current treatment practices. Institutions and organizations should support the dentist to allocate sufficient time to the patient and keep their records. Training on malpractice, complications and patient communication should be increased in undergraduate and specialty education curricula. Health institutions and organizations should inform their dentists about their rights and obligations.

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Ethical Approval

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Conflicts of Interest

All authors declare that they have no conflict of interest.

Author Contributions

Study concept/design: MKU, AND. Data collection: MKU. Data analysis/interpretation: MKU, AND. Manuscript writing: MKU, AND. Critical revision of the content: AND. Final approval and responsibility: MKU. Material and technical support: MKU. Supervision: MKU, AND.

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Evaluation of Orthodontic Wire-Bending Performance of Dental Students Between Two Consecutive Academic Years

Merve Nur EGLENEN[1*] Mehmet Ali YAVAN[2]

Yavuz Selim ASLAN[3] Nihal HAMAMCI[4]

[1] Assist. Prof., Yeditepe University, Faculty of Dentistry, Department of Orthodontics, İstanbul, Türkiye, nureglenen@yahoo.com

[2] Assoc. Prof., Adıyaman University, Faculty of Dentistry, Department of Orthodontics, Adıyaman, Türkiye, yavanmehmetali@gmail.com

[3] Dr., Private practice, Gaziantep, Türkiye, dt.yavuzselimaslan@gmail.com

[4] Prof., Adıyaman University, Faculty of Dentistry, Department of Orthodontics, Adıyaman, Türkiye, nhamamci@hotmail.com

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ABSTRACT

Aim: To compare orthodontic preclinical skills of same dental students that were trained using the same learning method in similar skills at an interval of one year

Material and Methods: The retrospective study evaluated the archived wire-bending and wax models that had been submitted by the same undergraduates who were fourth-year undergraduates (T0) in 2019-2020 and were promoted to the fifth year in 2020-2021 (T1). Orthodontic performances were taught to a total of 45 dental students (21 males and 24 females) using the live demonstration method prior to their internship in both academic years. Labial arch, Adams clasp, eyelet clasp bending and base plate wax modeling skills at the end of internship were compared between the two periods and between the two genders.

Results: A significant difference was found between the two genders with regard to T0 labial wire-bending (male: 9.90 ± 1.70, female: 10.66 ± 2.05) and T0 total skill score (male: 27.76 ± 2.94, female: 30.45 ± 3.00) ($p<0.01$). In female students, a significant increase was observed in the Adams clasp bending scores at T1 (11.33±1.27) compared to T0 (11.08±1.34), while in male students, a significant increase was detected in the eyelet clasp bending scores between T1 (3.28±0.56) and T0 (2.71±1.10) ($p<0.05$). However, no significant change was observed between T0 and T1 with regard to all parameters in the entire population ($p>0.05$).

Conclusion: The difference between the initial scores of both genders disappeared in the long term and there was no significant change in total skill scores between the two academic years.

Diş Hekimliği Öğrencilerine Canlı Demonstrasyon ile Öğretilen Ortodontik Preklinik Performanslarının Uzun Vadeli Karşılaştırması

Makale Bilgisi

Makale Geçmişi

Geliş Tarihi: 26.12.2023
Kabul Tarihi: 10.03.2024
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Anahtar Kelimeler:
Eğitim,
Dental,
Sürekli,
Ortodonti,
Zaman.

ÖZET

Amaç: Bir yıl arayla benzer becerilerde aynı öğrenme yöntemi kullanılarak eğitilen aynı diş hekimliği öğrencilerinin ortodontik preklinik becerilerini karşılaştırmak

Gereç ve Yöntemler: Bu retrospektif çalışmanın verileri, Diş Hekimliği Fakültesi öğrencilerinin ortodonti staj dönemlerinde yaptıkları büküm ve modelasyondan oluşmaktadır. Geleneksel canlı demonstrasyon yöntemiyle 21 erkek ve 24 kadından oluşan toplam 45 (ortalama yaş: 22,4 ± 1,8) dental öğrenciye 4. (T0) ve 5. (T1) sınıflarında stajları öncesinde ortodontik büküm ve mum modelaj canlı demonstrasyonla öğretilmiştir. Bir yıl arayla 20 günlük staj sonunda teslim edilen vestibul ark, adams ve eyelet kroşeleri ile mum modelasyondaki beceriler cinsiyetler ve yıllar arasında karşılaştırılmıştır.

Bulgular: T0 da vestibul ark (erkek: 9,90 ± 1,70, kadın: 10,66 ± 2,05) ve total beceri skorlarında (erkek: 27,76 ± 2,94, kadın: 30,45 ± 3,00) cinsiyetler arasında anlamlı bir fark ($p <0,01$) mevcutken, diğer parametrelerde anlamlı bir fark ($p >0,05$) bulunamamıştır. T0 ve T1 arasında, kadınlarda adams kroşe büküm skorunda anlamlı bir artış (T0: 11,08±1,34, T1: 11,33±1,27) ($p <0,05$) gözlenirken, erkeklerde damla kroşe büküm skorunda (T0: 2,71±1,10, T1: 3,28±0,56) anlamlı bir artış ($p <0,05$) mevcuttur. Totalde ise kroşeler ve modelasyon skorları hiçbir parametrede anlamlı bir fark göstermemiştir ($p >0,05$).

Sonuç: Dental öğrencilerin beceri skorlarında, cinsiyet grupları arasındaki fark uzun dönemde ortadan kalkarken, totalde iki yıl arasında beceri skorları arasında anlamlı bir değişim olmamıştır.

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***Corresponding Author:** Merve Nur EGLENEN, *nureglenen@yahoo.com*

INTRODUCTION

Acquisition of psychomotor skills is a key to clinical success in many branches of medicine and dentistry.[1] Most procedures in dental practice require psychomotor skills with cognitive planning as well as hand-eye coordination.[2] Therefore, many dentistry schools use the conventional live demonstration method to develop the psychomotor skills of undergraduate students.[3, 4] Live demonstration can increase students' confidence and improve their communication skills and also provides a better understanding of the procedure compared to didactic teaching.[5]

In previous studies, orthodontic preclinical laboratory performances of dental students have been evaluated based on their wire-bending skills. In those studies, conventional live demonstration has been compared with other methods that have been developed to overcome the difficulties of this method, including video demonstration,[6] video-live demonstration,[7] and flipped classroom.[8] The results of these studies showed that all of these methods were equally effective as conventional live demonstration. Additionally, Corpus and Eisbach[9] demonstrated that the conventional the live demonstration method had self-reported cognitive and motivational benefits in child development in the long-term follow-up.

Removable orthodontic appliances have three main components including acrylic base plate, clasps, and active elements.[10] Of these, clasps are obtained via wire-bending and are used to increase the retention of the appliance.[10] Many dentistry school curricula in undergraduate orthodontic education include preclinical wire-bending to improve students' manual dexterity. In ## dental school, the orthodontic curriculum focuses on the practical training of various orthodontic wire-bending skills in preclinical training in addition to didactic and clinical observational training in both the fourth and fifth years of the five-year program. The wire-bending procedure involves numerous sequential steps, each of which requires careful monitoring.[10]

Nowadays, due to the increase in the number of students in the classes, each student may not have the opportunity to observe the wire-bendings equally. However, this study aims to show that this disadvantage can be eliminated by live demonstration. To our knowledge, there is no study evaluating the long-term results of orthodontic preclinical laboratory skills taught with the use of the live demonstration method. The aim of the present study was to compare the performances of fourth- and fifth-year dental students that were trained using the same learning method in similar skills. Our null hypothesis was that the live demonstration method will improve the orthodontic laboratory skill scores of undergraduate dental students in the long term.

MATERIAL AND METHODS

The retrospective study evaluated the orthodontic bends made by the fourth graders were scored and the scores obtained by the same students by making the same orthodontic bends in the fifth grade were compared during the academic year 2019-2020 and 2020-2021, respectively. The study was approved by Adıyaman University Non-Interventional Clinical Research Ethics Committee (Approval No 2021/07-10). The present study was conducted in accordance with the Principles of the Declaration of Helsinki.

In the country where the study was conducted, the academic year covers the months between September and June and orthodontic internship is performed once for 20 working days in both fourth and fifth years of education. The orthodontics curriculum of our school requires a certain level of success (60 out of 100 points) both in preclinical laboratory skills and in the oral exam conducted at the end of the internship in order for students to pass the class in the fourth and fifth years. Out of 50 students that began the fourth year in the academic year 2019-2020, 45 of them were able to pass to the fifth year in the academic year 2020-2021 and

completed their orthodontics internship, all of whom were included in the study. Inclusion criteria of students were as follows:

1. Having successfully completed the fourth year of education including orthodontics and other clinics and courses and having passed to the fifth year at the end of the academic year 2019-2020.
2. Having successfully completed all the assignments including labial arch, Adams clasp, eyelet clasp bending and base plate wax modeling at the end of the orthodontic internship in the academic year 2019-2020 and 2020-2021.
3. Having been instructed about every step of wire-bending and modeling procedures by the same instructor using the live demonstration method.
4. Having practiced the wire-bending procedure in preclinical training for one hour on each internship day by using the same brand of pliers, wire, and wax on the same orthodontic model replicated during the 20-day orthodontics internship in the fourth- and fifth-year internships and having submitted the models to the same lecturer on the following day.
5. Students who repeated the fourth year of education in 2019-2020 and those who were transferred from other universities in 2020-2021 were excluded from the study.

Live demonstration technique

During the academic year 2019-2021, when this study was conducted, our fourth- and fifth-year students were divided into 9 internship groups (with 6 students each) according to the academic calendar. In the orthodontics internship, laboratory skills were taught using the live demonstration method during the preclinical training. In the same orthodontic preclinical training, each student was instructed on how to perform each step of clasp bending and base plate wax modeling by the same lecturer (MAY). In these sessions, students were allowed to ask their questions as needed. After the demonstration, which lasted for an average of 40 minutes, the clasp and wax models were left in the classroom for students to reference. Afterwards, for one hour of each internship day, students were allowed to practice using those clasp and wax models under the supervision of the same lecturer (YSA), during which they were allowed to ask questions as needed. On the following day, the resultant clasps and wax models were submitted by each student. At the end of the internship, all the students submitted their most successful clasp and wax models for final evaluation.

Evaluation

In order to standardize the scoring of students' skill scores between two academic years and between two genders and to evaluate their comparability with the studies in the literature, similar articles [8, 11] were reviewed. The scoring process was conducted by another blinded and calibrated lecturer (NH). While Table 1 presents the evaluation criteria used for labial arches and eyelet clasps, Table 2 for Adams clasp bending and wax modeling skills. The rater (NH) performed the scoring on four performances using the criteria presented in Table 1 and 2 by assigning 1 point for each criterion. The total skill score was obtained by summing the scores obtained for labial arch, Adams clasp, and eyelet clasp bending and wax modeling. To confirm intra-rater reliability, the same investigator (NH) randomly re-evaluated 20 models after 15 days. To confirm inter-rater reliability, a calibrated second investigator (ME) randomly re-evaluated 20 models.

Statistical analysis

Data were analyzed using SPSS for Windows version 25.0 (Armonk, NY: IBM Corp.). Normal distribution of data was assessed using Shapiro-Wilk test. All the scores excluding the eyelet clasp bending scores showed a normal distribution. Gender-based differences were compared using Independent-Samples t-test and Mann-Whitney U test. Differences between two time points (fourth-

year, T0;fifth-year, T1) were compared using Paired-Samples t-test and Wilcoxon signed rank test. A *p* value of <0.05 was considered significant.

Table 1: Evaluation criteria for vestibular arch and eyelet clasp bending

	Evaluation criteria for vestibular arch and eyelet clasp bending	Point
1.	The wire's labial segment might be placed in the the incisors' middle 1/3.	**1**
2.	The wire's mesial vertical segment might be started from the canine's mesial 1/3.	**1/ R**
3.		**1/ L**
4.	Mesial vertical segment and the labial segment might be perpendicular (90°) to the each other.	**1/ R**
5.		**1/ L**
6.	Distal and mesial vertical segment might be parallel to the each other.	**1/ R**
7.		**1/ L**
8.	Vertical segment might be at a distance of 0.5-1.5 mm from the the alveolar mucosa's buccal side.	**1/ R**
9.		**1/ L**
10.	The ring's vertical margin the might be 2-3 mm above the gingival margin.	**1/ R**
11.		**1/ L**
12.	The retention arm might follow the occlusal embrasure.	**1/ R**
13.		**1/ L**
14.	The retentive arm might contact to the tooth on the occlusal embrasure between the canine and first premolar.	**1/ R**
15.		**1/ L**
16.	There might be about 0.5 mm to 1 mm clearance when the retentive arm passes through the palatal tissue.	**1/ R**
17.		**1/ L**
18.	The tag might be facing towards the palate.	**1/ R**
19.		**1/ L**
	Evaluation criteria for eyelet clasp bending	
1.	The tip of the eyelet clasp might engage the undercut.	**1**
2.	There might be 45° between the eyelet clasp and the arm.	**1**
3.	The retentive arm might follow the occlusal embrasure.	**1**
4.	The retentive arm might contact to the tooth on the occlusal embrasure.	**1**
5.	There might be about 0.5 mm to 1 mm clearance when the retentive arm passes through the palatal tissue.	**1**

R: 1 point for right side, L: 1 point for left side

Table 2: Evaluation criteria for Adams clasp bending and wax modeling

	Evaluation criteria for Adams clasp bending	Point
1.	The bridge might be straight.	**1**
2.	The bridge and the buccal plate might be parallel to the each other.	**1**
3.	Bridge might not contact the first molar's buccal surface.	**1**
4.	The bridge's height might be at halfway up to the molar's buccal surface.	**1**
5.	The arrowhead might be at 45°.	**1/ R**
6.		**1/ L**
7.	The arrowhead might engage the mesiobuccal undercut.	**1/ R**
8.		**1/ L**
9.	The arm might follow the occlusal embrasure.	**1/ R**
10.		**1/ L**
11.	The arm might contact the occlusal embrasure.	**1/ R**
12.		**1/ L**
13.	There might be about 0.5 mm to 1 mm clearance when the mesial arm passes through the palatal tissue.	**1**
14.	There might be about 0.5 to 1 mm clearance when the distal arm passes through the palatal tissue.	**1**
15.	The mesial arm might be bent towards palate in a mesial direction.	**1**
16.	The distal arm might be bent towards palate in a mesial direction.	**1**
17.	The tag might be facing towards the palate.	**1/ R**
18.		**1/ L**
	Evaluation criteria for wax modeling	
1.	The thickness of the model might not exceed 2 mm.	**1**
2.	The thickness might be equal throughout the model.	**1**
3.	The model might end in the embrasures of anterior teeth.	**1**
4.	Posteriorly, the model might end at a location 2 mm beyond the distal segment of the Adams clasp.	**1**
5.	The model might end in the palatal embrasures of premolar and molar teeth.	**1/ R**
6.		**1/ L**
7.	The surface of the model might be smooth.	**1**
8.	The model might completely cover the palatal parts of the clasp.	**1**

R: 1 point for right side, L: 1 point for left side

RESULTS

Intra-rater correlation coefficients ranged between 0.869 and 0.980 and inter-rater correlation coefficients ranged between 0.841 and 0.978. Table 3 presents a gender-based comparison of preclinical orthodontic performances during the two time points. In this comparison, a significant difference was found between the two genders only with regard to T0 labial wire-bending (male: 9.90 ± 1.70, female: 11.66 ± 2.05) and T0 total skill score (male: 27.76 ± 2.94, female: 30.45 ± 3.00) (p<0.01). Other variables did not show a significant difference between the genders (p>0.05).

Table 4 presents a comparison of preclinical orthodontic skill scores between the two time points and between the two genders. In female students, a significant increase was observed in the Adams clasp bending scores at T1 (11.33±1.27) compared to T0 (11.08±1.34), while no significant change was found with regard to other scores (p>0.05). In male students, a significant increase was detected in the eyelet clasp bending scores between T1 (3.28±0.56) and T0 (2.71±1.10) (p<0.05), whereas no significant change was found with regard to other scores (p>0.05). On the other hand, no significant change was observed between T0 and T1 with regard to all parameters in the entire population (p>0.05).

Table 4: Year-based comparison of scores

Parameters	Female			Male			Total		
	T0	T1	P	T0	T1	P	T0	T1	P
Vestibular arch	11.66±2.05	10.75±2.60	0.155	9.90±1.70	9.71±2.41	0.857	10.84±2.07	10.26±2.54	0.178
Adams	11.08±1.34	11.33±1.27	**0.045***	10.90±1.33	10.90±1.64	0.502	11.00±1.33	11.13±1.45	0.596
Eyelet	3.12±0.94	3.08±0.77	0.808	2.71±1.10	3.28±0.56	**0.029***	2.93±1.03	3.17±0.68	0.150
Wax modeling	4.58±0.71	4.62±0.82	0.261	4.23±.76	4.38±1.07	0.051	4.42 ± 0.75	4.51±0.94	0.543
Total skill	30.45±3.00	29.79±4.03	0.435	27.76±2.94	28.28±3.71	0.546	29.20±3.24	29.08±3.91	0.854

T0: Fourth-year, T1: Fifth-year, SD: Standard deviation, **: P< 0.05

DISCUSSION

Preclinical training, which is an integral component of dentistry undergraduate education, plays a pivotal role in improving students' manual dexterity. In this training, live demonstration is the most frequently used and researched method.[7] In the present study, long-term effects of this method and gender-based differences were investigated and our null hypothesis was partially accepted.

In this study, the clasp bending and modeling scores (labial arch: 10.84±2.07, Adams clasp: 11.00±1.33) obtained by our fourth-year students who received live demonstration for the first time were higher than those reported by Sivarajan et al. [11] (labial arch: 9.26, Adams clasp: 4.58) and Lau et al. [8]. Additionally, the number of students participating in the live demonstration in this study was remarkably lower, which might have allowed our students to observe the bending and modeling steps easier and at a closer distance to the instructor, and also the students had longer periods for practice when compared to those of other studies. Meaningfully, it has been shown that poor seating arrangement can affect students' learning.[12] Moreover, numerous studies have suggested that learning is maximized when students are seated near the instructor, albeit not always significantly.[13-15]

The results indicated no significant change between T0 and T1 with regard to all parameters in the entire population (p>0.05). This finding could be attributed to the fact that the students submitted their most successful clasp and wax models for final evaluation at the end of the internship (~20 hours) and that they were required to obtain a minimum total score of 60 out of 100 to pass the class, which may have caused them to avoid exerting extra effort in the fifth year.

In the comparison of preclinical orthodontic skill scores between the two time points and between the two genders, the female students in the fourth-year had significant higher total skill and labial arch scores compared to male students. To our knowledge, there has been no study evaluating the skills of undergraduate dental students between the two genders. Some studies examined medical students and, contrary to our findings, reported that male students performed better in acquiring surgical skills, with the biggest differences detected in visuospatial abilities and speed.[16-18] In contrast, some other studies, in a similar way to the teaching technique used in this study, reported that female students acquired surgical skills significantly better when they were adequately trained with one-to-one feedback sessions.[18-21] Labial arch bending is the procedure that requires the most skills and care compared to other bending procedures and also requires 19 criteria to be fulfilled.[10] Literature indicates that adolescent girls have better writing skills than boys.[22, 23] This difference may explain the significantly higher labial arch bending and total skill scores in our female students compared to male students. In addition, this difference, which emerged when students practiced orthodontic bending for the first time in the fourth year, might have been caused by the possible stress experienced by the students during their dentistry education, as emphasized in many studies in the literature.[24-27] Some researchers also reported that female dental students experience significantly greater stress compared to male students.[28-30] Nevertheless, the pressure induced by possible stress is likely to cause female students to work harder and achieve higher scores. In this study, no significant difference was found between the two genders with regard to total skill scores at T1 as well as the change that occurred in these scores between T0 and T1. This finding implicates that the difference between the two genders with regard to orthodontic preclinical laboratory skills disappears in the long term. This hypothesis could be supported by the disappearance of the pressure in the first preclinical experience in the fifth year of education.

Comparison of orthodontic preclinical skill scores between the two time points indicated a significant increase in Adams clasp bending skills in female students compared to male students. The Adams clasp bending procedure ranks the second among the bending procedures that require the most skills, following labial arch bending. In this study, female students improved their Adams clasp bending scores in the long term (T1: 11.33±1.27), which were already remarkably high in fourth year (T0: 11.08±1.34). This finding implicates that women can further improve complex skills in the long term when compared to men. Male students, on the other hand, showed a significant improvement in eyelet clasp bending skills. In these skills, which require relatively few criteria, male students approached the ideal at T1.

This study was limited in several ways. First, due to its retrospective nature, the present study compared the long-term effects of live demonstration on a particular population at a given time period. Accordingly, the long-term effects of this method in other populations can be investigated by comparing it with other methods. In addition, the study focused on the preclinical laboratory skills of university students, which are an integral part of their education and are required for passing the class, and did not examine the effect of factors such as stress. Further prospective studies are needed to explore novel educational methods to be used in the pass/fail grading system with no grading.

Conclusion

The authors of this study found that by using the live demonstration method, the difference between the starting points of both genders disappeared over a long period of time.

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Ethical Approval

Ethics approval was obtained from Adıyaman University Non-Interventional Clinical Research Ethics Committee (Approval No 2021/07-10).

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Conflict of interest

All authors declare that they have no conflict of interest.

Author Contributions

Design: MAY, MNE, NH, Data collection: YSA, MAY, Analysis and interpretation: MAY, NH, Literature review: MNE, MAY, Writing: MNE, MAY.

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Evaluation of Periodontal Awareness of Parents with Periodontitis Regarding their Children's Oral and Dental Health

Eda ÇETİN ÖZDEMİR[1*] Meral UZUNKAYA[2]

[1] Assist. Prof., DDS, PhD, Kahramanmaraş Sütçü İmam University, Faculty of Dentistry, Department of Periodontology, Kahramanmaraş, Türkiye, drcetineda@gmail.com

[2] Assist. Prof., DDS, Kahramanmaraş Sütçü İmam University, Faculty of Dentistry, Department of Periodontology, Kahramanmaraş, Türkiye, uzunkaya_meral@hotmail.com

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ABSTRACT

Aim: Periodontal disease is thought to be seen in adults, children and adolescents can also be affected by this disease. The aim of this study was to evaluate parents with periodontitis in respect of the awareness and knowledge of oral and dental health of their children.
Material and Methods: The study included 183 parents diagnosed with periodontitis. A questionnaire was completed by the parents. The first 7 items were related to sociodemographic data and socioeconomic status, the next 13 items were multiple choice questions to evaluate the periodontal awareness of the parents, and the final section included 8 items for the parents to evaluate the oral hygiene habits of their children.
Results: Only 22.7% of the participants knew that there should be 20 primary teeth and the majority of those who responded correctly had an education level of primary school or middle school. When asked what oral care should be given to infants aged 0-3 years, the vast majority stated that they did not perform any oral care. The parents were seen to have knowledge consistent with scientific data on subjects that are constantly in printed and visual media such as the frequency of changing toothbrushes and the duration of teeth brushing but did not supervise their child when brushing their teeth.
Conclusion: The results of this study showed that there is a clear need to inform individuals with periodontitis about the oral and dental health of their children, and to raise awareness of periodontitis.

Periodontitisli Ebeveynlerin Çocuklarının Ağız ve Diş Sağlığına İlişkin Periodontal Farkındalıklarının Değerlendirilmesi

Makale Bilgisi

Makale Geçmişi

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Anahtar Kelimeler:
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Ebeveyn,
Çocuk.

ÖZET

Amaç: Periodontal hastalığın yetişkinlerde görüldüğü düşünülmekle birlikte, çocuklar ve ergenler de bu hastalıktan etkilenebilmektedir. Bu çalışmanın amacı periodontitisli ebeveynlerin çocuklarının ağız ve diş sağlığı konusundaki farkındalık ve bilgileri açısından değerlendirilmesidir.
Gereç ve Yöntemler: Çalışmaya periodontitis tanısı alan 183 ebeveyn dahil edildi. Ebeveynler tarafından bir anket doldurduldu. İlk 7 madde sosyodemografik veriler ve sosyoekonomik durumla ilgili, sonraki 13 madde ebeveynlerin periodontal farkındalığını değerlendirmeye yönelik çoktan seçmeli sorular, son bölümde ise ebeveynlerin çocuklarının ağız hijyeni alışkanlıklarını değerlendirmeye yönelik 8 madde yer aldı.
Bulgular: Katılımcıların yalnızca %22,7'si 20 adet süt dişi olması gerektiğini biliyordu ve doğru cevap verenlerin çoğunluğu ilkokul veya ortaokul eğitim seviyesine sahipti. 0-3 yaş arası bebeklere hangi ağız bakımının verilmesi gerektiği sorulduğunda büyük çoğunluk herhangi bir ağız bakımı yapmadıklarını belirtti. Ebeveynlerin diş fırçası değiştirme sıklığı, diş fırçalama süresi gibi yazılı ve görsel medyada sürekli yer alan konularda bilimsel verilerle tutarlı bilgiye sahip olduğu ancak çocuğunun dişlerini fırçalarken denetlemediği görüldü.
Sonuç: Bu çalışmanın sonuçları periodontitisli bireylerin çocuklarının ağız ve diş sağlığı konusunda bilgilendirilmesine ve periodontitis konusunda farkındalık yaratılmasına açık bir ihtiyaç olduğunu göstermiştir.

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***Corresponding Author:** Eda ÇETİN ÖZDEMİR, *drcetineda@gmail.com*

INTRODUCTION

Periodontal diseases represent a prevalent health issue worldwide.[1] Although periodontal disease is thought to be seen in adults in the population, it's noteworthy that children and adolescents can also experience this condition.[2,3] Periodontal disease usually forms due to micro-organisms in the dental plaque, and over time when it is not treated, can cause alveolar bone destruction resulting in dental losses. Therefore, with oral hygiene motivation, regular dental check-ups, and a high level of awareness of periodontal disease, the tissue damage caused by periodontal disease can be reduced. It can be considered that the creation of and raising the level of periodontal health awareness in individuals will help to control periodontal disease both in themselves and in their children.[4]

Periodontitis is a disease that causes loss in supporting dental tissues associated with chronic inflammation. Although the primary agent of periodontitis is microbial dental plaque, several factors can affect progression of the disease, such as some systemic diseases, hormonal changes, and smoking.[5] Previous studies have shown that individuals with periodontal disorders have low levels of awareness and knowledge about periodontal disease.[6-9] In addition to it being difficult for an individual with insufficient knowledge and awareness to maintain their own periodontal health, it may also cause them not to show sufficient attention to the oral hygiene practices of their children.

There are studies in literature showing that parents have insufficient knowledge of the oral health of their children and do not give enough importance to their oral health status.[10,11] However, there is very little information about the awareness and knowledge of parents on the subject of periodontal health. Only one study could be found that has investigated this relationship and as of the current literature, no research has been conducted to assess the awareness and knowledge of parents with periodontitis regarding the oral and dental health of their children. We think that our study can contribute to the literature by examining the knowledge and attitudes of parents who do not adequately implement their own oral hygiene practices regarding their children's oral and dental health. Therefore, the objective of this study was to assess the understanding and behaviors concerning the periodontal health of parents, examining the correlation with the oral health practices of their children. The study hypothesized that individuals with periodontitis would exhibit limited awareness and negative attitudes toward the periodontal well-being of their children, leading to a lack of emphasis on oral health practices.

MATERIALS AND METHODS

This cross-sectional study included patients who presented and were diagnosed with periodontitis in the Periodontology Department of the Dental Faculty of Kahramanmaraş Sütçü İmam University between April 2021 and June 2022. The study received approval from the Non-Interventional Clinical Research Ethics Committee of Kahramanmaraş Sütçü İmam University, indicated by decision number 10/2021711, dated March 22, 2021. All protocols adhered to the principles outlined in the Helsinki Declaration. Additionally, all participants in the study provided signed informed consent. All the patients who were planned to be included in the study underwent a clinical periodontal evaluation and radiographic examination. The classification of periodontitis in this study adhered to the guidelines outlined in the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. The patients included to the study with interdental clinical attachment loss of ≥2 mm in at least 2 non-adjacent teeth, buccal or lingual probing depth ≥3 mm in 2 or more teeth, and clinical attachment loss ≥3 mm.[12] The study included 183 parents diagnosed with periodontitis who had a child age 3-12 years.

A questionnaire was completed by the parents. The first 7 items were related to

sociodemographic data and socioeconomic status, including age, gender, education level, monthly income, occupation, and number of children in the family. The next 13 items on the questionnaire were multiple choice questions to evaluate the periodontal awareness of the parents, and the final section included 8 items for the parents to evaluate the oral hygiene habits of their children. While preparing the survey questions, studies in the literature evaluating parents' oral health awareness and articles related to periodontal awareness were used.[6,13,14] The questionnaire items are shown in Table 1.

Table1. Survey questions

Question No.	Question	Category
1	How many primary teeth are there in the mouth?	12
		16
		20
		32
2	What is the ideal length of time to brush the teeth?	A few seconds
		1 minute
		2 minutes
		3 minutes
3	How often do you change your child's toothbrush?	Once a month
		Once every 3 months
		Once a year
		There is no need to change it
4	What is the most appropriate age for your child's first dental examination?	At birth
		6 months -1 year
		After the age of 6 years
		When in pain
5	What is dental plaque?	Soft accumulation
		Hard accumulation
		I don't know
		Discolouration of the teeth
6	What is calculus?	Soft accumulation
		Hard accumulation
		I don't know
		Discolouration of the teeth
7	Why is it important to have fluoride added to toothpaste?	To prevent decay
		To whiten the teeth
		To clean the mouth
		I don't know
8	In what way do you think plaque most affects oral health?	It causes gum disease
		It causes bad breath
		It causes discolouration
		I don't know
9	Do milk tooth problems have an effect on permanent teeth?	Yes
		No
		I don't know
10	Do you think that the oral health of your child is affected by their general health?	Yes
		No
		I don't know
11	How many times a day do you brush your child's teeth?	Once a day
		Twice a day
		Three times a day
		I don't brush
12	Did you apply oral care to your infant at the time when primary teeth were emerging (0-3 years)?	I wipe the mouth with gauze
		I brush the teeth
		I wipe the mouth with a cloth
		I don't do anything
13	Has your child been given information about why teeth brushing is necessary?	At school
		During a previous visit to a dentist
		We have explained at home
		No information has been given

	Yes	No
1. Did your child brush their teeth under your supervision when aged 0-6 years?		
2. Does your child use a toothbrush when cleaning their teeth?		
3. Does your child use toothpaste when cleaning their teeth?		
4. Do you use dental floss when cleaning your child's teeth?		
5. Do you know the correct technique for brushing the teeeth?		
6. Does your child suck their thumb?		
7. Do you regularly examine inside the mouth of your child?		
8. Has a paediatric doctor to whom you have taken your child referred you to a dentist for oral and dental health examination?		

Statistical analysis

Jamovi (Version 2.2.5) software was used for statistical analysis. Descriptive analysis of demographic attributes of the involved population was presented. The relationship between demographic features and responses was tested via the chi-square test. The probability level for statistical significance was set at $p = 0.05$.

Power Analysis

The sample size was determined utilizing the Raosoft web survey software (http://www.raosoft.com/samplesize.html). To achieve an 80% confidence interval, a 5% alpha error, a 50% response distribution rate, and considering a population size of 150,000, a total of 165 participants were deemed necessary for the study.

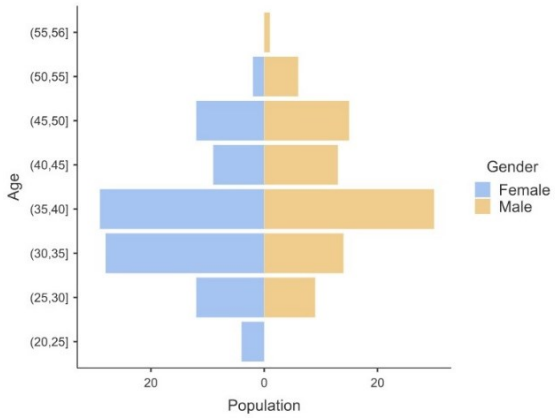

Figure 1. Age-Gender graph of the participants

RESULTS

The 183 parents included in the study comprised 95 females and 88 males, with the majority in the 35-40 years age range. The age and gender of the participants are shown in Figure 1. In the examination of education levels, the largest group (32%) was formed of those with a primary school level. The income level of most (42%) participants ranged between 3000 TL (Turkish lira) and 5000TL. A higher rate (34%) of the participants worked in the private sector and most (40%) had 2 children. The demographic data of the study participants are demonstrated within Table 2.

Table 2. Demographic features of the included population

Characteristic	**n =183**
Age range	
<39	103 (56%)
>38	80 (44%)
Gender	
Female	95 (52%)
Male	88 (48%)
Education	
Elementary school	58 (32%)
Secondary school	47 (26%)
Highschool	42 (23%)
University	36 (20%)
Income	
<3000	29 (16%)
3000-5000	76 (42%)
5000-10000	59 (32%)
>10000	19 (10%)
Profession	
Government official	51 (28%)
Special worker	63 (34%)
Own business	23 (13%)
Unemployed	46 (25%)
Number of children	
1	18 (9.8%)
2	73 (40%)
3	59 (32%)
4	33 (18%)

n (%)

Table 3. Knowledge and attitudes toward periodontal health among parents according to demographic variables

	Age range			Gender			Education					
	<39 (n=103)	**>38 (n=78)**	**p value**	**Female (n=96)**	**Male (n=85)**	**p value**	**Elementary school (n=58)**	**Secondary school (n=46)**	**Highschool (n=42)**	**University (n=35)**	**p value**	**Total (n=181)**
Question (1)			0.309			0.548					0.045*	
1	38 (36.9%)	31 (39.7%)		37 (38.5%)	32 (37.6%)		29 (50%)	21 (45.7%)	8 (19%)	11 (31.4%)		69 (38.1%)
2	38 (36.9%)	28 (35.9%)		31 (32.3%)	35 (41.2%)		17 (29.3%)	11 (23.9%)	21 (50%)	17 (48.6%)		66 (36.5%)
3	26 (25.2%)	15 (19.2%)		25 (26%)	16 (18.8%)		12 (20.7%)	12 (26.1%)	11 (26.2%)	6 (17.1%)		41 (22.7%)
4	1 (1%)	4 (5.1%)		3 (3.1%)	2 (2.4%)		0 (0%)	2 (4.3%)	2 (4.8%)	1 (2.9%)		5 (2.8%)
Question (2)			0.005*			0.112					0.308	
1	3 (2.9%)	10 (12.8%)		11 (11.5%)	2 (2.4%)		7 (12.1%)	2 (4.3%)	4 (9.5%)	0 (0%)		13 (7.2%)
2	31 (30.1%)	16 (20.5%)		25 (26%)	22 (25.9%)		17 (29.3%)	10 (21.7%)	10 (23.8%)	10 (28.6%)		47 (26%)
3	53 (51.5%)	30 (38.5%)		40 (41.7%)	43 (50.6%)		26 (44.8%)	22 (47.8%)	16 (38.1%)	19 (54.3%)		83 (45.9%)
4	16 (15.5%)	22 (28.2%)		20 (20.8%)	18 (21.2%)		8 (13.8%)	12 (26.1%)	12 (28.6%)	6 (17.1%)		38 (21%)
Question (3)			0.308			0.179					0.245	
1	30 (29.1%)	14 (17.9%)		26 (27.1%)	18 (21.2%)		17 (29.3%)	15 (32.6%)	7 (16.7%)	5 (14.3%)		44 (24.3%)
2	59 (57.3%)	52 (66.7%)		56 (58.3%)	55 (64.7%)		31 (53.4%)	28 (60.9%)	30 (71.4%)	22 (62.9%)		111 (61.3%)
3	13 (12.6%)	10 (12.8%)		14 (14.6%)	9 (10.6%)		8 (13.8%)	3 (6.5%)	5 (11.9%)	7 (20%)		23 (12.7%)
4	1 (1%)	2 (2.6%)		0 (0%)	3 (3.5%)		2 (3.4%)	0 (0%)	0 (0%)	1 (2.9%)		3 (1.7%)
Question (4)			0.920			0.747					0.210	
1	5 (4.9%)	4 (5.1%)		6 (6.2%)	3 (3.5%)		1 (1.7%)	2 (4.3%)	3 (7.1%)	3 (8.6%)		9 (5%)
2	28 (27.2%)	21 (26.9%)		24 (25%)	25 (29.4%)		15 (25.9%)	11 (23.9%)	8 (19%)	15 (42.9%)		49 (27.1%)
3	59 (57.3%)	47 (60.3%)		56 (58.3%)	50 (58.8%)		34 (58.6%)	28 (60.9%)	29 (69%)	15 (42.9%)		106 (58.6%)
4	11 (10.7%)	6 (7.7%)		10 (10.4%)	7 (8.2%)		8 (13.8%)	5 (10.9%)	2 (4.8%)	2 (5.7%)		17 (9.4%)
Question (5)			0.214			0.193					0.027*	
1	11 (10.7%)	10 (12.8%)		9 (9.4%)	12 (14.1%)		8 (13.8%)	3 (6.5%)	2 (4.8%)	8 (22.9%)		21 (11.6%)
2	58 (56.3%)	43 (55.1%)		55 (57.3%)	46 (54.1%)		23 (39.7%)	28 (60.9%)	29 (69%)	21 (60%)		101 (55.8%)
3	34 (33%)	22 (28.2%)		32 (33.3%)	24 (28.2%)		25 (43.1%)	14 (30.4%)	11 (26.2%)	6 (17.1%)		56 (30.9%)
4	0 (0%)	3 (3.8%)		0 (0%)	3 (3.5%)		2 (3.4%)	1 (2.2%)	0 (0%)	0 (0%)		3 (1.7%)
Question (6)			0.454			0.358					0.908	
1	15 (14.6%)	10 (12.8%)		17 (17.7%)	8 (9.4%)		9 (15.5%)	6 (13%)	7 (16.7%)	3 (8.6%)		25 (13.8%)
2	68 (66%)	56 (71.8%)		62 (64.6%)	62 (72.9%)		39 (67.2%)	29 (63%)	30 (71.4%)	26 (74.3%)		124 (68.5%)
3	17 (16.5%)	12 (15.4%)		16 (16.7%)	13 (15.3%)		9 (15.5%)	10 (21.7%)	5 (11.9%)	5 (14.3%)		29 (16%)
4	3 (2.9%)	0 (0%)		1 (1%)	2 (2.4%)		1 (1.7%)	1 (2.2%)	0 (0%)	1 (2.9%)		3 (1.7%)
Question (7)			0.942			0.760					0.070	
1	53 (51.5%)	38 (48.7%)		51 (53.1%)	40 (47.1%)		27 (46.6%)	24 (52.2%)	18 (42.9%)	22 (62.9%)		91 (50.3%)
2	20 (19.4%)	18 (23.1%)		18 (18.8%)	20 (23.5%)		10 (17.2%)	7 (15.2%)	13 (31%)	8 (22.9%)		38 (21%)
3	24 (23.3%)	18 (23.1%)		21 (21.9%)	21 (24.7%)		19 (32.8%)	9 (19.6%)	9 (21.4%)	5 (14.3%)		42 (23.2%)
4	6 (5.8%)	4 (5.1%)		6 (6.2%)	4 (4.7%)		2 (3.4%)	6 (13%)	2 (4.8%)	0 (0%)		10 (5.5%)
Question (8)			0.094			0.925					0.347	
1	58 (56.3%)	40 (51.3%)		51 (53.1%)	47 (55.3%)		26 (44.8%)	26 (56.5%)	23 (54.8%)	23 (65.7%)		98 (54.1%)
2	9 (8.7%)	17 (21.8%)		15 (15.6%)	11 (12.9%)		11 (19%)	6 (13%)	3 (7.1%)	6 (17.1%)		26 (14.4%)
3	16 (15.5%)	9 (11.5%)		14 (14.6%)	11 (12.9%)		9 (15.5%)	4 (8.7%)	8 (19%)	4 (11.4%)		25 (13.8%)
4	20 (19.4%)	12 (15.4%)		16 (16.7%)	16 (18.8%)		12 (20.7%)	10 (21.7%)	8 (19%)	2 (5.7%)		32 (17.7%)
Question (9)			0.840			0.048*					0.004*	

1	48 (46.6%)	36 (46.2%)	45 (46.9%)	39 (45.9%)	30 (51.7%)	19 (41.3%)	14 (33.3%)	21 (60%)	84 (46.4%)
2	21 (20.4%)	14 (17.9%)	25 (26%)	10 (11.8%)	17 (29.3%)	9 (19.6%)	5 (11.9%)	4 (11.4%)	35 (19.3%)
3	33 (32%)	26 (33.3%)	25 (26%)	34 (40%)	9 (15.5%)	18 (39.1%)	23 (54.8%)	9 (25.7%)	59 (32.6%)
4	1 (1%)	2 (2.6%)	1 (1%)	2 (2.4%)	2 (3.4%)	0 (0%)	0 (0%)	1 (2.9%)	3 (1.7%)
Question (10)		0.133		0.469				0.174	
1	66 (64.1%)	45 (57.7%)	57 (59.4%)	54 (63.5%)	31 (53.4%)	31 (67.4%)	27 (64.3%)	22 (62.9%)	111 (61.3%)
2	22 (21.4%)	17 (21.8%)	24 (25%)	15 (17.6%)	15 (25.9%)	6 (13%)	9 (21.4%)	9 (25.7%)	39 (21.5%)
3	15 (14.6%)	12 (15.4%)	14 (14.6%)	13 (15.3%)	8 (13.8%)	9 (19.6%)	6 (14.3%)	4 (11.4%)	27 (14.9%)
4	0 (0%)	4 (5.1%)	1 (1%)	3 (3.5%)	4 (6.9%)	0 (0%)	0 (0%)	0 (0%)	4 (2.2%)
Question (11)		0.204		0.525				0.595	
1	41 (39.8%)	23 (29.5%)	32 (33.3%)	32 (37.6%)	20 (34.5%)	12 (26.1%)	16 (38.1%)	16 (45.7%)	64 (35.4%)
2	33 (32%)	32 (41%)	36 (37.5%)	29 (34.1%)	21 (36.2%)	20 (43.5%)	15 (35.7%)	9 (25.7%)	65 (35.9%)
3	26 (25.2%)	17 (21.8%)	25 (26%)	18 (21.2%)	12 (20.7%)	13 (28.3%)	9 (21.4%)	9 (25.7%)	43 (23.8%)
4	3 (2.9%)	6 (7.7%)	3 (3.1%)	6 (7.1%)	5 (8.6%)	1 (2.2%)	2 (4.8%)	1 (2.9%)	9 (5%)
Question (12)		0.063		0.531				0.080	
1	11 (10.7%)	17 (21.8%)	12 (12.5%)	16 (18.8%)	8 (13.8%)	8 (17.4%)	4 (9.5%)	8 (22.9%)	28 (15.5%)
2	35 (34%)	15 (19.2%)	25 (26%)	25 (29.4%)	11 (19%)	11 (23.9%)	12 (28.6%)	16 (45.7%)	50 (27.6%)
3	55 (53.4%)	45 (57.7%)	57 (59.4%)	43 (50.6%)	38 (65.5%)	27 (58.7%)	25 (59.5%)	10 (28.6%)	100 (55.2%)
4	2 (1.9%)	1 (1.3%)	2 (2.1%)	1 (1.2%)	1 (1.7%)	0 (0%)	1 (2.4%)	1 (2.9%)	3 (1.7%)
Question (13)		0.252		0.392				0.282	
1	22 (21.4%)	17 (21.8%)	22 (22.9%)	17 (20%)	14 (24.1%)	9 (19.6%)	8 (19%)	8 (22.9%)	39 (21.5%)
2	40 (38.8%)	39 (50%)	46 (47.9%)	33 (38.8%)	25 (43.1%)	23 (50%)	18 (42.9%)	13 (37.1%)	79 (43.6%)
3	36 (35%)	17 (21.8%)	24 (25%)	29 (34.1%)	19 (32.8%)	9 (19.6%)	12 (28.6%)	13 (37.1%)	53 (29.3%)
4	5 (4.9%)	5 (6.4%)	4 (4.2%)	6 (7.1%)	0 (0%)	5 (10.9%)	4 (9.5%)	1 (2.9%)	10 (5.5%)

* indicates significance

Table 4. Oral hygiene habits of children according to demographic variables

	Age range			**Gender**			**Education**					
	<39 (n=103)	**>38 (n=80)**	**p value**	**Female (n=95)**	**Male (n=88)**	**p value**	**Elementary school (n=58)**	**Secondary school (n=48)**	**Highschool (n=41)**	**University (n=36)**	**p value**	**Total (n=183)**
Question (14)			0.479			0.708					0.987	
1	40 (38.8%)	27 (33.8%)		36 (37.9%)	31 (35.2%)		21 (36.2%)	17 (35.4%)	16 (39%)	13 (36.1%)		67 (36.6%)
2	63 (61.2%)	53 (66.2%)		59 (62.1%)	57 (64.8%)		37 (63.8%)	31 (64.6%)	25 (61%)	23 (63.9%)		116 (63.4%)
Question (15)			0.663			0.805					0.596	
1	85 (82.5%)	64 (80%)		78 (82.1%)	71 (80.7%)		48 (82.8%)	36 (75%)	35 (85.4%)	30 (83.3%)		149 (81.4%)
2	18 (17.5%)	16 (20%)		17 (17.9%)	17 (19.3%)		10 (17.2%)	12 (25%)	6 (14.6%)	6 (16.7%)		34 (18.6%)
Question (16)			0.623			0.347					0.901	
1	73 (70.9%)	54 (67.5%)		63 (66.3%)	64 (72.7%)		42 (72.4%)	32 (66.7%)	29 (70.7%)	24 (66.7%)		127 (69.4%)
2	30 (29.1%)	26 (32.5%)		32 (33.7%)	24 (27.3%)		16 (27.6%)	16 (33.3%)	12 (29.3%)	12 (33.3%)		56 (30.6%)
Question (17)			0.572			0.332					0.707	
1	37 (35.9%)	32 (40%)		39 (41.1%)	30 (34.1%)		19 (32.8%)	21 (43.8%)	15 (36.6%)	14 (38.9%)		69 (37.7%)
2	66 (64.1%)	48 (60%)		56 (58.9%)	58 (65.9%)		39 (67.2%)	27 (56.2%)	26 (63.4%)	22 (61.1%)		114 (62.3%)
Question (18)			0.031*			0.822					0.524	
1	44 (42.7%)	47 (58.8%)		48 (50.5%)	43 (48.9%)		27 (46.6%)	27 (56.2%)	22 (53.7%)	15 (41.7%)		91 (49.7%)

2	59 (57.3%)	33 (41.2%)	47 (49.5%)	45 (51.1%)	31 (53.4%)	21 (43.8%)	19 (46.3%)	21 (58.3%)	92 (50.3%)
Question (19)		0.305		0.788				0.702	
1	37 (35.9%)	23 (28.8%)	32 (33.7%)	28 (31.8%)	22 (37.9%)	15 (31.2%)	11 (26.8%)	12 (33.3%)	60 (32.8%)
2	66 (64.1%)	57 (71.2%)	63 (66.3%)	60 (68.2%)	36 (62.1%)	33 (68.8%)	30 (73.2%)	24 (66.7%)	123 (67.2%)
Question (20)		0.758		0.026*				0.058	
1	59 (57.3%)	44 (55%)	46 (48.4%)	57 (64.8%)	32 (55.2%)	28 (58.3%)	17 (41.5%)	26 (72.2%)	103 (56.3%)
2	44 (42.7%)	36 (45%)	49 (51.6%)	31 (35.2%)	26 (44.8%)	20 (41.7%)	24 (58.5%)	10 (27.8%)	80 (43.7%)
Question (21)		0.350		0.879				0.102	
1	47 (45.6%)	31 (38.8%)	41 (43.2%)	37 (42%)	23 (39.7%)	23 (47.9%)	12 (29.3%)	20 (55.6%)	78 (42.6%)
2	56 (54.4%)	49 (61.2%)	54 (56.8%)	51 (58%)	35 (60.3%)	25 (52.1%)	29 (70.7%)	16 (44.4%)	105 (57.4%)

When asked how many primary teeth there should be in the mouth, the majority of the participants thought there should be a total of 12. Only 22.7% of the participants knew that there should be 20 primary teeth and the majority of those who responded correctly had an education level of primary school or middle school (%46.7). The majority of the participants stated that 2 minutes was the ideal duration of tooth brushing (%45.9), a toothbrush should be renewed within 3 months (%61.3), and the child should be taken for their first dental examination after the age of 6 years (58.6%).

Only 11.6% of the parents gave a correct response to the question of "what is plaque?" and the vast majority (68.5%) knew that calculus was a hard accumulation on the tooth surface. Although most participants did not know what dental plaque is, the majority (54%) knew that dental plaque occurs gum disease. Of the total participants, 46% thought that the primary teeth affected the permanent teeth, and the majority (% 61.3) thought that general health was affected by oral health. When asked how they applied oral care to infants aged 0-3 years, the vast majority stated that they did not perform any oral care. The rate of this response from university graduates was lower than from the other education level groups. It was stated by a high rate of participants that education about tooth brushing had been given on previous visits to the dentist (%43.6) (Table 3).

The parents reported that the children did not brush their teeth by themselves (%63.4). The majority of participants stated that although they used a toothbrush and toothpaste, they did not use dental floss when applying oral care (%62.3). Approximately half of the parents stated that they regularly checked inside the child's mouth (% 56.3), and the majority of those were university graduates (%72.2). A negative response was given by the majority of parents to the question of "Has a paediatric doctor to whom you have taken your child referred you to a dentist for oral and dental health examination?" (%57.4) (Table 4).

DISCUSSION

Oral and dental health is one of the most important factors affecting the quality of life of individuals. Maintaining periodontal health involves crucial components such as practicing oral hygiene through tooth brushing and the use of dental floss.[15] The first factor in gaining awareness related to the oral and dental health of children is the parents as the primary caregivers. The knowledge and attitudes of parents related to periodontal health affect the level of adequacy of the oral hygiene habits of children.[16] Only one study could be found in the literature that has assessed the periodontal awareness of parents,[14] and the current study is the first to have evaluated the knowledge and awareness of parents diagnosed with periodontitis of the oral and dental health of their children.

The primary etiological factor of periodontal disease is microbial dental plaque. Using oral care tools, dental plaque can be removed from the tooth surface. In individuals with insufficient oral hygiene, when gingival inflammation that has formed is not treated it causes loss of the tooth supporting tissues and can become periodontitis.[17] It is inevitable that the primary influences are from the family when care habits related to oral and dental health are formed in children. Therefore, it can be expected that parents who do not pay enough attention to their own oral care will have low awareness of the oral and dental health of their children.[14] For children to be able to acquire correct oral care practice habits, it can be considered that maintaining high awareness of both the children and their families will also contribute to the oral and dental health of society.

Only 22.7% of the parents in the current study knew that there should be 20 primary teeth in the mouth. In a study by Nagaveni et al., it was reported that 18% of the participants thought that primary teeth were important,[18] and Narayanan et al., found this rate to be 83%.[19]

That there are different results in literature can be attributed to the differences in study populations.

The ideal duration for tooth brushing has been recommended as 2 mins by the American Dental Association.[20] The rate of respondents who thought 2 mins was the ideal tooth brushing time was determined to be 48.9% in the current study, 28.1% in the study by Hamasha et al.,[13] and 56% in the study bu Anusha et al.[21] When questioned about the frequency of replacing toothbrushes, the majority of parents stated that they thought it should be once every 3 months, which was consistent with the literature.[13,19,21] The majority of the parents in the current study thought that the first visit of a child to a dentist should be at the age of 6 years, which was seen to be similar to the results of other studies.[22]

When parents were asked what dental plaque and calculus were, the vast majority responded to both questions that they were hard accumulations on teeth. It was seen that the parents thought dental plaque and calculus were the same term. When the literature was examined, the rate of correct response to the question of "what is dental plaque?" was observed to be low in previous studies.[23-25] Although the majority of the current study participants knew that dental plaque caused gum disease, the results suggested that basic periodontal terms were foreign to these parents and they did not know the definitions.

Oral health is one of the components of systemic health. Periodontal diseases have been stated to be associated with some systemic diseases such as rheumatoid arthritis, diabetes and cardiac diseases.[26-28] Previous studies have shown a low awareness in the general population of the link between oral health and systemic health.[28,29] In contrast to the data in literature, the majority of the parents in the current study thought that systemic health was affected by oral health. It was thought that developments in technology and increased education levels could have been the reasons for increased awareness on the subject of this relationship.

While a very small proportion of the participants in this study stated that they cleaned the primary teeth between the ages of 0 and 3 years with gauze or a similar dental cloth, 55.2% stated that they applied no oral care to the primary teeth in this period. It was therefore observed that the participants did not make sufficient application on the subject of the need for oral care in the period when primary teeth are erupting. From an examination of literature, no study could be found that examined the awareness of parents about the tools and the need for oral care in the period of infancy from birth to 3 years. However, there are studies reporting the need for teeth cleaning in the early stages of tooth eruption.[30,31] Galganny-Almeida et al. reported that the formation of dental plaque was significantly reduced by cleaning teeth with an infant tooth cleaning cloth in the 8-15-month milk tooth eruption period.[32] Correa et al. evaluated toothbrush, tooth cloth, and gauze in respect of which was the more appropriate oral tool in the 8-15-month period. Although it was concluded that the use of all three significantly reduced the formation of biofilm, it was reported that mothers and infant carers preferred a tooth cloth for oral cleaning.[33]

The vast majority of the participants in the current study reported that education about correct tooth brushing had been given to the child by dentists during a previous visit to a dentist. The need to start oral care practices at an early age, and parents being informed about correct oral care practices are of great importance in respect of preventative dentistry.

It was reported by the majority of participants that the children aged 0-6 years did not brush their teeth under the supervision of the parents. In the study by Narayanan, the vast majority of parents thought it was necessary to supervise tooth brushing between the ages of 0 and 6 years.[19] In a study by Monahar et al., it was reported that the majority of parents did not supervise their children while brushing their teeth.[22] When it is considered that children of

this age do not have sufficient manual skills and may not undertake sufficient oral care when brushing their teeth by themselves, it is recommended that parents supervise teeth brushing.[34]

Conclusion

The findings of this study represent the awareness of a small population of parents with peridontitis about the oral and dental health of their children. The results showed a low level of periodontal awareness of these parents. Not only in this study group, but in society in general, there are low levels of awareness on subjects such as the need to supervise children up to the age of 6 years when they are brushing their teeth.[33] It can be considered that it would be beneficial to increase preventative dentistry practices and make parents more aware of oral health and periodontal diseases. One of the limitations of the study is that the age groups of the participants were not balanced. The other limitation of this study was that as the periodontal data of the patients diagnosed with periodontitis were not recorded, it was not possible to evaluate the correlation between disease severity and periodontal awareness. In future comprehensive studies, questions such as the presence of mouth breathing, which can affect the general periodontal health of children, whether the child has bad habits and malpositions, and whether the parent has tooth brushing habits and oral hygiene knowledge can be added.

Ethical Approval

The ethical approval for this study was received from the Kahramanmaraş Sütçü İmam University Non-Interventional Clinical Research Ethics Commitee (decision number 10/2021/11).

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

Author Contributions

Methodology: EÇÖ, MU. Data curation: EÇÖ. Formal analysis: EÇÖ, MU. Investigation: EÇÖ, MU. Writing-original draft: EÇÖ. Writing-rewiew&editing: EÇÖ, MU.

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The Relationship Between Moral Sensitivities and Ethical Decisions of Dentistry Faculty Students

Merve ABAKLI İNCİ[1] Yasemin Derya FİDANCIOĞLU[2] Hazal ÖZER[3*]

[1] Assoc. Prof, Necmettin Erbakan University, Faculty of Dentistry, Department of Pediatric Dentistry, Konya, Türkiye, merveabakli@gmail.com

[2] Lecturer, Dr., Necmettin Erbakan University, Faculty of Dentistry, Department of Pediatric Dentistry, Konya, Türkiye, yaseminfidancioglu@gmail.com

[2] Assist. Prof, Necmettin Erbakan University, Faculty of Dentistry, Department of Pediatric Dentistry, Konya, Türkiye, hazal0713ozer@gmail.com

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ABSTRACT

Aim: This study examines dental faculty students' ethical sensitivity and attitudes toward ethical decision-making in healthcare. Despite frequent ethical dilemmas among dentists, there's limited research on dental students' experiences. This study aims to fill this gap by assessing dental students' ethical sensitivity.
Methods: Conducted between June and July 2021 with 436 voluntary participants from 1st to 5th grade students at a Faculty of Dentistry. Data were collected using a sociodemographic form and "Moral Sensitivity Questionnaire" (MSQ), 30-item tool with six sub-dimensions: autonomy, benefit, holistic approach, conflict, implementation, and orientation. Reliability analysis used Cronbach's Alpha, statistical analyses were performed.
Results: Study found that 61.9% of participants were women, with an average age of 21.64 years. The overall reliability value of the MSQ scale was 0.920. The highest agreement among survey items was with "I often experience contradictions about how to approach the patient" (4.49±1.69). Significant differences were found in autonomy and application sub-dimensions based on students' grade levels (p=0.002). There was no significant gender difference in moral sensitivity (p>0.05), and no significant correlation was found between age and moral sensitivity.
Conclusion: Findings highlight the importance of developing and protecting dental students' moral and ethical sensitivities for their professional success and public health. They underscore the need for enhanced ethics education in dental curricula and stronger hospital ethics committees to support healthcare professionals in ethical decision-making. This research offers valuable insights into the ethical challenges faced by dental students and emphasizes the necessity for further studies in this area.

Diş Hekimliği Fakültesi Öğrencilerinin Ahlaki Duyarlılıkları ile Etik Kararlar Konusundaki Tutumlarının İlişkisi

Makale Bilgisi

Makale Geçmişi

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ÖZET

Amaç: Bu çalışma, diş hekimliği fakültesi öğrencilerinin ahlaki duyarlılıklarını ve sağlık hizmeti sunumu sırasında etik karar verme konusundaki tutumlarını incelemektedir. Diş hekimleri arasında sıkça karşılaşılan etik ikilemler olmasına rağmen, diş hekimliği öğrencilerinin deneyimlerine yönelik araştırmalar yetersizdir. Çalışmamız, diş hekimliği öğrencilerinin etik duyarlılıklarını değerlendirerek bu boşluğu doldurmayı amaçlamaktadır.
Gereç ve Yöntem: Araştırma Haziran-Temmuz 2021 tarihleri arasında gerçekleştirilmiştir. Araştırma, Diş Hekimliği Fakültesi'nde 1. ve 5. sınıf öğrencileri arasından gönüllü olarak katılan 436 öğrenciyi içermektedir. Veriler, sosyodemografik bilgi formu ve "Ahlaki Duyarlılık Anketi" (ADA) kullanılarak toplanmıştır. Anket; otonomi, yarar, bütüncül yaklaşım, çatışma, uygulama ve yönelim olmak üzere altı alt boyuta sahip 30 maddeden oluşmaktadır. Güvenilirlik analizi Cronbach's Alpha kullanılarak yapılmış ve istatistiksel analizler gerçekleştirilmiştir.
Bulgular: Katılımcıların %61,9'u kadındı ve ortalama yaş 21,64 idi. ADA ölçeğinin genel güvenilirlik değeri 0,920 olarak belirlenmiştir. Anket maddeleri arasında en yüksek katılım "Hasta yaklaşımı konusunda sık sık çelişkiler yaşıyorum" (4,49±1,69) olmuştur. Öğrencilerin sınıf düzeylerine göre otonomi ve uygulama alt boyutları değerlendirmelerinde anlamlı farklılıklar bulunmuştur (p=0,002). Cinsiyetler arasında ahlaki duyarlılık açısından anlamlı fark bulunmamış (p>0,05) ve yaş ile ahlaki duyarlılık arasında anlamlı korelasyon tespit edilmemiştir.
Sonuçlar: Çalışmanın bulguları, diş hekimliği öğrencilerinin mesleki başarıları ve halk sağlığı için etik duyarlılıklarının geliştirilmesinin önemli olduğunu vurgulamaktadır. Ayrıca, diş hekimliği müfredatında etik eğitiminin artırılması gerektiğini belirtmektedir. Araştırma, sağlık hizmeti sunumunda etik karar verme süreçlerini desteklemek için daha güçlü hastane etik komitelerine ihtiyaç olduğunu göstermektedir. Bu araştırma, diş hekimliği öğrencilerinin karşılaştıkları etik zorluklara dair önemli bilgiler sunmakta ve bu alanda daha fazla çalışma yapılması gerektiğini ortaya koymaktadır.

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***Corresponding Author:** Hazal ÖZER, *hazal0713ozer@gmail.com*

INTRODUCTION

Ethics is a branch of science that investigates the underlying values and judgments of moral attitudes, examining the reasons behind all human behaviors. [1-6] Ethical values are universal behavioral rules that determine what types of actions, intentions, and motives are valued, providing a practical basis. When considered as a whole, ethical values can be said to constitute a set of moral principles that govern how an individual or group should or should not behave. The focus is on the rightness and wrongness of actions, encompassing the decision-making process aimed at determining the ultimate outcomes of these actions.[7,8]

Professional ethics, on the other hand, can be defined as the total of ethical principles that guide and direct behaviors in a specific field of activity. Professional ethics, known as the entirety of rules that a particular professional group applies while practicing their profession or feels obliged to adhere to, aims to reveal the rights and wrongs in professional activities. Health institutions are among the institutions where professional ethical dilemmas are most commonly encountered.[9]

In today's healthcare provision, healthcare professionals experience ethical dilemmas in all service areas. Ethical dilemmas and conflicts related to informed consent, decision-making responsibility, equal distribution of resources, violation of principles of providing benefit or avoiding harm are the most commonly encountered issues. Although there are not many publications on the ethical dilemmas faced by dentists in the literature, there are no publications on dental students. However, dentists frequently experience ethical dilemmas regarding the provision of adequate service, fulfilling the correct indication, availability of sufficient treatment materials, establishment of appropriate patient-doctor relationship, and lack of informed consent. The increasing misinformation in healthcare, bias towards violence, and decreasing respect and importance towards healthcare professionals enhance the significance of ethical decision-making during service delivery. This study aims to examine the ethical sensitivity and attitudes of dental faculty students towards ethical decisions during the provision of healthcare services.[3]

MATERIALS AND METHODS

The research was conducted with the approval of Necmettin Erbakan University Dentistry Non-Drug and Non-Medical Device Research Ethics Committee (2021/06-69). This descriptive and cross-sectional research was conducted with 1st, 2nd, 3rd, 4th and 5th grade students of xx Dentistry. The study was conducted between June and July 2021 with 436 students who voluntarily agreed to participate in the research. The data of the research were obtained using the sociodemographic data form and the "Moral Sensitivity Questionnaire" consisting of 30 items.

Moral Sensitivity Questionnaire (MSQ): This questionnaire, which was developed by Kim Lutzen in 1994 in order to measure the ethical sensitivity of nurses, was adapted into Turkish by Hale Tosun.[2,3] The questionnaire, which consists of 30 items, has a total of 6 sub-dimensions: autonomy, benefit, holistic approach, conflict, implementation and orientation. Three items (items 3, 23, 26) were not included under any dimension. In the questionnaire where Likert type scoring is made between 1 and 7; “1 point” indicates high sensitivity towards completely agreeing, “7 points” indicates low sensitivity towards completely disagreeing. The lowest score that can be obtained from

the scale is 30 and the highest score is 210. A low score indicates high ethical sensitivity, and a high score indicates low sensitivity.[4]

Statistical Analysis: IBM SPSS v 22.0 (SPSS Inc. Chicago, IL, USA) package program was used within the scope of the research. Frequency analysis was used to analyze the demographic information of the participants. Within the scope of the study, reliability analyzes were carried out before the moral sensitivity scale was included in the analysis. Based on the results obtained, new variables were created based on the averages of the items in the scales. To test the relationship between the new variables created and demographic variables, Independent Sample t-test, One-Way Anova test and pearson Correlation analysis was applied. Within the scope of the study, the information of 436 participants was evaluated. The significance level was determined as p = 0.05.

RESULTS

Within the scope of the study, data of 436 dentistry faculty students were collected. When demographic data is evaluated, 61.9% of the participants in the study are female. The average age of the participants is 21.64, the lowest age is 18 and the highest age is 30. Considering the classes of the participants; The rate of those in the 1st grade is 19.7%, the rate of those in the 2nd grade is 20%, the rate of those in the 3rd grade is 18.3%, the rate of those in the 4th grade is 21.1% and the rate of those in the 5th grade is 20.9%.

The average of the responses to each item in the moral sensitivity questionnaire administered to the participants is shown in Table 1. According to the results obtained; The highest agreement was "I often experience contradictions about how to approach the patient" with an average of 4.49±1.69. The lowest agreement was "My responsibility as a dentist is to be informed about the general condition of patients" with a mean of 2.23±1.91.

Reliability analysis was performed to determine the suitability of the scale sub-dimensions based on the literature. A Cronbach Alpha value of over 0.70 and an item-total correlation value of over 0.35 indicate scale compliance. There are 7 items under the autonomy sub-dimension and the overall reliability value of the dimension was determined as 0.806. There are 4 items under the benefit sub-dimension, and the overall reliability value of the dimension was determined as 0.716. There are 5 items under the holistic approach sub-dimension, and the overall reliability value of the dimension was determined as 0.867. There are 3 items under the conflict sub-dimension, and the overall reliability value of the dimension was determined as 0.718. There are 4 items under the implementation sub-dimension, and the overall reliability value of the dimension was determined as 0.714. There are 4 items under the orientation sub-dimension, and the overall reliability value of the dimension was determined as 0.905. It was determined that all dimension items fit well and the general reliability value of the dimensions was appropriate.

The overall reliability value of the scale was determined as 0.920. It is seen that all scale items provide the general fit value (Table 2).

All items of the scale were summed and averaged. According to the result, the overall evaluation average of the scale is 3.14±0.97. The highest evaluation is in the conflict dimension, and the lowest evaluation is in the orientation dimension (Table 3).

There is no statistically significant difference in the evaluations of the moral sensitivity questionnaire and all sub-dimensions according to the gender of the participants (p>0.05) (Table 4).

Table 1: Average of the answers given to each item in the moral sensitivity questionnaire directed to the

participants

		N	Average	STD. Deviation
1	My responsibility as a dentist is to be informed about the general condition of patients.	436	2,23	1,91
2	If I can't see improvement in my patients, I feel like my job has no point.	436	3,41	1,87
3	It is important for me to get a positive response from the patient in every intervention I make.	436	2,51	1,91
4	When I feel the need to make a decision against the patient's wishes, I do what I believe is most beneficial for the patient.	436	2,41	1,97
5	If I lose the patient's trust, I think my job as a physician loses its meaning.	436	3,33	1,84
6	When I have to make a difficult decision, it is always important to be honest with the patient.	436	2,31	1,93
7	I believe that good care includes respect for the patient's own choice.	436	2,65	1.93
8	If the patient lacks understanding/understanding of his illness, there is something I can do for him, even if only a little.	435	2,61	1,81
9	I often feel conflicted about how to approach the patient.	436	4,49	1,69
10	I believe it is important to have firm principles in the care of patients.	436	3,18	1,69
11	I often encounter situations where I have difficulty deciding what the ethically correct action is.	436	4,26	1,56
12	If I do not have information about the patient's personal history, I rely on standard procedures.	436	3,33	1,61
13	I believe that the doctor-patient relationship is a very important component in care/treatment practices.	436	2,32	1,90
14	I often encounter situations where the patient has to make decisions for himself.	436	3,40	1,51
15	Even if the patient objects, I always act in line with what I believe to be the best approaches.	436	3,75	1,71
16	I believe that often good care includes making decisions for the patient.	436	2,89	1,78
17	When I'm not sure what to do; I mostly act by trusting other physicians' information about the patient.	436	3,31	1,63
18	The patient's response, more than anything else, determines whether I made the right decision.	436	3,97	1,79
19	I often reflect my norms and values in my actions.	436	2,76	1,75
20	In situations where I have difficulty knowing what is ethically right or wrong; I find my own experiences more useful than theoretical knowledge.	436	3,46	1,52
21	It is important that I have a set of rules to follow when a patient involuntarily refuses hospitalization/treatment.	436	2,75	1,63
22	I believe that good care includes patient participation.	436	2,41	1,87
23	I often encounter unpleasant situations where I have to make decisions without the patient's participation.	436	3,99	1,38
24	If the patient came to the hospital against his will; I must be prepared to act against the patient's wishes.	436	3,19	1,79
25	I think it is difficult to provide good care if the patient objects.	436	2,73	1,92
26	When oral therapy is refused by the patient, there are sometimes valid reasons for threatening to give the patient an injection.	436	4,05	1,88
27	When it is difficult to decide what is right, I consult with colleagues about what to do.	436	2,73	1,80
28	When I have to make a difficult decision for a patient, I often trust my own feelings.	436	3,63	1,52
29	As a physician, I always need to know what kind of specialized care patients are entitled to receive.	436	2,67	1,70
30	Even if I am not successful in helping the patient understand his/her illness, I find my professional role meaningful.	436	2,95	1,90

Table 2: Fit values of all scales sub-dimensions

Dimensions		Item Total Correlation	Cronbach Alpha
Autonomy	10	,495	0,806
	12	,365	
	15	,355	
	16	,680	
	21	,702	
	24	,586	
	27	,614	
Providing Benefit	2	,434	0,716
	5	,486	
	8	,552	
	25	,542	
Holistic Approach	1	,718	0,867
	6	,705	
	18	,470	
	29	,673	
	30	,582	
Conflict	9	,359	0,718
	11	,448	
	14	,424	
Application	4	,385	0,714
	17	,405	
	20	,370	
	28	.449	
Orientation	7	,726	0.905
	13	,854	
	19	,713	
	22	,858	
General Cronbach Alpha		0,920	

Table 3: Overall evaluation means of scale sub-dimensions

	N	Cover	STD Deviation
Autonomy	436	3,12	1,17
Providing Benefit	436	3,02	1,37
Holistic Approach	436	2,83	1,28
Conflict	436	4,05	1,06
Application	436	3,20	1,04
Orientation	436	2,53	1,64
Moral Sensitivity Questionnaire	436	3,14	0,97

Table 4: Distribution of means of all scale sub-dimensions by gender

		N	Cover	STD Deflection	t	p
Autonomy	Female	270	3,13	1,18	,374	,708
	Male	166	3,09	1,15		
Providing Benefit	Female	270	3,01	1,40	-,136	,892
	Male	166	3,03	1,31		
Holistic Approach	Female	270	2,87	1,30	,916	,360
	Male	166	2,76	1,26		
Conflict	Female	270	3,99	1,06	-1,422	,156
	Male	166	4,14	1,07		
Application	Female	270	3,28	1,03	1,912	,057
	Male	166	3,08	1,04		
Orientation	Female	270	2,50	1,69	-,491	,623
	Male	166	2,58	1,57		
Moral Sensitivity Questionnaire	Female	270	3,16	1,00	,476	,634
	Male	166	3,11	0.91		

Table 5: Distribution of means of all scale sub-dimensions by classes

		N	Cover	STD Deflection	F	p
Autonomy	1st grade	86	3,08	1,28	4,379	0.002
	2nd grade	87	2.78	0.97		
	3rd grade	80	3.32	1.13		
	4th grade	92	3.42	1.30		
	5th grade	91	2.99	1.03		
Providing Benefit	1st grade	86	3,15	1,59	3,102	0,016
	2nd grade	87	2,63	1,11		
	3rd grade	80	3,22	1,31		
	4th grade	92	3,21	1,47		
	5th grade	91	2,90	1,23		
Holistic Approach	1st grade	86	2,79	1,47	3,166	0,014
	2nd grade	87	2,50	1,07		
	3rd grade	80	2,82	1,32		
	4th grade	92	3,18	1,38		
	5th grade	91	2,84	1,07		
Conflict	1st grade	86	4,06	0,97	2,246	0,063
	2nd grade	87	3,93	1,20		
	3rd grade	80	3,81	0,94		
	4th grade	92	4,20	0,98		
	5th grade	91	4,21	1,16		
Application	1st grade	86	3,28	1,12	4,34	0,002
	2nd grade	87	2,86	0,97		
	3rd grade	80	3,20	0,88		
	4th grade	92	3,49	1,13		
	5th grade	91	3,17	0,97		
Orientation	1st grade	86	2,65	1,72	2,506	0,042
	2nd grade	87	2,18	1,50		
	3rd grade	80	2,66	1,73		
	4th grade	92	2,86	1,82		
	5th grade	91	2,33	1,36		
Moral Sensitivity Questionnaire	1st grade	86	3,17	1,09	4,215	0,002
	2nd grade	87	2,83	0,82		
	3rd grade	80	3,19	0,95		
	4th grade	92	3,41	1,05		
	5th grade	91	3,09	0,81		

Table 6: Evaluation of the relationship between moral sensitivity questionnaire and sub-dimensions

		Age	Autonomy	Providing Benefit	Holistic Approach	Conflict	Application	Orientation	Moral Sensitivity
Age	r	one	-,008	-,009	,047	,034	-,023	,004	,009
	p		,862	,856	,326	,473	,631	,932	,856
Autonomy	r		one	,701 **	,796 **	,012	,699 **	,814 **	,913 **
	p			,001	,001	,796	,001	,001	,001
Benefit Providing	r			one	,708 **	,028	,566 **	,736 **	,836 **
	p				,001	,561	,001	,001	,001
Holistic Approach	r				one	-,071	,690 **	,865 **	,903 **
	p					,140	,001	,001	,001
Conflict	r					one	,050	-,115 *	,116 *
	p						,299	,016	,016
Application	r						one	,676 **	,801 **
	p							,001	,001
Orientation	r							one	,901 **
	p								,001
Moral Sensitivity	r								one
	p								

*p<0,05; ** p<0,01 TABLO 5-6 Metinde yer almıyor

As a result of the analysis, there is a statistically significant difference based on class in the evaluations regarding the autonomy and application sub-dimensions (p=0.002; p=0.002).

To determine the relationship between the participants' ages and the evaluations of the moral sensitivity questionnaire and its dimensions, Pearson Correlation analysis was applied. According to the results obtained; No statistically significant relationship was detected between age and the moral sensitivity questionnaire and its sub-dimensions (p>0.05).

There is a statistically significant relationship between the moral sensitivity questionnaire and its sub-dimensions (p<0.05). The least significant relationship is between conflict and moral sensitivity questionnaire (r:0,116, p:0,016).

DISCUSSION

The moral and ethical sensitivities of dentistry faculty students are of fundamental importance in their professional practices. This sensitivity is necessary to maintain a healthy patient-physician relationship, gain the trust of patients, and protect the reputation of the profession. Students' behavior in accordance with ethical values and moral principles, respecting patient rights, paying attention to confidentiality and adhering to the principle of honesty increases their social reputation as well as their professional success. In addition, dentists who act correctly and ethically perform their profession more effectively and make more positive contributions to public health. Therefore, developing and protecting the moral and ethical sensitivities of faculty of dentistry students is extremely important for both the individual's own professional life and the general health and welfare of the society.[15]

That studies on ethical and moral principles for dental students are limited and there are deficiencies in the existing literature. This study aims to determine the current situation regarding the ethical and moral sensitivities of dentistry faculty students and to create an important resource to improve the content and structure of dentistry education programs according to the results of the study.

According to the findings of the study conducted using the MSQ scale in Turkey, Aydın et al. reported the moral sensitivity scale score of midwifery students as 86.81±20.86. [16] Akça et al.'s study on nursing students found that the students' MSQ score was 90.1±22.2. Studies have determined that MSQ scores are at a moderate level. [16] In our study, the overall reliability value of the MSQ scale was determined as 0.920. It is seen that all scale items provide the general fit value.

In a study where the ethical and moral sensitivities of medical school students were evaluated according to grades; The sensitivity scale score of 1st grade students was 89.92±21.04 and the sensitivity scale score of 6th grade students was 126.72±19.54, and it was determined that the level of ethical sensitivity decreased as the grade increased. [17] When studies conducted with different versions of the MSQ scale in different countries were examined, in a study conducted by Borhani et al. in Iran, it was seen that the sensitivity level of students was at a medium level, as in other similar studies. In the study conducted by Tuvesson and Lutzen in Sweden, they reported that nursing students' ethical sensitivity levels were at high and medium levels.[19] According to the results of our study; there is a statistically significant difference based on grade in the evaluation of moral sensitivity (p<0.05). The highest evaluation was in the 4th grade with 3.41±1.05, and the lowest was in the 2nd grade with 2.83±0.82. Here, it is thought that the fact that 4th grade students start caring for patients contributes to their understanding of the importance of ethical and moral sensitivity.

In a study examining whether the gender variable has any effect on the level of ethical sensitivity, it was observed that women had a higher level of ethical sensitivity than men. [11] In our study, it was observed that gender did not make a significant difference on ethical sensitivity ($p>0.05$).

In a study conducted with physicians and nurses working in intensive care units in Turkey, similar to our study, it was observed that physicians and nurses experienced contradictions in their approach to patients and when making decisions.[12] According to research findings, the majority of physicians ensure the participation of the patient/family in decisions regarding inpatients. According to the results of our study; Among the answers given to each item in the moral sensitivity questionnaire directed to the participants, the highest average was 4.49±1.69, with the item "I often experience contradictions about how to approach the patient."

In our study, it was determined that dentistry faculty students showed ethical sensitivity at a general level and in the dimensions of autonomy, holistic approach, Application and orientation, especially benefit. Providing benefit is one of the most important principles of medical ethics. It is stated that physicians more often use the decision they think will be in the patient's best interest, especially in urgent decision-making situations.

It was observed that age did not play a statistical role in the answers given. In the literature, there are studies in a similar study on physicians and nurses arguing that age and years of work make a positive contribution to the evaluation.[11,20] It is thought that the reason why the result of our study differs from the literature is due to the fact that the questionnaire was applied to student groups, the students are in similar age groups and have not yet completed their education.

When the literature is examined and according to the results of our study, the role of ethics committees within the hospital, which monitor the compliance of clinical research with ethical standards and relevant legal regulations, needs to be strengthened in order for healthcare professionals to make the right decisions when they encounter ethical problems. It is important that these boards are structured to provide consultancy services to healthcare professionals during diagnosis, treatment and care processes. Additionally, the frequency of results-related meetings needs to be increased and encouraged.

CONCLUSION

Students who begin their clinical internship at the faculty of dentistry reach an important stage in the process of caring for patients. During this period, they have the opportunity to translate their theoretical knowledge into practice and gain clinical experience. Students, who are given the authority and responsibility to intervene in real patients under supervision, learn many stages such as patient reception, examination, diagnosis, treatment planning and Application. This process is an important opportunity for students to improve their communication skills with patients, make clinical decisions and shape their professional identities. Additionally, this experience offers students the chance to strengthen their practical skills and deal with a variety of clinical scenarios they will encounter in their professional lives. This period helps students gain the self-confidence and competence necessary to safely perform their clinical practice.

This study can be seen as a step to examine ethical and moral issues in dentistry education more deeply and to make students more conscious of these issues. It will fill the gaps in the current literature and provide information and data for a better understanding of ethical and moral principles in dental education.

Ethical Approval

Bu çalışma için gerekli etik onay Necmettin Erbakan Üniversitesi İlaç ve Tıbbi Cihaz dışı etik kurul tarafından alınmıştır (2021/06-69).

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Conflict of Interest

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

Author Contributions

Tasarım: HÖ, YDF, MAİ Veri toplama veya veri girişi yapma: MAİ, YDF Analiz ve yorum: HÖ, MAİ Literatür tarama: HÖ, YDF, MAİ Yazma: HÖ, YDF, MAİ.

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Investigation of the Relationship Between Mandibular Gonial Angle and Impacted Mandibular Third Molar

Yiğit Ali ÖZKUBAT[1] Nesrin SARUHAN KÖSE[2] Yasin Çağlar KOŞAR[3] Görkem TEKİN[4*] Ömür DERECİ[5]

[1] Private Practice, Oral and Maxillofacial Surgeon, İzmir, Türkiye, yigitaliozkubat@gmail.com
[2] Assoc. Prof. Eskişehir Osmangazi University, Faculty of Dentistry, Eskişehir, Türkiye, dt_nesrin@yahoo.com
[3] Assist. Prof. Eskişehir Osmangazi University, Faculty of Dentistry, Eskişehir, Türkiye, ycaglarkosar@hotmail.com
[4] Assist. Prof.. Eskişehir Osmangazi University, Faculty of Dentistry, Eskişehir, Türkiye, dt.gorkemtekin@gmail.com
[5] Prof, Eskişehir Osmangazi University, Faculty of Dentistry, Eskişehir, Türkiye, omurdereci@hotmail.com

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ABSTRACT

Aim: The aim of this study is to investigate changes in the gonial angles of impacted lower third molars and associated parameters in individuals with impacted lower third molars aged twenty years and below.
Material and Methods: A retrospective study included 963 patients with impacted third molars. Impaction classification was done according to Pell-Gregory criteria. The teeth were divided into eight main groups based on their relationship with the ramus and second molar (1, 2, 3) and the depth within the bone (A, B, C). Teeth classified as erupted in 1A were excluded from the study. Gonial angle, mesiodistal distance (MDM), retromolar eruption distance (RED), retromolar eruption ratio (RER), A° (angle between the Gonion-symphysis plane and the long axis of the third molar), and B° (angle between the Gonion-symphysis plane and the long axis of the second molar) were evaluated. Panoramic radiographs were analyzed using specialized software to measure angles and distances. The angles and measurements were compared among impacted groups and genders. Statistical analyses including Pearson correlation and ANOVA tests were used to assess relationships between measurements and impact parameters. A significance level of $p<0.05$ was considered statistically significant.
Results: In females, the A□ was found to be significantly larger than in males ($p<0.05$). In males, however, RSM and RSO were found to be significantly larger than in females ($p<0.05$). There was no significant variation in gonial angle among the impaction groups. A angle was the narrowest in group 3/B and the largest in group 2/A.
Conclusion: While gonial angle are not a definitive indicator of impacted third molars, the study emphasizes the importance of A° and RED in predicting impaction.

Mandibular Gonial Açı ile Gömülü Mandibular Üçüncü Molar Arasındaki İlişkinin Araştırılması

Makale Bilgisi

Makale Geçmişi

Geliş Tarihi: 12.01.2024
Kabul Tarihi: 26.06.2024
Yayın Tarihi: 30.08.2024

Anahtar Kelimeler:
Panoramik radyografi,
Sınıflama,
Üçüncü molar.

ÖZET

Amaç: Bu çalışmanın amacı, alt yirmi yaş dişlerine sahip bireylerde gömülülük gösteren dişlerin gonial açıları ve bu durumla ilişkili parametrelerdeki değişiklikleri araştırmaktır.
Gereç ve Yöntemler: Retrospektif olarak yapılan araştırmada gömülü üçüncü molar dişleri olan 963 hasta çalışmaya dahil edildi. Gömülülük sınıflaması Pell-Gregory kriterlerine göre yapıldı. Dişin ramus ve 2. molar ile olan ilişkisine göre (1,2,3) ve dişin kemik içerisindeki derinliğine (A, B, C) göre sekiz ana gruba ayrılmıştır.1A sınıflamasındaki dişler sürmüş kabul edilerek çalışma dışı bırakılmıştır. Gonial açı, meziodistal mesafe (MDM), retromolar sürme mesafesi (RSM), retromolar sürme oranı (RSO), A□(Gonion-simfiz noktaları arasına çizilen düzlem ile 3. molar diş uzun ekseni arasındaki açı) ve B□(Gonion-simfiz arasına çizilen düzlem ile 2. molar dişin uzun ekseni arasındaki açı) değişkenleri değerlendirilmiştir. Panoramik radyografiler özel bir yazılım kullanılarak açılar ve mesafeler ölçülerek analiz edildi. Açı ve ölçümler gömülü grupları ve cinsiyetler arasında karşılaştırıldı. Ölçümler ve etki parametreleri arasındaki ilişkileri değerlendirmek için Pearson korelasyonu ve ANOVA testlerini içeren istatistiksel analizler kullanıldı. İstatistiksel anlamlılık değeri $p<0,05$ olarak kabul edilmiştir.
Bulgular: Kadınlarda A açısı, erkeklere göre anlamlı olarak daha büyük bulunmuştur ($p<0.05$). Erkeklerde ise RSM ve RSO, kadınlara göre anlamlı olarak daha büyük bulunmuştur ($p<0.05$). Gömülülük grupları arasında gonial açı bakımından anlamlı değişim bulunamamıştır. A açısı 3/B grubunda en dar açı iken 2/A grubunda en büyük açıya sahiptir.
Sonuç: Gonial açı üçüncü molar dişlerin gömülü kalmasının kesin bir göstergesi olmasa da, çalışma A° ve RSM'nin gömülü kalmayı öngörmedeki öneminin altını çizmektedir.

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***Corresponding Author:** Görkem TEKİN, *dt.gorkemtekin@gmail.com*

INTRODUCTION

Teeth that remain partially or completely within bone or soft tissue, failing to reach the occlusion level despite the time for eruption into the mouth, are referred to as impacted teeth.[1] The development and eruption processes of third molars are affected by many parameters, and studies report that the reason for impaction is that there is not enough distance between the ramus and the second molar tooth.[2] However, there is no consensus on primary mechanisms, corpus length, ramus angle, the congruence of mandibular development time with eruption time, or a combination of these and other factors.[3]

Third molars demonstrate great variation in terms of size, shape, position, root formation, development time, and eruption direction. Orthodontists frequently face challenges in predicting the eruption or impaction of these teeth in young patients during treatment planning. This prediction is typically based on radiographic assessments, which frequently result in ambiguous outcomes. Many of these studies are based on lateral cephalometric measurements[4] Additionally, periapical radiographs, bite-wing radiographs, and anterior-posterior imaging have been used.[5]

Panoramic imaging, which is increasingly used in dental practice, can also be utilized to predict the development of the third molars and could be beneficial in this regard.[6] As mandibular third molar impaction has a complex etiology, a definitive predictable method has not been developed. Factors such as insufficient space in the third molar area, angulation and ectopic position, obstruction in the eruption path, and late third molar mineralization have been suggested in previous studies related to third molar impaction. Moreover, gender, race, socio-economic differences, genetic and endocrinological factors can also affect eruption.[7] An inappropriate eruption pathway, excessive mesial angulation, and minimal upward orientation during eruption may potentially escalate the rate of impaction.[8]

The gonial angle, along with measures like the mandibular plane angle, is used to define facial growth patterns.[9] The gonial angle is a crucial parameter for determining growth patterns, and panoramic radiography is a suitable method for measuring it. The value of the gonial angle is considered important for early assessment of third molar development and eruption.[10]

This study aims to investigate whether there is a significant change in the gonial angles of individuals with lower third molars showing impaction, as indicated in the Pell and Gregory[11] classification. By observing tooth and jaw development better, it will allow us to predict tooth positions that may cause extraction difficulties.

MATERIAL AND METHODS

The summary text of this study was presented as an oral presentation at the Turkish Association of Oral and Maxillofacial Surgery 26th International Scientific Congress. Ethical approval was procured prior to the commencement of this study, which was structured as a retrospective investigation (Non-Interventional Clinical Research Ethics Committee Approval No:80558721/G-79). The study encompassed patients aged between 20 and 25, who sought treatment at the Oral and Maxillofacial Surgery Clinics. The inclusion criteria consisted of: patients with Class I dental occlusion, possessing intact lower third molars without any form of radiological data loss, having no history of orthodontic treatment, and no previous tooth loss. Patients were excluded from the study if they presented with radiographic data loss, were under the age of 20 or above 25, or exhibited pathological formations, impacted canines, or supernumerary teeth.

For each participant included in our study, a single mandibular third molar, whether on the right or left, was evaluated. The radiographic images studied were procured

using the Planmeca ProMax X-Ray Unit, an orthopantomography device, under parameters set at 90 kV, 10 mA, and 1 s. All images were reviewed and assessed using the specialized Romexis Reviewer© 4.3.0.R software, associated with the device, and measurements were conducted in millimeters using the same software. Consistent standards and radiological values were meticulously maintained during the acquisition of all panoramic radiographs.

The classification of tooth impaction was done according to the Pell-Gregory[11] classification. The Pell-Gregory[11] classification was formulated taking into consideration the distance of the anterior edge of the ramus to the 2nd molar tooth (Class 1, 2, 3) and the depth of impaction of the third molar tooth relative to the 2nd molar tooth (Position A-B-C) and is as follows;

In our study, teeth classified as class 1/A were considered erupted and were not included in the study, while the others were described as impacted and partially impacted, and evaluated under 8 groups as 1/B, 1/C, 2/A, 2/B, 2/C, 3/A, 3/B, 3/C.

Panoramic Radiography Measurements

The values measured are defined in Table 1. The parameters evaluated in the study are shown in Fig 1 and the measurements on the panoramic radiograph are displayed in Fig 2. Angles were measured in degrees (˚), and distances in millimeters (mm).

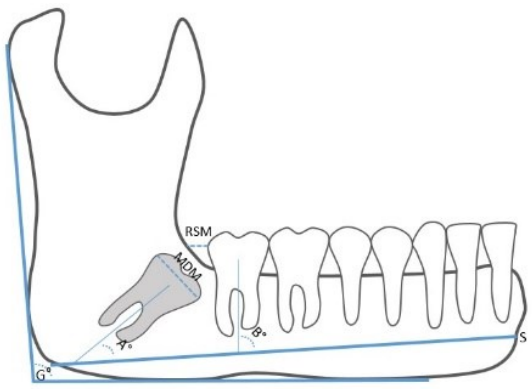

Fig 1. *Parameters evaluated in the study*

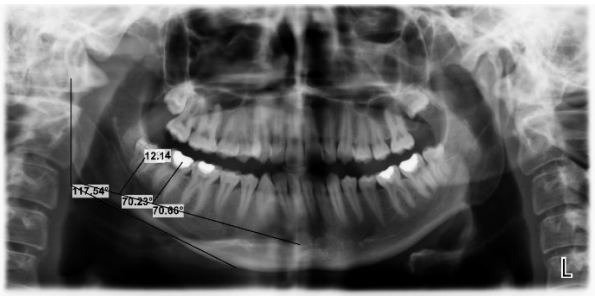

Fig 2. Measurement of panoramic radiography

Table 1. Measurements taken and their definitions

Values	Definitions
Gonial angle (G˚)	The angle formed at the intersection point of a line drawn tangent to the posterior ramus and a line drawn tangent to the mandibular corpus.
Mezio-distal distance (MDD)	The mesio-distal distance of the impacted third molar tooth.
Retromolar Eruption Distance (RED)	The distance between the ramus and the most prominent point of the distal region of the second molar tooth.
Retromolar Eruption Ratio (RER)	The ratio of RED to MDD.
A angle (A˚)	The angle between the plane drawn from gonion to the symphysis and the long axis of the third molar tooth.
B angle (B˚)	The angle between the plane drawn from gonion to the symphysis and the long axis of the second molar tooth.

Statistical Analysis

A frequency table containing the minimum, maximum, average, median, and standard deviations of all measurements was created. The relationship between the measurements made on the radiographic image and the determined impaction parameters was determined by Pearson correlation analysis. Whether the variations in impaction parameters among impaction groups were statistically significant was determined by the ANOVA test. The degree of statistical significance of the variations in impaction parameters between genders was determined by the Independent Sample t-test, and $p<0.05$ was accepted as statistically significant.

RESULTS

A total of 963 patients within the age bracket of 20-25 were incorporated into the study. The mean and standard deviation values for age, B˚, A˚, G˚, MDD, RED, RER of teeth

with varying degrees of impaction are presented in Table 2. The minimum, standard deviation, median, and maximum values for age, B˚, A˚, G˚, MDD, RED, RER of teeth with varying degrees of impaction are presented in Table 2.

337 (35%) male and 627 (65%) female were included in the study. The age range of male is 20-25 and the average age is 21.82±1.79. The age range of female was between 20-25 and the average age was 21.63±1.71.

Table 2. Descriptive statistics of all impacted group teeth

	1/B (n=12)	1/C (n=14)	2/A (n=254)	2/B (n=450)	2/C (n=168)	3/A (n=8)	3/B (n=34)	3/C(n=24)
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Age	21.83±0.36	21.36±0.51	21.72±0.11	21.79±0.08	21.54±0.12	21.88±0.74	21.41±0.30	21.17±0.33
B˚	74.53±2.17	73.97±3.24	76.47±0.45	78.06±1.6	74.65±0.47	82.59±4.63	83.79±1.86	79.09±1.96
A˚	55.72±6.53	44.41±4.60	72.2±1.9	39.24±1.25	40.47±1.62	46.08±14.32	29.99±4.45	38.98±4.75
G˚	114.81±2.12	113.95±2.75	114.77±0.41	114.32±0.31	113.78±0.5	117.83±2.65	111.72±3.2	115.50±1.25
MDD	10.27±0.22	10.05±0.33	10.96±0.05	11.06±0.05	11.24±0.53	10.88±0.28	11.18±0.13	10.91±0.20
RED	10.28±0.24	10.31±0.29	6.11±0.11	6.21±0.09	6.47±0.14	2.89±1.14	0.89±0.26	1.8±0.46
RER	1±**0.02**	1.03±0.03	0.56±0.01	0.57±0.01	0.60±0.01	0.28±0.12	0.08±0.02	0.17±0.04

SD, Standard deviation

In this study, no substantial correlation was identified between the B˚ and impaction (p>0.05). A weak and negative association might be inferred between the B˚ and the A˚ (r<0.3). Similarly, a weak and positive correlation appears to exist between the B˚ and the G˚ (r<0.3). A weak and positive association was established between the B˚ and MDD (r<0.3). A weak and negative association was perceived between the B˚ and RED (r<0.3).

No substantial correlation was observed between the gonial angle and impaction in this study (p>0.05). There appears to be a weak and positive correlation between the G˚ and the B˚ (r<0.3). It can be inferred that a weak and positive association exists between the G˚ and the A˚ (r<0.3). A weak and negative correlation was identified between the G˚ and MDD (r<0.3). A mild and positive correlation was observed between the G˚ and RED (r<0.3).

In our study, no substantial correlation was observed between MDD and impaction (p>0.05). A weak and negative association might be inferred between MDD and the A˚ (r<0.3). Similarly, a weak and positive correlation seems to exist between MDD and the G˚ (r<0.3). A weak and positive association was established between MDD and the B˚ (r<0.3). A weak and negative correlation was observed between MDD and RED (r<0.3). (Table 3)

Table 3. Correlations

	B˚	***A˚***	***G˚***	***MDD***	***RED***
B˚	1				
A˚	-0.09533	1			
G˚	0.04977	0.07818	1		
MDD	0.006087	-0.01126	-0.03081	1	
RED	-0.11294	0.177995	-0.03209	-0.00554	1

The A˚ was found to be larger in females compared to males (p<0.05). RED and RER measurements were observed to be larger in males compared to females (p<0.05). No statistically significant divergence was detected between the averages of the B˚, G˚, and MDD in both genders (p>0.05). (Table 4)

Table 4. Comparison of mean values between genders

	t-test		
	t	**std.**	**p**
B˚	0.905	962	0.366
A˚	-3.774	962	**0.000***
G˚	-1.031	962	0.303
MDD	1.691	962	0.091
RED	3.855	962	**0.000***
RER	1.954	962	**0.049***

Std., Standard deviation. * significance level p < 0.05. t-test, independent samples t test

Significant differences were identified between the averages of the A˚, RED, and RER across different groups ($p<0.05$). When categorized based on the magnitude of the A˚, the 3/B group was found to have the narrowest angle, followed by an incremental pattern in the 3/C, 2/B, 2/C, 1/C, 3/A, 1/B groups, with the 2/A group exhibiting the largest value. The narrowest RED was recorded in the 3/B group, demonstrating an ascending trend with the widest distance in the 1/C group, followed by an incremental pattern in the 3/C, 3/A, 2/A, 2/B, 2/C, 1/B groups. The highest RER was noted in the 1/C group, demonstrating a decreasing trend in the 1/B, 2/C, 2/B, 2/A, 3/A, 3/C groups, with the lowest value in the 3/B group (Table 5).

Table 5. Comparison of mean values among groups

		Sum of Squares	Std.	Mean Squares	F	p
B˚	**Inter-group**	3587.157	7	512.451	0.902	0.504
	Within-group	542965.683	956	567.956		
	Total	546552.840	963			
A˚	**Inter-group**	206642.391	7	29520.342	41.488	**0.000***
	Within-group	680234.446	956	711.542		
	Total	886876.837	963			
G˚	**Inter-group**	466.539	7	66.648	1.214	0.292
	Within-group	52488.051	956	54.904		
	Total	52954.591	963			
MDD	**Inter-group**	30.139	7	4.306	0.478	0.851
	Within-group	8604.884	956	9.001		
	Total	8635.023	963			
RED	**Inter-group**	1928.361	7	275.480	85.241	**0.000***
	Within-group	3089.573	956	3.232		
	Total	5017.934	963			
RER	**Inter-group**	17.832	7	2.547	91.917	**0.000***
	Within-group	26.495	956	0.028		
	Total	44.328	963			

Std., Standard deviation. *significance level $p < 0.05$.

DISCUSSION

The surgical extraction of the third mandibular molar is one of the most commonly performed operations by oral surgeons. Alhadi et al.[12] have shown that 22.8% of the population has at least one impacted lower third molar. Venta et al.[13] have reported that the incidence of impacted third molars varies between 22.3% and 66.6%.

In the present study, we have conducted an assessment on the relationships between the gonial angle, A˚, B˚, RED, MDD, and RER parameters with the status of impacted mandibular third molars. This was conducted according to the Pell-Gregory[11] impaction classification across a sample of 963 patients. It is important to note that our study specifically focused on partially impacted and fully impacted teeth. Therefore, teeth classified under Pell-Gregory[11] class 1/A, representing fully erupted teeth, were not incorporated into our analysis.

In our study, no significant relationship was identified between the G˚ and impaction. It was observed that there is a weak, positive correlation between the G˚ and A˚. A weak and positive relationship can be asserted between the G˚ and A˚. A weak, negative correlation has been determined between the G˚ and MDD. A mild, affirmative correlation was noted between the G˚ and RED. In the study conducted by Uthman et al.[5], it was noted that the G˚ was not a definitive reference. In some studies, a higher prevalence of impaction was observed in patients with narrower gonial angles.[14] This observation does not coincide with our study. In their research, Moshfeghi et al.[15] found no significant difference between G˚ and impaction. In the study conducted by Verma et al.[16], it was suggested that there exists a weak, negative correlation between the G˚ and eruption. Hattab ve Alhaija[17], indicated an

increase in the impaction rate in patients with smaller and steeper gonial angles. Begtrup ve ark.[18] were unable to detect any correlation between jaw angles and third molar eruption. For this reason, they stated that the G˚ is not a reliable measure in determining the impaction of the third molar. The study conducted by Kaur et al.[19] demonstrated that the G˚ displays the least variation. It was proposed that the gonial angle does not provide information about the eruption of the third molar.[6]

In our study, a significant difference was observed between the A˚ and impaction groups classified according to the Pell-Gregory[11] classification. When ranked by the size of A˚, the 3/B group has the narrowest angle, followed by an increase in the 3/C, 2/B, 2/C, 1/C, 3/A, 1/B groups, and the 2/A group has the largest value. During tooth development, the likelihood of the third molar remaining impacted increased as the angle of the third molar (A˚) decreased. Some researchers have proposed that for the third molar to properly emerge into the mouth, A˚ should be greater than 40º at the age of 10. Subsequently, with an appropriate increase in this angle, they have claimed that the third molar can fully erupt into the mouth.[20-22] A˚ was found to be higher in female when compared according to gender ($p<0.005$).

In a study conducted by Kaur et al.[19] in which two researchers independently measured 200 patients, A˚ was found to be significantly lower in the fully impacted group compared to the erupted group, and it was indicated that the chance of eruption decreases as the angle narrows. Nevertheless, in the partially impacted group, A˚ was measured to be larger compared to the erupted group, as wider A˚ vertical and distoangular impactions are more common in partially erupted teeth. A narrow A˚ is mostly due to mesioangular inclination in the fully impacted group.[20,21] In our study, a decrease in A˚ was observed as the Pell Gregory[11] impaction degree increased. The reason why the 3/C group is not the narrowest angle could be because the follicle forms in a location closer to the postero-inferior of the ramus.

In our study, no significant relationship was identified between B˚ and impaction, but a weak and negative correlation exists between B˚ and A˚. Similarly, a weak, positive correlation was observed between B˚ and the G˚. A weak, positive correlation has been identified between B˚ and MDD. A weak, negative relationship was observed between B˚ and RED. In their study, Kaur et al[19] demonstrated that B˚ shows the least variation. It has been proposed that B˚ does not provide information about the eruption of the third molar.[6] In the study of Uthman et al.[5], it was asserted that the second molar angulation does not serve as a definitive reference.

In our study, a significant difference was identified between the RED and impaction. The narrowest distance was measured in the 3/B group, which then increased sequentially in the 3/C, 3/A, 2/A, 2/B, 2/C, 1/B groups, and the widest distance was detected in the 1/C group. Numerous global studies have delved into the origins of third molar impaction, revealing a multitude of factors that may contribute to this condition. Limited space beyond the permanent second molar, postponed development of the third molar, and accelerated physical maturation are among the factors to consider.[23] RED was found to be higher in male when compared according to gender ($p<0.005$).

In their study, Verma et al.[16] analyzed panoramic radiographs of 90 patients, ranging in age from 21 to 45 years, categorizing the teeth as either impacted or erupted. They concluded that there is a strong positive correlation between RED and eruption; the likelihood of eruption increases as the RED increases. In contrast, Balla et al.[24] found inadequate RED in most cases of impacted third molars. On the other hand, Saputri[2] argued that the presence of sufficient space does not necessarily indicate whether the third molar will erupt or not. Hattab ve Alhaija[17] indicated that the RED was greater in erupted teeth, noting that lack of space was the most significant cause of impaction among all measurements evaluated. Venta et al.[6] asserted that there is a 100% chance of eruption when the RED is

greater than 16.5 millimeters. In their research, Mollaoğlu et al.[25] found that the RED in impacted third molars was smaller than that in erupted third molars. In line with other studies, Hattab and Alhaija's[17] research revealed that the RED was larger in erupted third molars compared to impacted ones, again highlighting space shortage as the principal cause of impaction.[17]

In our research, we did not discern a notable correlation between the MDD and tooth impaction. There appears to be a faint negative correlation between MDD and A˚. In a similar vein, a mild positive correlation is evident between MDD and the G˚. A slight positive correlation has been identified between MDD and B˚. We've observed a weak negative correlation between MDD and RED. In a study by Quiros[26], which involved panoramic radiograph measurements of 300 patients ranging in age from 12 to 30, MDD of the third molar was measured at approximately 15.8 mm, which is notably higher than the findings in our current study. This divergence in results could possibly be attributed to the different panoramic imaging devices utilized in the studies.

In some studies, although not definitively, the MDD in impacted teeth has been found to be wider compared to the erupted teeth.[6,17,27] The radiographic appearance of mandibular third molars is variable depending on the tooth's position in the dental arch and its orientation to the film. In panoramic imaging, third molars tilted lingually tend to appear larger compared to those tilted buccally. According to Sewerin[28], 65% of lower third molars are oriented buccally, 4% are tilted lingually, while 39% are directed towards the midline.

A noticeable difference between RER and embedment has been detected in our study. RER is predominantly present in Class 1/C, while showing a decrease in other groups as follows: 1/B, 2/C, 2/B, 2/C, 3/A, and reaching the lowest value in Group 3/B. Niedzielska et al.[29] evaluated the ratio of retromolar space to crown width (Gnass ratio) and claimed that it serves as a suitable reference for determining the position of the third molar. In a study conducted by Kaur et al.[19] RSO was found to be smaller in partially and fully impacted teeth compared to erupted teeth. Mollaoğlu et al.[25] reported an average RER of 1.1 in erupted third molars and 0.6 in impacted third molars. In a study, it was claimed that when RER is at least 1, 69% of third molars can erupt. [30] In the present study, similar to the A angle and RED, the lowest value of RER was found in Group 3/B. Despite being at a higher level vertically compared to Group 3/C, factors such as resorption of the anterior bone of the ramus, posterior movement of the anterior border of the ramus relative to the alveolar border, advancement of dentition, increase in mandibular length, sagittal growth of the mandible, and lesser sagittal eruption of teeth may explain why the lowest value is observed in Group 3/B. RER was found to be higher in male when compared according to gender ($p<0.005$).

According to the study by Eroz et al.[31] , the A˚ was found to be significantly larger in females compared to males ($p<0.05$). On the other hand, the RED and RER were found to be significantly larger in males compared to females ($p<0.05$). There were no significant differences between genders in terms of the G˚, B˚, and MDD averages ($p<0.05$). In our current study, out of 963 patients, 627 were females with an average MDM of approximately 10.7 mm, while 339 males had an average MDD of approximately 11.2 mm. In the study conducted by Kaur et al. [19], the MDD and RER values were found to be higher in males compared to females. In our study, similar to many international studies on third molar embedment, no gender differences were observed.[32] However, some studies have reported a higher prevalence of third molar embedment in females, which contradicts the findings of this study.[33,34] The higher occurrence of embedment in females has been attributed to developmental differences between males and females. Female body development generally stops at the onset of third molar eruption, whereas in males, mandibular development continues during the eruption of third molars, allowing for more

space. Nevertheless, a large majority of international studies still report no significant gender differences.[34]

In our study, according to the Pell-Gregory classification[11] out of 963 patients, 450 were classified as Class 2/B, 250 as Class 2/A, 168 as Class 2/C, 34 as Class 3/B, 24 as Class 3/C, 14 as Class 1/C, 12 as Class 1/A, and 8 as Class 3/C. In the study conducted by Hassan et al.[35] the level of embedment was calculated based on the cementoenamel junction (CEJ) level relative to alveolar bone height and was not associated with the occlusal surface of the adjacent second molar. Therefore, third molars that were erupting normally were excluded from the evaluation. In this study, Level B was found to be the most common level of embedment in both the maxilla and mandible. This finding is consistent with the study by Quek et al.[36] , but differs from the study by Hugoson and Kugelberg.[33] Hugoson and Kugelberg[33], correlated the third molar with the occlusal surface of the neighboring second molar, leading to variations in the occurrence of erupted molars and their frequencies at each level.

CONCLUSION

There was not a significant discrepancy concerning the gonial angle amongst the various impaction groups. However, considering that the eruption direction of wisdom teeth varies depending on multiple factors, there is a need for long-term studies that include reference points encompassing jaw and facial growth patterns.

Ethical Approval

The necessary ethical approval for this study was received by the Eskişehir Osmangazi University Non-Interventional Clinical Research Ethics Committee (80558721/G-79).

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Conflict of Interest

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

Author Contributions

Design: YAÖ, ÖD. Data Collection and Processing: YAÖ, ÖD. Analysis and Interpretation: ÖD. Literature Review: YAÖ. Writing: YAÖ.

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Color Agreement of Try-In Paste and Resin Cement on Zirconia Laminate Veneers

Esra TALAY ÇEVLİK[1*]

[1] Assist. Prof., Aydın Adnan Menderes University, Faculty of Dentistry, Department of Prosthodontics, Aydın, Türkiye, esra.talay.cevlik@adu.edu.tr

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ABSTRACT

Aim: This study investigates the reliability of try-in pastes in determining the final color of zirconia laminate veneer restorations produced with varying thicknesses.
Material and Methods: Phantom teeth were prepared in three thicknesses (0.5, 0.7, 1 mm) using depth gauge burs. The preparations were scanned with an intraoral scanner, and impressions were taken. Thirty resin die models were produced using a 3D printer. Zirconia laminate veneers were fabricated in three specified thicknesses. Initial color measurements (L, a, b values) of the veneers, applied to the die models with transparent petroleum jelly were taken. Color measurements were repeated using try-in paste after removing the petroleum jelly. The veneers were then roughened, ultrasonically cleaned, and ceramic primer applied. They were cemented with resin cement matched to the try-in paste color. Final color data were obtained using a spectrophotometer. Color change values were calculated from the L, a, b values, and data were compared using two-way ANOVA and Bonferroni Test.
Results: The thickness of the material did not influence color change, whereas the use of try-in paste or resin cement resulted in significant color differences.
Conclusion: The study findings indicate that try-in pastes are not reliable indicators of the final restoration color. It is crucial to consider that resin cement can substantially alter the color of zirconia laminate veneers when determining the final shade.

Deneme Pastası ve Rezin Simanın Zirkonya Laminate Veneerlerde Renk Uyumu

Makale Bilgisi

Makale Geçmişi

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Keywords:
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ÖZET

Amaç: Bu çalışma, farklı kalınlıklarda üretilen zirkonya laminate veneer restorasyonlarının sonuç renginin belirlenmesinde deneme pastalarının güvenilirliğinin araştırmaktadır.
Gereç ve Yöntemler: Fantom dişler derinlik ölçer frezler ile 3 farklı kalınlıkta (0,5, 0,7, 1 mm) prepare edilmiştir. Preparasyonlar bir ağızıçi tarayıcı ile taranarak ölçüsü alınmış ve 3 boyutlu yazıcı yardımı ile toplamda 30 adet rezin day model üretilmiştir. Zirkonya laminate veneerler, bu day modeller üzerine 3 farklı kalınlıkta üretilmiştir. Şeffaf renk vazelin ile day modele tutturulan laminate veneerlerin başlangıç renk (L, a, b değerleri) ölçümleri yapılmıştır. Ardından vazelin temizlenerek deneme pastası ile renk ölçümleri tekrarlanmıştır. Deneme pastası ile renk ölçümlerinin ardından, laminate veneerler 110 µm çaplı silika modifiye alüminyum oksit partikülleri ile pürüzlendirilmiş, ultrasonik olarak temizlenmiş ve veneerlere seramik primer uygulanmıştır. Laminate veneerler deneme pastası ile eş renkteki siman ile yapıştırılmıştır. Simantasyonun ardından spektrofotometre ile restorasyonun nihai renk verileri elde edilmiştir. Elde edilen L, a, b değerlerinden renk değişim değerleri hesaplanmış ve iki yönlü ANOVA ve Bonferroni Testi ile veriler karşılaştırılmıştır.
Bulgular: Materyal kalınlığı renk değişimine etki etmezken, deneme pastası veya rezin siman kullanımı önemli renk farklılıklarına yol açmıştır.
Sonuç: Çalışma bulguları, deneme pastalarının nihai restorasyon renginin güvenilir göstergeleri olmadığını ortaya koymaktadır. Nihai tonu belirlerken reçineli simanın zirkonya lamina kaplamalarının rengini önemli ölçüde değiştirebileceği dikkate alınmalıdır.

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***Corresponding Author:** Esra TALAY ÇEVLİK, *esra.talay.cevlik@adu.edu.tr*

INTRODUCTION

Patients undergoing dental treatment expect their smile to be restored in a healthy and aesthetically pleasing way. Therefore, treatments capable of altering the shape, size, and color of teeth while minimizing damage to dental tissues have gained popularity. Porcelain laminate veneers represent a conservative and highly aesthetic treatment option that provides long-term predictability and demonstrates good clinical performance.[1]

With technological advances in adhesive systems, it is possible to produce very thin laminate veneers that can be cemented to the tooth surface with minimal preparation.[1,2] In a retrospective study, the 10-year survival rate of laminate veneers was reported as 97,4%.[3]

Currently, materials such as lithium disilicate, feldspathic ceramics, leucite-reinforced feldspathic, fluorapatite, and zirconia-reinforced lithium silicate are commonly favored for the fabrication of laminate veneers.[4]

For many years, high crystal content ceramics, such as yttria partially stabilized tetragonal zirconia, have been frequently used due to their high fracture resistance and masking abilities.[5] However, in recent years, cubic zirconia ceramics have been developed through various alterations in the microstructure and composition of zirconia ceramics to enhance their translucency while retaining their fracture resistance.[6,7] The advancement of these translucent zirconia ceramics has enabled the production of laminate veneers with enhanced masking capabilities and greater strength compared to glass ceramics.[8]

In laminate veneers, it has been demonstrated that the color of the aesthetic restoration can be influenced by up to 10-15% due to the color of the resin cement.[9] Manufacturers recommend utilizing try-in pastes to estimate and verify the final restoration color before cementation. The dentist and patient can assess the color compatibility of the restoration by employing try-in pastes that correspond to the same shades as the resin cement.

Studies have been conducted to investigate the color compatibility between try-in pastes and permanent cement.[10-15] Nevertheless, these studies have not yet come to a consensus on this issue.[9-15] While a study.[11] reported a high consistency between the color values of the try-in pastes and the color properties of the resin cement, another study.[15] suggested that dentists should not rely solely on try-in pastes for color evaluation.

There have been limited studies reported on zirconia laminate veneers.[16-19] The definitive impact of try-in pastes on the final color of laminate veneer restorations fabricated from cubic zirconia remains uncertain. The objective of this study is to assess the efficacy of try-in pastes in predicting the final color of cubic zirconia laminate veneers with varying thicknesses. The null hypothesis of this study is: The cementation process of zirconia laminate veneers produced in varying thicknesses showed no significant difference between the color change values obtained with the try-in paste and those acquired after cementation.

MATERIALS AND METHODS

Using the Minitab Statistical Program (Minitab 22, Minitab LLC), the minimum sample size was determined based on data from previous studies [20]. With a statistical power (β) of 0.80 and a significance level (α) of 0.05, each of the four study groups required a minimum sample size of three to detect significant differences in color agreement. Ten samples per group were employed to enhance statistical power and to account for any potential sample loss throughout the study.

Three prefabricated upper right first incisors (Frasaco GmbH, Tettnang, Germany) were utilized for this study. Preparation depths for each tooth were established using depth gauge drills (Meisinger, Germany). A 1,5 mm incisal reduction and a butt-joint finish line were prepared on each tooth, followed by a depth reduction of 0,5 mm, 0,7 mm, and 1 mm on the labial surfaces. The preparations were then finalized with a chamfer finish line.

The impressions of the prepared prefabricated teeth were captured using a digital intraoral scanner (TRIOS3, 3Shape, Copenhagen, Denmark). A total of 30 resin replicas in A1 color were produced using a 3D printer (NextDent 5100, 3D Systems, NextDent B.V., Soesterberg, Netherlands), with 10 replicas for each preparation depth.

The cement gap of the zirconia laminate veneers was set to 40 µm. It was designed using computer-aided design software, with a restoration thickness ranging from 0,5, 0,7 and 1 mm, positioned 1 mm above the labial restoration edge. The designed laminate veneers were milled from presintered monolithic zirconia blocks (KATANA Zirconia STML A1, Noritake Dental Supply Co., Ltd., Miyoshi, Japan) using a computer-aided manufacturing device (Ceramill Motion 2, Amann Girrbach, Austria). Following milling, the zirconia laminate veneers were sintered in accordance with the manufacturer's instructions using a sintering oven. After the sintering process, all samples were manually polished using the Luster Meisinger polishing kit (Hager & Meisinger GmbH, Neuss, Germany). For this purpose, green, blue, red, and yellow burs from the polishing kit were utilized under water cooling. Each bur was applied for 60 seconds by a single researcher, respectively. The thickness of the samples was measured using a digital caliper (Digimatic Caliper IP67, Mitutoyo, Tokyo, Japan). Examples of the produced resin replicas and monolithic zirconia laminate veneers are depicted in Figure 1.

Figure 1: Resin replica model and zirconia laminate veneer example

After sample preparation, the color measurement procedures commenced. All color measurement procedures were conducted three times by a single researcher at the same time of day using a spectrophotometer (Vita Easyshade®, Vita Zahnfabrik, Bad Säckingen, Germany), and L, a, b values were recorded. The average value for each sample was determined by calculating the average of the three measurements.

The initial measurement was taken by applying transparent petroleum jelly between the resin replicas and zirconia laminate veneers, and the resulting L_0, a_0, b_0 values were recorded. The petroleum jelly on the laminate veneers was eliminated using an ultrasonic cleaner. Subsequently, a clear glyserin try-in paste (Panavia V5 Try-in Paste Clear, Kuraray, Japan) was applied to the zirconia laminate veneers, which were then positioned on resin dies, and the resulting L_d, a_d, b_d values were recorded.

Following the removal of the try-in paste using an ultrasonic cleaner, the inner surfaces of the zirconia laminate veneers were sandblasted with silica-modified aluminum oxide particles (Rocatec Plus, 3M ESPE, Seefeld, Germany) with a diameter of 110 µm. After applying the MDP-containing ceramic primer (Clearfil™ Ceramic Primer Plus, Kuraray, Japan), the zirconia laminate veneers were cemented using the same color cement (clear shade) as the try-in paste (Panavia V5 Paste, Kuraray, Japan).

Excess cement was removed, and then the cement was light-cured (Elipar Freelight; 3M ESPE, Seefeld, Germany) for 20 seconds each on the labial and palatal surfaces.

Following cementation, the final L_s, a_s, b_s data were measured and recorded.

ΔE values were calculated using the following formulas:

$\Delta E_d = [(L_d-L_0)^2 + (a_d-a_0)^2 + (b_d-b_0)^2]^{1/2}$ (ΔE_d= color change value with the try-in paste)

$\Delta E_s = [(L_s-L_0)^2 + (a_s-a_0)^2 + (b_s-b_0)^2]^{1/2}$ (ΔE_s= color change value after cementation)

Statistical Analysis

Statistical analyses were conducted using SPSS version 22 (SPSS Inc., IL, USA) statistical software program. The Kolmogorov-Smirnov test and Levene's test were utilized to assess the normality of ΔE values and to confirm the homogeneity of variances, respectively. The ΔE_d and ΔE_s data among zirconia laminate veneers of different thicknesses were compared using two-way ANOVA, followed by the Bonferroni test for post-hoc analysis. The ΔL, Δa, and Δb values calculated from the samples after trial paste and cementation were compared using the independent samples t-test. A p-value < 0.05 was considered significant for all tests.

RESULTS

According to the results of the two-way ANOVA analysis, the parameters of try-in paste and cement usage exhibited a significant effect, while the thickness parameter did not lead to a significant change. Additionally, the interaction between these two parameters demonstrated a significant effect. (Table 1)

Table 1: Two-way ANOVA test results

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	83,629[a]	5	16,726	33,654	0,000	0,757	168,268	1,000
Intercept	835,505	1	835,505	1681,100	**0,000**	0,969	1681,100	1,000
Thickness	1,761	2	0,880	1,771	0,180	0,062	3,542	0,355
Trial/cement	79,640	1	79,640	160,242	**0,000**	0,748	160,242	1,000
Thickness* trial cement	2,228	2	1,114	2,242	0,116	0,077	4,483	0,437

a. R Squared =0,757 (Adjusted R Squared = 0,735) b. Computed using alpha = 0,05

The post hoc Bonferroni test results are presented in Table 2. While the restoration thickness did not lead to a significant change in the ΔE_d and ΔE_s values, there were significant differences in the ΔE_d and ΔE_s values among different thicknesses at all thickness levels. The highest color change value was observed for the ΔE_s value (4,88 ± 0,71) at a thickness of 0,5 mm. The lowest color change values were calculated for ΔE_d values at thicknesses of 0,7 mm and 1 mm (2,56 ± 0,87 and 2,56 ± 0,50, respectively).

Table 2: ΔEd± Standard Deviation, ΔE_s ± Standard Deviation Values and Bonferroni Test results

Thickness	ΔE_d ±SD	ΔE_s ±SD	p
0,5 mm	2,67± 0,41	4,88± 0,71	<0,001
0,7 mm	2,56± 0,87	4,45± 0,87	<0,001
1 mm	2,56±0,50	4,32± 0,80	<0,001
p*	0,844	0,056	

Intragroup comparison results between p, ΔE_d and ΔE_s values. Intragroup comparisons of p ve ΔE_s values between thicknesses

Table 3 presents the ΔL, Δa, and Δb values calculated with both the try-in paste and cement. According to the independent samples t-test results, a significant difference was observed in all of these data when comparing the use of try-in paste and cement. At all thickness values, the ΔL value after cementation was significantly lower than the ΔL value calculated with the try-in paste ($p < 0.001$). In all thickness values, Δa and Δb values decreased after cementation compared to the values calculated with the trial paste ($p < 0.001$).

Table 3: Mean ± Standard Deviations of ΔL, Δa, Δb values of subgroups, comparison of trial and cemented samples with independent samples t test.

		Trial (Mean±SD)	Cement (Mean±SD)	p
0,5 mm	ΔL	-2,35± 0,15	-4,7± 0,22	<0,001*
	Δa	0,76± 0,07	0,36± 0,06	<0,001*
	Δb	0,88± 0,13	-0,43± 0,30	<0,001*
0,7 mm	ΔL	-2,25± 0,28	-4,18± 0,30	<0,001*
	Δa	0,67± 0,45	0,31±0,08	<0,001*
	Δb	0,92±0,12	-0,54± 0,23	<0,001*
1 mm	ΔL	-2,42±0,16	-4,85± 0,26	<0,001*
	Δa	0,54± 0,37	0,03±0,05	<0,001*
	Δb	-0,31±0,52	-2,12±0,18	<0,001*

*p<0.05

Discussion

According to the results of this study, the null hypothesis "There is no detectable color difference between the try-in paste and the corresponding resin cement in zirconia laminate veneers produced in different thicknesses" was partially rejected. Although the material thickness did not have a significant effect on the ΔE_d and ΔE_s values, there was a significant difference between the use of try-in paste and cement across all thicknesses.

Indeed, achieving the desired color match in indirect restorations is crucial for both patients and dentists. Try-in pastes serve as valuable tools to guide the selection of the appropriate color of luting cement, ensuring optimal aesthetic outcomes.

In previous studies, it has been noted that the visually detectable color change value typically falls within the range of 1 to 3.7 units, and any color change exceeding 3.7 units is generally considered clinically unacceptable.[21, 22] Therefore, in this study, the acceptable color change value limit was set at 3.7 units. In this study, while the use of try-in paste at all thicknesses resulted in an acceptable color change, a color change exceeding the acceptable limits was observed after cementation. Additionally, the color change value (ΔE_s) obtained after cementation was significantly higher than the color change value (ΔE_d) calculated with the try-in paste. This result is consistent with other studies indicating that the color of the try-in paste does not necessarily match the color of the corresponding resin cement.[13-15, 19]

In their study on ceramic veneers, Xing et al.[11] demonstrated that neither material thickness nor color significantly influenced the color change. Indeed, this finding is in line with the results of the current study. However, in contrast to this study, Xing et al.[11] reported that the try-in paste and cement color were compatible. This may be due to the different veneer material used. In this research, the material under examination consisted of monolithic cubic zirconia with a super translucent structure, incorporating 4.8% yttria. Cubic zirconia exhibits an isotropic state in various crystallographic orientations, which helps reduce light scattering that occurs at grain boundaries.[23] As a result, cubic zirconia ceramics demonstrate higher translucency properties.

Paken et al.[24] conducted a comparison of the color between try-in paste and post-cementation in zirconia-reinforced lithium disilicate samples. They concluded, similar to the findings in this study, that the restoration color experienced more significant changes with the final cement after cementation. Moreover, this result suggests that the trial pastes have a low masking effect. Therefore, in situations where masking the color of the teeth is desired, it is advisable not to rely solely on the try-in paste result.

Turgut and Bagis[25] assessed the optical properties of monolithic zirconia ceramics cemented with various cements. Their findings indicated that the type of cement used influenced the optical properties of monolithic zirconia restorations. Previous studies have demonstrated that the color of the resin cement used during the cementation of laminate veneers can influence the color of the final restoration.[26-28] Turgut and Bagis[25] investigated the color change of laminate veneers with varying thicknesses, fabricated from leucite-reinforced ceramics. They reported that the color of the resin cement could indeed impact the color of the final restoration. They also demonstrated that the color change decreased as the restoration thickness increased. In this study, the resin cement significantly altered the color of the final restoration. However, while the color change in the final restoration decreased as the thickness increased, this decrease was not found to be significant.

The CIELAB color system is a color space that characterizes color using three axes: L, a, and b values. The L coordinate represents the lightness-darkness continuum of the color. a value of 0 corresponds to pure black, while 100 represents pure white. As the L value increases, the color becomes lighter, and as it decreases, it becomes darker. The a coordinate indicates the ratio of redness to greenness in the color. Positive values of a denote redness, while negative values indicate greenness. The b coordinate represents the ratio of yellowness to blueness. Positive values of b signify yellowness, while negative values denote blueness.[29] As a result of this study, significant differences were found between the color of the try-in paste and the final restoration across all material thickness values, as indicated by ΔL, Δa, and Δb values. A decrease was observed in the ΔL values obtained with the trial paste and after cementation in all thicknesses, suggesting a darkening of the restoration color. Furthermore, upon examination of Δa and Δb values, an increase in the greenness and blueness values was observed after cementation.

In this study, clear color try-in paste and cement were selected, as they were presumed to have the least impact on color change. This choice aimed to achieve a more transparent cement color and minimize the color change between the try-in paste and the final restoration. However, despite these efforts, it was concluded that the color of the final restoration may still vary beyond acceptable limits when rehearsing on the prepared tooth.

One limitation of this study is the absence of try-in paste and cement in different colors. Using try-in pastes and cements with higher color pigment content could potentially yield more compatible results. Additionally, the use of petroleum jelly to provide primary stability to the restoration during initial color measurements might have caused light refraction, affecting color perception. Although applying silica-modified aluminum oxide particles before cementation is a recommended procedure for zirconia cementation, it might have influenced the color of the final restoration. Further clinical studies are warranted to investigate whether the use of trial paste in zirconia laminate veneers aligns with the final restoration color.

CONCLUSION

Within the limitations of this study; it was concluded that during zirconia laminate veneer cementation, the color of the try-in pastes and the final cement may be different, regardless of the restoration thickness. Material thicknesses

did not have a significant effect on the ΔE_d and ΔE_s values obtained in zirconia laminate veneers. . When planning the color of zirconia laminate veneers, it should be considered that the color of the permanent restoration may vary beyond perceptible limits after cementation, regardless of the restoration thickness.

Ethical Approval

Ethical approval was not obtained for this study as no human or animal subjects were involved.

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Conflict of Interest

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

Author Contributions

Design: ETÇ. Data collection and processing: ETÇ. Analysis and interpretation: ETÇ. Literature review: ETÇ. Writing: ETÇ.

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Evaluation of Soft Tissue Calcifications in the Head and Neck Region on Panoramic Radiography of Edentulous Patients

Merve Hacer DURAN[1*] Sümeyye COŞGUN BAYBARS[2]

[1] Res. Ass., Fırat University, Faculty of Dentistry, Department of Oral and Maxillofacial Radiology, Elazığ, Türkiye, dtmerveduran@gmail.com

[2] Assist. Prof., Fırat University, Faculty of Dentistry, Department of Oral and Maxillofacial Radiology, Elazığ, Türkiye, sbaybars@firat.edu.tr

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ABSTRACT

Aim: The aim of this study is to determine the types and incidence of soft tissue calcifications observed on panoramic radiographs of edentulous patients.
Material and methods: A total of 1297 panoramic radiographs of edentulous patients who applied to Fırat University School of Dentistry for different reasons between 2013 and 2022 and had a consent form were evaluated retrospectively. 131 radiographs with magnification and positioning errors were not included. Calcifications were classified according to localization, number, structure, shape and appearance. IBM SPSS Statistics 22 program was used for statistical analysis. Compatibility of the parameters with normal distribution was evaluated with the Kolmogorov-Smirnov test. In addition to descriptive statistical methods; Mann-Whitney U, Chi-Square, Fisher's Exact Chi-Square, Kruskal Wallis tests and Continuity (Yates) Correction were used. Significance was evaluated at $p<0.05$.
Results: A total of 1166 panoramic radiographs (539 female, 627 male) were examined and soft tissue calcifications were detected in 274 patients (23.5%). The ages of patients with calcification range from 36 to 88; 146 (53.3%) were male and 128 (46.8%) were female. The mean age was 64.45±9.06 years. Tonsillolith in 17.5%, carotid artery calcification in 10.6%, lymph node calcification in 4.8%, triticeous cartilage calcification in 2.1%, antrolith in 0.9%, rhinolith in 0.7%, sialolith in 0.4% and phleboliths were detected in only one patient (0.08%) of all cases.
Conclusion: The diagnosis of soft tissue calcifications by dentists and their differentiation from anatomical structures and pathologies are very crucial. In this way, it is possible to prevent unnecessary examinations and treatments and also to refer patients for further examinations when necessary.

Total Dişsizlik Durumunda Baş ve Boyun Bölgesindeki Yumuşak Doku Kalsifikasyonlarının Panoramik Radyografi Aracılığıyla Değerlendirilmesi

Makale Bilgisi

Makale Geçmişi

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Kalsifikasyon,
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Panoramik radyografi.

ÖZET

Amaç: Bu çalışmanın amacı dişsiz hastaların panoramik radyografilerinde görülen yumuşak doku kalsifikasyonlarının tipini ve görülme sıklığını belirlemektir.
Gereç ve yöntemler: 2013-2022 yılları arasında Fırat Üniversitesi Diş Hekimliği Fakültesi'ne farklı nedenlerle başvuran ve onam formu bulunan dişsiz hastalara ait toplam 1297 panoramik radyografi retrospektif olarak değerlendirildi. Magnifikasyon ve pozisyonlandırma hatası olan 131 radyografi çalışmaya dahil edilmedi. Kalsifikasyonlar lokalizasyon, sayı, yapı, şekil ve görünümlerine göre sınıflandırıldı. İstatistiksel analiz için IBM SPSS İstatistik 22 programı kullanıldı. Kolmogorov-Smirnov testi ile parametrelerin normal dağılıma uygunluğu değerlendirildi. Tanımlayıcı istatistiksel yöntemlerin yanı sıra Kruskal Wallis, Mann-Whitney U, Ki-Kare, Fisher's Exact Ki-Kare testleri ve Süreklilik (Yates) Düzeltmesi kullanıldı. $P<0,05$ anlamlı olarak kabul edildi.
Bulgular: Toplam 1166 panoramik radyografi (539 kadın, 627 erkek) incelendi ve 274 hastada (%23,5) yumuşak doku kalsifikasyonu tespit edildi. Kalsifikasyonu bulunan hastaların yaşları 36 ile 88 arasında değişmekte olup 146'sı (%53,3) erkek, 128'i (%46,8) kadındı. Ortalama yaş 64,45±9,06 olarak bulundu. Tonsillolit %17,5, karotid arter kalsifikasyonu %10,6, lenf nodu kalsifikasyonu %4,8, tritiseöz kıkırdak kalsifikasyonu %2,1, antrolit %0,9, rinolit %0,7, sialolit %0,4 ve sadece bir hastada (%0,08) flebolit tespit edildi.
Sonuç: Diş hekimleri tarafından yumuşak doku kalsifikasyonlarının teşhisi ve anatomik yapı ve patolojiler ile ayırıcı tanısının yapılması oldukça önemlidir. Bu sayede gereksiz tetkik ve tedavilerin önüne geçilebileceği gibi gerekli durumlarda da hastaların ileri tetkikler için yönlendirilmesi mümkün olacaktır.

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***Corresponding Author:** Merve Hacer DURAN, *dtmerveduran@gmail.com*

INTRODUCTION

Complete edentulism is a marasmic and irreversible situation and defined as the "last marker of disease burden" for oral health. This condition is an important public health problem for the elderly population and a possible threat for the young population through affecting primary healthcare services.[1] Edentulism is known to have negative effects on oral health as well as functional, psychologic and social limitations, systemically.[1-3] While the complete edentulism have been decreasing in all age groups in many Western countries over the last 20 years; the situation is exactly the opposite and it is still increasing in less developed countries.[4,5] Abnormalities in edentulous jaws are often overlooked because most of the time they do not cause clinical signs and symptoms A detailed radiological examination should be performed in these patients and normal anatomical formations, foreign bodies, pathological lesions such as cysts and tumors, impacted teeth and roots should be evaluated.[6] The prevalence of soft tissue calcifications is quite common and it is important to diagnose them correctly to differentiate benign lesions from pathologies.[7] Considering the rate of edentulous patients in the general population, detection of these findings is essential for successful dental treatment.

Panoramic radiography (PR) maintains its place as the most important imaging method used in the diagnosis and treatment planning of many oral and maxillofacial diseases in dentistry practice, under favour of its advantages such as low radiation dose, ease of application, low cost and easy accessibility.[8] Soft tissue calcifications (STCs), which occur with the precipitation of calcium salts, are generally asymptomatic radiopaque formations observed on PR images during routine dental examination. In the presence of STC, identification of calcification, differentiation from anatomical variations or pathological formations and the need for treatment must be determined. It is the responsibility of dentists to diagnose STCs which superimposed on anatomical structures, to make a differential diagnosis with dental anomalies, bone lesions, foreign bodies and artifacts and also normal anatomical entities that give a radiopaque appearance.[9,10]

Calcified lymph nodes, tonsilloliths, cysticercosis and arterial calcifications are dystrophic calcifications that give a radiopaque appearance in the head and neck region and are usually asymptomatic. Lymph node calcification, which is often occurs in the submandibular, deep and superficial cervical lymph nodes, is located in the angulus mandible, below or above the lower edge or superimposed on the mandible. Rarely, it can be seen as a single or multiple chains in between the posterior ramus and the cervical vertebra. Radiographically, it has an irregular shape with distinct borders and often a cauliflower-like appearance. Radiopacity may occur to varying degrees in different parts of the lesion and in this case it exhibits a layered appearance called ‘‘eggshell calcification’’. Tonsilloliths or tonsil stones are calcified deposits that generally form on tonsillar crypts unilateral or bilaterally in older individuals, seen as multiple, ill-defined, small radiopaque entities of varying sizes which superimposed on the middle parts of the ramus. It rarely reaches large sizes, and its density is close to the cortical bone.[8,9] Carotid artery calcifications occur in the damaged endothelium of the intima layer of the vessels. They are observed as numerous calcifications with a heterogeneous, irregular structure in the soft tissue in the postero-inferior aspect of the angulus mandible at the C4 intervertebral level.[7] Sialolith, antrolith, rhinolith, dacryolith, phlebolith and laryngeal calcifications detected in the head and neck region can be listed as idiopathic calcifications.[9,11] Submandibular sialoliths are seen superimposed on the

mandibular corpus or below, mesial to the angulus of the mandibula above the level of the hyoid bone. While the sialoliths localized in the duct are cylindrical and smooth-surfaced; those localized within the gland are large and irregularly bordered. Sialoliths originating from the parotid gland are superimposed on the superior 1/3 part of the ramus or located anterior or posterior to the ramus. They can be seen superimposed on the roots of premolar and molar teeth on periapical radiographs.[11] Antroliths are generally found on the sinus floor in the form of a regular/irregular structure, unilateral or bilateral, single or multiple radiopacities. Radiographically, the integrity of the sinus walls is generally intact. Rhinolith (nasal calculus) is seen as a well-circumscribed, flat or irregular, usually single radiopaque mass within the nasal fossa.[11] Phleboliths are commonly seen in the buccal mucosa, lips, salivary glands, mental and masseter region and they appear as numerous, round or oval, bull's eye or target-like appearance radiographically.[8,9]

The objective of this study is to determine the types and frequency of soft tissue calcifications that are encountered incidentally and can often be overlooked in panoramic radiographs of edentulous patients which taken for diagnostic and therapeutic reasons.

MATERIALS AND METHODS

1297 digital panoramic radiographs of edentulous patients who applied to Fırat University School of Dentistry for different reasons between 2013 and 2022 and had a consent form were evaluated retrospectively. All images had been taken using a panoramic radiographic system (Planmeca ProMax 3D mid, Planmeca OY, Helsinki, Finland) with the exposure settings of 10 mA, 85 kVp, and 14 sec. All examinations and measurements were made together under soft light by two dentists, a specialist and a research assistant. The length measurement tool and magnifying glass feature in the existing software (Metasoft) were used. 131 PRs with magnification and positioning errors were not included. The age and gender were recorded based on the Metasoft system. Calcifications were classified according to localization, number, structure, shape and appearance.

Statistical Analysis

IBM SPSS Statistics 22 program was used for statistical analysis. Compatibility of the parameters with normal distribution was evaluated with the Kolmogorov-Smirnov test. In addition to descriptive statistical methods (minimum, maximum, mean, standard deviation, median, frequency), the Kruskal Wallis test was used for comparisons between more than two groups of parameters that did not show normal distribution in comparing quantitative data and the Mann-Whitney U test was used for comparisons between two groups. Chi-Square, Fisher's Exact Chi-Square tests and Continuity (Yates) Correction were used to compare qualitative data. Significance was evaluated at $p<0.05$.

RESULTS

PRs of a total 1166 patients (539 female, 627 male) were evaluated and STCs were detected in 274 patients (23.5%). The ages of patients with calcification range from 36 to 88; 146 (53.3%) were male and 128 (46.8%) were female. The mean age was 64.45±9.06 years. Tonsillolith in 17.5%, carotid artery calcification in 10.6%, lymph node calcification in 4.8%, triticeous cartilage calcification in 2.1%, antrolith in 0.9%, rhinolith in 0.7%, sialolith in 0.4% and phleboliths were detected in only one patient (0.08%) of all cases (Table 1).

Among the 274 patients with calcification, 51.5% had one type of calcification, 39.4% had two types of calcification, 8.4% had three types of calcification and 0.7% had four types of calcification. The total calcification type ranged from 1 to 4, the average was 1.58±0.67 and the median was 1 (Figure 1).

Table 1: Prevalence of Soft Tissue Calcifications

Calcification Type	n	%
Carotid Artery Calcifications	124	10,6
Tritiseous Cartilage Calcifications	25	2,1
Tonsilloliths	204	17,5
Lymph Node Calcifications	56	4,8
Antroliths	11	0,9
Phleboliths	1	0,08
Rinoliths	8	0,7
Sialoliths	5	0,4

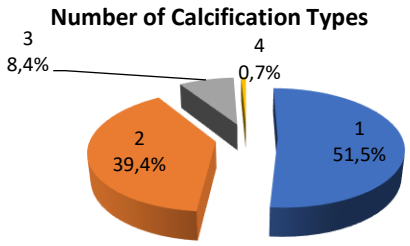

Figure 1: Prevalence of the number of calcification types

Among patients with calcification, the rate of carotid artery calcification in female (57.8%) was statistically significantly higher than in male (34.2%) (p:0.001; p<0.05).

The prevalence of tonsillitis in male (80.8%) was statistically significantly higher than in female (67.2%) (p:0.010; p<0.05). There was no statistically significant difference between genders in terms of the prevalence of other calcifications (p>0.05) (Table 2).

There was no statistically significant difference in terms of number of the calcification types between genders (p>0.05) (Table 3).

Among patients with calcification, the average age of patients with tonsilloliths was statistically significantly lower than those without tonsilloliths (p:0.033; p<0.05). There was no statistically significant difference in the mean age for other calcifications (p>0.05) (Table 4).

Table 2: Distribution of calcification types by gender

	Male (n=146)	Female (n=128)	
Calcifications	n (%)	n (%)	p
Carotid Artery Calcifications	50 (%34,2)	74 (%57,8)	[1]0,001*
Tritiseous Cartilage Calcifications	10 (%6,8)	15 (%11,7)	[2]0,235
Tonsilloliths	118 (%80,8)	86 (%67,2)	[1]0,010*
Lymph Node Calcifications	34 (%23,3)	22 (%17,2)	[1]0,212
Antroliths	8 (%5,5)	3 (%2,3)	[2]0,312
Phleboliths	0 (%0)	1 (%0,8)	[3]0,467
Rinoliths	5 (%3,4)	3 (%2,3)	[3]0,727
Sialoliths	1 (%0,7)	4 (%3,1)	[3]0,188

[1]Chi-square test [2]Continuity (yates) correction [3]Fisher's Exact Test *p<0.05

Table 3: Distribution of number of calcification types by gender

	Male (n=146)	Female (n=128)	
Total Number	n (%)	n (%)	p
1	76 (%52,1)	65 (%50,8)	0,177
2	61 (%41,8)	47 (%36,7)	
3 and above	9 (%6,2)	16 (%12,5)	

Chi-square test

Table 4: Evaluation of calcification types according to age

		Yaş		
		Min-Max	Ort±SS (medyan)	p
Carotid Artery Calcifications	Yok	40-81	63,8±8,6 (64)	0,183
	Var	36-88	65,3±9,5 (65)	
Tritiseous Cartilage Calcifications	Yok	36-88	64,4±9,2 (64)	0,801
	Var	54-85	65,3±7,1 (65)	
Tonsilloliths	Yok	36-87	66,6±9,5 (67)	0,033*
	Var	37-88	63,7±8,8 (64)	
Lymph Node Calcifications	Yok	36-88	64,4±9,3 (64)	0,866
	Var	49-81	64,8±7,9 (65)	
Antroliths	Yok	36-88	64,5±9,2 (65)	0,510
	Var	54-76	63,2±6,5 (62)	
Phleboliths	Yok	36-88	64,4±9 (65)	-
	Var	77-77	77	
Rinoliths	Yok	36-88	64,5±9,1 (65)	0,833
	Var	48-81	64,1±9,8 (63)	
Sialoliths	Yok	36-88	64,4±9,1 (65)	0,551
	Var	63-72	66,6±3,8 (65)	

Mann Whitney U test *p<0.05

There was no statistically significant difference in the number of calcification types in terms of average age (p>0.05) (Table 5).

Table 5: Evaluation of the number of calcification types according to age

	Age		
Total Number	Min-Max	Average±SD (median)	p
1	36-87	64,1±9,4 (64)	
2	37-88	65,3±9,2 (65)	0,276
3 and above	48-71	62,6±5,5 (64)	

Kruskal Wallis test

DISCUSSION

The rate of aged 60 and over in the world was 11% in 2006, this rate is expected to increase up to 22% in 2050. The world population has increased fourfold in the last 100 years between 1950 and 2050 and according to estimations the elderly population will increase tenfold and 7-69% of this population will be completely edentulous.[12-14] Although aging is not a cause of tooth loss, it is a fact that functional insufficiency that occurs with advancing age and the high frequency of dental and systemic diseases predispose elderly patients to be edentulous.[8] Considering the rate of edentulous patients in the general population, evaluation of positive findings detected on PR is essential for a successful dental treatment.

In the literature, the prevalence of STCs on PR has been reported to be between 2.61-19%.[7] In the present study, this rate was found to be higher. This result may be because of present study included edentulous and older age groups.

While STCs can be observed as a single type, more than one type of calcification can be seen together in the same patient. Çitir and Gündüz[7] detected more than one type of calcification with a rate of 3.7% in their studies. In the current study, the rate of patients with more than one type of calcification was found to be higher. The reason for this may be that the prevalence of systemic diseases are relatively higher in this population.

In the literature, the incidence of tonsilloliths on PR has been reported between 1.45-8.14%.[15-19] In the present study, it was more common than in the literature. Unlike studies stating that there is no difference between genders; the incidence of tonsilloliths in male was statistically significantly higher than female.[7, 17-19] While there are a few studies stating that the incidence of tonsilloliths is not related to age; there are more studies reporting that it increases with age.[7,20] The high rate of tonsillitis in the present study may be due to the fact that included patients were in the older age group and systemic diseases were more common in this group.

In the present study, carotid artery calcifications were determined as the second most common STC. Maia et al.[21]'s study, which included only older adults, carotid artery calcifications are reported as 12.5%, similar to current results. This may be due to the similarity of the populations included. Brito et al.[22] investigated the factors that may predispose to the formation of carotid artery calcification in young and elderly people and it was found that age was an important factor in the development of these calcifications. The authors reported that young people were nine times less likely to have carotid artery calcification than patients over 60 years of age.

In addition to the chronic nature of calcifications, the higher frequency of carotid artery calcifications in older adults may be due to the higher prevalence of related diseases such as diabetes, cardiovascular disease and severe chronic kidney disease in this age group.[21]

Although carotid artery calcifications are often asymptomatic, they can be an indicator of atherosclerotic disease, so detection by the dentist on routine PRs may enable early diagnosis of cerebrovascular and embolic diseases. This finding is especially important in older adults, as atherosclerotic disease can predispose to the development of cardiovascular disorders such as myocardial infarction and stroke, which are leading causes

of death in people aged 60 and over.[9,21]

Calcified lymph nodes are more easily distinguished from other calcifications with their irregular specific structure with often cauliflower-like appearance is evaluated together with their localization.[9] It has been reported that lymph node calcifications occur with a frequency of 0.1-3.6% in the literature.[15,16] Current results were similar to the literature. Triticeous cartilage calcification is differentiated from carotid artery calcifications by its more medial location and generally well-circumscribed, oval, smooth structure.[7, 23] Its incidence is reported to be 8.6-10.6%.[7,24] In the present study it was found to be lower than in the literature. In terms of gender, it was found to be higher in women, similar to the literature.[7]

In a recent study with a sample size of 9553 investigating the prevalence of STCs on PR, antroliths were reported as 0.8% and rhinoliths as 0.1%.[25] In the present study, the rates of antrolith and rhinolith were higher. In the same study, the sialolith rate was reported as 1.9%, which is similar to current results.[25] In another study investigating STCs on PR of 1175 patients, phlebolith was detected in only one patient.[21] Similarly, phlebolith was observed in only one patient among 1166 patients in the present study.

PR has disadvantages such as magnification, distortion and superposition as a result of imaging three-dimensional structures in two dimensions. Some researchers have reported that these calcifications can be better evaluated with advanced imaging methods such as computed tomography.[26,27] A limitation of the present study is that some calcifications cannot be detected on PR, even if they are present. However, the higher biological and financial costs of advanced imaging methods should also be taken into account.

CONCLUSION

STCs are incidental findings that commonly encountered during routine radiographic examination. It is important for dentists to diagnose the STCs observed on PR and to differentiate from existing anatomical structures and pathologies. Thus, it is possible to prevent unnecessary radiological examinations and treatments and also to refer patients for further examinations when necessary.

Ethical Approval

The ethical approval for this study was received by the Fırat University Non-Pharmaceutical and Medical Device ethics committee.

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The authors declare that this study received no financial support.

Conflict of Interest

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

Author Contributions

Study Design: MD, SCB. Data collection: MD. Analysis and interpretation of data: MD, SCB. Literature research: MD, SCB, Writing: MD, SCB.

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Assessing the Information Quality, Accuracy and Content of YouTube Videos on the Endo-Perio Lesions: A Cross-Sectional Study

Sevda DÜRÜST BARIŞ[1*] Dilek HANÇERLİOĞULLARI[2] Kubilay BARIŞ[3] Ali TÜRKYILMAZ[4] Ali ERDEMİR[5]

[1] Specialist Dentist, University of Kırıkkale, Faculty of Dentistry, Deparment of Endodontics, Kırıkkale, Türkiye, svdedrst@hotmail.com

[2] Assist. Prof., University of Kırıkkale, Faculty of Dentistry, Department of Endodontics, Kırıkkale, Türkiye, dilekefebora@gmail.com

[3] Assist. Prof., University of Kırıkkale, Faculty of Dentistry, Department of Periodontology, Kırıkkale, Türkiye, dt.bkubilay@gmail.com

[4] Assist. Prof., University of Kırıkkale, Faculty of Dentistry, Department of Endodontics, Kırıkkale, Türkiye, turkyilmaz_a@hotmail.com

[5] Prof.. University of Kırıkkale, Faculty of Dentistry, Department of Endodontics, Kırıkkale, Türkiye, erdemirali@hotmail.com

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ABSTRACT

Aim: The aim of this study is to evaluate and analyse the quality, accuracy and content of videos about endo-perio lesions on the Youtube platform.

Material and Methods: The search term "endo-perio lesions" was identified using the Google Trends application. On 1 December 2023, between 10:00 and 13:00, the term "endo-perio lesions" was searched on YouTube videos. The URLs of the first 200 videos were copied and the 40 videos that met the inclusion criteria were evaluated and scored for Global Quality Score (GQS), Modified DISCERN (mDISCERN) scale and completeness. Statistical analysis was conducted using descriptive statistics, as well as the Shapiro-Wilk and Mann-Whitney U tests. The significance level was determined as $p<0.05$.

Results: The highest average GQS (mean±SD: 4,40 ± 0,52), mDISCERN (mean±SD: 4,80 ± 0,42) and completeness score (mean±SD: 4,90 ± 1,45), were found in videos posted by dentists or specialists. Among the content of the 40 videos, the most frequently mentioned topic was 'treatment of endo-perio lesions' (%82.5), followed by 'clinical and radiographic findings' (%77.5), 'etiological factors' (%62.5) and 'diagnosis' (%62.5). Other topics included, in decreasing order, 'classification of endodontic lesions' (%55), 'prognosis (%50)', 'microbiology' (%10) and 'pathology' (%10).

Conclusion: It can be concluded that YouTube can provide valuable and useful information about endodontic lesions, within the limitations of this study. However, it is recommended to supplement this information with additional details on the prognosis, microbiology, and pathology of the lesions.

Endo-Perio Lezyonlar Konusundaki YouTube Videolarının Bilgi Kalitesinin, Doğruluğunun ve İçeriğinin Değerlendirilmesi: Kesitsel Bir Çalışma

Makale Bilgisi

Makale Geçmişi

Geliş Tarihi: 17.01.2024
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Anahtar Kelimeler:
Endodonti,
Endo-perio lezyonlar,
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Sosyal medya,
YouTube.

ÖZET

Amaç: Bu çalışmanın amacı YouTube platformunda endo-perio lezyonlarla ilgili videoların kalitesini, doğruluğunu ve içeriğini değerlendirmek ve analiz etmektir.

Gereç ve Yöntemler: Google Trends uygulaması ile arama terimi olarak "endo perio lesions" belirlendi ve 1 Aralık 2023 günü saat 10:00 ile 13:00 arasında YouTube videolarında "endo-perio lezyonlar" terimi arandı. İlk 200 videonun URL'leri kopyalanmış ve dahil edilme kriterlerini karşılayan 40 video Global Kalite Puanı (GQS), Modifiye DISCERN (mDISCERN) ölçeği ve video içerik bütünlüğü açısından değerlendirilerek puanlandı. İstatistiksel analiz, tanımlayıcı istatistiklerin yanı sıra Shapiro-Wilk ve Mann-Whitney U testleri kullanılarak yapıldı. Anlamlılık düzeyi $p<0,05$ olarak belirlendi.

Bulgular: En yüksek ortalama GQS (ortalama±SS: 4,40 ± 0,52), mDISCERN (ortalama±SS: 4,80 ± 0,42) ve video içerik bütünlüğü puanı (ortalama±SS: 4,90 ± 1,45) diş hekimleri veya uzmanlar tarafından yayınlanan videolarda bulundu. 40 videonun içeriğinde en sık bahsedilen konu 'endo-perio lezyonların tedavisi' (%82.5) olurken, bunu 'klinik ve radyografik bulgular' (%77.5), 'etiyolojik faktörler' (%62.5), ve 'tanı' (%62.5) takip etti. Diğer konular azalan sırayla 'endodontik lezyonların sınıflandırılması' (%55), 'prognoz' (%50), 'mikrobiyoloji' (%10) ve 'patoloji'yi (%10) içeriyordu.

Sonuç: Bu çalışmanın sınırları dahilinde YouTube'un endodontik lezyonlar hakkında değerli ve faydalı bilgiler sağlayabileceği sonucuna varılabilir. Ancak bu bilgilerin lezyonların prognozu, mikrobiyolojisi ve patolojisine ilişkin ek ayrıntılarla desteklenmesi önerilir.

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***Corresponding Author:** Sevda DÜRÜST BARIŞ, *svdedrst@hotmail.com*

INTRODUCTION

The periodontium is connected to the pulp by various anatomical structures, such as the dentinal tubules, the apical foramen and the lateral and accessory canals. This relationship can lead to the spread of infection, resulting in typical symptoms of endodontic-periodontal bone lesions. Pulpal and periodontal issues can interact and cause tooth loss in over 50% of cases. Therefore, managing the treatment of endo-perio lesions is crucial for preserving the tooth and achieving a positive prognosis.[1]

Although several classifications[2-6] have been proposed for endo-perio lesions, the most widely used one is the classification developed by Simon et al.[7] This classification comprises five subcategories: Primary Endodontic Lesions, Primary Endodontic Lesions with Secondary Periodontal Involvement, and Primary Periodontal Lesions. Primary Periodontal Lesion with Secondary Endodontic Involvement. “True” Combined Lesions.

Primary endodontic and periodontal lesions are generally easy to diagnose and treat clinically. The pulp remains vital in primary periodontal disease. However, in primary endodontic disease, the pulp is infected and non-vital and does not respond to vitality tests. Diagnosing endo-perio lesions can be challenging for dentists due to the clinical and radiographic similarities between secondary periodontal relationship and primary endodontic disease, secondary endodontic relationship and primary periodontal disease, or combined diseases.[8,9] However, there is a lack of current documentation providing information regarding current treatment protocols for endo-perio lesions.

Search engines on the internet allow people to quickly access to curious topics. YouTube is easily accessible and provides cost-free information to users. Since its official launch in The rapid increase in smartphone usage in November 2005 enabled YouTube videos to reach more users. Every day, 65,000 new videos are uploaded and 100 million videos are watched.[10]

YouTube has recently been the subject of academic studies due to its popular content production and impact on the masses. As patients and professionals frequently refer to YouTube for health-related issues, the accuracy and quality of the information on the platform is of utmost importance. Previous studies have analysed the quality, content and accuracy of dentistry videos on YouTube, covering topics such as dental implants, broken instruments, orthodontics and wisdom tooth surgery.[11-14]

According to the our researches, there is currently no study in the literature that evaluates the quality, content and accuracy of YouTube videos on endo-perio lesions. The aim of this study was to analyse the quality, content and accuracy of such videos on endo-perio lesions.

MATERIALS AND METHODS

Google Trends is a service that provides statistical information on word or sentence queries searched in Google, including their frequency, language, and geographic location. In this study, we consulted the search terms 'endo perio lesions', 'perio endo lesions', and 'Combined periodontic-endodontic lesions' using the Google Trends application. We found that 'endo perio lesions' is the most frequently searched term on the subject. On 1st December 2023, between 10:00 and 13:00, a search was conducted on YouTube (www.youtube.com) for videos related to endo-perio combined lesions in endodontics using the search term 'endo perio lesions'. YouTube search results were sorted by relevance, which is the default.

This study included the first 200 videos encountered. Two observers, each with at least 7 years of clinical experience in endodontics, further evaluated these videos. 160 videos,

which not contain visual and audio content, were not in English, were longer than 30 minutes, were duplicates, or were unrelated to the topic were excluded from evaluation (Table 1). The remaining 40 videos that met the inclusion criteria were analyzed by the two observers. All video links have been included as search results may vary over time after applying exclusion criteria. This study did not require approval from the local ethics committee as the survey data is publicly available on YouTube.

Table 1. Reasons for exlusion

Reasons	Value
Not in English	10
No audio	6
Duplicated	4
Longer than 30 minutes	10
Irrelevant	130
Total excluded	160

A literature review was conducted to assess the accuracy and currency of the videos. The investigators scored each video based on its information content regarding etiology, treatment, and prognosis on a scale of 0-2 (0 = incomplete, 2 = very complete), with a total score of 6. Another evaluation method used was the 5-point Global Quality Score (GQS) index. Videos were scored from 1 to 5 based on their quality, usefulness to patients, flow, educational value, and overall quality (Table 2). The reliability and accuracy of the information presented in the videos were evaluated using the 5-point mDISCERN scale, which was developed from the mDISCERN reliability tool. (Table 3).

Table 2. Global quality score

Scores description
1. Poor quality; Very unlikely to be of any use to patients
2. Poor quality but some information present; Of very limited use to patients
3. Suboptimal flow, some information covered but important topics missing; Somewhat useful to patients
4. Good quality and flow, most important topics covered; Useful to patients
5. Excellent quality and flow; Highly useful to patients

Table 3. The Modified DISCERN score (1 point for every yes, 0 points for no)

Item Questions
1.Are the aims clear and achieved?
2.Are reliable sources of information used? (i.e., publication cited, speaker is specialist in diabetes)
3.Is the information presented both balanced and unbiased?
4.Are additional sources of information listed for patient reference?
5. Are areas of uncertainty mentioned?

The videos covered the definition, causes, clinical and radiographic findings, diagnosis, classification, treatment, pathology, microbiology, and prognosis of endo-perio lesions. Each video was analysed to determine whether it covered these topics. Additional features such as video duration, upload date, likes, views, and source were also recorded. The study evaluated viewers' interactions by calculating the engagement index and view rate. The engagement index was calculated as the number of likes minus the number of dislikes divided by the total number of views, multiplied by 100%. The view rate was calculated as the number of views divided by the number of days since upload, multiplied by 100%. The videos were classified based on their source as Dentist / Specialist, Hospital / University, TV / YouTube channel, or commercial. In cases where there was disagreement among the researchers in the classification and scoring of the videos, a consensus was reached by conducting an unbiased and careful literature search.

Statistical Analysis

The SPSS 21.0 program was used to conduct the data analysis. Interobserver agreement was assessed through Fleiss Kappa analysis. The normal distribution of the data was checked using the Shapiro-Wilk test, and non-parametric tests were performed due to the parameters not being normally distributed. Pairwise comparison tests were conducted using the Mann Whitney U test. The confidence interval for the analysis was set at 95% with a significance level of 0.05 ($p<0.05$).

RESULTS

Following the application of inclusion and exclusion criteria, 40 out of 200 videos were included in the study. Table 3 presents the distribution of reasons for exclusion. The first video was uploaded in 2013, with 13 videos uploaded between 2013 and 2019, and 27 videos uploaded between 2020 and 2023. Descriptive statistics of video shares are presented in Table 4. The average length of YouTube videos discussing endo-perio lesions was found to be 24,45 minutes. The videos had an average of 998,50 views (Min.: 7 / Max.: 18000) and a viewing rate of 94,36 (Min.: 8,05 / Max.: 1666,66). On average, viewers interacted with the videos by giving 12,00 likes (Min.: 0 / Max.: 408) and 0.15 comments (Min.: 0 / Max.: 20). The videos had been installed for an average of 1080,00 days (Min.: 21 / Max.: 3600) (Table 4). Comparison of the quantitative data of the videos by source category is presented in Table 5.

Table 4. Descriptive statistics of the YouTube videos about Endo-perio lesions search term

Quantitative variable	Min	Max	Median	SD	IQR
Views	7,00	18000,00	998,00	3489,56	2355
Likes	0,00	408,00	12,00	68,00	39
Comments	0,00	20,00	0,15	3,31	1,00
Duration	0,00	29,00	23,00	16,96	31,75
Days since upload	21,00	3600,00	1080,00	960,82	720
Interaction index	0,00	14,28	1,86	2,81	1,94
Viewing rate	8,05	1666,66	94,36	322,39	224,22

SD: Standard deviation; IQR: Interquartile range; Min; Minimum; Max: Maximum

Table 5. Comparison of quantitative data of YouTube videos about Endo-perio lesions according to loading source

Quantitative variable	Dentist/Specialist (n=10) Median (Min; Max; IQR)	Hospital/University (n=6) Median (Min; Max; IQR)	Commercial (n=3) Median (Min; Max; IQR)	TV/Youtube (n=24) Median (Min; Max; IQR)	p value
Views	551,00 (87; 18000; 2939)[a]	653,5 (305; 8700; 7035)[a]	250,00 (1500; 2600; 10)[a]	100,00 (7; 11000; 1610)[a]	>0,05
Likes	23,50 (2; 408; 43)[a]	14,50 (3; 76; 61)[a]	22,00 (0; 45; 15)[a]	10,00 (1; 133; 37)[a]	>0,05
Comments	0,50 (0; 20; 1)[a]	0,00 (0; 1; 0)[a]	1,00 (0; 2; 0)[a]	0,00 (0; 5; 1)[a]	>0,05
Duration	15,50 (0; 29; 26,5)[a,b]	20,00 (10; 26; 6,25)[a]	29,67 (18; 29; 0) [b]	25,00 (3; 29; 37,5)[a,b]	**<0,05**
Days since upload	1080,00 (360; 2520; 308)[a]	900,00 (360; 2880; 1710)[a]	360,00 (360; 3600; 0)[a]	720,00 (21; 3600; 720)[a]	>0,05
Interaction index	2,87 (1; 5,53; 2,67)[a]	1,51 (0,75; 3,05; 2,08)[a,d,e]	1,46 (0; 1,80; 0)[b,c,d]	1,67 (0,15; 14,28; 2,09)[b,c,e]	**<0,05**
Viewing rate	47,86 (8,05; 1666,66; 265,52)[a]	165,00 (17,66; 805,55;369,37)[a]	416,66 (72,22; 694,44; 0)[a]	137,63 (14,02; 833,3; 170)[a]	>0,05

n: Number of videos; SD: Standard deviation; p: Significance level; IQR: Interquartile range; Min; Minimum; Max: Maximum, a-e: Different letter indicates statistical difference within the same line.

Based on the source of the uploaded videos, there were 10 (%25) videos in the Dentist/Specialist category, 6 (%15) in the Hospital/University category, 3 (%7,5) in the commercial category, and 21 (% 52,5) videos in the TV/YouTube channel category. The videos were ranked by number of views, with the Hospital/University category having the highest number of views, followed by the Dentist/Specialist category, the commercial category, and finally the TV/YouTube channel category (Table 5).

Based on the comparison test results from video sources, there was no statistical difference found between dentist/specialist and hospital/university sources in terms of quantitative variables ($p>0.05$) (refer to Table 5). However, the interaction index in the

dentist/specialist source (2,87) was significantly higher than that in the commercial source (1,46) (refer to Table 5). Table 5 shows that the interaction index in the dentist/expert source (2,87) was significantly higher than that in the TV/Youtube channel (1,67).

The completeness, Modified DISCERN and GQS scores are shown in Table 6. The weighted kappa value for inter-observer agreement was 0,84, 0,80, and 0,80 for completeness score, Modified DISCERN score, and GQS, respectively. No statistical difference was found in terms of completeness, Modified DISCERN score, and quality scores for the videos uploaded between dentist/specialist and hospital/university sources (p>0.05) (Table 6).

Table 6. Comparison of information completeness, accuracy and general quality scores according to the upload source of the videos

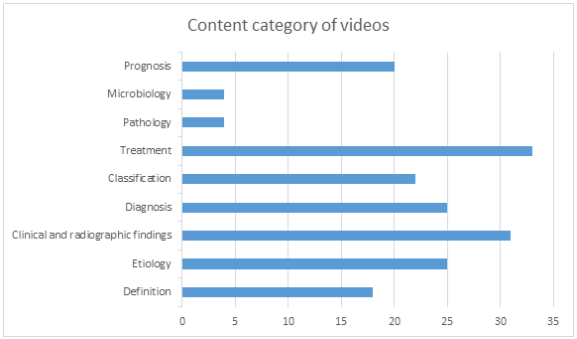
Scores	Dentist/Specialist (n=10) Median (Min; Max; IQR)	Hospital/University(n=6) Median (Min; Max; IQR)	Commercial (n=3) Median (Min; Max; IQR)	TV/Youtube (n=24) Median (Min; Max; IQR)	p value
Etiology	2,00 (1; 2; 1)^{a}	1,50 (0; 2; 1)^{a,b}	1,00 (0; 2; 0)^{a,b}	1,00 (0; 2; 1)^{b}	**p<0,05**
Treatment	2,00 (1; 2; 1)^{a}	1,00 (1; 2; 1)^{a,b}	2,00 (1; 2; 1)^{a,b}	1,00 (0; 2; 1)^{b}	**p<0,05**
Prognosis	2,00 (0; 2; 2)^{a}	1,00 (0; 2; 1)^{a}	2,00 (0;1; 1)^{a}	1,00 (0; 2; 1)^{a}	p>0,05
Overall Score (0-6)	5,50 (2; 6; 2)^{a}	4,00 (2; 4; 3)^{a,b}	5,00 (1; 4; 1)^{a,b}	3,00 (0; 6; 2)^{b}	**p<0,05**
mDiscern (1-5)	5,00 (4; 5; 0)^{a}	4,00 (4; 5; 1)^{a,d}	3,00 (2; 3; 1)^{c}	4,00 (3; 5; 2)^{b}	**p<0,05**
GQS (1-5)	4,00 (4; 5; 1)^{a}	3,00 (2; 5; 2)^{b,c}	3,00 (2; 3; 1)^{b,c}	3,00 (2; 4; 2)^{a,b,c}	**p<0,05**

n: Number of videos; SD: Standard deviation; p: Significance level; IQR: Interquartile range; Min; Minimum; Max: Maximum, a-d: Different letter indicates statistical difference within the same line

A statistically significant difference was found in the modified discern and GQS scores between videos uploaded by dentists/specialists and those uploaded by commercial sources (p<0.05). Modified Discern and GQS scores for videos uploaded by dentists/specialists were significantly higher than scores for videos uploaded from commercial sources (Table 6). A statistical difference was detected in terms of etiology, treatment, total score, modified discern and GQS scores for the videos uploaded between dentist/specialist and TV/Youtube sources (p<0.05). Etiology, treatment, total score, Modified Discern and GQS scores for the videos uploaded by the dentist/specialist were significantly higher than the scores in the videos uploaded from TV/Youtube sources (Table 6).

The 40 videos covered various topics related to endo perio lesions. The most commonly mentioned topic was the treatment of such lesions (%82,5), followed by clinical and radiographic findings (%77,5), etiology (%62,5), and diagnosis (%62,5). The remaining topics, in decreasing order of frequency, were classification of endo perio lesions (%55), prognosis (%50), microbiology (%10), and pathology (%10) (Fig. 1).

Figure 1. Frequency distribution of videos by content category



DISCUSSION

In today's digital world, the first sources used to research or get information about a subject are websites such as YouTube and Google. Websites have a significant role in our daily lives and have become increasingly important in various aspects. As well as showcasing patient experiences, YouTube also serves as a source of information for both patients and healthcare professionals. Videos

uploaded without scientific filtering may provide incorrect or incomplete information to patients and healthcare professionals.[15] Given the increasing use of the internet in healthcare, it is clear that the professionals should to do more to address this issue.

There are many studies in the literature that have been conducted using YouTube to analyse videos related to dentistry.[10-14,16,17] While some researchers reported that the content quality of YouTube videos on dental topics was adequate[16,17], some studies reported that the video content was inadequate.[14,18,19] Differences in the subject analysed, evaluation criteria and parameters used may have led to different results. To date, no other study has been found that analyses the quality, content and accuracy of videos about endodontic lesions on YouTube. The aim of this study was to assess the quality of information and content in videos on YouTube related to endo-perio lesions. YouTube offers various filter options, including 'video duration', 'upload date', and 'views'. For our study, we used the 'sort by relevance' filter, which has been found to be the most popular filter in previous research.[16-20]

The first video uploaded was in 2013, 13 videos were uploaded between 2013 and 2019, and 27 videos were uploaded between 2020 and 2023. The fact that the majority of videos were uploaded in the last 3 years may be due to the popularity of YouTube for sharing health content in recent years. Our study analysed a total of 40 videos that met the criteria. While some previous studies include a larger number of videos[16,18], others include a similar number of videos.[17,19] This study revealed that the interaction index of the dentist/expert upload source was significantly higher than that of commercial sources and TV/Youtube channel sources. However, it is important to note that the ranking of videos on YouTube can impact their interaction and viewing rates. Therefore, videos with accurate and comprehensive information may not always appear at the top, resulting in lower viewing rates.

Singh et al. (2012) developed the mDISCERN score to estimate the reliability and clarity of information in YouTube videos, which was used in this study.[21] The study employed the GQS to assess the quality of patient information, consistent with prior research.[17,19] In addition, the quality and accuracy of the information in the videos were determined using the completeness score, in line with previous studies.[13,14,17] The GQS and mDISCERN scores of the dentist/expert upload source were significantly higher than those of commercial sources and TV/Youtube channel sources. In addition, the GOS, mDISCERN and completeness scores of the dentist/expert source were found to be higher than all other sources, although not statistically significant. Consistent with previous studies[14,16,17], it is expected and acceptable that the quality, accuracy, and completeness scores of videos uploaded by dentists and professionals are higher than those from other sources.

The most commonly mentioned topic was the treatment of such lesions (%82.5), followed by clinical and radiographic findings (%77.5), etiology, and diagnosis (%62.5). The topics that were least frequently mentioned included prognosis (%50), microbiology (%10), and pathology of the lesions (%10). There is a lack of content on YouTube regarding the microbiology (%10) and pathology of endo-perio lesions (%10).

This study has limitations, particularly in the classification of videos according to their sources. For instance, some videos may belong to multiple categories such as dentist/specialist and TV/Youtube channels. One limitation of this study is that the results may vary depending on the chosen keywords. The search term used in this study was selected based on Google Trends application data. Furthermore, due to the dynamic nature of YouTube[16], the order of search results is subject to constant change as a result of viewer interaction over time.[22] It is important to note that the data collection

method used in this study was instantaneous, which is a limitation shared by similar studies. Another limitation of this study was that only English language videos were included in the study. Since there are many countries where English is not the native language, changing the target audience in cases where the search term is not written in English may have affected the results of the study.

A further limitation of the study is that the videos of endo-perio lesions were not evaluated by a periodontist, and video analysis was performed only by endodontists. Furthermore, the classification scoring of endo-perio lesions was not conducted in accordance with the most recent and updated classification.[23] Since it is more widely known and used, Simon et al.[7] it was made based on the endo-perio lesion classification made by. This constitutes an additional limitation of the study. There is a significant lack of information on YouTube regarding the new classification. It is therefore necessary to create informative expert-led videos on this subject.

Based on the limitations of this study, it can be concluded that YouTube may serve as a valuable source of information for endo-perio lesions. However, it is recommended to supplement this information with additional details on the prognosis, microbiology, and pathology of the lesions.

CONCLUSION

The information quality and accuracy of videos uploaded to YouTube about endodontic lesions was generally considered sufficient. To improve the information available on YouTube about endo-perio lesions, it is recommended to eliminate gaps in knowledge regarding their prognosis, microbiology, and pathology. The quality and accuracy of videos about endo-perio lesions uploaded by dentists/experts is higher than other uploader sources. Dentists should be aware of dental information available on YouTube and other websites. Healthcare professionals should oriented the patients to up-to-date resources with accurate information.

Ethical Approval

Bu çalışmada insanlardan ya da hayvanlardan elde edilen kaynaklar kullanılmadığından etik kurul onayı alınmamıştır.

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Conflict of Interest

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

Author Contributions

Design: SDB, DH, KB, AE. Data collection and processing: SDB, KB. Analysis and interpretation: SDB, AT, AE. Literature review: SDB, DH, AT, KB. Writing: SDB.

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Examination of Mandibular Lingual Foramen Variations with Cone Beam Computed Tomography: A Pilot Study

Merve ÇAKIR[1*] Cansu BÜYÜK[2]

[1] Assist. Prof., İstanbul Okan University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, İstanbul, Türkiye, dtmervecakir@gmail.com

[2] Assoc. Prof., İstanbul Okan University, Faculty of Dentistry, Department of Oral and Maxillofacial Radiology, İstanbul, Türkiye, cansu.buyuk@okan.edu.tr

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ABSTRACT

Aim: The aim of this study was to determine the number, location, dimensions, and distance from the lower edge of the mandible and the crest of the medial and lateral lingual foramen (MLF-LLF) in cone beam computed tomography (CBCT) images and to evaluate the relationships with age and gender.
Material and Methods: The locations of MLF and LLF were identified in cross CT sections and their numbers, the dimensions of the foramen, the distances were recorded, and relationships with age and gender were evaluated.
Results: The study included 93 patients (mean age 39.85±13.28 years), with 48 male and 45 female participants. One MLF was found in 48 patients, 2 in 33 patients, 3 in 5 patients, and no MLF in 7 patients. 1 LLF was detected in 32 patients, and 2 LLF in 5 patients. No foramen was found in 5 patients. The MLF dimensions and the distance of the MLF to the lower edge of the mandible in men were found to be significantly higher than women. It was determined that as age increases, the distance of MLFs from the lower edge of the mandible increases. MLFs were mostly located above the genial tubercle. A total of 16 LLFs were identified in the anterior region outside the midline, 20 LLFs in the premolar region, and 6 in the molar region.
Conclusion: This study revealed that LFs were predominantly located in the midline and in the inter-foraminal area. A detailed radiological examination of these areas must be performed before the operations.

Mandibular Lingual Foramen Varyasyonlarının Konik Işınlı Bilgisayarlı Tomografi ile İncelenmesi: Pilot Çalışma

Makale Bilgisi

Makale Geçmişi

Geliş Tarihi: 14.01.2024
Kabul Tarihi: 25.04.2024
Yayın Tarihi: 30.08.2024

Anahtar Kelimeler:
Konik ışınlı bilgisayarlı tomografi,
Lingual foramen,
Mandibula.

ÖZET

Amaç: Bu çalışmada, konik ışınlı bilgisayarlı tomografi (KIBT) görüntülerinden medial ve lateral lingual foramenlerin (MLF-LLF) sayısı, yerleşimi, boyutları, mandibula alt kenarı ve kret tepesine olan uzaklıklarının belirlenmesi ve bu verilerin yaş ve cinsiyetle olan ilişkilerinin değerlendirilmesi amaçlanmıştır
Gereç ve Yöntemler: Tomografi kesitlerinde MLF ve LLF lokasyonları belirlenmiş ve sayıları kaydedilmiştir. Foramenlerin boyutları, mandibula alt kenarı ve alveol kret tepesine olan mesafeleri ölçülmüş ve yaş ve cinsiyetle olan ilişkileri değerlendirilmiştir.
Bulgular: Çalışmaya dahil edilen 93 hastanın 48'i erkek, 45'i kadındır ve hastaların yaş ortalaması 39.85±13,28'dir. 48 hastada 1 tane MLF, 33 hastada 2 tane, 5 hastada ise 3 tane bulunurken sadece 7 hastada MLF bulunamamıştır. 32 hastada 1 tane LLF, 5 hastada ise 2 adet LLF tespit edilmiştir. 5 hastada ise foramen bulunamamıştır. Erkeklerin MLF boyutları ve MLF'lerinin mandibula alt kenarına uzaklıkları, kadınlara göre anlamlı düzeyde daha yüksek bulunmuştur. Yaş arttıkça MLF'lerin mandibula alt kenarı ile olan mesafesinin arttığı belirlenmiştir. MLF'lerin çoğunlukla genial tüberkül üstünde yer aldıkları belirlenmiştir. LLF'lerin 16 tanesinin orta hat harici anterior bölgede, 20 tanesinin premolarlar sahasında, 6 tanesinin de molar bölgede olduğu belirlenmiştir.
Sonuç: Bu çalışmanın sonucunda; LF'lerin çoğunlukla orta hatta ve mental foramenler arası sahada olduğu görülmüştür. Cerrahi operasyon öncesi bu sahaların radyolojik muayenesinin detaylı bir şekilde yapılması gerekmektedir.

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***Corresponding Author:** Merve ÇAKIR, *dtmervecakir@gmail.com*

INTRODUCTION

Before surgical operations on the mandible, it is essential to precisely determine the location of the anterior extension of the inferior alveolar canal (IAC), the presence of lingual concavity, and the location of crucial anatomical structures such as the lingual canal, foramina and accessory mandibular canals.[1]

Many surgical procedures are performed in the mandible and inter-foraminal region, such as placing dental implants, orthognathic surgery, and obtaining autogenous grafts, and this area is considered as relatively 'safe and simple' area by surgeons. However, this region contains critical anatomical structures such as sublingual, submental, and incisive arteries and the anastomoses formed by these arteries. Perforation of the lingual cortex during the operation and bleeding that may occur due to damage to these structures may lead to life-threatening complications that may cause airway obstruction.[2,3]

Arterial branches arising from these anastomoses penetrate the mandible through the lingual foramen (LF) to provide nutrition to the mandible.[4] Lingual foramina associated with intrabony canals are divided into two: medial and lateral lingual foramina. Medial lingual foramen (MLF) is located in the midline and almost everyone has at least one.[2,4,5] The lateral lingual foramen (LLF) can be seen through the mandible, particularly between the midline and premolar teeth.[2,4]

When any surgical operation is planned in the mandibula anterior region, the anatomical locations of the lingual canal and foramen must be determined precisely and in detail.[2,3] Conventional periapical and panoramic radiographs are insufficient to determine this anatomical structure before the operation.[2-4] Cone beam computed tomography (CBCT) images enable a three-dimensional examination of the hard tissues in the operation area before surgery and the location of anatomical structures in detail. Bone canals on the lingual surface of the mandible are visible in cross-sections of CBCT images and these images are very useful to reduce the possibility of complications.[2,3]

In this study, it was aimed to determine the number, location, dimensions, and distances to the lower edge of the mandible and the crest of the medial and lateral lingual foramen on CBCT images of a specific population and to evaluate the relationships of the obtained data with age and gender.

MATERIAL AND METHOD

In this retrospective study, the images of 120 patients who had lower jaw CBCT scans performed for various reasons (such as the presence of impacted teeth, cysts or tumors, implant planning, pre-surgical planning, temporomandibular joint diseases, malocclusion) at Istanbul Okan University Faculty of Dentistry Hospital between 2022 and 2023 were examined. The research was approved by the Istanbul Okan University Ethics Committee decision numbered 168-19.

In the Power analysis performed with G*Power (Heinrich Heine University Düsseldorf) software, based on similar studies,[2-4] it was calculated that working with 90 samples is appropriate. The mandibular tomography images with no image artifacts due to patient position or movement, the absence of a foreign object, and standard exposure parameters (96 kV, 5.6 mA, 12 s, 200 mm voxel size, 13x9 mm or 13x5.5 mm imaging areas) were included in the study. Tomography images with diseases such as fibrous dysplasia, medication related osteonecrosis of the jaw (MRONJ), and multiple myeloma that cause changes in bone density, insufficient diagnostic quality, exposure parameters outside the specified standard values, missing teeth in the premolar area, and images of patients under 18 years of

age were excluded from the study. As a result of the preliminary investigation, 10 images were excluded because of edentulousness, 9 images were excluded because of pathology in the relevant region, 8 images were excluded because of artifacts, and images of 93 patients were included in the study.

Images were examined in Romexis dental imaging software (Planmeca, Helsinki, Finland) by two observers (an oral and maxillofacial surgeon, and a dentomaxillofacial radiologist both with over 10 years of experience) with different clinical and radiological experiences. Both observers completed the assessments separately; 20 tomography images were chosen at random to determine intra-observer agreement; and two weeks after the first measurements were finished, both observers repeated the assessments. Cross-sectional tomography images were used to identify the MLF and LLF locations, and their numbers were noted. The measurements include the foramen dimensions as well as their distances from the alveolar crest superior surface and the mandible inferior border (Figures 1, 2, and 3). MLFs were named MLF1, MLF2, and MLF3 according to the order of their detection starting from the crest, and LLFs were named LLF1, and LLF2 according to the order of their detection from the midline to the distal.

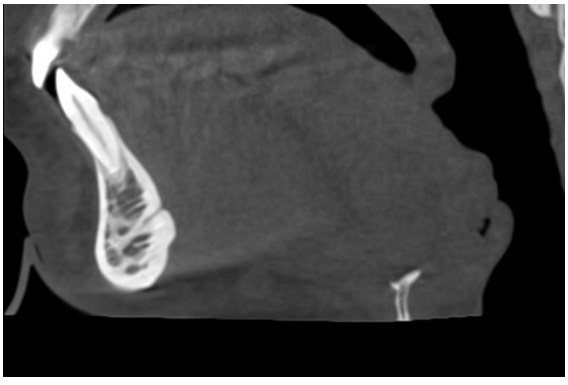

Figure 1: MLF is positioned on the genial tubercle in the midline of the lower jaw.

(MLF: Medial Lingual Foramen)

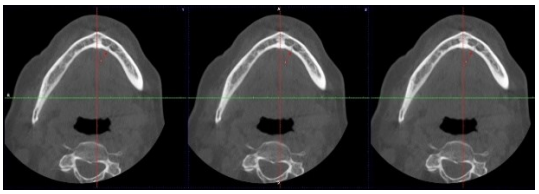

Figure 2: LLF observed in CBCT images is shown with a red arrow in consecutive axial sections.

(LLF: Lateral Lingual Foramen, CBCT: cone-beam computed tomography)

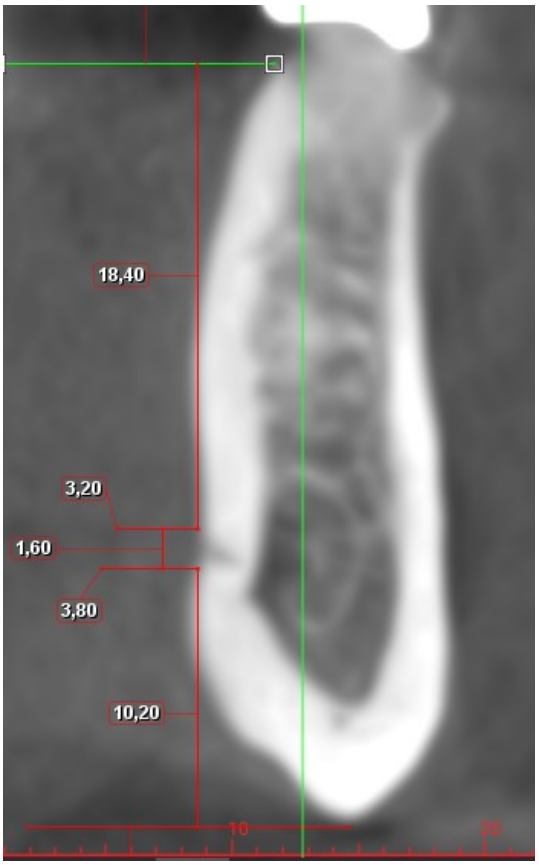

Figure 3: Measurement of the size and distance of the foramen from the top of the alveolar crest and the inferior cortex.

Statistical analysis:

Intra-observer and inter-observer agreements were measured by Cohen's Kappa coefficient. Categorical data are expressed with frequency and percentage rate; whereas numerical data are expressed as mean ± SD. The relationship between independent variables was analyzed with Spearman's rho correlation test and Mann Whitney U test. SPSS 21.0 (SPSS, Chicago, IL, USA) program was used in data analysis. Type I error level was accepted as 0.05.

RESULTS

The mean age of the 93 individuals who were included in the study was determined as 39.85±13.28, with 48 of them male and 45 female.

Detailed information about the number and location of the foramina is given in Table 1. One MLF was found in 48 patients, 2 in 33 patients, and 3 in 5 patients, only 7 patients had no foramen. One LLF was detected in 32 patients, and 2 LLFs were detected in 5 patients. In 5 patients, neither LLF nor MLF was found.

Table 1: Foramen frequencies and locations

	n	%
Medial Lingual Foramen		
One	48	51.61
Two	33	35.48
Three	5	5.37
None	7	7.52
Location		
Under the genial tubercle	54	41.86
Above the genial tubercle	75	58.13
Lateral Lingual Foramen		
One	32	34.4
Two	5	5.37
None	56	60.21
Location		
Anterior	16	38.09
Premolar	20	47.61
Molar	6	14.28

Table 2 shows the comparison of MLF and LLF numbers by gender, the MLF and LLF numbers did not differ significantly by gender ($p>0.05$). Additionally, it was determined that there was no significant relationship ($p>0.05$) between MLF and LLF numbers and age (Table 3).

Table 2: Comparison of MLF and LLF Frequencies by Gender

Parameter	Gender	Med (SS)	Z	p
MLF	Female Male	1.39 (0.66) 1.58 (0.66)	-1.17	0.240
LLF	Female Maler	1.28 (0.49) 1.00 (0.00)	-1.25	0,210

Test: Mann Whitney U, $p<0.05$
(MLF: Medial Lingual Foramen, LLF: Lateral Lingual Foramen)

Table 3: Relationship Between MLF and LLF and Age

	Age	
Parameter	**r**	**p**
MLF	-0.002	0.882
LLF	0.195	0.544

Test: Spearman's rho correlation test, $p<0.05$
(MLF: Medial Lingual Foramen, LLF: Lateral Lingual Foramen)

In the gender comparison of MLFs' size and the distances from the alveolar crest and the inferior border of mandible, it was determined that MLF1 dimensions and distances from the inferior border of the mandible were significantly different between genders. MLF1 dimensions and distances of MLF1 from the inferior border of the mandible in men are significantly higher than in women (Table 4).

Table 4: Comparison of MLF Parameters by Gender

Parameter	Gender	n	Med (SS)	Z	p
MLF1 Size	Female Male	42 45	1.53 (0.54) 1.82 (0.51)	-2.65	**0.008**
MLF1 Cret	Female Male	42 45	13.93 (3.57) 16.05 (5.93)	-1.61	0.108
MLF1 Inf	Female Male	42 45	12.22 (4.00) 13.21 (5.25)	-2.13	**0.033**
MLF2 B Size	Female Male	16 22	1.50 (0.45) 1.49 (0.56)	-0.36	0.720
MLF2 Cret	Female Male	16 22	23.56 (4.19) 24.12 (5.45)	-0.44	0.657
MLF2 Inf	Female Male	16 22	3.38 (2.50) 5.15 (3.19)	-1.88	0.060
MLF3 Size	Female Male	1 4	1.00 (.) 1.56 (0.40)	-1.41	0.157
MLF3 Cret	Female Male	1 4	26.00 (.) 20.90 (4.20)	-1.41	0.157
MLF3 Inf	Female Male	1 4	1.40 (.) 4.65 (4.65)	-1.45	0.147

Test: Mann Whitney U, $p<0.05$

Size: The distance at which the foramen is widest in the mesiodistal direction, Crest: The distance between top the alveolar crest and the foramen, Inf: The distance between the foramen and the inferior border of the mandible, MLF: Medial Lingual Foramen

Table 5 shows the results of the relationship between MLF parameters and age. Accordingly, it was determined that there was a positive and significant relationship between the distance of MLF1s from the inferior border of the mandible and age. It was revealed that as age increases, the distance of MLF1s to the lower edge of the mandible increases.

Table 5: Relationship Between MLF Parameters and Age

	Age	
Parameter	**r**	**p**
MLF1 Size	-0.118	0.170
MLF1 Cret	-0.030	0.784
MLF1 Inf	0.261	**0.015**
MLF2 Size	-0.132	0.428
MLF2 Cret	0.265	0.108
MLF2 Inf	-0.129	0.439
MLF3 Size	0.300	0.624
MLF3 Cret	0.200	0.747
MLF3 Inf	-0.718	0.172

Test: Spearman's rho correlation test, $p<0.05$

Size: The distance at which the foramen is widest in the mesiodistal direction, Crest: The distance between top of the alveolar crest and the foramen, Inf: The distance between the foramen and the inferior border of the mandible, MLF: Medial Lingual Foramen.

There was no statistically significant difference ($p>0.05$) when examining the association between gender and position of MLFs above or below the genial tubercle.

LLF was seen in a total of 37 patients. While 1 LLF was observed in 32 patients, 2 LLFs were detected in 5 patients. It was determined that 16 (38.1%) of the LLFs were in the anterior region outside the midline, 20 (47.6%) were in the premolar region, and 6 (14.2%) were in the molar region.

The relationship between LLF locations, age and gender were examined, and no statistically significant difference was found ($p>0.05$).

The dimensions of the LLFs and their distance from the alveolar crest and the inferior border of the mandible were examined according to age and gender, and no statistically significant difference was found ($p>0.05$).

DISCUSSION

Each location within the maxillofacial area has unique anatomical and dental characteristics. As a result, an extensive radiological examination of the relevant region needs to be performed prior to dental implant treatment or any surgical operations. The jaws have many unnamed accessory foramina. Lingual foramina are usually observed in the midline and the area between the premolars, where nerves and vessels exit, especially on the lingual side of the lower jaw.[6] The presence of LFs is crucial for bleeding because it increases the risk of lingual cortex perforation during implant placement, especially in ridges with thin bucco-lingual direction.[5] Perforation of the lingual cortex during surgery in the inter-foraminal area can cause excessive bleeding and life-threatening complications due to lingual artery damage. In the literature, there are some case reports [7-9] that present this complication. To control these complications, patients were urgently hospitalized, intubated, and operated to remove the hematoma. The objective of this study was to reduce the risk of clinicians experiencing this kind of complication by providing information about the positions and dimensions of LLFs and MLFs.

It is very difficult to identify LFs using conventional radiographic methods.[10] CBCT provides detailed three-dimensional imaging of the structures in the jaw at high resolution.[6] In this study, determining the number, location, and size of LFs, and evaluating the relationship of these data with age and gender to give clinicians an idea in pre-operative evaluations is aimed by examining CBCT images.

Classification of LFs varies according to studies. In some studies,[2,3,11-14] the LFs located in the midline were referred to as medial lingual foramen, those outside the midline as lateral lingual foramen, and in the other studies, [1,5,15,16] the foramina located in the entire mandible lingual were referred to as LF and examined. While in some studies, [11,15] only the LFs in the inter-foraminal area were examined, in others,[1-3,5,12-14,16] the LFs in the entire mandible were examined. In this study, the LFs located in the midline were referred to as MLF, while the LFs located outside the midline were referred to as LLF, and the entire mandible was examined. Complications may increase if the radiographic examination fails to evaluate the entire jaw, and the relatively "safe and simple"

inter-foraminal area is not examined precisely.

Absence of LF in the mandible is extremely rare.[13] Sekerci et al. [1], Demiralp et al. [17] and Taschieri et al. [13] stated that there were very few patients without LF in their study, and in this study, LF could not be detected in only 5 patients, supporting previous studies.

Studies indicated that approximately 3–3.8% of individuals showed absence of the lingual foramen in the midline. Kuzu et al. [18] examined MLF in 136 patients and found that each individual had at least one MLF.[3,14] In this study, MLF was not found in 7.52% (7 patients), and it was thought that this may be related to the population that included in the study. Studies [3,13,14,19] examining the number of MLFs reported that the highest rate was two foramina in the midline; however, in this study, one MLF was observed in 51.6% of cases, and a maximum of three foramina were detected in a patient. According to researches [1,6,13,19] analyzing whether MLFs are placed below or above the genial tubercle, MLFs are generally positioned above the genial tubercle, supporting this study. These findings point out that caution should be taken when lifting the flap in the midline, beginning at the top of the ridge.

When comparing MLF sizes and locations with age and gender, it was observed that MLF sizes and, the distance of MLFs to the inferior edge of the mandible were greater in men, and the MLF size increased with age. These findings are consistent with previous studies.[3,4,11] This demonstrates the need for caution when operating on the mandible of elderly and male patients.

In this study, LFs located outside the midline were named LLF, and the entire lower jaw was examined. The presence of LLF was mostly observed in the premolar region, followed by the anterior region, excluding the midline. The results of studies investigating LLFs[2-5,12,16] also support these findings. These findings indicate the need for extra care while operating in the inter-foraminal region. Also, it was determined that the prevalence of LLF was not influenced by gender or age.

Studies examining the dimensions of the LLFs and their distances from the crest and inferior edge of the mandible have shown that LLF dimensions are greater in males, while the distance between LLFs and the inferior edge and crest of the mandible is shorter in females.[2-4,20] In this study, no statistically significant difference was found in terms of these parameters, and it was thought that this may be due to the population included in the study.

The present study has certain limitations, and there is room for improvement in future research directions. The sample size comprised a specific number of patients from a single center sharing similar geographic characteristics within a specific timeframe. Future studies investigating the variations of LF in diverse and larger populations will enhance our comprehension of these variations and potentially mitigate associated complications.

CONCLUSION

As a result of this study, it was observed that the lingual foramen was mostly located in the midline and in the inter-foraminal area. In order to avoid serious complications in this area, which is considered as relatively 'safe area' for surgical operations, a detailed radiological examination must be performed before the operation.

Ethical Approval

The research was approved by the Istanbul Okan University Ethics Committee decision numbered 168-19.

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Conflict of Interest

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

Author Contributions

Design: MÇ, CB. Data collection or data entry: MÇ, CB. Analysis and interpretation: MÇ, CB. Literature search: MÇ. Writing: MÇ, CB.

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When Should Direct Pulp Capping or Pulpotomy Be Preferred In Deciduous Teeth?

Melek BELEVCİKLİ[1] **Edanur ÇAKIR**[2*]

[1] Assist. Prof., Zonguldak Bülent Ecevit University, Faculty of Dentistry, Department of Pedodontics, Zonguldak, Türkiye, mbelevcikli@hotmail.com

[2] Res. Ass., Zonguldak Bülent Ecevit University, Faculty of Dentisrty, Department of Pedodontics, Zonguldak, Türkiye ckredanur@gmail.com

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ABSTRACT

Dental caries is a serious health problem with too high prevalence among children. It can affect the pulp and lead to infection, fistulas, abscesses, and premature tooth loss. The main purpose of pulp treatment in the primary teeth is to maintain health of teeth and oral tissues, thus, preserving functions of orofacial complex, such as chewing, speaking, and to keep primary teeth in position to maintain the arch size until the permanent teeth erupt. Contemporary pediatric dentistry seeks new materials and strategies to stimulate the regenerative ability of dental tissues. Dentists must be aware of the most suitable treatment choices to keep pulp tissue vitality. Vital pulp therapies (VPT) consist of indirect pulp capping, direct pulp capping, and pulpotomy for the treatment of deep carious lesions in teeth without a history of pain or with reversible pulpitis. VPT is used to treat reversible pulpal inflammation and maintain vitality and functionality of the pulp. Due to its high internal resorption and failure rate, direct pulp capping is still a controversial treatment choice for deep carious lesions. In this review, studies on direct pulp capping and pulpotomy treatments of VPT in primary teeth are presented together.

Direkt Pulpa Kuafajı Mı Yoksa Pulpotomi Mi: Süt Dişlerindeki Derin Çürük Lezyonlarının Tedavisinde Hangisi Daha İyidir?

Makale Bilgisi

Makale Geçmişi

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Anahtar Kelimeler:
Vital Pulpa Tedavileri,
Direkt Pulpa Kuafajı,
Pulpotomi.

ÖZET

Diş çürüğü, pulpa canlılığını etkileyebilen ve sonuçta enfeksiyona, apselere, fistüllere ve bununla birlikte erken diş kayıplarına yol açabilen, çocuklar arasında çok yüksek bir yaygınlık sergileyen, önemli bir sağlık sorunudur. Süt dişlenme döneminde pulpa tedavisinin temel amacı, oro-fasiyal kompleksin çiğneme, konuşma, estetik gibi fonksiyonlarını sürdürmek için dişlerin ve onları destekleyen dokuların sağlığını sürdürmek ve süt dişlerini daimi dişler sürene kadar ark boyutunun korunması için mevcut konumlarında tutmaktır. Modern pediatrik diş hekimliği, diş dokularının rejeneratif kapasitesini uyarmak için yeni stratejiler ve materyaller arar. Diş hekimleri pulpa dokusunun canlılığını korumak için en uygun tedavi seçeneklerini bilmelidir. Vital pulpa tedavileri (VPT), ağrı öyküsü olmayan veya reversibl pulpitisli dişlerdeki derin çürük lezyonlarının tedavisine yönelik indirekt pulpa kuafajı, direkt pulpa kuafajı ve pulpotomiden oluşur. VPT'nin amacı, geri dönüşümlü pulpal inflamasyonu tedavi etmek, pulpa canlılığını ve fonksiyonlarını korumaktır. Süt dişlerinde derin çürük lezyonlarının tedavisinde direkt pulpa kuafajı yüksek internal rezorbsiyon ve başarısızlık oranı nedeniyle hala tartışmalı bir tedavi seçeneğidir. Bu derlemede, süt dişlerinde vital pulpa tedavilerinden direkt pulpa kuafajı ve pulpotomi tedavileri ile ilgili araştırmalar bir arada sunulmuştur.

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***Corresponding Author:** Edanur ÇAKIR, *ckredanur@gmail.com*

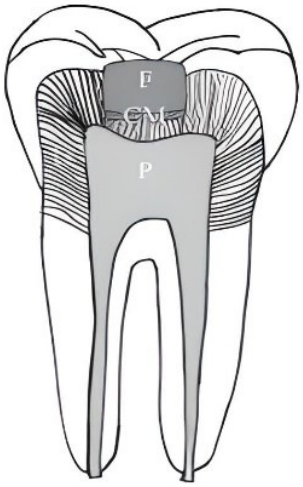
INTRODUCTION

The prevelance of dental caries is high in children, which can have an impact on pulp vitality and lead to infection, fistulas, abscesses, and premature tooth loss.[1] Due to the lack of access to dental treatment, lack of oral hygiene education, and the absence of symptoms of the tooth, treatment is usually performed when the dental caries reaches a profound and cavitated stage that involves the pulp, depending on the degree of progression.[2] Health of teeth and oral tissues in the primary teeth is maintained by pulp treatment to preserve orofacial complex functions, including speaking, chewing, and maintaining primary teeth in their current position and arch size until the permanent teeth erupt.[3]

The evaluation of primary teeth's pulp therapy is relies on clinical and/or radiographic evidence.[4] The absence of any signs or symptoms, such as abscess, swelling, pain, sensitivity to percussion, fistula, and excessive mobility of the tooth, determines clinical success. Periapical and/or radicular radiolucency, absence of phatological root resorption and cystic growth, primary tooth exfoliation and normal physiological resorption, healthy supporting tissues, normal development and eruption of permanent tooth are the basis for measuring radiographic success.[5] The criteria mentioned are not a reliable indicator of treatment success. Histological evidence is the most trustworthy indicator of a pulp treatment's failure or success. Clinical judgment is based on preset standards, but histological investigation remains the ultimate gold standard for determining pulp state.[6] Modern pediatric dentistry seeks novel materials and strategies that can stimulate the regenerative capacity of dental tissues, and dentists must be aware of the most suitable treatment options to maintain pulp vitality.[7]

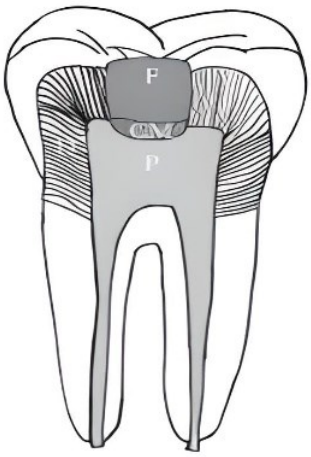
Vital pulp therapies (VPT) include direct pulp capping, indirect pulp capping, and pulpotom for treating deep carious lesions without reversible pulpitis or a history of pain (Figures 1,2 and 3).[8] Reversible pulpitis describes mild to moderate inflammation of the pulp caused by noxious stimuli, in which the pulp can return to a non-inflamed state after removal of the stimuli.[10] The discomfort experienced when a cold or sweet stimulus is applied disappears a few seconds after the stimulus is removed.[10] The purpose of VPT is maintain pulp vitality and function and to treat reversible pulpal inflammation.[11]

Figure 1: Schematic representation of indirect pulp capping in primary teeth



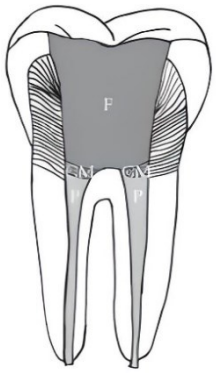
(D = Dentin; P = Pulp; CM = Covering material; F = Filling).

Figure 2: Schematic representation of direct pulp capping in primary teeth



(D = Dentin; P = Pulp; CM = Covering material; F = Filling).

Figure 3: Schematic representation of pulpotomy in primary teeth



(D = Dentin; P = Pulp; CM = Covering material; F = Filling).

Vital pulp therapies

VPT aims to preserve and maintain damaged pulp in cases where the pulp hasn't become necrotic and/or degenerated due to caries, trauma, or restorative processes. [12] The treatment methods used in VPT are determined by the exposure of dental pulp. VPT's success is related to appropriate vascularization, which is essential for the vitality of the pulp and, particularly, the active formation and function of odontoblasts.[13]

Indirect pulp capping

Indirect pulp capping (IDPC) is done on a tooth with deep carious lesion approaching the pulp, but there are no symptoms or signs of pulpal degeneration.[14] In the case of pulpal degeneration, the pain usually persists after the cause is eliminated, but can be increased by heat, and sometimes cold is good. However, continued cold can aggravate the pain. The pain is usually defined as sharp piercing or shooting, and is often severe.[10]

Indirect pulp treatment is preferred if the cavity is large and the pulp is not exposed.[15] To prevent pulp exposure, this method involves removing large caries and leaving enough caries on the pulp horn to prevent exposure. The cavity is typically sealed with a biocompatible material, and the liner is placed on the remaining decayed dentin to enable the pulp to repair itself.[15] The liner materials consist of resin-modified glass ionomer cement (RMGIC), glass ionomer cement (GIC), calcium hydroxide ($Ca(OH)_2$), and adhesive resin.[2]

Direct pulp capping

Direct pulp capping (DPC) is applied to teeth where the healthy pulp is mechanically or accidentally exposed during cavity preparation or trauma. The tooth should be free of oral contaminants and asymptomatic, with an exposure area of a pinpoint size.[14]

DPC is a conservative treatment option for reversible pulpitis. Direct pulp capping is to keeps pulp vitality by incentivizing young, healthy pulp to form a repairable dentin-like bridge in pulp exposure area.[16]

A biocompatible restorative material is immediately sealed on exposed pulp during direct pulp treatment to prevent further damage and stimulate pulp cells' regeneration potential. Direct pulp treatment is a method that is both minimally invasive, economical, and relatively straightforward.[16] Calcium hydroxide, mineral trioxide aggregate (MTA), bioactive glass, calcium enriched mixture (CEM), enamel matrix derivative (EMD), and simvastatin are used for DPC in primary teeth.[17]

Pulpotomy

Pulpotomy is a clinical procedure that is widely accepted for treating decayed pulp in primary teeth that are not symptomatic. The treatment is determined by the healing capacity of radicular pulp tissue after removing affected or infected coronal pulp.[14]

Various techniques and materials are used in primary tooth amputation treatment applications. Formocresol, glutaraldehyde, MTA, ferric sulfate, calcium hydroxide, amputation applications with electrosurgery, laser-assisted amputation applications, and applications with biological materials (bone morphogenic protein and enriched collagen solutions) are among the options.[18]

DPC of primary teeth is a controversial treatment method and has a low success rate for primary teeth.[14] The high failure rate of DPC is due to undifferentiated mesenchymal cells that can differentiate into odontoclasts, which can lead to internal resorption.[14] Biological distinction between primary and permanent teeth is a higher amount of undifferentiated mesenchymal stem cells in primary teeth.[19] Internal resorption and unsuccess of direct pulp treatment can be caused by the differentiation of these cells into odontoclasts.[16] Understanding mechanisms that prevent, control, and regulate internal resorption can help preserve the primary tooth until the time of exfoliation.[7]

According to studies by the American Academy of Pediatric Dentistry (AAPD),[2] Agamy et al.,[20] Maroto et al.,[21] and Tuna et al.,[19] direct pulp therapy is advised for primary teeth when biological conditions are optimal and when minimal pulp exposure (1 mm or less) occurs. However, it isn't advised in situations when pulp exposure happens after the removal of caries from primary teeth since in these situations, nearly all of the exposed pulps are already damaged by caries.[2]

Due to the restricted use of DPC, the AAPD clearly stated that carious pulp exposure in primary teeth isn't advised.[22] Sujlana et al.[23] noted that this treatment "was literally removed from the repertoire of therapeutic procedures for primary teeth". However, compared to immature or mature permanent teeth, use of DPC in primary teeth is more constrained, and research has shown that it is less effective than pulpotomy.[24-26] In a meta-analysis and systematic review by Coll et al.[27] of VPT, they concluded that after 24 months, pulpotomy with IDPC and different materials for treatment of deep carious in primary teeth is supported by quality of literature evidence and highest level of success. Success rates for DPC and IDPC at 24 months were 88.8% and 94.4%, respectively, whereas the success rate for all pulpotomies in a total of 1,022 primary teeth was 82.6%. Although pulpotomy and IDPC have higher success rates than DPC, these conclusions are based on less reliable literature information.

Failure to recommend DPC for primary teeth was associated with a reported risk of internal root resorption, unsatisfactory success rates, and poor prognosis in literature, possibly due to high cellular content of primary tooth pulp (mainly mesenchymal cells) that tends to differentiate into odontoclasts versus irritants.[16] However, various studies reported that pulp inflammation, calcification, acute abscesses, and periapical bone loss, can occur following the treatment.[23,25,28]

According to specific research, primary teeth DPC with pulp exposure and intact dentin produces excellent results since primary tooth pulp cells have a well-known capacity for healing, negating the necessity for more extreme or invasive procedures (such as pulpotomy).[27,29,30]

Dimitraki et al.[31] reported that DPC showed good radiographic and clinical success rates (75%) in their study in which they compared DPC with pulpotomy. They stated that compared to pulpotomy, DPC showed lower clinical success (pulpotomy 87.5% vs DPC 75%), but a higher radiographic success rate (pulpotomy 68.8% vs DPC 75%), due to the not high quality of evidence. It was stated that DPC is not inferior to pulpotomy in radiographic and clinical success rates (provided that the pulp condition is diagnosed carefully). DPC is a more time-saving treatment and conservative pulpotomy, which might be more comfortable for children.[32]

However, some studies that only recommend DPC when physiological exfoliation of the affected tooth is expected within 1 or 2 years.[33] According to these studies, treatment should be undertaken after careful clinical and radiographic investigations to confirm that pulpitis is reversible, using strict and specific diagnostic criteria and proven capping materials.[26]

Various materials were proposed for DPC in primary teeth treatment.[17] In their

comprehensive review and meta-analysis of the various agents employed in DPC, Schwendicke et al.[34] concluded that there is indequate evidence to accept or reject any particular substance for primary teeth's DPC.

Chronic pulp inflammation and internal resorption were reported as common results when $Ca(OH)_2$ was used as a DPC agent.[35] It was reported that the success rates of $Ca(OH)_2$ in pulp treatment of primary teeth vary considerably, from 53% when $Ca(OH)_2$ powder is used compared with 100% of fast-setting calcium hydroxide (Dycal). Furthermore, in treatments with Dycal, the success rate of DPC was reported to be 70–100% with follow-up periods of up to 24 months.[32] Conversely, it was stated that $Ca(OH)_2$ has several disadvantages as a DPC agent.[32] Therefore, the long-term efficacy of $Ca(OH)_2$ was questioned by factors, such as its tendency to cause internal root resorption, its failure to bond to dentin, its slow stimulation of dentin bridge formation, and the fact that the morphological structure of the dentin bridge is highly permeable due to the tunnel defect.[36] Primary tooth pulp/dentin complex can be repaired and regenerated, albeit with no systemic side effects and low toxicity, because to of new and improved bioactive and biocompatible DPC agents.[37,38] These materials are currently preferred in place of the conventional DPC agent, such as Ca(OH)2, which is regarded as the industry standard for pulp treatment.[19,23]

According to findings from studies included in systematic review by Garrocho-Rangel et al.,[39] many of the recently introduced and evaluated regenerative materials showed promising potential for DPC treatment of primary teeth. Clinically and histologically tested in this study, MTA showed high success rates ranging from 90–100%.[39] The success rates of these agents, which have a bright future in DPC treatment of primary teeth, are influenced by the substance's inherent qualities (such as an antibacterial effect, the preservation of pulp tissue integrity, or minimal cytotoxicity), as well as by its biocompatibility with the pulp of primary teeth.[36] These findings imply that MTA might be a suggested primary teeth DPC material due to its potential for stimulation and sufficient sealing ability for pulp and bone/peridontal tissues healing.[36,40] MTA is expensive, difficult to manipulate, takes a long time to cure, and discolors teeth, among other drawbacks.[41]

Twenty-one healthy children aged 5–8 years with asymptomatic vital pulp exposure and at least two decayed second primary molars, at least two-thirds of root length, were included in study conducted by Ghajari et al.[30] CEM and MTA were used for DPC and patients were followed for 20 months. As a result of this randomized controlled trial, it was shown that CEM group's two cases and MTA group's only one case failed. Therefore, the success of MTA and CEM was 95% and 81%, respectively. Ghajari et al. also reported that the cases did not fail due to internal resorption. They explained this by assuming that, under the pulp conditions, inflammatory mediators could cause mesenchymal cells to differentiate into the odontoclasts responsible for resorbing dentin, changing the environment from one of inflammation to one of reparation, and that CEM and MTA could circumvent this issue.

Among other relevant materials, CEM is regarded as a superior substitute Ca(OH)2 and MTA because of its various benefits, including its calcium enriched mixture, hydroxyapatite/ hard tissue biostimulation, antibacterial effect, impermeability, and fast setting time, with a reported success rate of 85–100%.[42] Comparing MTA and CEM, it was shown that during the 9-month follow-up, both substances displayed comparable high clinical and radiographic efficacy.[30]

It is debatable whether bonding systems should be used as a pulp coating material to primary teeth.[43] Some authors agree with the use

of these materials as a biocompatible procedure based on the formation of a hybrid layer on pulp that allows hermetic sealing and adhesion between the dentin-pulp complex and the resin.[35] However, they do not advise its usage as a DPC agents because to of the toxic nature of adhesive resin's constituents (mostly monomers), their tendency to shrinkage, the absence of dentin bridge formation, bleeding, and an inflammatory reaction that seriously jeopardizes pulp healing.[44,45] In studies evaluating the success rates of different DPC agents, clinically varied between 62% and 100%, and radiographically ranged between 53% and 100%, regardless of the agent used. According to the data, MTA had the greatest value for both radiographic and clinical success at 100% for both.[19,26,43] It has been reported that teeth with/without reversible pulpitis pain show comparable success after 12 months of treatment with IDPC or calcium silicate pulpotomy, and factors such as coronal pulp removal methods; irrigation solution; method of controlling bleeding; base on MTA; treatment in one or two sessions; anterior or posterior teeth have little or no effect on the success of MTA pulpotomy.[46] A recent meta-analysis reported that the success of indirect pulp therapy or pulpotomy with calcium silicate cement was better than that of direct pulp closure and other pulpotomies with moderate certainty based on 24 months of evidence.[47] The 2024 clinical practice guideline Recommendations for the use of vital pulp therapies in deciduous teeth: clinical practice guidelines for VPT in deciduous teeth with deep caries states that pulpotomy using indirect pulp therapy or calcium silicate cement (mineral trioxide aggregate [MTA] or Biodentine®) is more successful than DPC and other pulpotomies.[46] The different materials do not affect the success of IDPC (high certainty) or DPC (very low certainty) at the end of 24 months. Calcium silicate cement pulpotomy is strongly recommended over formocresol, ferric sulphate, zinc oxide eugenol pulpotomy and other pulpotomies with high certainty based on 24-month data. It has been reported that pulpotomy is statistically significantly better than pulpectomy for vital primary incisors with deep caries.[46] The type of final restoration used on the treated primary tooth may have an impact on DPC success rates also the careful identification of pulp state. Due to the outstanding complete coverage protection and hermetic features of the crown, it has been demonstrated that immediate cover of stainless steel crown considerably improves the success of decaying primary teeth's pulp treatment.[28,48] The success of primary teeth DPC is strongly correlated with the absence of microbial contamination from the microleakage restoration margin and the maintenance of healthy pulp in the exposure area.[49]

CONCLUSION

DPC remains a controversial treatment option for primary teeth' deep carious lesions because of its high internal resorption and failure rate. DPC can be applied as an alternative to pulpotomy if the tooth will exfoliate physiologically within 1–2 years, since the conversion potential of undifferentiated mesenchymal cells to odontoclasts in pulp of aged primary teeth is lower than that of pulp of young primary teeth. It is known that with the right case selection for DPC in deciduous teeth, vital deciduous tooth pulp has the biological capacity to heal. DPC can be applied when biological conditions are optimal, pulp exposure is minimal, and there is no contamination with caries. There is no evidence of any superior material for DPC to maintain pulp health in primary teeth. However, $Ca(OH)_2$ and adhesive systems appear to be more likely to fail. Therefore, another more reliable and biocompatible agents such as MTA, CEM, emdogain, calcium sulfate, and simvastatin might be better options. The treatment option for deep decayed primary

teeth, should be determined by considering all of these conditions.

Ethical Approval

Ethics committee approval was not required in this study.

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Conflict of Interest

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

Author Contributions

Design: MB, EÇ. Data collection and processing: MB, EÇ. Analiysis and interpretation: MB, EÇ. Literature Review: EÇ. Writing: MB, EÇ.

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Maxillary Anterior Esthetic Rehabilitation of Twin Patients Following Orthodontic Treatment - Case Reports

Cansu ATALAY[1*] **Esra ERGİN**[2]

[1] Assoc. Prof., Department of Restorative Dentistry, School of Dentistry, Hacettepe University, Ankara, Türkiye, cansuatalaydr@gmail.com

[2] Prof., Department of Restorative Dentistry, School of Dentistry, Hacettepe University, Ankara, Türkiye, esra.ergin@hacettepe.edu.tr

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ABSTRACT

Aim: These case reports detail the treatment of multiple diastemas, peg-shaped lateral incisors and gingival asymmetries in the maxillary anterior areas of twin patients.
Case Report: Two 21-year-old female twin patients (D.C.&T.C) visited our clinic to address their concern about gaps between maxillary anterior teeth. The teeth were vital and the surrounding tissues were healthy. In all cases, gingivectomy were performed using a 940 nm diode laser. Following a 14-day recovery time, the patient had diastema closure (D.C) and peg-shaped lateral incisors shaping (T.C) treatments. After choosing the shade, teeth were isolated using a rubber dam, no preparations were performed. G2-Bond Universal adhesive (GC) and a universal resin composite (G-aenial ACHORD, GC) were applied for restorative procedure and polymerized using an LED device for 20s. Subsequently, the macro and micro surface morphologies on the buccal surfaces were created and any occlusal interferences were checked. The restorations underwent polishing using polishing discs, silicone rubber polishers, and polishing strips. The patients were motivated to maintain dental hygiene and were told about the need for follow-up appointments.
Results: Following the restorative procedures, the patients expressed contentment with their physical appearances. During the 24-month follow-up, there were no signs of discoloration or chipping on the restorations, and the gingival contours were found to be satisfactory.
Conclusion: The utilization of laser aided gingivectomy in conjunction with direct composite resin make-ups resulted in the achievement of a balanced and aesthetically pleasing alignment of the teeth. Moreover, it is a prudent strategy for adolescent patients who have finished orthodontic treatment.

İkiz Hastalarda Ortodontik Tedavi Sonrası Üst Anterior Dişlerin Estetik Rehabilitasyonu - Olgu Raporları

Makale Bilgisi

Makale Geçmişi

Geliş Tarihi: 21.02.2024
Kabul Tarihi: 27.05.2024
Yayın Tarihi: 30.08.2024

Anahtar Kelimeler:
Diastema kapama,
Kama şekilli lateral,
Anterior estetik,
Kompozit rezin.

ÖZET

Amaç: Bu olgu raporları, ikiz hastaların maksiller ön bölgelerindeki çoklu diastemaların, kama şekilli yan kesici dişlerin ve diş eti asimetrilerinin tedavisini detaylandırmaktadır.
Olgu Raporu: 21 yaşında iki kadın ikiz hasta (D.C.&T.C), üst ön dişler arasındaki boşluklarla ilgili endişelerini gidermek için kliniğimizi ziyaret etti. Dişler canlıydı ve çevre dokular sağlıklıydı. Tüm vakalarda, gingivektomi 940 nm diyot lazer kullanılarak yapıldı. 14 günlük iyileşme sürecinin ardından hastaya diastema kapama (D.C) ve kama şekilli lateral diş şekillendirme (T.C) tedavileri uygulandı. Renk seçiminin ardından dişler bir lastik örtü kullanılarak izole edildi ve herhangi bir preparasyon yapılmadı. Restoratif prosedür için G2-Bond Üniversal adeziv (GC) ve üniversal kompozit rezin (G-aenial ACHORD, GC) uygulandı ve bir LED cihazı kullanılarak 20 saniye süresince polimerize edildi. Daha sonra bukkal yüzeylerdeki makro ve mikro yüzey morfolojileri oluşturuldu ve okluzal temaslar kontrol edildi. Restorasyonlara polisaj diskleri, silikon kauçuk lastikler ve kompozit zımparaları kullanılarak polisaj uygulandı. Hastalar oral hijyenlerini koruma konusunda motive edildi ve takip randevularının gerekliliği anlatıldı.
Bulgular: Restoratif prosedürlerin ardından hastalar fiziksel görünümlerinden memnun olduklarını ifade ettiler. 24 aylık takipte restorasyonlarda herhangi bir renk değişikliği veya kopma görülmedi ve diş eti konturlarının tatmin edici olduğu görüldü.
Sonuç: Lazer destekli gingivektominin direkt kompozit rezin restorasyonlar ile birlikte uygulanması, dişlerde estetik açıdan hoş bir dizilimin elde edilmesiyle sonuçlandı. Bu kombine tedavi şekli, ortodontik tedavisi henüz sonlanmış ergen hastalar için de ideal bir stratejidir.

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***Corresponding Author:** Cansu ATALAY, *cansuatalaydr@gmail.com*

INTRODUCTION

Diastemas can be occurred by differences in tooth size, such as narrow or peg-shaped teeth, or the difference between gap in the arch and tooth size. Various methods have been documented to rehabilitate diastemas with the help of multiple dental disciplines. Orthodontic treatment is a conservative approach that can achieve satisfactory aesthetic results. However, it may not be sufficient to establish ideal proximal contacts and proper vertical and horizontal overlaps when there are differences in tooth size and shape.

Direct resin composite (RC) restorations are a reasonable treatment option for addressing aesthetic issues in anterior teeth. They are minimally invasive or noninvasive approaches that allow for functional, aesthetic, and repairable restorations to be placed in a single visit with minimal or no tooth preparation.[1,2] There is a current trend in dentistry towards simplicity, driven by the desire to minimize application failures through the use of easier-to-handle dental materials and more efficient treatment methods. One aspect of this trend is the simplification of color selection, which can be challenging due to various environmental and operator-dependent factors. As a result, the development of universal RCs has emerged.[3] These materials possess a universal opacity and come in multiple Vita shades. Developers recommend their use in a single shade increment, with the potential to match different teeth colors.[4]

In the aesthetic rehabilitation of anterior teeth, there are instances where both the teeth and gums may require simultaneous arrangement. This means that not only the appearance and alignment of the teeth are considered, but also the positioning and contouring of the gums. This comprehensive approach ensures a harmonious and natural-looking result in the aesthetic enhancement of the anterior teeth. In modern dentistry, there are various methods available for soft tissue management, including gingivectomy/gingivoplasty for gingival reshaping and crown lengthening. Among these methods, lasers have gained significant popularity.[5] Diode lasers, in particular, are widely used due to their ability to provide superior comfort for patients during gingivoplasty procedures. These lasers cause minimal tissue damage, effectively control bleeding, and promote reduced wound contraction. Additionally, the use of diode lasers results in decreased swelling and postoperative pain for patients.[6]

These case reports describe the management of multiple diastemas, peg-shaped lateral incisors and gingival asymmetries in the maxillary anterior areas of twin patients.

CASE REPORTS

Two 21-year-old female twin patients (D.C. & T.C.) visited the clinic to report diastemas in their upper front teeth following orthodontic treatment. In the intraoral examinations, it was observed that both of the patients had periodontally healthy, normal vertical and horizontal bite and canine-sparing occlusion. In addition, diastema closure was found to be sufficient for one of the twins (D.C), while wedge lateral shaping was required for the other one (T.C). On the other hand, it was necessary to eliminate gingival irregularities in order to obtain a more aesthetic appearance. After explaining the treatment options for the relief of patients' complaints, it was decided to perform a laser gingivectomy for gingival asymmetries and close the diastemas with direct RC in both patients with their consents.

Firstly, we started the procedure with topical anesthesia and drew the surgery line with a tissue marker. Then we passed to gingivectomy by holding the laser tip parallel to the teeth and perpendicular to the margin of free gingivae with a 940 nm diode laser (Diode Epic, BioLase, California, USA) device in C2 pulsed mode with a E3 fiber tip at 1,8 W power. The tissue was gently removed just like brushing off the excessive tissues until the desired contour was achieved. Then the procedure was ended up

with gingivoplasty to achieve a knife-edge shaped gingival morphology. Hemostasis was optimal so no suturing was done. The patient was given verbal instructions to avoid taking hot and spicy food for a few days and to maintain meticulous oral hygiene. Postoperative analgesics were recommended in case of pain.

Following a 14-day period of recuperation, the patients had diastema closure (D.C) and peg-shaped lateral incisors shaping (T.C) procedures. The teeth were initially cleansed using a mixture of pumice and water, applied with a rubber cup, and the suitable color was determined. In order to achieve effective separation, the maxillary front teeth were isolated using a rubber dam (Thick Blue, Nictone, Romania) and retracted either with dental floss or specialized rubber dam retraction clamps. Neither restoration type required any tooth preparations. Subsequently, the enamel surfaces of the teeth were treated with a 37% phosphoric acid gel for a duration of 30 seconds, after which they were thoroughly rinsed and dried. For the adhesive step, G2-Bond Universal adhesive (GC, Tokyo, Japan) was applied following the directions provided by the manufacturer. A light-emitting diode curing unit (Elipar Deepcure S, 3M, USA) with a light irradiance of 1370 mW/cm2 and an irradiated diameter of 10 mm was used. The irradiance was measured for each curing process to ensure proper polymerization.

The restorations were performed with the free-hand layering technique by transparent and contoured matrix bands. Monochromatic layering was performed gradually in ≤2 mm layers with universal RC, G-aenial ACHORD (A1, GC, Tokyo, Japan). Each layer was polymerized for 20 s for all composites.

For the finishing and polishing procedures, a set of aluminum oxide embedded polishing discs (Optidisc, Kerr Corp, USA) in three different grits (medium, fine, superfine) were utilized. These discs were used under dry conditions at a speed of 15,000 rpm. To set the occlusion in the protrusive and lateral movements of the mandible, a 12-blade carbide bur (Diatech, Heerbrugg, Switzerland) was employed at a speed of 30,000 rpm under water cooling. In cases where a microsurface morphology was required, a blue diamond bur (Diatech, Heerbrugg, Switzerland) was used horizontally at a speed of 5,000 rpm without water cooling. Silicone rubber polishers (HiLuster; Kerr Corp, USA) were selected to polish the labial and palatal surfaces at a speed of 10,000 rpm, following the manufacturer's instructions. Finally, interdental polishing strips (Epitex Strips, GC, Tokyo, Japan) were used. Surface re-polishing was performed during a single visit within one week after the restorations were placed to ensure complete curing.

The patients were motivated to maintain good dental hygiene and were told about the need for follow-up appointments. During the 24-month follow-up examinations, no instances of tooth sensitivity, discolorations, chippings, or fractures were observed on both the teeth and the restorations.

Discussion

The presence of diastemas usually disturbs young patients aesthetically. Diastemas may occur either due to developmental factors or as a consequence of teeth not being fully aligned following orthodontic procedures. RCs, as preferred in these cases, could be used in order to achieve harmony, proportionality, and aesthetics in the anterior teeth after orthodontic treatment. Moreover, restorations made with direct RCs have some advantages. They usually do not require tooth preparation compared to laminate veneers, as they are a more conservative approach. In addition, if deterioration of marginal edge or a discoloration is observed in the RC restoration, there is a chance for repair as the treatment is reversible.

In a case report, direct midline diastema closure with composite layering technique were followed for one-year and no sensitivities, discolorations, or fractures were reported.[7] Another study conducted by Peumans et al [8], the

clinical performance of direct composite buildups for tooth reshaping were assessed over a period of 5 years. The findings showed that only 89% of the restorations were considered aesthetically satisfactory, while the remaining restorations needed to be replaced due to significant differences in color and loss of anatomic form. In the current case reports, all restorations presented satisfactory esthetic results. Similarly, Demirci et al. [9] evaluated direct composite build-ups for diastema closure after orthodontic treatment for 4 years and concluded that survival rates for the restorations were favorable for the specified period.

One potential drawback in such cases is the need for periodic re-polishing of the RCs. Nanohybrid RCs, like the ones used in these cases, initially exhibit high polishing gloss unit values. However, over time, this gloss can diminish due to various factors such as dietary habits, functional forces, and parafunctional habits.[10] On the other hand, the marketing strategies of the universal RC, G-aenial ACHORD, highlight its natural fluorescence, invisible filling, and long-lasting gloss properties.[11] Clinical follow-up at the 24-month mark has shown that restorations using this material maintain color harmony and gloss properties. Another potential drawback is the difficulty some clinicians may face with the free-hand restorative technique. It requires a high level of skill and expertise to ensure a successful and long-lasting restoration. Therefore, it is crucial for clinicians to undergo extensive training to achieve optimal results.

When it comes to area isolation in dental restorative treatments, the use of a rubber dam remains the gold standard. It offers optimal conditions for an adhesive approach by preventing contamination. Additionally, it aids in achieving effective gingival retraction, allowing for better access to the cervical region and the placement of RCs in areas previously covered by gingival tissue, as needed.[12] In both cases mentioned, a rubber dam isolation was performed. On the other hand, it is important to recognize that the use of a rubber dam is crucial, but it can impact the assessment of the final aesthetic outcome since it dehydrates the teeth. Therefore, it is recommended to evaluate the final result at a second appointment when the teeth have had a chance to rehydrate properly.

In the literature, there are studies showing that the wound created by laser surgery contracts less because of less collagen and less myofibroblast formation,[13] and has a shorter healing time and less scarring.[14] In gingivectomy with traditional methods, patients may report "fear of scalpel", pain and difficulty in post-operative recovery. In these cases, fast and comfortable recovery processes were observed after laser gingivectomy. This accelerated the treatment process and increased patient cooperation.

Frequently, when treating the esthetic concerns of a patient, clinicians usually focus on the teeth and ignore the gingivae. As a beautiful smile depends on the harmony of the white and pink aspects, simply dealing with white teeth component is not sufficient to achieve the best esthetic outcome. In pink esthetic treatments which are frequently required in esthetic smile design; soft tissues can be artistically removed and shaped with several types of lasers with the advantage of better wound healing, less contraction, reduced need for infiltration anesthesia, good hemostasis, improved vision on surgical area and enabling other procedures like impression taking and adhesive restorations at the same session. Lasers also reduce the amount of bacteria and other pathogens in the surgical field and therefore decrease the risk of infection.[15] Postoperative edema is reduced with lasers as the blood vessels and lymphatic channels are sealed, which also enable less postoperative discomfort. Additionally, with low-level-laser-therapy effect; pain, scarring and inflammation can be reduced whereas tissue repair and healing can be accelerated.[16] In gingivectomy with traditional methods, patients may report "fear of scalpel", pain and difficulty in post-operative recovery. In these cases, fast and comfortable recovery processes were observed after laser gingivectomy. This

accelerated the treatment process and increased patient cooperation.

Although the final outcomes were excellent for both patients, it is crucial to arrange monthly maintenance visits and carefully strategize all situations in order to attain consistent and long-lasting aesthetic results.

Conclusion

Diode laser-assisted gingivectomy and gingivoplasty have proven to be effective in achieving satisfactory results for both patients and dentists in the esthetic rehabilitation of gingival contours. These procedures offer the advantage of being more tissue-friendly and comfortable compared to other alternatives. In the case of young patients who have completed their orthodontic treatment, direct resin bonding is a conservative approach that can be employed. In cases requiring aesthetic applications, ideal aesthetic results and smile symmetry can be achieved when current restorative materials are combined with the correct treatment options. It is crucial for dentists to stay up-to-date, knowledgeable, and equipped with the latest technologies and techniques in order to meet their patients' expectations in a minimally invasive manner. By embracing these advancements, dentists can provide optimal esthetic outcomes while prioritizing the preservation of tooth structure.

Figure 1. Baseline photographs of one of the twins (D.C.) with peg-shaped lateral incisors.

Figure 2. Baseline photographs of other twin (T.C.) with diastemas.

Figure 3. Laser gingivectomy and 2 weeks recovery (A- D.C.; B-T.C.).

Figure 4. Restorative treatment protocol of the patient with peg-shaped lateral incisors (D.C.).

Figure 5. Restorative treatment protocol of the patient with diastemas (T.C.).

Figure 6. 24-month follow-up of the patient with peg-shaped lateral incisors (D.C.).

Figure 7. 24-month follow-up of the patient with diastemas (T.C.).

Ethical Approval

Since the present study did not use sources derived from humans or animals, ethics committee approval was not obtained.

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Conflict of Interest

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

Author Contributions

Design: CA. Clinical procedures: CA, EE. Analysis and interpretation: CA, EE. Literature search: CA. Writing: CA.

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