ATATURK
UNIVERSITY
PUBLICATIONS

Current Research *in* Dental Sciences

Formerly: Journal of the Dental Faculty of Atatürk University
Official Journal of Atatürk University, Faculty of Dentistry

Volume 34 • Issue 2 • April 2024

EISSN 2822-2555
https://dergipark.org.tr/en/pub/currresdentsci

Current Research *in* Dental Sciences

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Current Research
in Dental Sciences

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The Effect of Different Zirconia Core Thicknesses and Veneer Types on Color Stability After Artificial Accelerated Aging

Farklı Zirkonya Çekirdek Kalınlıkları ve Kaplama Tiplerinin Yapay Hızlandırılmış Yaşlandırma Sonrası Renk Stabilitesine Etkisi

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ABSTRACT

Objective: The aim of this study to evaluate the color stability of zirconia-based crown veneered with different materials after artificial aging procedures.

Methods: Sixty simple and 60 anatomical designs of cores were milled from yttria-stabilized pre-sintered zirconium oxide blocks for prepared typodont the first premolar. The simple and anatomical cores were divided into 5 subgroups (Layering technique, feldspathic cemented/fused and lithium disilicate cemented/fused). Color measurement was completed via a spectrophotometer with artificial aging procedures. ΔE values were calculated with CIEDE2000 formula. ANOVA was used to evaluate the ΔE values among the groups. Post hoc comparisons between examples were conducted using the Bonferroni test.

Results: The ΔE values of the simple core design (1.5±0.5) were significantly lower compared to the anatomical core group (2.89±1.03; *P* <.05). The layering group ΔE value (2.37±0.56) was significantly less than the other groups in the anatomical core design (*P* <.05). Additionally, no significant differences existed in the ΔE values between simple core design groups (*P* >.05).

Conclusion: All groups were affected by the artificial aging procedures. The simple core designs and layering technique showed the lowest ΔE values. Also, the cementation and fused techniques did not affect the color change of restorations.

Keywords: Dental CAD-CAM, Zirconia-based restorations, Color stability, Artificial aging, Spectrophotometer

ÖZ

Amaç: Bu çalışmanın amacı; farklı malzemelerle kaplanmış zirkonya esaslı kron restorasyonların yapay yaşlandırma işlemleri sonrasındaki renk stabilitelerini değerlendirmektir.

Yöntemler: Prepare edilen standart fabrikasyon tipodont birinci premolar diş için, yttriya ile stabilize edilmiş ve önceden sinterlenmiş zirkonyum oksit bloklardan 60 standart ve 60 anatomik kore tasarımı elde edilmiştir. Sabit ve anatomik kor örnekler karşılaştırılmak üzere 5 alt gruba (Tabakalama tekniği, feldspatik korun simantasyonu / seramik kaynaşması ile bağlantısı ve lityum disilikat korun simantasyonu / seramik kaynaşması ile bağlantısı) ayrılmıştır. Renk ölçümü; yapay yaşlandırma prosedürleri uygulanarak sonrasında bir spektrofotometre ile tamamlanmıştır. ΔE değerleri CIEDE2000 formülü ile hesaplanmıştır. Gruplar arası ΔE değerlerini değerlendirmek için ANOVA, örnekler arasında post hoc karşılaştırmalar için de Bonferroni testi kullanılmıştır.

Bulgular: Standart sabit kor tasarımının ΔE değerleri (1.5 ± 0.5), anatomik kor grubuna göre anlamlı derecede düşük (2.89 ± 1.03; *P* <.05) bulunmuştur. Anatomik kor tasarımında tabakalama grubu ΔE değeri (2.37 ± 0.56) de diğer gruplara göre anlamlı derecede düşük sonuç vermiştir (*P* <.05). Ayrıca sabit kor tasarım grupları arasında ΔE değerlerinde anlamlı bir farklılık bulunmamıştır (*P* > .05).

Sonuç: Tüm test grupları yapay yaşlandırma işlemlerinden etkilenmiştir. Standart kor tasarımları ve tabakalama tekniği en düşük ΔE değerlerini göstermiştir. Ayrıca simantasyon ve kaynaştırma (fuse) teknikleri restorasyonların renk değişimini etkilememiştir.

Anahtar Kelimeler: Dental CAD-CAM, Zirkonya esaslı restorasyonlar, Renk stabilitesi, Yapay yaşlandırma, Spektrometre

Geliş Tarihi/Received 17.01.2022
Kabul Tarihi/Accepted 28.03.2022
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Akat B, Şentürk A, Çakırbey Tanış M, Kılıçarslan MA. The Effect of Different Zirconia Core Thicknesses and Veneer Types on Color Stability After Artificial Accelerated Aging. *Current Research in Dental Sciences*. 2024; 34(2): 84-88.

INTRODUCTION

Dental applications are provided to enhance both function and also esthetics.[1,2] That's why, full ceramic restorations are used as an alternative to metal-based applications.[3] Zirconia cores with glass-ceramic veneers show an important alternative for metal - ceramic restorations due to the huge physical features of zirconia ceramics and esthetic features of veneering materials.[4,5] Veneering of this core is necessary to achieving outstanding esthetic outputs. The veneer layer is generally manipulated directly. The method has also shown insufficiency of shade uniformity, formation of bubbles, and lack of the skill of the dental technician.[6,7]

CAD-CAM fabricated zirconia cores and CAD-CAM fabricated ceramic veneer combinations represent a relatively new technique.[8-10] The veneer and core can be combined with glass-ceramic powder by only one firing.[11,12] Another way to combine the veneer and core is by using resin cement, which has no firing requirement.[13,14] Kim et al.[7] reported that the color repeatability of the veneering application with the digital technique was important clinically suitable esthetic criteria.

The color suitability and stability features of an esthetic restorations are important to its survival success.[15] The color in ceramics is affected by intrinsic factors like the ceramic composition, and extrinsic factors such as dietary habits.[16-18] The oral environment may negatively affect ceramics. Artificial accelerated aging can simulate oral environments, allowing the evaluation of discolorations in materials over time.[19,20] The most commonly used tests for ceramic materials are prolonged water storage and exposure to ultraviolet light.[21,22]

The color of restorations can be measured with spectrophotometers.[23,24] The Commission Internationale de l' Eclairage (CIE) Lab color system has been used to investigate the color difference between a restoration and tooth.[25] According to a spectrophotometer evaluations the CIELab values of the examples, their color difference (ΔE) is determined.[26-28] The ΔE mean is then compared with a threshold for clinical acceptability to determine whether the color difference is suitable.[29,30] Currently, CIE has suggested the CIEDE2000 formula as a novel method. Previous studies have stated that the CIEDE2000 formula obtains the color difference more accurately than CIELab.[31,32]

Present in-vitro study aimed to evaluate the effect of aging on the color stability of zirconia based single crown restorations veneered with feldspathic or lithium disilicate CAD-CAM materials and fluorapatite ceramic applied with a veneering technique. CAD-CAM fabricated ceramic veneers were connected to 2 different zirconia cores by resin cement or low-fusing porcelain. The null hypotheses were that an artificially accelerated aging procedure would cause a similar color change in all groups and that the core design, ceramic manufacture type, ceramic material, and core-ceramic connection type would not affect the color change.

METHODS

A typodont the first premolar (Phantom Frasaco, Frasaco GmbH) was prepared according to 1-mm chamfer finish line, occlusal anatomical reduction of 1.5–2 mm, and 8° taper. A digital impression was performed with the CEREC Omnicam system (Sirona Dental Systems GmbH). Multilayered designs were performed with either the simple or anatomical core design. The simple core was designed with a 0.5-mm thickness; the anatomical core was anatomically reduced 1 mm from the full crown dimension.

Equal numbers of simple and anatomical designs of 120 cores were milled from yttria-stabilized pre-sintered zirconium oxide blocks (InCoris ZI, Sirona Dental Systems GmbH; Cerec In Lab MC XL, Sirona Dental Systems). The zirconia specimens were sintered in the sintering oven (Sirona in Fire HTC, Sirona Dental Systems GmbH), following manufacturer instructions. After the sintering process, the cores were checked for flaws under light microscopy (Leica MZ12, Leica Microsystem Inc.) and sandblasted with 50-µm aluminum oxide particles (BEGO Korox) with 2-bar pressure for 15 seconds. Ultrasonic cleaning was applied for 5 minutes with distilled water (Whaledent, BIOSONIC, Coltene/ Whaladent Inc.).

According to the veneering procedure and material type, the simple and anatomical core specimens were divided into 5 subgroups, each with 12 samples.

1) Layering Group: Layering was applied as the control group. Fluorapatite ceramic (IPS e.max Ceram, Ivoclar-Vivadent) was applied by a certificated technician to minimize operator-sourced mistakes. Dentin, enamel, and glaze layers were applied regularly.

2) Feldspathic Cemented Group: A CAD-CAM fabricated feldspathic veneer (CEREC Blocs; Sirona Dental Systems GmbH) was cemented to a zirconia core.

3) Lithium Disilicate Cemented Group: A CAD-CAM fabricated lithium disilicate veneer (IPS e.max CAD, Ivoclar-Vivadent AG) was cemented to a zirconia core.

4) Feldspathic Fused Group: A CAD-CAM fabricated feldspathic veneer (CEREC Blocs) was fused to a zirconia core with IPS e.max Ceram.

5) Lithium Disilicate Fused Group: A CAD-CAM fabricated lithium disilicate veneer (IPS e.max CAD) was fused to a zirconia core with IPS e.max Ceram.

The core and veneer were designed together (InLab 16, Dentsply Sirona). Additional scanning of the core was not performed for veneer design. All crowns were standardized with the same final form. The first, a simple core was designed with 0.5-mm thickness, and a veneer was designed with a 2-mm total restoration thickness. The milled simple core and veneer complex was scanned with the CEREC Omnicam system. The scanned crown was used as a biogeneric copy to design the crowns with an anatomical core in exactly the same contour and shape as the simple core crowns. A silicone mold was prepared from digitally fabricated crowns for fabricating the layered crowns.

After controlling the adaptation of the cores and CAD-CAM fabricated veneers, these were connected by fluorapatite fusion ceramic or resin cement. Fusion ceramic and resin cement were applied with a vibrator (Vibroboy SL, Bego). The veneers were seated on the zirconia core with finger pressure, and excess material was removed with hand instruments. The fusion ceramic was sintered according to manufacturer instructions. Resin cement was light-cured from all restoration sites for 20 seconds (Panavia V5, Kuraray Noritake Dental Inc.).

The same expert researcher completed all the color measurements with a spectrophotometer (Vita EasyShade Advanced, Vita Zahnfabrik, Bad Säckingen, Germany). The CIELab values of the restorations' cervical, middle, and occlusal third areas were measured with the spectrophotometer. Color measurements were conducted 3 times in 3 different areas for each restoration, and the average L, a, and b values were recorded.

After the initial color measurements, the restorations were subjected to optical aging (Q-Panel company, Cleveland, USA). For each restoration, an aluminum mold was prepared, and the restorations were inserted into the aluminum mold using transparent silicone (Poly Max Crystal Express, Bison International B.V., Goes, Holland) resistant to UV light and water spray. All restorations were exposed to UV light under

water spray via the test machine for 300 hours. Cycles of 8 hours of lighting at 600°C±20°C under a type II lamp (UVB-313) and 4 hours of condensation at 500°C±20°C were repeated for 300 hours. This aging application was equivalent to 5 years of clinical survival.

The later spectrophotometric evaluation was performed under the same initial conditions, following the artificial aging process. Color changes were evaluated using the CIEDE2000 color system before and after each aging test. The CIEDE2000 ΔE values were calculated using following formula:

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

The ΔE_{00} data were considered to be perceptible if they were above 1.30 and clinically acceptable if they were below 2.25.[33,34]

All statistical analysis was conducted using statistical software (IBM SPSS Statistics v22.0; IBM Corp). The Kolmogorov–Smirnov test showed a normal data distribution in all groups. Repeated measures ANOVA was used to compare the ΔE values among the groups. Post hoc comparisons between groups were conducted using the Bonferroni test.

RESULTS

The mean, standard deviations, and statistical differences of the color changes (ΔE) of the simple core design groups and anatomical core design groups are given in Table 1 and Table 2. Zirconia core and ceramic veneer thickness significantly affected the ΔE values. The ΔE values of the simple core design (1.5±0.5) were significantly lower compared to the anatomical core group (2.89±1.03; *P* <.05).

The layering group ΔE value (2.37±0.56) was significantly lower than the lithium disilicate cemented group (3.49±0.78), felspathic fused group (3.41±0.66), and lithium disilicate fused group (3.68±0.55) in the anatomical core design (*P* <.05). The feldspathic cemented group showed statistically similar ΔE values to the other groups (*P* >.05; Table 1). Additionally, the feldspathic cemented group with the simple core design showed the lowest ΔE value (1.95±0.72). However, no significant differences existed in the ΔE values between the simple core design groups (*P* >.05; Table 2).

Table 1: Mean values, standard deviations, lower and upper bound values of anatomical core design groups.

			95% Confidence Interval for Mean	
	n	Mean±SD	Lower Bound	Upper Bound
Layering	12	2.37±0.56 [a]	2,009	2,730
Feldspatic Cemented	12	3.11±0.84 [ab]	2,580	3,655
Lithium Disilicate Cemented	12	3.49±0.78 [b]	2,993	3,991
Feldspatic Fused	12	3.41±0.66 [b]	2,986	3,835
Lithium Disilicate Fused	12	3.68±0.55 [b]	3,332	4,040

SD: Standart deviation
Groups with the same letters do not have statistically significant differences (*P* >.05)

Table 2: Mean values, standard deviations, lower and upper bound values of simple core design groups

			95% Confidence Interval for Mean	
	n	Mean±SD	Lower Bound	Upper Bound
Layering	12	2.01±0.58 [a]	1,642	2,380
Feldspatic Cemented	12	1.95±0.72 [a]	1,497	2,418
Lithium Disilicate Cemented	12	2.35±0.71 [a]	1,900	2,811
Feldspatic Fused	12	2.04±0.51 [a]	3,142	4,944
Lithium Disilicate Fused	12	2.46±0.60 [a]	2,078	2,843

SD: Standart deviation
Groups with the same letters do not have statistically significant differences (*P* >.05)

DISCUSSION

According to these results of this study, the null hypothesis was partially rejected. The ΔE values of restorations were affected by the core designs. The simple core design groups showed lower ΔE values than the anatomical core design groups. Further, the anatomical core design groups and layering technique ΔE values were significantly lower than the CAD-CAM groups. Ceramic materials and core-ceramic connection presented similar color differences for the restorations with the anatomical core design. On the other hand, the simple core design groups were not affected by the ceramic manufacture type, material, or core-ceramic connection type.

The color of dental restorative materials can be measured visually or instrumentally reported that correctly matching shade was 5 times more likely via Vita Easyshade spectrophotometer than the visual method.[28] In this in vitro study, the color change was evaluated by a spectrophotometer (Vita Easyshade) because of its ability to simulate reproducible measurements free of the subjective effect of color.[14,26] This spectrophotometer also measures a small area on the teeth or materials, determined by the 3-mm diameter of the optical probe aperture.[35-37] Three repeated measurements were performed in a central area of all restorations, and the mean value for the L, a, and b were applied to the CIEDE2000 formula (ΔE_{00}) to obtain color differentiation caused by the experimental variables.[38]

The color differences of all groups were calculated via the CIEDE2000 formula. CIEDE2000 has been recommended instead of CIELab because it provides a better fit for measuring the color difference and acceptability threshold for dental ceramics and corrects the nonuniformity of the CIELab color space.[31,32] Many studies have found a clinically acceptable color difference value of 2.25 for CIEDE2000.[33,34] In the present study, color difference which is clinically acceptable, was determined as 2.25. The anatomical core groups exhibited ΔE values above the clinically acceptable range. Additionally, the lithium disilicate cemented and fused subgroups showed values above 2.25, unlike the layering and feldspathic cemented and fused subgroups. The feldspathic cemented, layering, and feldspathic fused groups represented the lowest ΔE values at 1.95±0.72, 2.01±0.58, and 2.04±0.51, respectively. The highest color change was observed for the lithium disilicate subgroup of anatomical design (3.68±0.55).

Choi et al.[38] reported that the color stability of all CAD-CAM ceramic materials except resin nanoceramics was found clinically acceptable. A previous study reported that lithium disilicate was the greatest color change–resistant material.[39] However, the color change of the anatomical core design groups (2.37±0.56 to 3.68±0.55) and simple core design groups veneered with lithium disilicate (2.35±0.71to 2.46±0.60) showed clinically unacceptable ΔE values. Kang et al.[40] indicated that CAD-CAM fabricated lithium disilicate ceramics were been affected by different veneer and core thicknesses. In the current study, the lithium disilicate with simple core design groups were affected more than the feldspathic ceramic with simple core design groups. The other simple core design groups' ΔE values were in the acceptable range (1.95–2.04).

After the artificial aging procedure, the lowest ΔE value was found for the feldspathic cemented subgroup of the simple core design. Similarly, Karaokutan et al.[19] reported that the ΔE values of felspathic ceramics after artificial aging were clinically acceptable for inlay restorations.

Dikicier et al.[41] indicated that different core thicknesses affected the color stability of ceramic materials. Similarly in this study, the core thickness affected the color change of restorations. The simple core design (0.5 mm) showed lower ΔE values than the anatomical core design (1 mm). The decreased core thickness caused a decrease in color change. However, the relationship between color difference and core thickness was not significant for all the restoration groups. The layering

technique was not affected by the core thickness. The layering subgroup with anatomical core design showed a lower color difference than the lithium disilicate and feldspathic subgroups with anatomical core groups. However, this ΔE value was above the clinically acceptable value (2.37±0.56).

CAD-CAM fabricated veneers were connected to a zirconia core structure by fusion ceramic or resin cement.[11-14] Fusion ceramic and resin cement showed similar ΔE values. The connection type didn't apparently affect the color stability of the restorations.

The color stability of the materials used in restorations is important. Several conditions affect materials in the oral environment that are susceptible to discoloration.[19] Different artificial aging simulations can be applied to compare the color stability of dental materials.[41] A lot of methods deal to extrinsic factors, including environmental conditions.[20,42,43] In the current study, all groups were subjected to UV and water spray, and artificial aging led to color change in all groups and increased the ΔE parameter of the anatomical core design groups beyond the critical threshold. Although significant color changes were obtained after artificial accelerated aging for all groups, the anatomical core groups had higher deterioration values than the simple core groups.

There is a correlation between surface roughness and the color change of ceramic materials. Tang et al.[44] tested the textures of 5 different ceramics for zirconia frameworks and indicated that veneer ceramics were changed by an artificial accelerated aging test. In the present study, surface texture change after artificial accelerated aging may have affected the color change of ceramic materials. According to another theory, the metal oxides necessary to observe acquired color shades can break down under UV radiation and may change the color of ceramics.[45] Therefore, the effect of different core thicknesses and veneer materials should be investigated with further in vivo studies.

CONCLUSION

Within the limitations of this study, these conclusions can be drawn:

1) All groups were affected by the artificial aging procedures.
2) The simple core designs showed lower color change than the anatomical core designs.
3) The lowest ΔE values were detected for the layering group (IPS e.max Ceram).
4) The cementation and fused techniques did not affect the color change of restorations.

Etik Komite Onayı: Bu çalışmada kullanılan dişler typodont yapay plastik dişlerdi. Dolayısıyla herhangi bir etik kurul yazısı mevcut değildir.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir –M.A.K; Tasarım –M.A.K; Denetleme – A.M, B.A, A.S, M.Ç,T, M.A.K; Kaynaklar — A.M, B.A, A.S, M.C,T, M.A.K; Malzemeler — B.A., M.Ç,T, M.A.K.; Veri Toplanması ve/veya İşlemesi —A.M, B.A, A.Ş, M.Ç,T, M.A.K.; Analiz ve/veya Yorum – A.M, B.A, A.Ş, M.Ç,T, M.A.K.; Literatür Tarama– A.M, B.A, A.Ş, M.Ç,T, M.A.K.; Yazıyı Yazan – M.A.K.; Eleştirel İnceleme – M.A.K.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: These gifted teeth were typodont artificial plastic teeth. Therefore, there is no ethics committee
Peer-review: Externally peer-reviewed.
Author Contributions: Concept –M.A.K; Design – A.M, B.A, A.Ş., M.Ç,T, M.A.K; Supervision – A.M., B.A., A.Ş., M.Ç,T, M.A.K.;Resources — A.M, B.A, A.s, M.C,T, M.A.K; Materials —B.A, M.C,T., M.A.K.; Data Collection and/or Processing —A.M, B.A, A.S., M.C,T., M.A.K.; Analysis and/or Interpretation – A.M, B.A, A.s, M.C,T, M.A.K.; Literature Search – A.M, B.A, A.s, M.C,T, M.A.K.; Writing Manuscript – M.A.K.; Critical Review – M.A.K.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATURK UNIVERSITY PUBLICATIONS

Araştırma Makalesi *Research Article* DOI: 10.5152/CRDS.2023.22038

Comparative Evaluation of the Cyclic Fatigue Resistance of Thermally Treated Nickel-Titanium (Ni-Ti) instruments at Varying Temperatures

Isıl İşlem Görmüş Nikel-Titanyum (Ni-Ti) aletlerin Değişen Sıcaklıklarda Döngüsel Yorulma Direncinin Karşılaştırmalı Değerlendirilmesi

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ABSTRACT

Objective: This study aimed to evaluate the stationary cyclic fatigue resistance (CFR) of three endodontic instrument systems at varying temperatures (20 ± 1°C and 37 ± 1°C)..

Methods: Ninety endodontic instruments from three instrument systems (HyFlex CM, 2Shape and Hero Gold) of constant tip size and taper (25.04) were selected for this study. These systems were broadly, divided into three groups (n=30): Group 1 (Hyflex CM), Group 2 (2Shape) and Group 3 (Hero Gold). Each group was further subdivided into two subgroups based on the temperature variable used. The endodontic instruments were subjected to stationary cyclic fatigue testing at 20 ± 1°C and 37 ± 1°C using a stainless-steel block with an artificial canal. The number of cycles to failure (NCF) were recorded

Results: Data was analysed using two-way ANOVA and Tukey post-hoc tests at a 95% confidence level. The instrument type and temperature variable significantly affect the NCF values. The observed NCF of the tested instruments was higher at 20±10 °C compared to its values at 37±10 °C and was statistically significant. The HyFlex CM group exhibited the highest CFR at 20±10 °C, while at 37±10 °C the Hero Gold instruments exhibited a higher CFR.

Conclusion: It can be inferred that Hero Gold instruments exhibited superior clinical performance when compared with Hyflex CM and 2Shape rotary instruments at body temperature (37±10 °C). The observed reduction in the NCF when increasing the temperature ranges between 30.29% - 71.27%..

Keywords: Cyclic Fatigue Resistance, Hero Gold, Hyflex CM, Nickel-Titanium, Stationary Fatigue, and 2Shape

ÖZ

Amaç: Bu çalışma, üç endodontik alet sisteminin değişen sıcaklıklarda (20 ± 1°C ve 37 ± 1°C) sabit yorulma direncini (CFR) değerlendirmeyi amaçladı

Yöntemler: Bu çalışma için sabit uç boyutu ve konikliğe (25,04) sahip üç alet sisteminden (HyFlex CM, 2Shape ve Hero Gold) doksan endodontik alet seçildi. Bu sistemler genel olarak üç gruba ayrıldı: Grup 1 (Hyflex CM), Grup 2 (2Shape) ve Grup 3 (Hero Gold). Her grup ayrıca kullanılan sıcaklık değişkenine bağlı olarak iki alt gruba bölündü. Endodontik aletler, yapay kanallı paslanmaz çelik bir blok kullanılarak 20 ± 1°C ve 37 ± 1°C'de sabit döngüsel yorulma testine tabi tutuldu. Arızaya kadar olan döngü sayısı (NCF) kaydedildi

Bulgular: Veriler, iki yönlü ANOVA ve Tukey post-hoc testleri kullanılarak %95 güven seviyesinde analiz edildi. Alet tipi ve sıcaklık değişkeni NCF değerlerini önemli ölçüde etkiler. Test edilen cihazların gözlenen NCF'si 20±10 C'de 37±10 C'deki değerlerine göre daha yüksekti ve istatistiksel olarak anlamlıydı. HyFlex CM grubu en yüksek CFR'yi 20±10 C'de sergilerken, 37±10 C'de Hero Gold aletleri daha yüksek bir CFR sergiledi

Sonuç: Hero Gold aletlerinin vücut sıcaklığında (37±10 C) Hyflex CM ve 2Shape döner aletlerle karşılaştırıldığında üstün klinik performans sergilediği söylenebilir. Sıcaklık artırıldığında NCF'de gözlenen azalma %30,29 - %71,27 arasında değişmektedir.

Anahtar Kelimeler: Cyclic Fatigue Resistance, Hero Gold, Hyflex CM, Nickel-Titanium, Stationary Fatigue, and 2Shape

Geliş Tarihi/Received 10.05.2022
Kabul Tarihi/Accepted 30.11.2022
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: : Akat B, Şentürk A, Çakırbey Tanış M, Kılıçarslan MA. The Effect of Different Zirconia Core Thicknesses and Veneer Types on Color Stability After Artificial Accelerated Aging. *Current Research in Dental Sciences*. 2024;34(2):89-93.

INTRODUCTION

The introduction of NiTi alloy has revolutionized the field of endodontics due to its superior flexibility, shape memory and super elasticity.[1,2] In recent years thermomechanical processing and surface treatment have been employed to further improve the properties of rotary endodontic instruments.[3]

However, instrument fatigue is a major concern associated with endodontic instruments, which can lead to instrument separation. The instrument fatigue can be cyclic or torsional. Cyclic fatigue failure occurs due to repeated compressive and tensile stresses in a curved canal. However, when instrument tip locks and shank continues to rotate exceeding its elastic limit, resulting into Torsional fatigue.[4,5]

Cyclic fatigue tests can be classified as dynamic or static. The dynamic test is performed with a back-and-forth movement simultaneous to the free rotation of the instrument inside the canal. Whereas, the static test does not involve any back-and-forth movement of the instrument. Factors associated with cyclic fatigue include the metallurgy of the instrument, operational setting, core mass, taper of the instrument, cross-sectional area, type of motion and environmental temperature.[6,7]

The HyFlex CM (Coltene/ Whaledent AG, Altstatten, Switzerland) is machined from a Controlled Memory (CM) wire. Its manufacturing process allows for a 300% increase in flexural strength as compared to conventional NiTi alloys. The file sizes 8/25, 6/20, 4/30 and 4/40 have triangular cross-sections while the 4/20 and 4/25 sizes have a quadrangular cross section. The manufacturer recommends a speed of 500 rpm and a torque 2N-cm for operating the HyFlex CM instruments. The shape and strength of the instruments with straightened spirals can be restored with autoclaving.[8] In their study Elnaghy et al.[9] observed the highest number of cycles to failure (NCF) with HyFlex CM when compared with Vortex Blue and TruNatomy.

The 2Shape instruments (MicroMega, Besancon, France) was introduced with a proprietary treatment (T-Wire), and claimed to offer increased flexibility and cyclic fatigue resistance (CFR) by 40%. 2Shape rotary instruments have an asymmetrical triple helix cross-section, two main cutting edges, and one secondary cutting edge which enhances the cutting action and removal of debris. It is available as a two rotary instrument system, TS1 (25/.04) and TS2 (25/.06). The manufacturer recommends a 250-400 rpm speed and a torque 2 N-cm when operating the 2Shape instruments. In a study by Mahmoud and Ismail, 2Shape showed more resistance to flexural cyclic fatigue than OneShape, and at a high temperature had a reducing effect on the flexural CFR of both the tested rotary endodontic instruments.[10]

Hero Gold (Micro-Mega, Becacon, France) is machined with heat treatment technology and has an electropolished surface. It is available either a 4% or 6% taper and has an innovative pitch design that avoids any screwing effects. It has a varied helical pitch and the pitch varies according to the taper of the instruments. The manufacturer recommends a speed of 300-600 rpm and a torque 2 N-cm to operate these instruments [11]. The literature search revealed no studies to date that evaluate the performance of the Hero Gold rotary instruments.

Several studies have assessed the CFR of NiTi instruments at room temperature (20^0 C) and body temperature (37^0 C)[3,12-15]. The results have shown that a decrease in temperature and/or application of stress drastically affects the flexural resistance of NiTi instruments, owing to a phase transformation from austenite to martensite.[3]

To the best of our knowledge none of these studies have compared the CFR of Hero Gold, HyFlex CM and 2Shape (25/.04) rotary instruments at 20 ± 1^0 C and 37 ± 1^0 C. Thus, this study aimed to evaluate and compare the CFR of thermally treated NiTi rotary instruments designed with different manufacturing technology at varying temperatures (20 ± 1^0 C and 37 ± 1^0 C). The null hypothesis for the present *in-vitro* study was as follows: there would be no significant differences among the thermally treated NiTi instruments in terms of stationary fatigue and temperature variable.

METHODS

Ethical Approval

Institutional Ethical Committee approval was obtained for this *in-vitro* study (PDCH/20/EC-200).

Instrument's Selection and Groups

Ninety NiTi rotary instruments (25.04) of 25mm in length were tested using 316L series stainless steel metal block with a 1.5 mm wide simulated canal, 7-mm radius of curvature and an angle of 90^0.

Group 1: HyFlex CM instruments (n = 30) developed from proprietary heat treatment technology

Group 2: 2Shape instruments (n= 30) developed from heat treatment T wire technology.

Group 3: Hero Gold instruments (n= 30) developed from controlled memory (CM) wire technology.

Each instrument group was further divided into two subgroups A and B (n = 15), depending on the temperature used (20 ± 1^0 C and 37 ± 1^0 C).

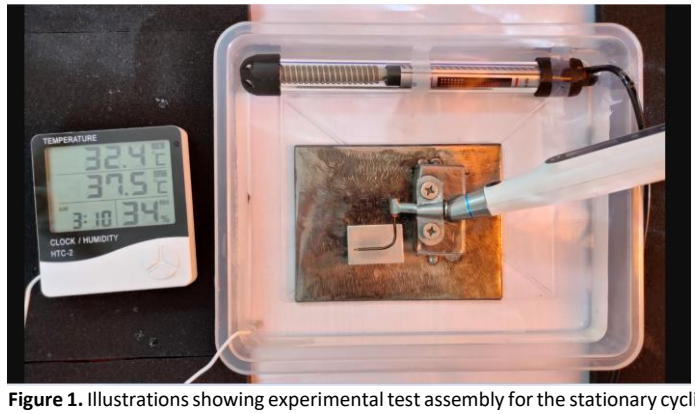

Figure 1. Illustrations showing experimental test assembly for the stationary cyclic fatigue assessment at varying temperatures (20 ± 1^0 C and 37 ± 1^0 C)

Experimental Procedure for the Assessment of Cyclic Fatigue:

The experimental procedure followed for the assessment of CFR was identical to that used by Klymus et al.[3] The stationary cyclic fatigue test assembly was submerged in a container filled with 400ml of deionized water at temperatures of 20 ± 1^0 C and 37 ± 1^0 C which were maintained using a thermostat during the stationary cyclic fatigue assessment. The Hyflex CM, 2Shape and, Hero Gold instruments were allowed to rotate at speeds and torques of 500/3, 350/2.5 and, 450 rpm/2 N-cm respectively in a stainless-steel block with an artificial canal, until it fractures, and the time to fracture was recorded using a digital stopwatch. The number of cycles to fracture (NCF) was calculated using a formula [3]:

NCF = rotational speed (rpm) × time to fracture (sec)/60

RESULTS

Data was analysed using two-way ANOVA and Tukey post-hoc tests at a 95% confidence level. The instrument type and temperature variables significantly affect the NCF values (see Table 1). The means and standard deviations (SD) of the NCF are summarized in Table 2. At 20 ± 1^0

C, the highest NCF was observed with the Hyflex CM instruments (5432.22) followed by the Hero Gold (2756.00) and 2Shape (655.00) instruments. At 37±1^0 C, the highest NCF was observed with the Hero Gold instruments (1811.00) followed by the Hyflex CM (1560.55) and 2Shape (456.55) instruments. The highest mean difference at varying temperatures (20±1^0 C and 37±1^0 C) was observed with the Hyflex CM instruments (3871.66), followed by Hero Gold (945.00) and 2Shape (208.44) rotary instruments (Table 2).

With an increase in temperature to 37±1^0 C, there was a 34.28 % reduction in NCF for the Hero Gold instruments, 30.29 % for 2Shape and 71.27 % for the Hyflex CM instruments.

Table 1. Two-way ANOVA for the main effects and the interaction effects according to NCF data

	F	p	Partial eta squared
Instrument type variable (Hero Gold, 2Shape, Hyflex CM)	950.009	**0.000**	0.916
Temperature variable	918.663	**0.000**	0.958
Instrument type* Temperature	409.770	0.000	0.907

a. R Squared = .977 (Adjusted R Squared = .976)

Table 2. Mean NCF registered at 20±1^{0}C and 37±1^{0}C during Cyclic Fatigue Testing.

	Instruments			
	Hyflex (Group 1)	2Shape (Group 2)	Hero Gold (Group 3)	Total
Temperature				
20±1°C (A)	5432.223	655.001	2756.000	1998.336095
37±1°C (B)	1560.555	456.556	1811.000	620.6607233
Total	3496.389	555.7785	2283.500	

*Statistically significant difference (*P* .05) within and between group

DISCUSSION

Several factors contribute to instrument fracture during root canal preparation owing to torsional failure and cyclic fatigue.[9,16] Studies have reported a higher prevalence of torsional failure (56%) than cyclic fatigue (44%) after multiple use of NiTi rotary instruments.[16]

It has been claimed that thermomechanical technology improves the transformation characteristics and the microstructure of the NiTi instruments.[6,17] Studies have reported a higher cyclic fatigue resistance (CFR) with thermomechanical treated endodontic instruments.[18]

Various studies have been carried out using temperature variables to evaluate the CFR of NiTi instruments.[3,14,19-24] Klymus et al [3] observed a decrease in CFR with an increase in temperature, using Reciproc Blue, Blue file and Wave One Gold Primary rotary NiTi instruments. While verifying the Protaper Universal and Protaper Gold Plotino et al.[17], reported that the latter did not suffer any significant statistical difference in thermal variation between the temperatures of 20^0 C and 35^0 C. Keleş et al. reported no statistically significant difference between Wave One (Dentsply Sirona, Ballaigues, Switzerland) and Reciproc (VDW, Munich, Germany) instruments at temperatures between 22±1^0 C and 35±1^0 C.[23]

Controversially, Keleş et al. [25] reported that the immersion of Reciproc blue instruments in liquid for five minutes at a higher temperature (60^0 C) positively affects CFR. In their study, while the instruments were immersed for five minutes in heated liquids, the tests were performed at room temperature. Such a high temperature (60^0 C) does not reflect a clinical situation.

Thus, it is now well established that instrument fatigue is not only affected by the instrument type but also by the temperature variable employed for the study. The results from this *in-vitro* study showed that CFR is significantly affected by variations in temperature as well as the instrument type (*P* <.05) (Table 1). A statistically significant difference in CFR was observed with the tested instruments at both 20±1^{0}C and 37±1^0 C (Table 2). Thus, the null hypothesis is rejected.

The Hyflex CM (Coltène-Whaledent, Altstätten, Switzerland) instruments produced by thermal treatment offers maintenance of the original root canal curvature during endodontic shaping procedure.[6] Topçuoğlu et al.[26] reported a higher CFR with Hyflex CM when compared with OneShape, ProTaper Universal and, ProTaperNext instruments in the apical curvature of simulated canal. Mario et al.[18] reported no significant difference in NCF between EdgeFile and MTwo, as well as HyFlex CM. In the present *in-vitro* study, Hyflex CM (Group 1A) instruments exhibited the highest NCF at 20±1^0 C. However, at 37±1^0 C, the instruments exhibited intermediate results.

The 2Shape (Micro Mega, Besancon, France) rotary instruments were also introduced to achieve superior results in canal shaping and instrument efficacy.[27] Uslu et al.[27] reported a higher CFR with 2Shape instruments when compared with Twisted and Endo Sequence Xpress rotary instruments.

The Hero Gold (Micro-Mega, Becacon, France) heat treated Ni-Ti file has a smoother electropolished surface. It has a large inner core and three cutting edges. It has an anti-breakage control feature which unwinds the file to indicate the risk of fracture. There is very little literature evaluating and comparing the CFR of Hero Gold with other rotary instruments.

In the present *in-vitro* study the cyclic fatigue results from the 2Shape instruments (Group 2A and 2B) were the lowest at both 20±1^0 C and 37±1^0 C (Table 2).

A statistically significant difference in the CFR was observed with the tested instruments at 20±1^0 C and 37±1^0 C (Table 2). The mean differences obtained at 20±1^0 C and 37±1^0 C for 2Shape, Hero Gold and Hyflex CM instruments were 208.445, 945.000 and 3871.668 respectively (Table 2).

The results from the present *in-vitro* study demonstrate a decrease in the CFR with an increase in temperature. This is in accordance with the studies conducted by Klymus et al.[3], Dosanjh et al.[28], and Shen et al.[22] in which the resistance to cyclic fatigue decreased with an increase in temperature. A statistically significant difference was reported in the NCF at 20±1^0 C and 37±1^0 C for the tested endodontic instruments. This higher NCF at a low temperature (20±1^0 C) could be attributed to its increased flexibility (martensitic phase), as when subjected to heat, the alloy returns to its original shape (Austenitic phase).[14]

At 20±1^0 C, the Hyflex CM instruments (Group 1A) exhibited the highest NCF when compared to all the tested instruments. This could be attributed to the thermal processing of the alloy, the presence of a martensitic phase, and the austenite finish (A_f) temperature. This supports the belief that the more martensitic an NiTi alloy is, the more flexible, and fatigue resistant the instrument becomes. Also, the martensitic phase transformation exhibits damping characteristics, thereby rendering crack propagation difficult.[14]

The 2Shape instruments exhibited the lowest NCF values at both temperatures, possibly due to their metallurgy. The instruments manufactured with the T wire technology (2Shape) had lower fatigue resistance and instrument flexibility than the instruments manufactured with CM wire technology (Hyflex CM). This result is in accordance with the studies conducted by Ozurek et al.[29] and Mustafa Gündoğar et al.[30]

At 37±1^0 C, the Hero Gold instruments (Group 3B) exhibited highest the NCF compared to the 2Shape (Group 2B) and Hyflex CM (Group 1B) rotary instruments.

There is little literature comparing the CFR of Hero Gold instruments with other rotary instruments. Hence, a comparison of the results could not be made between the Hero Gold and other tested instruments. However, it is possible that the proprietary heat treatment technology involved and the cross-sectional design could be responsible for its higher CFR when compared with Hyflex CM instruments at 37±1^0 C.

Thus, the present *in-vitro* study observed a 34.28% reduction in the NCF for Hero Gold, 30.29% for 2Shape and 71.27% for Hyflex CM rotary instruments, with an increase in temperature to 37±1^0 C. This finding

suggests that the Hyflex CM instruments underwent large changes in their internal microstructure with an increase in temperature from 20±1^0 C to 37±1^0 C. Differential Scanning Calorimetry (DSC) can be employed to analyze the phase transformation of the NiTi instruments. In this analysis, certain peaks related to the cooling and heating cycles indicate a martensitic (cooling) and austenitic (heating) transformation. The austenitic finish (A_f) temperature for the Hyflex CM was about 44^0 C, which suggests that Hyflex CM has varying degrees of a martensitic condition at 20±1^0 C and moves to austenitic state at body temperature (37±1^0 C).[14]

Thus, the Hyflex CM instruments owing to their austenite finish (A_f) temperature (44^0 C), have austenitic and martensitic content at the intracanal temperature (37±1^{0}C). The presence of an austenitic phase at the intracanal temperature (37±1^0 C) causes a decrease in fatigue resistance and instrument flexibility, thereby making it prone to fracture. The highest NCF values of the Hyflex CM instruments at 20±1^0 C cannot be correlated with their superior clinical performance as the intracanal temperature (37±1^{0}C) simulation was not achieved.

The results obtained for the Hero Gold instruments could not be compared with results from other studies owing to the lack of literature comparing Hero Gold rotary instruments with other endodontic instruments. This is a limitation of the present study. The body temperature (37^0 C) simulation would not be the only consideration either, for a clinical simulation, factors such as root dentin, irrigating solution among others, need also to be considered when evaluating the CFR. The static cyclic fatigue testing was also performed. Most of the studies have used simulated canal curvatures of 60^0 as compared to 90^0 used in the present *in-vitro* study, this might also affect the CFR.

The preliminary findings of the present *in-vitro* study must be confirmed by further investigation to evaluate the clinically relevant mechanical properties of the instruments. Further *in-vivo* studies need to be performed to investigate similar parameters.[19]

CONCLUSION

The present *in-vitro* study demonstrates how the intra canal temperature can affect the properties of different rotary endodontic instruments including cyclic fatigue. A rise in the temperature increases the presence of the austenitic phase, thereby making the instrument less flexible and more prone to fracture. At 37±1^0 C the Hero Gold instruments demonstrated superior performance compared to the Hyflex CM and 2Shape rotary instruments. However, further analysis needs to be performed to evaluate clinically relevant mechanical properties and the CFR of Hero Gold instruments because these are not explored as much in any other studies.

Etik Komite Onayı: Çalışma için kurumsal etik kurul onayı alındı (PDCH/20/EC-200).
Hasta Onamı: Bu bir in vitro çalışma olduğu için hasta onamı alınmamıştır
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – A. A, I.A.; Tasarım A. A, I.A.; Denetleme - A. A, I.A.; Kaynaklar - A. A, I.A.; Malzemeler - A. A, I.A.; Veri Toplanması ve/veya İşlemesi - A. A, I.A.; Analiz ve/veya Yorum - A. A, I.A.; Literatür Taraması - A. A, I.A.; Yazıyı Yazan - A. A, I.A.; Eleştirel İnceleme - A. A, I.A., Metgud S.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Institutional ethical committee approval was obtained for the study (PDCH/20/EC-200).
Informed Consent: Since this was an in vitro study, patient consent was not obtained
Peer-review: Externally peer-reviewed.
Author Contributions: Concept A. A, I.A.; Design - A. A, I.A.; Supervision - A. A, I.A.; Resources - A. A, I.A.; Materials - A. A, I.A.; Data Collection and/or Processing - A. A, I.A.; Analysis and/or Interpretation - A. A, I.A.; Literature Search - A. A, I.A.; Writing Manuscript - A. A, I.A.; Critical Review - A. A, I.A., M.S.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Araştırma Makalesi *Research Article* DOI: 10.5281/zenodo.11059438

Diş Hekimlerinin Kardiyopulmoner Resüsitasyon ve Mavi Kod Uygulamaları Konusunda Bilgi Düzeylerinin Değerlendirilmesi

An Evaluation of the Knowledge Levels of Dentists on Cardiopulmonary Resuscitation and Code Blue Applications

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ÖZ

Amaç: Diş hekimlerinin kardiyopulmoner resüsitasyon (KPR) ve mavi kod uygulamaları (MKU) hakkındaki bilgi düzeylerini değerlendirmektir.

Yöntemler: Anket formları, Kayseri ilindeki çeşitli kamu kurumları veya üniversitede görev yapan 210 diş hekimine ulaştırılmıştır. Soruları yanıtlamayı kabul eden 165 katılımcı çalışmaya dahil edilmiştir. Katılımcılara demografik özelliklerini, KPR ve MKU hakkındaki bilgi ve deneyimlerini değerlendiren 19 adet soru sorulmuştur. Veriler istatistiksel olarak değerlendirilmiştir.

Bulgular: Katılımcıların %70,3'ünün mavi kod vermeyi bildiği ve %43,6'sının önceden mavi kod verdiği tespit edilmiştir. Katılımcıların %15,2'si herhangi bir zamanda, %0,6'sı ise diş tedavisi sırasında kardiyak arrest durumu ile karşılaştığını belirtmiştir. Mezuniyet sonrası KPR eğitimi alanların oranı %69,7 ve KPR uygulayanların oranı ise %6,7 idi. Katılımcılar, KPR sırasında göğüs kompresyon hızı, göğüs kompresyonu / solunum oranı ve uygulama yeri ile ilgili sorulara sırasıyla %61,2, %55,2 ve %57,6 oranında doğru cevap vermiştir. Mesleki tecrübe süresi 1-5 yıl arasında olan diş hekimlerinin bu soruları cevaplamada daha başarılı olduğu tespit edilmiştir ($p<0,05$).

Sonuç: Katılımcıların KPR ve MKU konusunda bilgi eksikliklerinin olduğu görülmüştür. Bu nedenle, diş hekimlerine yönelik KPR eğitimleri lisans düzeyinde başlamalı ve mezuniyet sonrası dönemde devam etmelidir.

Anahtar Kelimeler : Diş hekimi, Kardiyopulmoner resüsitasyon, Mavi kod

ABSTRACT

Objective: To evaluate the dentists' knowledge of cardiopulmonary resuscitation (CPR) and code blue application (CBA).

Methods: The study was conducted among 210 dentists working in the public hospitals or dental faculty in Kayseri. The study included 165 dentists who volunteered to respond the survey questions. Participants were asked 19 questions about their demographics, as well as their knowledge and experience of CPR and CBA. The dataset was statistically evaluated.

Results: It was determined that 43.6% of the participants had used CBA before, and 70.3% of the participants were capable of giving the code blue. The participants' rates of experiencing cardiac arrest cases anywhere or in their dental practice were 15.2% and 0.6%, respectively. After graduation, 69.7% of the participants received CPR training; however, only 6.7% performed CPR. 61.2%, 55.2%, and 57.6% of participants correctly answered questions about chest compression rate, chest compression/respiration ratio, and application site, respectively. It was found that participants with 1 to 5 years of professional experience answered the questions more accurately.

Conclusion: The participants in the study had a lack of knowledge regarding CPR and CBA. As a result, CPR training for dentists should begin in the undergraduate years and continue in the postgraduate years.

Keywords: Dentist, Cardiopulmonary resuscitation, Code blue

Geliş Tarihi/Received 27.03.2022
Kabul Tarihi/Accepted 05.08.2022
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Yüce Yıldırım M, Bilge S, Topan C, Karakaya M, Demirbaş AE. An Evaluation of the Knowledge Levels of Dentists on Cardiopulmonary Resuscitation and Code Blue Applications. *Current Research in Dental Sciences*. 2024;34(2):94-98.

GİRİŞ

Herhangi bir nedenle dolaşımı ve solunumu durmuş kişiye uygulanacak olan yeniden canlandırma işlemlerine kardiyopulmoner resüsitasyon (KPR) denir. Kardiyak arrest (kalbin durması) sonrası beyin ve kalp gibi organlara yeterli oksijenlenmenin sağlanması için temel ve ileri yaşam desteği konusunda eğitimli bir ekibin varlığı çok önemlidir.[1,2] Bu anlamda hastanelerde, KPR konusunda eğitimli sağlık çalışanlarından oluşan mavi kod ekipleri oluşturulmuştur. Bu ekibin görevi, tıbbi acil müdahaleye gerek duyulduğu durumlarda olay yerine en kısa sürede ulaşmak ve hastalara ilk müdahaleyi yapmaktır.[3]

Diş hekimliği pratiğinde kardiyak arrest gibi acil durumlara nadiren de olsa rastlanmaktadır. Diş hekimliğinde, bu tür acil durumların görülme ihtimali, ilave sağlık problemleri olan yaşlı hastalarda ve dental kaygısı yüksek olan hastalarda daha fazladır.[4] Amerika Birleşik Devletleri'nde (ABD) 2001 yılında yapılan bir çalışmada, her 133 doktor ve diş hekimi muayenehanesi için kardiyak arrest insidansı yılda %0.008-1 arasında değişmektedir. Birleşik Krallık'ta yapılan benzer bir çalışmada ise diş hekimi başına yıllık kardiyak arrest insidansının %0.002 olduğu tespit edilmiştir.[5] Kalp durmasından sonra hemen KPR uygulanmazsa, hastaların hayatta kalma şansı her bir dakika için %7-10 oranında azalmaktadır.[6] Bu yüzden, diş hekimleri KPR gibi tıbbi acil durumları tanıma ve hastalara gerekli müdahaleyi etkin bir şekilde yapabilme yetkinliğine sahip olmalıdır.

Bu çalışma, diş hekimlerinin KPR ve mavi kod uygulamaları (MKU) hakkındaki bilgi düzeylerinin değerlendirilmesi amacıyla yapılmıştır.

YÖTEMLER

Bu çalışma, Kayseri Erciyes Üniversitesi Klinik Araştırmalar Etik Kurulu tarafından 12.06.2019 tarihinde onaylanmıştır (karar no 2019/442). Anket formu, Temmuz 2019-Aralık 2020 tarihleri arasında Kayseri ilindeki çeşitli kamu kurumları veya üniversitede görev yapan 210 diş hekimine ulaştırılmıştır. Ankette diş hekimlerinin adı ve iletişim bilgileri yer almadığından katılımcıların gizliliği korunmuştur. Anketin sınav amaçlı olmadığı ve çalışmadan elde edilen verilerin bilimsel amaçla kullanılacağı katılımcılara açıklanmıştır. Anket formunu yanıtlamayı kabul eden 165 katılımcı çalışmaya dahil edilmiştir. Anket soruları iki bölümden oluşturulmuştur. İlk bölümde katılımcılara yaşı, cinsiyeti, mesleki tecrübesi, uzmanlık durumu ve çalıştığı kurum ile ilgili demografik bilgileri içeren 5 adet soru sorulmuştur. İkinci bölümde ise katılımcıların KPR ve MKU ile ilgili bilgi düzeylerini değerlendiren 14 adet soru sorulmuştur. İkinci bölüm için Amerikan Kalp Derneği (AHA) ve Avrupa Resüsitasyon Konseyi (ERC) tarafından oluşturulan 2010 kılavuzu esas alınmıştır.

İstatistiksel analiz

Veriler SPSS 22.0 (IBM Corp., Armonk, NY, ABD) paket programı kullanılarak değerlendirilmiştir. Tanımlayıcı istatistiksel yöntemler olarak sayı (n), yüzde (%) kullanılmıştır. Veriler SPSS programında ağırlıklandırılmış ve Ki-kare bağımsızlık testi ile analiz edilmiştir. Verilerdeki beklenen değerler 25'ten büyük ise Pearson Chi-square, beklenen değerler 5-25 arasında ise Yates Chi-square ve beklenen değerlerden en az biri 5'ten küçükse Fisher's exact testi uygulanmıştır. Sonuç olarak, 0,05'in altındaki p değerleri istatistiksel olarak anlamlı kabul edilmiştir.

BULGULAR

Çalışmaya 91'i (%55,2) kadın ve 74'ü (%44,8) erkek olmak üzere toplamda 165 katılımcı dahil edilmiştir. Katılımcıların yaş ortalaması 29,81±5,10 olarak hesaplanmıştır. Katılımcıların mesleki tecrübe süresi, çalıştığı kurum ve uzmanlık durumu ile ilgili bilgiler tablo 1'de yer almaktadır.

Tablo 1. Diş hekimlerinin sosyo-demografik özellikleri

Sosyo-demografik Özellikler		n	%
Yaş	24-30	112	67.9
	31-39	41	24,8
	40-50	12	7,3
Cinsiyet	Kadın	91	55,2
	Erkek	74	44,8
Mesleki tecrübe süresi	<1yıl	22	13,3
	1-5yıl	75	45,5
	5-10yıl	45	27,3
	>10yıl	23	13,9
Çalıştığı kurum	Kamu	86	52,1
	Üniversite	79	47,9
Uzmanlık durumu	Var	46	27,9
	Yok	119	72,1

n: hasta sayısı

Katılımcıların %70,3'ünün (n=116) mavi kod vermeyi (numarasını) bildiği ve %43,6'sının (n=72) daha önceden mavi kod verdiği tespit edilmiştir. Katılımcıların %15,2'si (n=25) herhangi bir zamanda, %0,6'sı (n=1) ise diş tedavisi sırasında daha önceden kardiyak arrest durumu ile karşılaştığını belirtmiştir. Katılımcıların %16,4'ü (n=27) kardiyak arrest durumunu doğru bir şekilde değerlendirmeyi bildiğini belirtmiştir. Katılımcıların %69,7'si (n= 115) mezuniyet sonrası KPR eğitimi aldığını, %55,6'sı (n=64) aldığı eğitimin yeterli düzeyde olmadığını ve %91,5'i (n=151) ise bu eğitimlerin lisans düzeyinde verilmesi gerektiğini belirtmiştir. Katılımcıların %6,7'si (n=11) daha önce KPR uyguladığını bildirmiştir. Katılımcılar KPR uygulaması sırasında göğüs kompresyon hızı, göğüs kompresyonu / solunum oranı ve uygulama yeri ile ilgili sorulara sırasıyla %61,2 (n=101), %55,2 (n=91) ve %57,6 (n=95) oranında doğru cevap vermiştir. Katılımcıların erişkinlerde KPR uygulama sırası ile ilgili soruyu doğru cevaplama oranı %18,8 olarak bulunmuştur. Katılımcıların MKU ve KPR ile ilgili sorulara verdiği yanıtlar Tablo 2'de yer almaktadır.

Katılımcıların sosyo-demografik özelliklerine göre KPR uygulamasında göğüs kompresyon hızını ve KPR uygulama yerini bilme durumları ayrı ayrı incelenmiş ve aralarında istatistiksel olarak önemli bir farklılık bulunmamıştır (p>0,05), (Tablo 3), (Tablo 4). Katılımcıların sosyo-demografik özelliklerine göre KPR uygulamasında göğüs kompresyonu / solunum oranını ve KPR uygulama sırasını bilme durumları istatistiksel olarak ayrı ayrı incelenmiştir. Mesleki tecrübe süresi 1-5 yıl arasında olan diş hekimlerinin diğer mesleki tecrübe süresine sahip diş hekimlerine kıyasla bu sorulara önemli bir şekilde daha fazla oranda doğru cevap verdiği tespit edilmiştir (p<0,05), (Tablo 5), (Tablo 6).

Tablo 2. KPR ve mavi kod sorularına verilen yanıtlar

Sorular	*n*	*%*
Hastanenizde mavi kod uygulaması var mı?		
Evet	159	96.4
Hayır	2	1.2
Bilmiyorum	4	2.4
Mavi kod vermeyi (numarasını) biliyor musunuz?		
Evet	116	70.3
Hayır	49	29.7
Daha önce mavi kod verdiniz mi?		
Evet	72	43.6
Hayır	93	56.4
Herhangi bir yerde kardiyak arrest vakası ile karşılaştınız mı?		
Evet	25	15.2
Hayır	136	82.4
Emin değilim	4	2.4

Diş tedavisi esnasında kardiyak arrest vakası ile karşılaştınız mı?		
Evet	1	0.6
Hayır	164	99.4
Kardiyak arrest durumunu doğru bir şekilde değerlendirmeyi biliyor musunuz?		
Evet	27	16.4
Hayır	29	17.6
Emin değilim	109	66.1
Mezuniyet sonrası KPR eğitimi aldınız mı?		
Evet	115	69.7
Hayır	50	30.3
Aldığınız KPR eğitimi sizce yeterli düzeyde mi?		
Evet	26	22.6
Hayır	64	55.6
Emin değilim	25	21.8
Sizce KPR eğitimi mezuniyet öncesi eğitimin bir parçası olmalı mı?		
Evet	151	91.5
Emin değilim	14	8.5
Kendiniz daha önce KPR uyguladınız mı?		
Evet	11	6.7
Hayır	154	93.3
KPR uygulamasında göğüs kompresyon hızı kaçtır?		
150/dk	5	3.0
100/dk	101	61.2
50/dk	14	8.5
Bilmiyorum	45	27.3
KPR uygulamasında göğüs kompresyonu / solunum oranı nedir?		
5/1	11	6.7
15/2	30	18.2
30/2	91	55.2
Bilmiyorum	33	20.0
Erişkinlerde KPR uygulama yeri neresidir?		
Göğüsün üst bölümü	7	4.2
Göğüsün ortası	95	57.6
Göğüsün alt bölümü	39	23.6
Bilmiyorum	24	14.5
Erişkinlerde KPR uygulama sırası nasıldır?		
B-A-C	8	4.8
A-B-C	109	66.1
C-A-B	31	18.8
A-C-B	17	10.3

n: hasta sayısı, KPR: kardiyopulmoner resüsitasyon

Tablo 3. Diş hekimlerinin sosyo- demografik özelliklerine göre KPR uygulamasında göğüs kompresyon hızını bilme durumları

Özellikler	KPR uygulamasında göğüs kompresyon hızı kaçtır?				x^2	p
	150/dk	100/dk	50/dk	Bilmiyorum		
Yaş						
24-30	4 (3.6)	69 (61.6)	9 (8.0)	30 (26.8)	4.512	0.608
31-39	0 (0.0)	27 (65.9)	4 (9.8)	10 (24.4)		
40-50	1 (8.3)	5 (41.7)	1 (8.3)	5 (41.7)		
Mesleki tecrübe süresi						
<1yıl	0 (0.0)	11 (50.0)	1 (4.5)	10 (45.5)	9.241	0.415
1-5yıl	4 (5.3)	49 (65.3)	6 (8.0)	16 (21.3)		
5-10yıl	0 (0.0)	29 (64.4)	4 (8.9)	12 (26.7)		
>10yıl	1 (4.3)	12 (52.2)	3(13.0)	7 (30.4)		
Çalıştığı kurum						
Kamu						
Üniversite	2 (2.3)	52 (60.5)	9 (10.5)	23 (26.7)	1.159	0.763
	3 (3.8)	49 (62.0)	5 (6.3)	22 (27.8)		
Uzmanlık durumu						
Var	1 (2.2)	27 (58.7)	8 (17.4)	10 (21.7)	6.899	0.075
Yok	4 (3.4)	74 (62.2)	6 (5.0)	35 (29.4)		

x^2: Chi Square

Tablo 4. Diş hekimlerinin sosyo- demografik özelliklerine göre erişkinlerde KPR uygulama yerini bilme durumları

Özellikler	Erişkinlerde KPR uygulama yeri neresidir?				x^2	p
	Üst bölümü	Ortası	Alt bölümü	Bilmiyorum		
Yaş						
24-30	4 (3.6)	68 (60.7)	25 (22.3)	15 (13.4)	2.732	0.842
31-39	2 (4.9)	22 (53.7)	11 (26.8)	6 (14.6)		
40-50	1 (8.3)	5 (41.7)	3 (25.0)	3 (25.0)		
Mesleki tecrübe süresi						
<1yıl	1 (4.5)	12 (54.5)	4 (18.2)	5 (22.7)	5.385	0.800
1-5yıl	3 (4.0)	47 (62.7)	19 (25.3)	6 (8.0)		
5-10yıl	2 (4.4)	24 (53.3)	10 (22.2)	9 (20.0)		
>10yıl	1 (4.3)	12 (52.2)	6 (26.1)	4 (17.4)		
Çalıştığı kurum						
Kamu	4 (4.7)	46 (53.5)	22(25.6)	14 (16.3)	1.251	0.741
Üniversite	3 (3.8)	49 (62.0)	17 (21.5)	10 (12.7)		
Uzmanlık durumu						
Var	1 (2.2)	29 (63.0)	9 (19.6)	7 (15.2)	1.442	0.696
Yok	6 (5.0)	66 (55.5)	30 (25.2)	17 (14.3)		

x^2: Chi Square

Tablo 5. Diş hekimlerinin sosyo- demografik özelliklerine göre KPR uygulamasında göğüs kompresyonu/solunum oranını bilme durumları

Özellikler	Erişkinlerde KPR uygulama yeri neresidir?				x^2	p
	5/1	15/2	30/2	Bilmiyorum		
Yaş						
24-30	5 (4.5)	21 (18.8)	66 (58.9)	20 (17.9)	6.291	0.391
31-39	4 (9.8)	8 (19.5)	20 (48.8)	9 (22.0)		
40-50	2 (16.7)	1 (8.3)	5 (41.7)	4 (33.3)		
Mesleki tecrübe süresi						
<1yıl	1 (4.5)	4 (18.2)	10 (45.5)	7 (31.8)	19.226	0.023
1-5yıl	3 (4.0)	17 (22.7)	47 (62.7)	8 (10.7)		
5-10yıl	2 (4.4)	7 (15.6)	24 (53.3)	12 (26.7)		
>10yıl	5 (21.7)	2 (8.7)	10 (43.5)	6 (26.1)		
Çalıştığı kurum						
Kamu					6.001	0.112
Üniversite	8 (9.3)	18 (20.9)	40 (46.5)	20 (23.3)		
	3 (3.8)	12 (15.2)	51 (64.6)	13 (16.5)		
Uzmanlık durumu						
Var					0.944	0.815
Yok	3 (6.5)	9 (19.6)	27 (58.7)	7 (15.2)		
	8 (6.7)	21 (17.6)	64 (53.8)	26 (21.8)		

x^2: Chi Square

Tablo 6. Diş hekimlerinin sosyo- demografik özelliklerine göre erişkinlerde KPR uygulama sırasını bilme durumları

Özellikler	Erişkinlerde KPR uygulama yeri neresidir?				x^2	p
	B-A-C	A-B-C	C-A-B	A-C-B		
Yaş						
24-30	5 (4.5)	77 (68.8)	21 (18.8)	9 (8.0)	7.280	0.296
31-39	3 (7.3)	27 (65.9)	6 (14.6)	5 (12.2)		
40-50	0 (0.0)	5 (41.7)	4 (33.3)	3 (25.0)		
Mesleki tecrübe süresi						
<1yıl	1 (4.5)	16 (72.7)	5 (22.7)	0 (0.0)	5.300	0.021
1-5yıl	4 (5.3)	51 (68.0)	13 (17.3)	7 (9.3)		
5-10yıl	3 (6.7)	30 (66.7)	8 (17.8)	4 (8.9)		
>10yıl	0 (0.0)	12 (52.2)	5 (21.7)	6 (26.1)		
Çalıştığı kurum						
Kamu	3 (3.5)	56 (65.1)	18 (20.9)	9 (10.5)	1.153	0.764
Üniversite	5 (6.3)	53 (67.1)	13 (16.5)	8 (10.1)		
Uzmanlık durumu						
Var	3 (6.5)	28 (60.9)	9 (19.6)	6 (13.0)	1.114	0.774
Yok	5 (4.2)	81 (68.1)	22 (18.5)	11 (9.2)		

x^2: Chi Square

TARTIŞMA

Bu çalışma, Kayseri ilinde çeşitli kamu kurumları veya üniversitede görev yapmakta olan diş hekimlerinin KPR ve MKU uygulamaları hakkındaki bilgi düzeylerini ve farkındalıklarını değerlendirmek amacıyla yapılmıştır. Çalışmanın sonucunda, diş hekimlerinin KPR ve MKU konusunda teorik bilgi anlamında eksikliklerinin olduğunu ortaya konmuştur.

Diş hekimliği pratiğinde tıbbi acil durumlara nadiren rastlanır, ancak bu tür durumlar hastaların hayatını tehdit edebilir. Özellikle hastalar üzerinde lokal anestezi altında gerçekleştirilen dental cerrahi işlemler kardiyak arrest riskini arttırabilir. Bununla birlikte, diş hekimliğinde rutin kullanılan bazı ilaçlar ve malzemeler (lateks, reçineler, lokal anestezikler vb.) hastalarda ciddi sonuçlar doğurabilen aşırı duyarlılık reaksiyonlarına neden olabilir.[7] Görülme sıklığı düşük olsa da diş hekimlerinin kardiyak arrest vakaları ile karşılaşma olasılığı vardır. ABD'de acil servislere gelen kardiyak arrest vakalarını retrospektif olarak inceleyen bir çalışmada, toplamda 8088 kardiyak arrest olgusunun 142'sinin (%2) medikal ve dental uygulamalarla ilişkili olduğu ve bunların 6 tanesinin (%0,07) dental uygulamalar sırasında gelişmiş olduğu rapor edilmiştir.[8] Canpolat ve ark. çalışmasında, diş hekimlerinin çalışma ortamında kardiyak arrest ile karşılaşma oranı %2,6 ve herhangi bir yerde kardiyak arrest ile karşılaşma oranı %19,5 olarak bulunmuştur.[9] Ekici'nin çalışmasında ise diş hekimlerinin dental tedaviler sırasında kardiyak arrest ile karşılaşma oranı %1,3 olarak tespit edilmiştir.[10] Alkandari ve ark. çalışmasında bu oranın %4,3 ve Arsati ve ark. çalışmasında ise %0,2 olduğu rapor edilmiştir.[5,11] Bu çalışmanın sonuçlarına göre diş hekimlerinin dental tedaviler sırasında ve herhangi bir yerde kardiyak arrest ile karşılaşma oranı sırasıyla %0,6 ve %15,2 olduğu tespit edilmiştir. Bu anlamda, literatürdeki oranların çalışmamızın sonuçlarından elde ettiğimiz oranlar ile uyumu olduğu görülmüştür. Diş hekimlerinin nadiren de olsa dental tedaviler sırasında kardiyak arrest ile karşılaşabileceği ve bu tür tıbbi acil durumların tanı ve tedavileri konusunda hazırlıklı olmaları gerektiği unutulmamalıdır.

Literatürde, dental kliniklerde kardiyak arrest sonrası ölümle sonuçlanan vaka raporları mevcuttur.[12,13] Bu yüzden, diş hekimleri kardiyak arrest gibi tıbbi acil durumlarda hastalara anında müdahale edebilecek seviyede pratik ve teorik donanıma sahip olmalıdır. Canpolat ve ark. çalışmasında, katılımcıların %10,4'ünün KPR konusunda kendilerini yeterli görmediği ve %44,1'inin ise kardiyak arrest geçiren bir hastayı doğru bir şekilde değerlendirmeyi bilmediği rapor edilmiştir.[9] Bizim çalışmamızdaki katılımcıların yalnızca %16,4'ü kardiyak arrest durumunu doğru bir şekilde değerlendirmeyi bildiğini belirtmiştir. Ancak bu çalışma pratik uygulamaya yönelik planlanmamıştı, sadece diş hekimlerinin kendi değerlendirmelerine dayanıyordu. Çalışmamıza katılan diş hekimlerinin %69,7'si mezuniyet sonrası KPR eğitimi aldığını belirtmiştir. Katılımcıların %91,5'i KPR eğitiminin mezuniyet öncesi eğitimin bir parçası olması gerektiğini ve %55,6'sı ise aldıkları eğitimin yeterli olmadığını ifade etmiştir. KPR'ye yaklaşım ile ilgili teorik ve pratik bilgiler belirli aralıklar ile güncellenmektedir. Kardiyak arrest vakaları ile karşılaşma ihtimali en yüksek olan grup sağlık personelleridir.[14] KPR eğitimlerinde katılımcılara yeterli teorik bilgi verilmez ve pratik uygulama yaptırılmaz ise katılımcıların 12 ay sonra teorik bilgilerinin önemli bir kısmını ve 18 ay sonra da pratik becerilerini unuttuğu belirtilmiştir.[15] Bu yüzden, diş hekimleri de diğer sağlık personelleri gibi KPR ile ilgili bilgilerini taze tutmak için belirli dönemlerde bu alanda eğitim almalı, AHA ve ERC'nin yayınladığı güncel kılavuzları yakından takip etmelidir.

2020 yılında yapılan bir çalışmada, diş hekimlerine KPR uygulaması ile ilgili sorular sorulmuştur. Katılımcıların %1,3'ü kalp masajının uygulama yerini, %13,2'si suni solunum oranını, %27,6'sı göğüs kompresyon oranını ve %42,1'i solunum/kompresyon oranını doğru cevapladığı görülmüştür.[10] İran'daki diş hekimlerinin temel yaşam desteği ile ilgili bilgi ve beceri düzeylerini değerlendirmek için bir çalışma yapılmıştır. Çalışmaya göre, katılımcıların yaklaşık %39'unun hiçbir soruya cevap vermediği ve %2,5'inin ise tüm soruları doğru olarak yanıtladığı belirtilmiştir Bununla birlikte, katılımcıların %45'inin mezuniyet sonrası KPR eğitimi aldığı ve bu eğitime katılan diş hekimlerinin soruları doğru cevaplama konusunda daha başarılı olduğu bulunmuştur.[6] Bizim çalışmamızda, KPR ile ilgili sorulara katılımcılar %55,2 ile %61,2 oranında doğru cevap vermişlerdir. Bu oran literatür ile benzerlik göstermektedir. Yoldaş ve ark. çalışmasında, kardiyak arrest vakalarında yaşam kurtarma zincirinin doğru sıralamasını doktorların %64,1'inin doğru cevapladığı tespit edilmiştir. Aynı zamanda, KPR eğitimi alanların bu soruya istatistiksel olarak daha yüksek oranda doğru cevap verdiği belirtilmiştir.[14] Bizim çalışmamızda ise bu oran %18,8 olarak bulunmuştur. Çalışmamıza katılan diş hekimlerinin tıbbi acil durumlar ile ilgili bilgilerinin eksik veya güncel olmaması sebebiyle bu oran düşük çıkmış olabilir. Asistan doktorların temel ve ileri yaşam desteği konusundaki bilgi düzeylerini değerlendiren bir çalışmada, 20-30 yaş grubu arasındaki katılımcıların soruları doğru cevaplama konusunda daha başarılı oldukları tespit edilmiştir.[16] Bizim çalışmamızda, mesleki tecrübe süresi 1-5 yıl arasında olan diş hekimlerinin soruları doğru cevaplama oranının daha yüksek olduğu tespit edilmiştir. Bu durum, mesleğe yeni başlamış olan diş hekimlerinin tıbbi acil durumlar ile ilgili lisans düzeyinde öğrendikleri bilgilerin daha güncel olmasından kaynaklı olabilir.

Profesyonel bir ekip aracılığıyla MKU sayesinde hastaların sağ kalım oranı artmış ve günümüzde bu uygulama hastanelerin vazgeçilmez bir standardı haline gelmiştir.[17] Çalışmamızda, katılımcıların %70,3'ü mavi kodun numarasını bildiğini ve %43,6'sı ise daha önce mavi kod verdiğini belirtmiştir. Katılımcıların yaklaşık yarıya yakınının daha önce mavi kod verdiğini belirtmesi ve bu oranın bu kadar yüksek olması, bizce tıbbi acil durum kavramının katılımcılar tarafından yeterince ayırt edilememesi kaynaklı olabilir. Doğruel ve ark. mavi kod çağrı sonuçlarını incelediği çalışmasında, yanlış mavi kod çağrı oranının %100 olması bizim çalışmanın sonuçları ile benzerlik göstermektedir.[3] Bu çalışmanın limitasyonu, araştırmanın pratik uygulamaya yönelik tasarlanmaması ve diş hekimlerinin sadece kendini değerlendirmelerine dayalı olmasıdır.

SONUÇ

Çalışmamızda, örneklemimizdeki katılımcıların KPR ve MKU konusunda bilgi eksikliklerinin olduğu sonucuna varılmıştır. Katılımcıların büyük bir çoğunluğunun KPR eğitimi aldığı ancak bu eğitimin teorik ve pratik içeriğinin kendileri için yeterli olmadığı sonucuna varılmıştır. Diş hekimleri tıbbi acil durumlar ile karşılaştıklarında doğru tanı ve müdahaleyi zamanında yapabilmeli ve MKU'dan da faydalanabilmelidirler. Bu nedenle, diş hekimlerine yönelik KPR eğitimleri lisans düzeyinde başlamalı ve bu eğitimler mezuniyet sonrası dönemde teorik ve uygulamalı olarak devam etmelidir.

Etik Komite Onayı: Etik kurul onayı Kayseri Erciyes Üniversitesi Yerel Etik Kurulu'ndan (Tarih: 12.06.2019, Karar no 2019/442) alınmıştır.
Hasta Onamı: Yazılı onam bu çalışmaya katılan tüm katılımcılardan alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – S.B., C.T., M.K.; Tasarım – M.Y.Y.; Denetleme – A.E.D.; Kaynaklar – M.Y.Y.; Malzemeler – S.B.; Veri Toplanması ve/veya İşlemesi – C.T.; Analiz ve/veya Yorum – M.Y.Y.; Literatür Taraması – M.Y.Y.; Yazıyı Yazan- M.K.; Eleştirel İnceleme – A.E.D.
Çıkar Çatışması: Bu makalenin yazarları arasında çalışma kapsamında herhangi bir kişisel çıkar çatışması yoktur.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was received from Kayseri Erciyes University Local Ethics Committee (Date: 12.06.2019, Decision no 2019/442)

Informed Consent: Written consent was obtained from all participants participating in this study..
Peer-review: Externally peer-reviewed.
Author Contributions: Concept – S.B., C.T., M.K.; Supervision - M.Y.Y.; Resources – A.E.D.; Materials - M.Y.Y.; Data Collection and/or Processing - M.Y.Y.; Analysis and/or Interpretation - M.Y.Y.; Literature Search - M.Y.Y.; Writing Manuscript – M.K.; Critical Review – A.E.D.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Araştırma Makalesi *Research Article* DOI: 10.5152/CRDS.2023.2273121

Radiologic Changes in Patients with Temporomandibular Joint Hypermobility: A Cone Beam Computed Tomography Study

Temporomandibular Eklem Hipermobilitesi Olan Hastalarda Radyolojik Değişiklikler: Koni Işınlı Bilgisayarlı Tomografi Çalışması

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ABSTRACT

Objective: This study aimed to evaluate radiologic changes in patients with temporomandibular joint hypermobility using Cone Beam Computed Tomography (CBCT).

Methods: This retrospective study included the first-visit CBCT images of 41 patients (mean age, 32.83 ± 13.63 years) treated for TMJ hypermobility. CBCT images of sixty-eight joints with TMJ hypermobility taken by using NewTom 3G were evaluated. Condylar erosion, sclerosis, hypoplasia, and flattening were assessed on the CBCT images. In addition, flattening of articular eminence, subchondral cyst, and pneumatization were also evaluated in the images. Descriptive statistical analysis was performed on the data.

Results: Degenerations were observed in 47 joints (%69.11). Condylar erosion was the most common finding of TMJ hypermobility (43 of 68 joints, 63.2%). Other frequent condylar bony changes were condylar osteophyte (32 joints, 47.1%), sclerosis (8 joints, 11.8%), hypoplasia (8 joints, 11.8%), and flattening (6 joints, 8.8%). The flattening of articular eminence (3 joints, 4.4%) and subchondral cyst (3 joints, 4.4%)), and) were other findings on CBCT images. One joint showed a bifid condyle and pneumatization (1.5 %) (Table 1).

Conclusion: The present study showed that two of three patients with TMJ hypermobility had joint degenerations. Condylar erosion and osteophyte are the most common degenerations observed in these patients. Therefore, CBCT is recommended for the diagnosis and management of TMJ hypermobility.

Keywords: Cone beam computed tomography, TMJ hypermobility, Diagnosis

ÖZ

Amaç : Bu çalışmada temporomandibular eklem hipermobilitesi olan hastalarda Koni Işınlı Bilgisayarlı Tomografi (CBCT) kullanılarak radyolojik değişikliklerin değerlendirilmesi amaçlandı.

Yöntemler: Bu retrospektif çalışmaya, TME hipermobilitesi nedeniyle tedavi edilen 41 hastanın (ortalama yaş, 32,83 ± 13,63 yıl) ilk ziyaret KIBT görüntüleri dahil edildi. TME hipermobilitesi olan 68 eklemin NewTom 3G kullanılarak alınan KIBT görüntüleri değerlendirildi. KIBT görüntülerinde kondiler erozyon, skleroz, hipoplazi ve düzleşme değerlendirildi. Ayrıca görüntülerde eklem eminensinde düzleşme, subkondral kist ve pnömatizasyon da değerlendirildi. Veriler üzerinde tanımlayıcı istatistiksel analiz yapıldı.

Bulgular : 47 eklemde (%69,11) dejenerasyon gözlendi. Kondiler erozyon, TME hipermobilitesinin en sık görülen bulgusuydu (68 eklemden 43'ü, %63,2). Kondiler osteofit (32 eklem, %47,1), skleroz (8 eklem, %11,8), hipoplazi (8 eklem, %11,8) ve düzleşme (6 eklem, %8,8) diğer sık görülen kondiler kemik değişiklikleriydi. Artiküler eminenste düzleşme (3 eklem, %4,4) ve subkondral kist (3 eklem, %4,4) ve) KIBT görüntülerindeki diğer bulgulardı. Bir eklemde bifid kondil ve pnömatizasyon (%1,5) görüldü (Tablo 1).

Sonuç: Bu çalışma TME hipermobilitesi olan üç hastadan ikisinde eklem dejenerasyonunun olduğunu gösterdi. Bu hastalarda en sık görülen dejenerasyonlar kondiler erozyon ve osteofittir. Bu nedenle TME hipermobilitesinin tanı ve tedavisinde KIBT önerilmektedir.

Anahtar Kelimeler : Konik ışınlı bilgisayarlı tomografi, TME hipermobilitesi, Tanı

Geliş Tarihi/Received 30.10.2022
Kabul Tarihi/Accepted 20.01.2023
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Cömert Kılıç S, Kılıç N, Sümbüllü MA. Radiologic Changes in Patients with Temporomandibular Joint Hypermobility: A Cone Beam Computed Tomography Study. *Current Research in Dental Sciences*. 2024;34(2):99-102

INTRODUCTION

Temporomandibular joint (TMJ) hypermobility is a disorder that involves condyle-disc complex and eminence. The temporomandibular joint (TMJ) dislocation occurs when the condyle moves beyond the eminence during an extensive mandibular opening. Before returning to the fossa, the condyle catches in an open position.[1,2] A temporary pause is followed by a sudden jump or leap to the maximal position. This jump creates a sound like a thud, not clicking. According to the Diagnostic Criteria for Temporomandibular Disorders (DC/ TMD), the jaw can close spontaneously, or the patient can close the jaw with self-maneuver.[2,3] This situation is called subluxation or hypermobility.[1,2] According to Schiffman et al,[3] Temporomandibular joint dislocation is characterized by an "open lock" of the lower jaw, and diagnosis of the TMJ dislocation is based on patient history. If a patient is able to reduce the dislocation, it is called "subluxation." If a patient is unable to reduce this dislocation, the dislocation requires an interventional reduction and it is called "luxation".

The etiology of TMJ hypermobility is mainly associated with the morphological structure of the joint. Other etiological factors include generalized joint laxity, elongation of the ligaments, internal derangement and disc interference disorders, and occlusal disturbances.[2,3]

CBCT has remarkable research areas in TMJ imaging. The 3-D imaging modality of CBCT provides influential diagnostic assessments of a variety of TMJ conditions, such as osteoarthritis and hypermobility.[4,5]

CBCT has several advantages over conventional CT for diagnosis and treatment planning: lower cost and radiation dose, 3D imaging ability, better resolution, shorter acquisition time, and more essential details. In addition, osseous components of the TMJ joint, integrity of cortical bone, and destruction/production of subcortical bone can be viewed with superior sensitivity on CBCT, [4,5].

CBCT findings of temporomandibular joint disorders have been subjected to several studies.[5-7] A recent study found that most joints showed degenerations on CBCT evaluations.[6] Other studies[7] assessed the CBCT images to detect degenerative changes in TMJ. The most common osseous changes in degenerative joint disease are erosion, osteophytes, and flattening.

CBCT evaluations of patients with TMJ hypermobility have been carried out in a few studies.[8] However, bony osseous changes of the mandibular condyle and articular fossa were never evaluated in previous studies with large sample-sized populations. Therefore, this study aimed to evaluate radiologic changes in patients with temporomandibular joint hypermobility using Cone Beam Computed Tomography (CBCT).

METHODS

This retrospective study included the first-visit CBCT images of 41 patients (mean age, 32.83 ± 13.63 years) treated for TMJ hypermobility. CBCT images of sixty-eight joints with TMJ hypermobility were evaluated. All participants signed the informed consent, and the informed consents were included in the study. The Ethics Committee of the Faculty of Dentistry, XXX University, approved this study (Approval Date: 28.04.2014; Approval Number: 2014/11).

Diagnosis of TMJ hypermobility was based on the condylar movement that the condyle slides just anterior to the articular eminence and then goes back to the glenoid fossa by active jaw manipulation of the patient or self-reduction.

The inclusion criteria were as follows:1) had clinical complaints of TMJ-hypermobility according to DC/TMD axis I group IIc, 2) existing CBCT with high quality, 3) age > 16 years. Exclusion criteria were as follows: 1.) had previous temporomandibular joint disorder treatment; 2.) had a hematologic or neurologic disorder and any disease of inflammatory or connective tissues 3.) had pregnancy; 4.) a history of drug allergy; immunosuppressive drug intake, and degenerative TMJ disorders.

CBCT Evaluation

During the mouth closed position, a NewTom 3G flat panel was used to get CBCT of TMJ (Quantitative Radiology, Verona, Italy). All images were recorded at 5.4 second exposure time, 110 kV and 3-5 mA, and .16 mm voxel size. CBCT images were assessed in three planes: axial (0.5 mm), coronal, and sagittal (2 mm). The CBCT evaluations were performed on lateral slices using the NewTom CBCT software.

Condylar erosion, sclerosis, hypoplasia, and flattening were assessed on the CBCT images. In addition, flattening of articular eminence, fossa resorption and sclerosis, subchondral cyst, and pneumatization was also evaluated on the images.

Statistical Analysis

All statistical analyses were conducted using the SPSS 17.0 (Statistical Package of Social Sciences, Chicago, IL, USA) software program. Descriptive statistical analysis was performed on the data.

RESULTS

Degenerations were observed in 47 joints (%69.11). Condylar erosion was the most common finding of TMJ hypermobility (43 of 68 joints, 63.2%). Other frequent condylar bony changes were condylar osteophyte (32 joints, 47.1%), sclerosis (8 joints, 11.8%), hypoplasia (8 joints, 11.8%), and flattening (6 joints, 8.8%). The flattening of articular eminence (3 joints, 4.4%) and subchondral cyst (3 joints, 4.4%)), and) were other findings on CBCT images. One joint showed a bifid condyle and pneumatization (1.5 %) (Table 1).

Table 1. CBCT results show osseous changes related to the condyle, articular fossa, and eminence.

CBCT findings	*n*	%	CBCT findings	*n*	%
Condylar erosion	43	63.2	Fossa resorption	2	3.6
Condylar osteophyte	32	47.1	Fossa sclerosis	3	5.5
Condylar sclerosis	8	11.8	Subcortical cyst	3	4.4
Condylar hypoplasia	8	11.8	Flattening of art. eminence	3	4.4
Condylar flattening	6	8.8	Bifid condyle	1	1.5
Pneumatization	1	1.5			

CBCT, cone beam, computed tomography.
n = number of joints.

DISCUSSION

During a wide mouth opening, temporomandibular joint (TMJ) hypermobility occurs with an excessive translation of the condyle anterior to the eminence. TMJ hypermobility is mainly associated with the morphological structure of the joint. Other factors included occlusal disturbances and trauma, internal derangement and disc interference disorders, TMJ ligament and joint capsule laxity, and hyperactivity of the lateral pterygoid muscle.[2,3,9]

CT, MRI, plain radiography, arthrography, and panoramic radiography have been used with varying frequencies to get images of the TMJ and surrounding structures and to diagnose TMJ disorders. However, all these modalities have limitations and drawbacks for effectively visualizing TMJ structures. These modalities' main limitations and drawbacks are the presence of artifacts and the superimposition of

the adjacent structures. On the other hand, CBCT lets precise measurements of the condyle surface and condylar volume with dose- and cost-effectiveness. CBCT provides an evaluation of hard tissue abnormalities of the TMJ with high-quality 3D images.[4] For accurate assessment of osseous TMJ structures, CBCT has been advocated due to its high-diagnostic accuracy.[10]

Scanning times of CBCT are significantly shorter (10-70 seconds), and it offers submillimeter spatial resolution images with lower radiation dosages than CT methods.[10]

Katakami et al[11] reported that CBCT showed high sensitivity in demonstrating hard tissue changes, which is consistent with our findings. These authors reported that CBCT images showed an erosive shift in the cortical bone. On the other hand, other authors[12] wrote that the sensitivity of CBCT depends on the defect's size, and the sensitivity is low in small-sized hard tissue defects.

CBCT has a sensitivity between 72.9–87.5% in detecting condylar bone changes[12], and condylar erosion can be seen more quickly than other degenerative changes.[12] It has been emphasized that defects smaller than 2 mm may be challenging to detect, and defect size is essential for CBCT sensitivity. However, some reports revealed that when using higher scanning resolutions (0.2-mm voxel size), bony defects can be detected with 80% sensitivity, regardless of the size of the defects.[13]

Tuijt et al[8] evaluated CBCTs of the patients with TMJ hypermobility. The authors used the CBCT to provide a patient-specific biomechanical model. However, hard-tissue changes of the condyle and fossa were never evaluated in previous studies with large sample-sized populations.

Therefore, this study evaluated radiological changes of the condyle and articular fossa in CBCT images of patients with TMJ hypermobility. The present study found that two of three patients showed joint degeneration. Condylar erosion was the most common finding of TMJ hypermobility (43 of 68 joints, 63.2%). Other frequent condylar bony changes were condylar osteophyte (32 joints, 47.1%), sclerosis and hypoplasia (8 joints, 11.8%), and flattening (6 joints, 8.8%). The flattening of articular eminence (3 joints, 4.4%) and subchondral cyst (3 joints, 4.4%)), and) were other findings on CBCT images. One joint showed a bifid condyle and pneumatization (1.5 %) (Table 1).

Lee at al.[14] evaluated patients with temporomandibular disorder (TMD) by means of clinical and MR findings. These authors reported that condylar degeneration, disc displacement, disc deformity were frequent among patients with TMD. The authors reported that 37 percent of the patients showed condylar degeneration.

Cömert Kilic et al[5] evaluated CBCT of 76 patients with temporomandibular joint osteoarthritis (TMJ-OA), and they reported 94 percent condylar erosion, 92 percent condylar flattening, approximately 80 percent osteophytes, and 12 percent sclerosis. In addition, five joints showed pneumatization and flattening of the articular eminence in this study.

Some experimental studies[15] have shown that alterations of functional TMJ loading cause a density loss in the subchondral bone of condyle and condylar cartilage.[15]

A CBCT analysis by Talaat et al.[16] revealed that joints with TMD patients had frequent flattening, condylar osteophytes, and irregularities. Some authors suggested that erosive lesions may indicate early and acute bony changes in TMJ structures. In contrast, osteophyte and flattening formation indicates late alterations in the TMJ and may suggest a bone repair.[17]

Ogütcen-Toller[18] suggested that temporomandibular joint sounds may be considered signs of an abnormal joint disorder. On the other hand, other researchers suggested that pathological bony changes in TMD patients osteophyte formation, erosion, or deformity) may be associated with joint sounds.[19]

CONCLUSION

Findings of the present study showed that two of three patients with TMJ hypermobility had joint degenerations, and condylar erosion and osteophyte are the most common degenerations observed in these patients. Therefore, CBCT is recommended for the diagnosis and management of TMJ hypermobility.

Etik Komite Onayı: Etik kurul onayı Atatürk Üniversitesi Yerel Etik Kurulu'ndan (Tarih: 28.04.2014, Sayı: 2014/11) alınmıştır.
Hasta Onamı: Bu çalışmaya katılan tüm katılımcılardan yazılı onam alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – S.C.K.; Tasarım – S.C.K., N.K., M.A.S; Denetleme – S.C.K.; Kaynaklar – S.C.K., N.K.; Veri Toplanması ve/veya İşlemesi – S.C.K., M.A.S.; Analiz ve/veya Yorum – S.C.K., N.K., M.A.S.; Literatür Taraması –S.C.K., N.K; Makaleyi Yazan – S.C.K., N.K.; Eleştirel İnceleme – N.K..
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was obtained from Atatürk University Local Ethics Committee (Date: 28.04.2014, Number: 2014/11)
Informed Consent: Written consent was obtained from all participantswho participated in this study
Peer-review: Externally peer-reviewed.
Author Contributions: Concept – S.C.K.; Design – S.C.K., N.K., M.A.S; Supervision – S.C.K..; Resources – S.C.K., N.K.; Data Collection and/or Processing – S.C.K., M.A.S.; Analysis and/or Interpretation – S.C.K., N.K., M.A.S.; Literature Search –S.C.K., N.K; Writing Manuscript – S.C.K., N.K.; Critical Review – N.K.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Araştırma Makalesi *Research Article* DOI: 10.5152/CRDS.2022.2276127

Effect of Different Surface Coating Applications on The Surface Roughness and Color Stability of Resin-Based Composites: An SEM Study

Farklı Yüzey Örtücü Uygulamalarının Rezin Bazlı Kompozitlerin Yüzey Pürüzlülüğü ve Renk Stabilitesine Etkisi: SEM Çalışması

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ABSTRACT

Objective: To investigate color change and surface roughness of resin-based composites treated with a surface coating agent.

Methods: Forty specimens were prepared from each resin [G-ænial Posterior (microhybrid composite/GP) and SDR flow+(bulk-fill composite/SDR)]. Following baseline color and surface roughness (Ra) measurements, the specimens were randomly divided into 4 groups (n=10) according to surface coating agents [(Permaseal, Biscover LV, Prebond SE, and control group]. Following the application procedures, color and roughness measurements were repeated. The specimens were discolored for 144 hours in a coffee solution, renewing daily. Final measurements were performed. Color change values (ΔE_{00}) and Ra were calculated. Surface topography was determined using scanning electron microscopy. Two-way analyses of variance, Tukey's post-hoc test and Student t-test were performed, with a $p<0.05$ regarded as indicative of significance.

Results: SDR showed more color change and surface roughness than GP and both materials presented unacceptable (AT>1.8) and perceptible (PT>0.8) discoloration. The highest discoloration was observed for Permaseal and Prebond SE in terms of ΔE_2 and ΔE_3. GP-Biscover LV, SDR-Prebond SE combinations showed the lowest and clinically acceptable (AT<1.8) ΔE values. There were no significant differences between surface coating agents in terms of surface roughness ($p>0.05$). GP-Permaseal and SDR-Prebond SE combinations were exhibited less surface roughness.

Conclusion: A bulk-fill composite is more prone to discoloration than a microhybrid composite. At each period, the bulk-fill composite exhibited greater surface roughness than the microhybrid composite. Biscover LV showed more acceptable results in terms of color stability and roughness than other surface coating agents (Permaseal and Prebond SE).

Keywords: Sealant, Permaseal, Biscover LV, Prebond, Discoloration, Roughness

ÖZ

Amaç : Yüzey örtücü ajanı ile muamele edilmiş rezin esaslı kompozitlerin renk değişimi ve yüzey pürüzlülüğünü araştırmak.

Yöntemler: Her rezin materyalinden [G-ænial Posterior (mikrohibrit kompozit/GP) and SDR flow+(bulk-fill kompozit/SDR)] kırk numune hazırlandı. Başlangıç renk ve yüzey pürüzlülüğü (Ra) ölçümlerinin ardından, numuneler yüzey örtücü ajanlarına [(Permaseal, Biscover LV ve Prebond SE] ve kontrol grubu distile su olacak şekilde rastgele 4 gruba (n=10) ayrıldı. Uygulama işlemlerinin ardından renk ve pürüzlülük ölçümleri tekrarlandı. Numuneler, günlük olarak yenilenen kahve solüsyonunda 144 saat boyunca renklendirildi. Son ölçümler yapıldı. Renk değişim değerleri (ΔE_{00}) ve Ra hesaplandı. Yüzey topografisi, taramalı elektron mikroskobu kullanılarak belirlendi. İki yönlü varyans analizleri, Tukey post hoc testi ve Student-t testi yapıldı ve $P<0,05$ anlamlılık göstergesi olarak kabul edildi.

Bulgular : SDR, GP'den daha fazla renk değişimi ve yüzey pürüzlülüğü gösterdi ve her iki materyal de kabul edilemez (AT>1,8) ve algılanabilir (PT>0,8) renk değişikliği gösterdi. ΔE_2 ve ΔE_3 açısından en yüksek renk değişimi Permaseal ve Prebond SE için gözlendi. GP-Biscover LV ve SDR-Prebond SE kombinasyonları en düşük ve klinik olarak kabul edilebilir (AT<1,8) ΔE değerlerini gösterdi. Yüzey pürüzlülüğü açısından yüzey örtücü ajanları arasında anlamlı fark yoktu ($p>0,05$). GP-Permaseal ve SDR-Prebond SE kombinasyonları daha az yüzey pürüzlülüğü sergiledi.

Geliş Tarihi/Received 08.11.2022
Kabul Tarihi/Accepted 12.12.2022
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Ertürk Avunduk AT, Delikan E. Effect of different surface coating applications on the surface roughness and color stability of resin-based composites: An SEM study *Current Research in Dental Sciences*. 2024;34(2):103-110.

Sonuç: Bulk-fil rezin kompoziti, mikro-hibrit kompozite göre renk bozulmasına daha yatkındır. Her periyotta, Bulk-fil kompozit, mikro-hibrit kompozitten daha fazla yüzey pürüzlülüğü sergiledi. Biscover LV, hem renk stabilitesi hem de pürüzlülük açısından diğer yüzey örtücü ajanlarına (Permaseal ve Prebond SE) göre daha kabul edilebilir sonuçlar gösterdi.
Anahtar Kelimeler: Örtücü, Permaseal, Biscover LV, Prebond, Renk değişikliği, Pürüzlülük

INTRODUCTION

Color and surface properties of resin-based composites (RBCs) are important factors affecting the long-term prognosis of restorations.[1] Additionally, resin composites' organic structure and filler particle ratio directly affect the surface's roughness and propensity for external discoloration. Rough restoration surfaces can cause plaque accumulation, gingival irritation, and secondary caries formation. These surfaces are easily discolored by the absorption and adsorption of oral fluids.[2]

Another significant issue with RBCs materials is the formation of micro-gaps.[3] Factors such as polymerization shrinkage, characteristics of the restorative material, finishing and polishing processes, morphological and histological structure of enamel and dentin, application method of composite resin, number of bonded surfaces, the position of the cavity and occlusion can cause micro-gap formation.[4] Contrary to conventional incremental 2mm material thickness, bulk-fill composites enable insertion in single-layer thicknesses of 4-6mm, reducing the number of clinical steps and internal/external marginal gap development.[5]

Surface coating agents (surface sealants, composite glaze materials, bonding adhesive agents) have been developed to cover micro-porosities on the restoration surfaces, increase marginal integrity and abrasion resistance, and ensure color stability by preventing the absorption of pigments.[6] These materials, with their low viscosity and high wettability, can penetrate through micro-cracks and form a shiny, slippery surface on the restoration.[7] Manufacturers aim to eliminate the oxygen inhibition layer on the composite surface and to reduce plaque formation and staining with the clinical applications of these agents.[7] Although not specified in the manufacturer's recommendations, in clinical practice, dentists commonly use bonding agents in the finishing process to provide smoother restoration surfaces.[8] However, these materials contain hydrophilic monomers and solvents that can damage some properties of RBCs (such as discoloration).[9]

The effects of surface sealant applications on RBCs have been evaluated in many studies.[4,10] Nevertheless, there is a lack of information about the effect of using bonding adhesive and surface sealant materials on the color stability and surface structure of RBCs restorations. The aim of the present study is to evaluate the color change and surface roughness of RBCs surface covered with different surface coating materials. The definitions of the study's null hypotheses were as follows: (1) application of surface coating agents does not cause color change on RBCs, (2) surface sealants or bonding adhesive agents do not have an effect on the surface roughness of RBCs.

METHODS

A microfilled hybrid (mFR) resin composite [G-ænial Posterior (GP)], and a bulk-fill resin composite [SDR flow+ (SDR)] were evaluated in this study. And the properties of these materials are given in Table 1.

Specimen preparation

Figure 1 is a simplified representation of study design. The sample size was calculated with the G*Power program (version 3.1.9.4, Heinrich Heine, University of Düsseldorf, Düsseldorf, Germany). A supposed significance level of 0.05 and an effect size of 0.25 was applied and a total of 80 specimens were prepared to obtain 10 specimens at the final subgroups of each material.

Teflon molds in size of 6*2 mm were used to prepare specimens for each resin composite (GP and SDR). A mylar strip band and a glass plate were used to obtain smooth surfaces on the specimens. All the specimens were polymerized using a LED (D-Light Pro, GC, Japan) with irradiation of 1200 mW/cm^2 for 20 sec. A polishing system (Super-Snap Rainbow Technique Kit, Shofu Inc., Kyoto, Japan) was applied to a single surface of the samples in each group. Then the specimens were post-polymerized in distilled water at 37°C for 24 hours.

Color measurement

A digital spectrophotometer (Vita Easyshade V, Vita Zahnfabrik, Bad Säckingen, Germany) was used to measure baseline colors (T0) of the specimens. The device's probe was positioned in the center of the specimens, which are on a white surface without reflection. "L, C, and H" values were averaged after being measured three times for each specimen. The spectrophotometer was re-calibrated in accordance with the manufacturer's instructions after every nine measurements.

Surface roughness measurement

Initial surface roughness (Ra0) measurements (T0) were determined with a mechanical contact profilometer (Mitutoyo, Surftest SJ-410, Japan) with a measuring distance of 4 mm and a cut-off value of 0.8 mm. Before each measurement, calibration of the profilometer was performed using a reference block with a Ra value of 3.05 µm. Three measurements were obtained at the center of each specimen surface were averaged and Ra0 values were recorded in µm.

Surface coating agents' applications

Following the baseline color and surface roughness measurements, the specimens were randomly divided into four groups (n=10): Permaseal, Biscover LV, Prebond SE, and control group. The three surface coating agents (Table 1) were applied to the polished surfaces in accordance with the manufacturer's recommendations.

Following the application of the surface coating materials, color, and surface roughness (Ra1) measurements (T1) were repeated.

Staining procedure

The specimens were immersed in a 20 ml diffuse coffee solution prepared using 5 g of coffee (Nescafe Gold, Nestle, Istanbul, Turkey) and 300 ml of boiling water for a total of 144 hours. The staining beverage was re-prepared daily. Following this process, the specimens were rinsed with water for 10 s and gently dried. Distilled water was preferred as a control group to appreciate the intrinsic changes.

When the immersion period was completed, the final color and surface roughness (Ra2) measurements (T2) were performed. To evaluate the color differences between the baseline and final measurements after staining, ΔE_{00} (T_1- T_0) values were calculated via the following formulation:

$$\Delta E_{00} = \left[\left(\frac{\Delta L}{k_L S_L}\right)^2 + \left(\frac{\Delta C}{k_C S_C}\right)^2 + \left(\frac{\Delta H}{k_H S_H}\right)^2 + R_T\left(\frac{\Delta C}{k_C S_C}\right)\left(\frac{\Delta H}{k_H S_H}\right)\right]^{1/2}$$

In this study, CIEDE2000 (1:1:1) formula was used. The color changes were analyzed based on an 'Acceptability Threshold' (AT) of 50:50% (AT:ΔE_{00}=1.8) and a 'Perceptibility Threshold' (PT) of 50:50% (PT:ΔE_{00}=0.8) for all the resin-based materials.[11]

Table 1. Chemical composition of restorative materials and surface coating agents used in the study

Resin-based composites							
Product	**Lot Number**	**Manufacturer**	**Shade**	**Classification**	**Composition**		
					Monomer Composition	**Filler Type**	**Filler Amount (wt%/vol %)**
G-ænial Posterior (GP)	1709223	Kuraray Noritake Dental Inc.; Okayama, Japan	A3	Microfilled hybrid (mFR)	Bis-GMA, TEGDMA, and hydrophobic aromatic dimethacrylate	Glass ceramics, surface-treated alumina micro filler, silica, particle size 6 µm	92/82
SDR™ Flow⁺ (SDR)	1903000872	Dentsply, Konstanz, Germany	U	Bulk-Fill flowable composite	Modified UDMA, ethoxylated bisphenol-A-dimethacrylate (EBPADMA), TEGDMA, butylated hydroxytoluene (BHT), UV stabiliser, titanium dioxide and iron oxides, camphoroquinone.	Ba-Al-F-B-Si glass and St-Al-F-Si-glass, particle size 10 µm	70.5/47.4
Surface coating agents							
Product	**Lot Number**	**Manufacturer**	**Composition**		**Application procedure**		
Permaseal	BM6TJ	Ultradent Products, UT, USA	Bis-GMA 60%, TEGDMA 40%, 1-dimethylaminoethyl metacrylate <3%		37% phosphoric acid (Panora 200 Phosphoric Acid, Imıcryl, Konya, Turkey) was applied to the resin composite specimens for 20 seconds. The specimens were washed for 15 seconds and dried for 10 seconds. Then, a thin layer of PermaSeal surface sealant was applied to the specimen surfaces for 5 seconds with the help of the brush included in the package. After 5 seconds of gentle airflow, polymerization was achieved for 30 seconds.		
Biscover LV	2200001852	Bisco, IL, USA	Dipentaerythritol penta-acrylateesters and ethanol		37% phosphoric acid (Panora 200 Phosphoric Acid, Imıcryl, Konya, Turkey) was applied on the resin composite samples for 15 seconds. The specimens were washed for 15 seconds using an air-water syringe and dried for 10 seconds. A thin layer of Biscover LV was then applied to the specimen surfaces using disposable adhesive application brushes. 15 seconds was waited without applying air to remove the solvents and then polymerization was achieved for 30 seconds.		
Prebond SE	216644	President Dental, München, Germany	Funtional MDP monomer, methacrylate, photoinitiators, ethanol, water		The bottle was shaken well before use. A thin layer of Prebond SE was then applied to the specimen surfaces using disposable adhesive application brushes for 20 seconds. The specimens were dried with gentle airflow and then polymerized for 20 seconds.		

Abbreviations: Bis-GMA = bisphenol-glycidyl methacrylate; TEGDMA = triethyleneglycol dimethacrylate; UDMA = urethane dimethacrylate; MDP = methacryloyloxydecyl dihydrogen phosphate

Table 2. The mean ΔE_{00} values ± standard deviations after treatment with surface coating agents and immersion in coffee

Materials	**Surface coating agents**					
	Control (Distilled water)	**Permaseal**	**Biscover LV**	**Prebond SE**	Results	Total
ΔE_1 (T1-T0)						
GP	1.00 ±0.55 ^{B,b}	1.12 ±.57^{b}	0.65 ±0.12 ^{B,b}	1.96 ±072^{A,a}	*p^a=0.000*	*1.18*±0.71
SDR	0.51 ± 0.39 ^{A,b}	1.50 ±0.55^{a}	1.12 ±0.43^{A,a,c}	0.88 ±0.57^{B,b,c}	*p^a=0.001*	*1.0*±0.59
	p^b=0.038	*p^b=0.152*	*p^b=0.004*	*p^b=0.002*		*p^b=0.230*
Total	*0.75*±0.53^{z}	*1.31*±0.58^{x,y}	*0.88*±0.39^{y,z}	*1.42*±0.84^{x}	*p^a=0.001*	
ΔE_2 (T2-T0)						
GP	5.14 ±1.06^{A,a,b}	6.12 ±1.22^{B,a}	4.24 ±0.97^{b}	5.83 ±0.6^{B,a}	*p^a=0.001*	*5.33*±1.20
SDR	3.83 ±0.86^{B,b}	9.38 ±3.38^{A,a}	6.46 ±3.27^{a,b}	8.94 ±2.25^{A,a}	*p^a=0.000*	*7.15*±3.39
	p^b=0.007	*p^b=0.01*	*p^b=0.055*	*p^b=<0.001*		*p^b=0.000*
Total	*4.48*±1.16^{y}	*7.75*±2.99^{x}	*5.35*±2.61^{y}	*7.38*±2.26^{x}	*p^a=0.000*	
ΔE_3 (T2-T1)						
GP	5.08 ±0.99^{A,a}	5.99 ±1.40^{B,a}	3.69 ±0.96^{B,b}	6.11±0.84^{B,a}	*p^a=0.000*	*5.22*±1.42
SDR	3.72 ±0.74 ^{B,b}	9.72 ±3.39^{A,a}	6.82 ±3.62^{A,a,b}	8.49 ±2.66^{A,a}	*p^a=0.000*	*7.19*±3.55
	p^b=0.003	*p^b=0.005*	*p^b=0.016*	*p^b=0.015*		*p^b=0.000*
Total	*4.40*±0.1.10^{z}	*7.85*±3.17^{x}	*5.26*±3.04^{y,z}	*7.30*±2.27^{x,y}	*p^a=0.000*	

ΔE_1: Color change between sealant application and baseline; ΔE_2: Color change between discoloration and baseline;
ΔE_3: Color change between discoloration and sealant application. Lower letters indicate the difference between lines, capital letters indicate the differences between rows. AT:ΔE_{00}=1.8 and PT:ΔE_{00}=0.8
GP: G- ænial posterior, SDR: SDR™ Flow⁺.
p^a values are based on One-way ANOVA test, p^b values are based on The Student t-test, *p<0,05 is significant.

Table 3. Comparison of mean surface roughness (Ra) values for material groups and tested surface coating agents

Materials		Surface coating agents				
	Distilled water	Permaseal	Biscover LV	Prebond SE	Results	Total
G- ænial posterior						
Ra0	1.99 ±1.21	2.23 ±1.09	1.17 ±0.60	1.79 ±0.1	p^a=0.120	1.79±1.04
Ra1	1.91 ±1.22	1.19 ±1.03	2.31 ±1.55	1.72 ±1.10	p^a=0.258	1.78±1.26
Ra2	2.51 ±1.79	1.28 ±0.82	1.90 ±1.22	1.71 ±0.86	p^a=0.472	1.85±1.74
	p^b=0.384	p^b=0.097	p^b=0.262	p^b=0.988		p^b=0.996
Total	2.14 ± 1.41	1.57 ± 1.07	1.79 ± 1.62	1.74 ± 1.33	p^a= 0.436	1.81±1.37
SDR						
Ra0	3.09 ±2.5	2.27 ±1.28	2.76 ±2.23	1.53 ±1.27	p^a=0.296	2.42±1.92
Ra1	2.54 ±1.59	2.85 ±2.0	1.79 ±0.81	2.69 ±1.81	p^a=0.684	2.47±2.04
Ra2	1.87 ±1.16	2.30 ±1.53	2.51 ±1.71	2.80 ±1.41	p^a=0.556	2.37±1.45
	p^b=0.407	p^b=0.584	p^b=0.179	p^b=0.06		p^b=0.926
Total	2.50 ± 2.17	2.47 ± 1.60	2.35 ± 1.91	2.34 ± 1.57	p^a= 0.979	2.42±1.81

Lower letters indicate the difference between lines and capital letters indicate the difference between columns.
Ra0: Baseline surface roughness, Ra1: Surface roughness after surface coating agent application, Ra2: Surface roughness after staining procedure.
p^a values are based on One-way ANOVA test, p^b values are based on Repeated Measures for One Way ANOVA, *p<0,05 is significant. The acceptability threshold of surface roughness was considered as 0.2 µm.

Table 4. Factors affecting color change (ΔE_{00}) and surface roughness at different times

	Source	Type III sum of squares	df	Mean square	F	Sig.
ΔE_1	Material	0.632	1	0.632	2.373	0.128
	Surface coating agent	6,327	3	2.109	7.919	0,000
	Material*Surface coating	8.097	3	2.699	10.134	0.000
	R Squared = ,440 (Adjusted R Squared = ,385)					
ΔE_2	Material	66.394	1	66.394	16.689	0.000
	Surface coating agent	149.171	3	49.724	12.499	0.000
	Material*Surface coating	68.416	3	22.805	5.732	0.001
	R Squared = ,498 (Adjusted R Squared = ,449)					
ΔE_3	Material	77.598	1	77.598	16.877	0.000
	Surface coating agent	161.618	3	53.873	11.717	0.000
	Material*Surface coating	78.488	3	26.163	5.690	0.001
	R Squared = ,490 (Adjusted R Squared = ,440)					
Ra	Material	0.288	2	0.144	0.072	0.930
	Surface coating agent	0.288	2	0.144	0.073	0.930
	Material*Surface coating material	8.498	6	1.416	0.713	0.640

ΔE values are based on the One-way ANOVA test, and Ra values are based on Repeated Measures for One-way ANOVA.

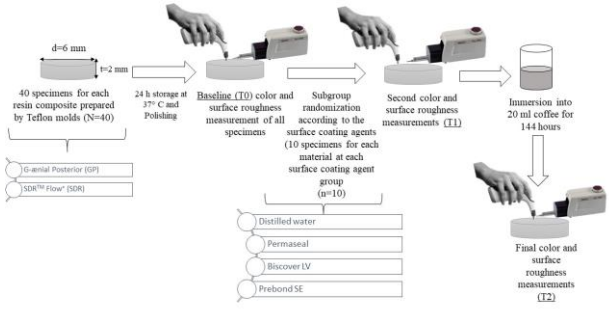

Figure 1. Schematic illustration of study design.

Surface topography evaluation by Scanning Electron Microscope (SEM)

Scanning electron microscope images were taken from randomly chosen specimens from all experimental groups following the staining procedure. Specimens were sputter-coated with palladium in the ion plating unit (Polaron SC500 sputter coater, FISONS Instrument, UK) and were observed by SEM device (Zeiss GEMINI 500, Zeiss, Oberkochen, Germany) at the Erciyes University Technology Research and Application Center. The entire surface of the specimen was scanned, and the most representative areas were photographed at a magnification of 1,500x.

Statistical analyses

Statistical analyses were performed using the Statistical Package for the Social Sciences (version 25.0, IBM SPSS Corp., Armonk, NY, USA). The normality of the ΔE00 and Ra (µm) data was determined using the Shapiro-Wilk test. Two-way analysis of variance (ANOVA) was used to determine the significance of color change caused by surface coating materials in restorative materials. Intra-group color change differences of materials were performed by Student t-test. Two-way analysis of variance (ANOVA) and repeated measures for the two-way ANOVA test were employed to indicate the evaluation of surface roughness due to the parametric test assumptions being fulfilled. Student t-test was used to determine the surface roughness differences of the materials in the same time period. P=0.05 was set the level of statistical significance.

RESULTS

Assessments of resin-based materials' color changes

The mean ΔE_{00} values and standard deviations of the restorative materials after treatment with surface coating agents (T1- T0) and immersion in coffee (T2- T0) are shown in Table 2. Regarding ΔE_1 values, no significant difference was detected between resin composite materials used in the present study (p^b>0.05). The discoloration of the GP and SDR specimens were below AT threshold (<1.8), while the values were above the PT threshold (>0.8). Regarding the ΔE_2 and ΔE_3 values, there were significant differences between restorative materials (p^b=0.000) due to more color change observed in SDR than in GP. Also, both materials presented unacceptable and perceptible discoloration.

Assessments of surface coating agents' color changes

There were significant differences among surface coating agents, regarding ΔE_1 values (p^a=0.001). All values were below AT threshold (<1.8). Only distilled water showed imperceptible color change. Also, there were significant differences among the surface coating agents, regarding the ΔE_2 and ΔE_3 values (p^a=0.000). All values were above AT (>1.8) and PT (>0.8) thresholds. The highest discoloration was observed for Permaseal and Prebond SE in terms of ΔE_2 and ΔE_3 (Table 2).

Assessments of resin-based materials' surface roughness

The difference in surface roughness between restorative materials in the same period is schematized in Figure 2. Regarding Ra0 and Ra1, there were significant differences between resin composites due to the SDR exhibiting more surface roughness in Biscover LV and Permaseal groups (p=0.001 and p=0.002, respectively). In addition, the Ra values of both resin composites were above the threshold value (Ra=0.2 µm). Regarding Ra2 values of materials, no significant difference was found.

Assessments of surface coating agents' surface roughness

The mean surface roughness (Ra) values and standard deviations of the restorative materials after treatment with surface coating agents and immersion in coffee are summarized in Table 3. No significant differences were detected between surface coating agents for both GP and SDR. Permaseal showed the lowest roughness in GP specimens, whereas Prebond SE was in SDR specimens. However, all Ra values of surface coating agents were above the threshold value (Ra=0.2 µm).

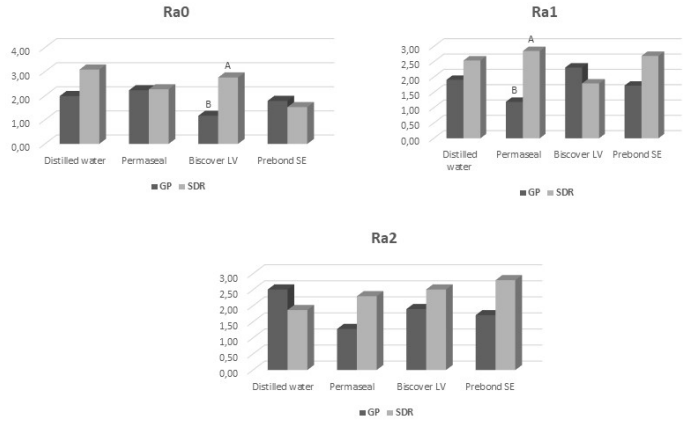

Figure 2. Avarage Ra values of resin composite materials after surface coating agent aplications and staining procedure. GP: G-ænial Posterior, SDR: SDR™ Flow⁺ Ra0: Baseline surface roughness, Ra1: Surface roughness after surface coating agent application, Ra2: Surface roughness after staining procedure.

Assessment of resin-based materials/ surface coating agents' interactions

The factors affecting color change (ΔE_{00}) and surface roughness (Ra) at different times were summarized in Table 4. Regarding the interactions of composite resin materials/surface coating agents, there were significant differences in all evolution periods of ΔE values (p=0.000, p=0.001, and p=0.001; respectively). When the origin of the differences was evaluated (Table 2), it was seen that GP- Biscover LV and SDR-Prebond SE combinations showed the lowest and clinically acceptable ΔE values. Also, the combinations with the control group exhibited the lowest color change values.

Considering the interaction between surface coating agents and restorative material, there was no significant difference regarding the surface roughness at each time (Table 4). Although no significancy, GP-Permaseal and SDR-Prebond SE combinations were exhibited less surface roughness (Table 3).

Assessment of SEM images

Scanning electron microscope images of a specimen from each group of the GP and SDR are shown in Figure 3 and Figure 4, respectively. SEM micrographs of the SDR specimens treated with surface coating agents revealed a more surface porosity compared to specimens immersed in distilled water. However, this condition was the opposite for GP resin composite. The SDR resin composite specimen displayed slight alterations compared to the GP resin composite specimen. The GP resin composite treated with Permaseal specimen showed fewer surface alterations compared to other surface coating agents and distilled water (Figure 3). Among the surface coating agents, similar surface alterations were observed for the SDR resin composite specimen (Figure 4).

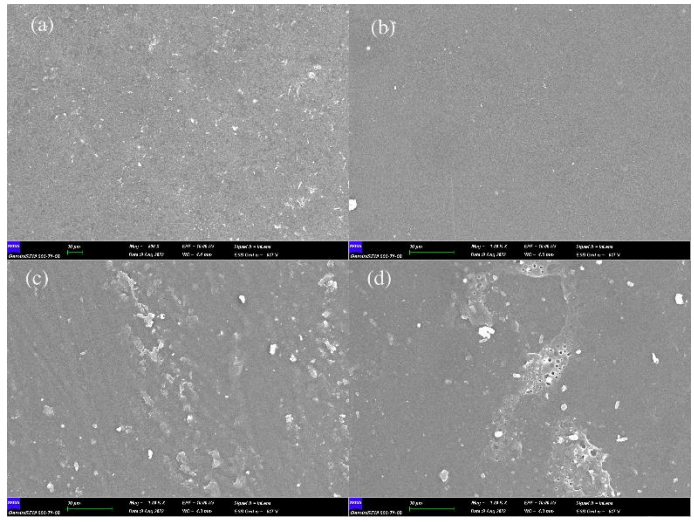

Figure 3 SEM images of a G-ænial Posterior specimen. (a) control group, (b) Permaseal group, (c) Biscover LV group, (d) Prebond SE group.

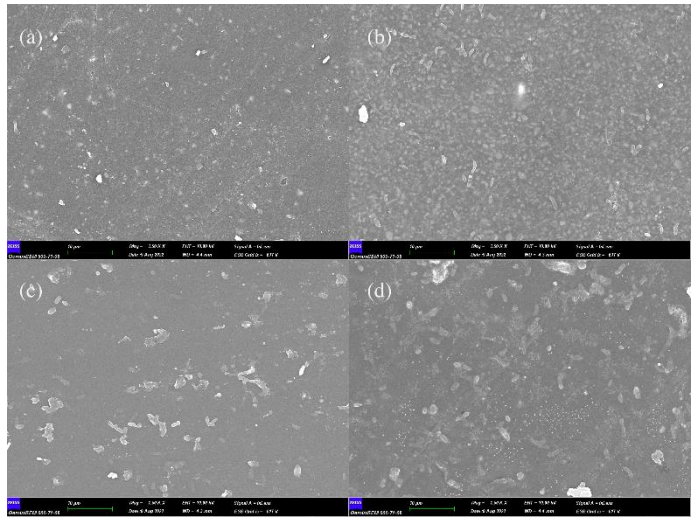

Figure 4 SEM images of a SDR™ Flow⁺ specimen. (a) control group, (b) Permaseal group, (c) Biscover LV group, (d) Prebond SE group.

DISCUSSION

Surface topography and color stability are the major factors determining the clinical performance of resin-based materials. The surface of dental restoration should have as smooth as possible to reduce plaque accumulation and discoloration.[12] In this context, this study sought to answer the effects of surface sealant applications on the color stability and surface roughness of different resin-based composites.

Visual and instrumental methods are available to investigate the color differences of dental materials, however instrumental techniques have been widely recommended due to visual color assessment can create inconsistencies inter-observers in color perception.[13] The clinical spectrophotometer including the CIEDE2000 system was performed to measure the color changes of specimens in this study.[14] The CIEDE2000 formula is more preferred in recent studies evaluating color stability than the CIE L*a*b* formula, as it offers a better fit and provides a comprehensible indication of perceptibility and acceptability.[13, 14]

The acceptability and visual perceptibility threshold values are significant in detecting color differences of dental tissues and materials in clinical dentistry.[15] In the current study, the PT and AT in analyzing color changes were specified as ΔE_{00}=0.8 and ΔE_{00}=1.8 respectively, as reported by Paravina et al.[16] No color change should be determined after being subject to the test environment for the material to achieve complete color stability (ΔE=0).[17] Additionally, in the current study, the CIEDE2000 (1:1:1) formula was used instead of the CIEDE2000 (2:1:1) formula because of insufficient data on acceptability and perceptibility threshold values for the CIEDE2000 (2:1:1).[18]

In most studies evaluating the color stability of resin composites exposure to staining solutions, samples were immersed in tea, red wine, coffee, and other beverages for extended periods (hours or days) without interruption.[19] Among these staining solutions, coffee is reported to be one of the most effective agents that can mimic the daily routine *in-vitro*.[20] The mechanism of coffee-induced color change in resin-based materials is the adsorption and absorption of yellow pigments through the organic phase of the materials.[21] It has been reported in the literature that 72 hours of simulated coffee consumption corresponds to 3 months of daily consumption [20], while immersion for 15 days simulates one-year daily coffee consumption [22]. The immersion time acknowledged in the current study was 144 hours uninterruptedly, which is corresponding to approximately 6 months of clinical aging, in accordance with Korkut et al.[19] It has been also reported that hot coffee solution is a more active agent for discoloration.[20] Therefore, in the present study, to stimulate oral conditions, the specimens were continuously exposed to the staining solution at 37°C and the solution was refreshed daily.

In the present study, a micro-filled hybrid (mFR) resin composite (G-ænial Posterior) was chosen as the control material to compare with the bulk-fill resin composite (SDR). The findings of the current study revealed that the color stability of RBCs was affected following the application of surface coating agents. Therefore, the first null hypothesis of this study is rejected. G- ænial Posterior resin composite, presented a significantly low amount of color change than SDR (Table 2). However, the discoloration was at a clinically unacceptable level in both materials (AT>1.8). Some researchers have stated that increased composite thickness is responsible for the higher color change observed in bulk-fill resin composites compared to conventional resin composites.[17, 23] Based on this information, flowable bulk-fill specimens were prepared with a thickness of 2 mm instead of a 4 mm single layer. Packable composites are generally reported to have less color change than the flowable composite used in thinner layers. [17] Not in consistent with the present study, Bilgili Can D. & Özarslan M. [24] stated that the most color change was observed in G-ænial Posterior specimens. Staining of resin composites has been stated to be closely related to the resin phase. Bisphenol-glycidyl methacrylate (Bis-GMA) is less stain-resistant than Urethane dimethacrylate (UDMA) due to its high water absorption characteristics. [25] Bis-GMA monomer has a viscous and bulky bifunctional matrix.[26] Therefore, it is diluted by the addition of a more reactive monomer, triethylene glycol dimethacrylate (TEGDMA). The dilution process allows a higher amount of nanofillers to be added to the resin matrix. [27] The increased filler and monomer (hydrophobic aromatic dimethacrylate) content is thought to be the reason for less discoloration in GP specimens due to reduced water absorption rates in the material.

The surface structure of restorative materials affects plaque accumulations, wear resistance and physical properties.[12] Surface roughness depends on the type of resin matrix, amount, type, shape, size and distribution of inorganic filler particles, filler and resin matrix combination, finishing and polishing procedure, abrasive hardness and application methods.[28] Surface roughness measurements can be performed qualitatively (qualitative) such as scanning electron microscopy (SEM), surface profile analysis (Profilometer), and quantitatively (quantitative) methods.[29] However, it has been reported that supporting profilometry findings with qualitative methods increases the reliability of the findings due to these methods provide more detailed surface information than profilometry.[30] Considering these findings, SEM imaging was performed to support and detail the profilometer findings in the current study (Figure 3 and 4). According to the profilometer findings, there was no significant difference regarding the surface roughness between the restorative materials at each treatment stage (Table 3). However, surface roughness values of the materials were above the cut in each period (T0, T1, and T2) (Ra>0.2 µm). According to these findings, the second hypothesis is also rejected. The highest mean Ra values in all periods of the current study were seen in SDR (Ra=2.47 µm). Previous studies stated that a perfectly smooth surface cannot be obtained after finishing-polishing methods in tooth-colored restorative materials.[12] Although the threshold surface roughness was mentioned for bacterial plaque retention as 0.2 µm, no significant difference was found in plaque on surfaces with Ra values between 0.7 and 1.4 µm.[29] Due to the presence of specimens showing roughness above these values in the current study, surface smoothness could be checked with a method such as light microscopy after finishing-polishing methods, and if the polishing was found to be insufficient, this process could be repeated with different finishing-polishing kits. This condition is the first limitation of the present study.

All treatment groups presented discoloration above AT including the control group. The degree of water absorption and the hydrophilic/hydrophobic structure of the resin matrix may contribute to the specimens' staining sensitivity following immersion in distilled water.[23] There are studies in the literature using distilled water and/or artificial saliva as a control group[31], and in both, it was observed that the specimen's color change was within clinically acceptable limits due to material aging. Artificial saliva does not contain any chemical enzymes that will affect the resin matrix and cause the softening of the dimethacrylate polymers in its structure and the hydrolysis of methacrylate ester linkages.[32] For this reason, distilled water was used as a control group to compare the effect of surface sealants on color and roughness changes in restorative materials in the current study, as in most studies investigating color change.

The level of color changes in the surface coating agent groups was higher than the control group. In contrast to this finding, Korkut et al.[19] and Pedroso et al.[4] observed that the discoloration of surface sealant applied to resin composite specimens was lower. However, this finding was variable according to the resin composite type and the surface coating agent type in the current study. The highest color change was observed in Permaseal and Prebond SE, and the lowest in Biscover LV (Table 2). According to the baseline color measurements, the color change observed after the Biscover LV application was below the clinical AT (1.8) and very close to the PT (0.8). This supports the argument stated in previous studies[10, 19] that the reason for the less color change of Biscover is that it has a shorter polymerization time and contains dipentaerythritolpentaacrylate. On the other hand, the adhesive system (Prebond SE) presented worse color stability than the surface sealants

(Permaseal and Biscover LV) in the current study. Self-etching adhesives present a high content of hydrophilic monomers.[8] This may lead to higher water and coffee pigment absorption. In addition, solvents present in the structure of adhesive systems, which can lead to insufficient polymerization if not evaporated well, may cause worse performance.[8]

Surface coating agents have been recommended for composite resins to obtain smoother surfaces. However, it is difficult to obtain a smooth surface on restorations with the application of liquid agents.[3] In the present study, it was observed that the surface coating agents showed better results in terms of roughness than the control group. The main reason for this finding may be that surface coating agents reduce surface irregularities and defects and increase smoothness. The lowest roughness was observed in Permaseal, but the difference between groups was not significant and similar results were obtained when compared with other coating agents. Opposing to our results, Ruschel et al.[33] reported that Permaseal had significantly higher roughness than other surface coating agents (Fortify and Biscover). Also, Rizzante et al.[10] stated that Biscover showed lower roughness than the other groups (Fortify, Lasting touch, Fill glaze). On the other hand, the performances of the self-etching adhesive system and surface sealants were similar in terms of roughness in the current study. In accordance with the results of this study, Cortopassi et al.[8] reported that the surface roughness decreased in adhesive systems.

Considering the interaction between the type of surface coating agents and the type of restorative material, the findings of the present study revealed that there was a significant difference at each stage of the color measurements. The combinations of GP (microhybrid)-Biscover LV, SDR (bulk-fill)-Biscover LV, and SDR (bulk-fill)-Biscover LV were successful in terms of color stability in the present study. Miotti et al.[34] reported similar results of Biscover LV and microhybrid resin combination. Another study contrastly reported that the surface sealant application negatively affected the color stability of microhybrid composite resins.[1] On the other hand, SDR-Permaseal combination showed most discoloration in our study. Variations in the formulation and roughness of the resin composites tested in the studies may have caused these contradictory results. In addition, material combinations with distilled water exhibited less color change generally. In light of these results, it can be said that applying surface sealants may not always provide favorable outcomes.

Considering the interaction between the type of surface coating agents and the type of restorative material, the present study revealed no significant difference regarding the surface roughness at each period. GP-Permaseal and SDR-Biscover LV/Prebond combinations were effective regarding roughness. A previous study reported that surface sealant application reduced roughness in all tested composites.[35] These results may depend on the type of composite resin and surface coating agent used, or differences in finishing and polishing processes.

This in vitro study also has other limitations: Use of a single staining solution to simulate intraoral conditions, only 144 hours of storage time and no thermocycle application for aging. In addition, it should be considered that different finishing-polishing systems, prolonged exposure time of the specimens in the staining beverages, and many other factors (such as dietary and oral hygiene habits, the effect of saliva, toothbrushing, or occlusion) might influence the surface alterations of restorative materials. Therefore, further clinical studies should be designed to verify the discoloration degree and surface roughness of resin composites in the oral environment.

Within the limitations of the present study, the findings can be summarized as follows: In this in vitro experimental model designed to determine the effect of daily coffee consumption on the surface and color change of resin composites treated with surface coating agents, the time simulating a period of 6 months was deemed sufficient. A bulk-fill resin composite is more prone to discoloration than micro-filled hybrid (mFR) resin composite. At each period, the bulk-fill composite exhibited greater surface roughness than the microhybrid composite. Biscover LV showed more acceptable results in terms of both color stability and roughness than other surface coating agents (Permaseal and Prebond SE). The combination of resin composites used in the current study with Biscover LV might be considered the most effective combination for inhibiting discoloration. However, the microhybrid composite-Permaseal combination was found to be successful in reducing the surface roughness. Clinicians should be aware that the consumption of coffee for long periods may lead to more discoloration in resin composites and surface coating agents can be applied over the surface of resin composites to decrease the color stability and surface roughness.

Etik Komite Onayı: Bu in-vitro çalışma, yazarların herhangi biri tarafından insan katılımcılarla veya hayvanlarla gerçekleştirilen herhangi bir çalışma içermemektedir. Tüm yöntemler ilgili kurallara ve düzenlemelere uygun olarak gerçekleştirildi.
Hasta Onamı: Bu tür in-vitro çalışma için resmi onam gerekli değildir.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir –A.T.E.A.; Tasarım – E.D., A.T.E.A; Denetleme – E.D., A.T.E.A.; Kaynaklar – E.D., A.T.E.A.; Veri Toplanması ve/veya İşlemesi – E.D., A.T.E.A.; Analiz ve/veya Yorum – E.D., A.T.E.A.; Literatür Taraması – E.D., A.T.E.A; Makaleyi Yazan – E.D., A.T.E.A.; Eleştirel İnceleme – E.D., A.T.E.A.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: This in-vitro study does not contain any studies with human participants or animals performed by any of the authors. All methods were performed in accordance with the relevant guidelines and regulations.
Informed Consent: For this type of in-vitro study, formal consent is not required.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept – A.T.E.A.; Design – E.D., A.T.E.A; Supervision – E.D., A.T.E.A; Resources – E.D., A.T.E.A; Data Collection and/or Processing – E.D., A.T.E.A; Analysis and/or Interpretation – E.D., A.T.E.A; Literature Search – E.D., A.T.E.A; Writing Manuscript – E.D., A.T.E.A; Critical Review – E.D., A.T.E.A;
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Araştırma Makalesi *Research Article* DOI: 10.5281/zenodo.11059225

How Do Endodontic Irrigation Solutions Affect the Surface Roughness of Bulk Fill Resin Composite?

Endodontik İrrigasyon Solüsyonları Bulk Fill Reçine Kompozitin Yüzey Pürüzlülüğünü Nasıl Etkiler?

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ABSTRACT

Objective: The goal is to find out how irrigation and chelating solutions change the average surface roughness (Ra) of resin composites when root canal treatment is done on teeth with composite restorations.

Methods: A total of 40 disc-shaped composite specimens (Tetric®-N-Ceram-Bulk-Fill-IVA) were used in the study. The specimens were randomly divided into 4 groups (n=10) and Ra values were measured before treatment. Group1 (Gr1) was then immersed in 5% sodium hypochlorite (NaOCl), group2 (Gr2) in 17% ethylenediaminetetraacetic acid (EDTA), group3 (Gr3): 10% citric acid (CA), group4 (Gr4): 0.9% saline (SS) for 15 minutes. After treatment, the Ra values of the samples were measured again. Comparison of Ra values before and after treatment was performed by paired samples t-test, and one-way ANOVA analysis was used for comparison between groups.

Results: There was a statistically-significant difference between the 4 groups in terms of post-treatment Ra measurements ($p<0.05$). While there was no statistically-significant difference between the pre-treatment and post-treatment Ra values in NaOCl and SS ($p>0.05$). There is a statistically-significant difference between the pre-treatment and post-treatment Ra values in EDTA and CA ($p<0.05$). There is also a statistically-significant difference between NaOCl and SS and EDTA and CA in terms of post-treatment Ra values ($p<0.05$).

Conclusion: Among the solutions used in our study, EDTA and CA increased the Ra values on resin composites. It is recommended to polish the surface of composite restorations after the treatment to avoid problems related to the increase in roughness after the irrigation procedure.

Keywords: Endodontic irrigation, composite resin, bulk fill, surface roughness

ÖZ

Amaç: Kompozit restorasyonlu dişlere kök kanal tedavisi yapıldığında irrigasyon ve şelasyon solüsyonlarının rezin kompozitlerin ortalama yüzey pürüzlülüğünü (Ra) nasıl değiştirdiğini bulmaktır.

Yöntemler: Çalışmada toplam 40 adet disk şeklinde kompozit numune (Tetric®-N-Ceram-Bulk-Fill-IVA) kullanıldı. Örnekler rastgele 4 gruba (n=10) ayrıldı ve tedavi öncesinde Ra değerleri ölçüldü. Daha sonra; grup 1 (Gr1): %5 sodyum hipoklorit (NaOCl), grup 2 (Gr2): %17 etilendiamintetraasetik asit (EDTA), grup 3 (Gr3): %10 sitrik asit (SA) ve grup 4 (Gr4): %0,9 salin solüsyonu (SS) içine 15 dakika boyunca daldırıldı. Tedavi sonrasında örneklerin Ra değerleri tekrar ölçüldü. Tedavi öncesi ve sonrası Ra değerlerinin karşılaştırılması için bağımlı örneklem t-testi kullanılırken, gruplar arası karşılaştırma için tek yönlü ANOVA analizi kullanıldı.

Bulgular: Tedavi sonrası Ra ölçümleri açısından 4 grup arasında istatistiksel olarak anlamlı fark vardı ($p<0,05$). NaOCl ve SS'de tedavi öncesi ve tedavi sonrası Ra değerleri arasında istatistiksel olarak anlamlı bir fark bulunmazken ($p>0,05$). EDTA ve SA'da tedavi öncesi ve tedavi sonrası Ra değerleri arasında istatistiksel olarak anlamlı fark vardır ($p<0,05$). Ayrıca NaOCl ve SS ile EDTA ve SA arasında tedavi sonrası Ra değerleri açısından da istatistiksel olarak anlamlı farklılık bulunmuştur ($p<0,05$).

Sonuç: Çalışmamızda kullanılan solüsyonlardan EDTA ve SA, rezin kompozitlerde Ra değerlerini arttırmıştır. İrrigasyon işlemi sonrasında pürüzlülük artışına bağlı problemlerin yaşanmaması için kompozit restorasyonların yüzeyinin tedavi sonrasında cilalanması tavsiye edilir.

Anahtar Kelimeler : Endodontik irrigasyon, kompozit rezin, bulk fill, yüzey pürüzlülüğü

Geliş Tarihi/Received 25.08.2023
Kabul Tarihi/Accepted 06.11.2023
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Topbas C, Öztekin F. How Do Endodontic Irrigation Solutions Affect the Surface Roughness of Bulk Fill Resin Composite? *Current Research in Dental Sciences*. 2024;34(2):111- 115

INTRODUCTION

Composite resins are being increasingly used throughout the world due to their ever-improving mechanical and physical properties, the availability of effective adhesive systems, improved clinical properties, acceptable esthetic properties with tooth-like color and translucency, and increasing public concern about the use of amalgam. The increasing demand for these restorative materials has led to the emergence of a wide range of products over time.[1,2] Bulk fill composites, which have recently become more widely used, are available in the dental markets in two main forms: flowable and higher viscosity, with various variations. The advantages of bulk fillings include reduced polymerization shrinkage, increased polymerization depth and reduced chair time, which are of great importance to both clinicians and patients.[3,4]

One of the most important features to be considered in composite resin restorations is the roughness left on the surface of the restoration after various finishing polishing procedures. There are various composite resins available on the dental market from different companies. These different materials contain different proportions of filler and matrix. These differences also affect the roughness on the surface of the restoration after final polishing. The ratio of roughness to lustre in the restorative material is directly related to the aesthetic expectations of the patient and the biological success of the restoration.[5] Finishing is the grinding and shaping of restoration surfaces to mimic the lost tooth tissue anatomy. Polishing, on the other hand, is the removal of scratches and roughness created on the restoration surface during the finishing process and the attempt to achieve an enamel-like lustrous surface.[6-8] This is very important because, in addition to meeting aesthetic expectations, a shiny restoration surface prevents staining of the restoration, plaque and biofilm accumulation on the tooth surface, recurrent caries, secondary infection in root canal-treated teeth, gingival irritation, increased abrasion of the filling surface and the patient's sensation of constantly touching the rough surface with the tongue.[7,8]

A change of 0.25-0.5 µm on the surface of the restoration is perceived by the patient's tongue and negatively affects patient comfort.[9] Wear resistance depends on the polymerization quality of the resin composite used, the filler to matrix ratio, the shape and size of the filler and the polymerization thickness of the material. The gloss and wear resistance of properly finished and polished restoration surfaces can deteriorate over time due to factors such as pH, temperature, dietary and brushing habits, and poor oral hygiene.[10,11] When root canal treatment is performed on teeth with composite restorations, the tooth and restoration surfaces remain in contact with various endodontic solutions for a period of time. Due to the different pH values and chemical properties of these solutions, abrasions may occur on the restoration surface, microhardness may decrease, gloss may deteriorate, and Ra values may increase.[12,13]

Although the importance of composite resin restorations in endodontics is well known in many aspects such as coronal sealing and prevention of secondary caries, there are not many studies in the literature on the roughening effects of these solutions on composite resin restorations. In our study, different solutions are used in routine endodontic practice and their roughening effects on resin materials are investigated. Our null hypothesis is that there is no difference between the endodontic solutions in terms of their roughening effect on composite restorative resins.

METHODS

Sample size determination

According to the results of the power analysis performed with the G-Power program (G*Power 3.1 Software; Heinrich-Heine-University, Düsseldorf, Germany) as part of the study; for the F-test, Anova: Fixed Effect Omnibus, one-way analysis, it was determined that 10 samples were required in each subgroup, with a minimum of 40 in total, at the level of 0.55 effect (f) and 0.80 power (1-β) when α (margin of error) of the study was 0.05.

Informed Consent and Ethics Committee Approval

Our study investigated the roughening effect of solutions on composite resins. Since the study did not involve any medical materials, images, or questionnaires containing patient information from humans or animals, no informed consent or ethics committee approval is required.

Sample preparation

The composite resin used in our study was Tetric® N-Ceram Bulk Fill IVA (TCNB) (Ivoclar, Vivadent AG, Schaan, Liechtenstein) (Table 1). A total of 40 disc-shaped composite resin specimens were prepared using a round silicone mould with a diameter of 7 mm and a height of 3 mm. The silicone mould was placed on a strip of clear Mylar matrix (Palmero Healthcare, 120 Goodwin Place, CT, 06615, USA) supported by a 2 mm thick glass plate. After composite loading of the mould, a second transparent Mylar strip was placed on top. A second 2mm glass sheet was placed on top of this strip. In order to remove the overflowing material from the silicone mould and to obtain a more homogeneous, non-porous and smooth surface, the glass sheet was pressed with a force of 500 g for 30 s. The glass sheet was then removed, and the composite resin samples were light polymerized over the Mylar matrix strip to avoid the formation of an oxygen inhibited layer.

Table 1. Properties of Bulk-fill resin composite material used in the study.

Resin Composite	Type	Composition	Filler Wt/Vol	Manufacturer	Lot Number
Tetric® N-Ceram Bulk Fill IVB	Nanohybrid Bulk Fill	Matrix: Bis-GMA, Bis-EMA, UDMA, Polymer filler (%17) (Ba-Al-Si glass filler, Ytterbium trifluoride), mixed oxides, additives, catalyst, stabilizers, and pigments	75-77 % by weight 53-55 % by volume Filler size: 0,04-3 µm	Ivoclar Vivadent AG, Schaan, Liechtenstein	W42311

Bis-GMA: Bisphenol A glycidyl methacrylate
Bis-EMA: Ethoxylated bisphenol A glycol dimethacrylate
UDMA: Urethane dimethacrylate

Each composite resin specimen was polymerized using an LED light polymerization device (X-Cure, Woodpecker, Medical Instrument, Guangxi, China) with active light calibrated at 1200 mw/cm2 for 20 s (separately on the upper and lower surfaces of the specimen) according to the manufacturer's instructions. The probe tip of the LED light device was placed on the specimen at a distance of approximately 1 mm and at right angles to the specimen. The underside of each specimen was marked with an indelible pencil to prevent interference between the top and bottom surfaces. The demoulded samples were stored in a container in an incubator at 37°C and distilled water for 24 hours. The specimens were then ground with water-cooled #500, #600, #800, #1000 and #1200 grit sandpaper and polished with DirectDia diamond polishing paste (Shofu Dental Corp., PN 0558, DirectDia, Shofu Inc., Kyoto, Japan). The samples were then randomly divided into 4 groups (n=10).

Quantitative evaluation of Ra was performed using a digital surface profilometer (Surftest sj-410, Mitutoyo Corp., Kanagawa, Japan) at a tip feed rate of 0.5 mm/s, a cut point of 0.8 mm and a trace length of 5 mm. Three measurements were taken from the top surface of each sample and from different parts of the surface, and the average Ra values of the sample before processing were calculated by taking the arithmetic averages. The averages were tabulated and recorded as "pre-treatment

average Ra values" in µm. The samples were then immersed in different endodontic solutions Gr1: 5% NaOCl, Gr2: 17% EDTA, Gr3: 10% CA, Group 4 (Gr4): 0.9% SS for 15 minutes.

The samples were then rinsed with an air-water spray for 10 seconds. Quantitative Ra measurements were performed using a profilometer device to measure Ra values after treatment. For all samples, 3 measurements were taken from the top surface and different parts of the surface, the arithmetic mean was taken, tabulated, and recorded as 'average Ra values after treatment' in µm. The pre- and post-treatment Ra values were then statistically analyzed.

Statistical analysis

As part of the study, statistical analyses were performed using the SPSS 26.0 software package. Firstly, the normality of the distribution was checked using the Kolmogorov-Smirnov and Shapiro-Wilk tests. According to the results obtained, it was concluded that the data had a normal distribution and parametric tests were considered appropriate. The paired samples t-test was used to compare the pre-treatment and post-treatment measurements of Ra values, while one-way ANOVA analysis was used to compare the groups. The Bonferroni test was used as a post hoc test for significant results. Statistical significance was accepted as $p<0.05$ throughout the study.

Table 2. Normality Test (df: degree of freedom, p: p-value=probability)

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	p	Statistic	df	p
Pre-treatment	0,098	40	,200*	0,949	40	0,069
Post-treatment	0,108	40	,200*	0,946	40	0,056

RESULTS

The study included 10 samples in each solution group. According to the results obtained, there was no statistically significant difference between the 4 groups in terms of pre-treatment Ra measurements ($p>0.05$). The pre-treatment Ra values of the groups were found to be close to each other (Table 3).

Table 3. Pre-Treatment Ra Measurements (Gr: Group, NaOCl: Sodium hypochlorite, EDTA: Ethylenediaminetetraacetic acid, N: number, S.D.: Standard Deviation, p: p-value=probability)

	N	Minimum	Maximum	Average ± S.D.	p
Gr1(NaOCl)	10	0,144	0,292	0,198±0,048	0,933
Gr2(EDTA)	10	0,141	0,264	0,196±0,037	
Gr3(Citric Acid)	10	0,151	0,262	0,200±0,037	
Gr4(Saline)	10	0,140	0,260	0,189±0,043	

There is a statistically significant difference between the 4 groups in terms of post-treatment Ra measurements ($p<0.05$). When the comparisons between the groups were analyzed in detail using the post-hoc test, the lowest post-treatment Ra value was found in the SS group and the highest Ra value was found in the CA group. While the post-treatment Ra values of the NaOCl and SS groups were close to each other and there was no significant difference between them, there was a significant difference between these two groups and the EDTA and CA groups. Similarly, there was no significant difference between the EDTA and CA groups (Table 4).

Table 4. Post-Treatment Ra Measurements (Gr: Group, NaOCl: Sodium hypochlorite, EDTA: Ethylenediaminetetraacetic acid, N: number, S.D.: Standard Deviation, p: p-value=probability *Exponential letters are used to indicate the difference between groups. There was no significant difference between groups receiving the same letter.)

	N	Minimum	Maximum	Average ± S.D.	p
Gr1(NaOCl)	10	0,141	0,297	0,205±0,053 [a]	0,001
Gr2(EDTA)	10	0,244	0,381	0,298±0,044 [b]	
Gr3(Citric Acid)	10	0,258	0,371	0,314±0,034 [b]	
Gr4(Saline)	10	0,148	0,281	0,190±0,044 [a]	

There is no statistically significant difference between the pre-treatment and post-treatment Ra values of the NaOCl solution samples ($p>0.05$). There was no significant change in Ra values after treatment. There is a statistically significant difference between the pre-treatment and post-treatment Ra values of EDTA solution samples ($p<0.05$). After treatment, the average Ra value increased and showed a significant difference. There is a statistically significant difference between the pre-treatment and post-treatment Ra values of CA solution samples ($p<0.05$). After treatment, the average Ra value increased and showed a significant difference. There is no statistically significant difference between the pre-treatment and post-treatment Ra values of SS samples ($p>0.05$). There was no significant change in Ra values after treatment.

When analyzing the difference values between pre-treatment and post-treatment, the highest value was observed in CA with 0.114 and the lowest value was observed in SS with 0.001. There was no statistically significant difference between NaOCl and SS and no statistically significant difference between EDTA and CA. EDTA and CA have a statistically significant difference with NaOCl and SS (Table 5). According to the difference values, which can also be expressed as roughening power, the strongest roughening effect was observed with CA, while the least roughening effect was observed with SS).

Table 5. Comparison of the Difference Measurements of the Pre- and Post-treatment values (Gr: Group, NaOCl: Sodium hypochlorite, EDTA: Ethylenediaminetetraacetic acid, N: number, Dif: Difference, p: p-value= probability)

	N	Minimum	Maximum	Average ± S.D.	p
Gr1(NaOCl)	10	**0,198**±0,048	**0,205**±0,053	**0,007**±0,064[a]	0,747
Gr2(EDTA)	10	**0,196**±0,037	**0,298**±0,044	**0,102**±0,060[b]	**0,001**
Gr3(Citric Acid)	10	**0,200**±0,037	**0,314**±0,034	**0,114**±0,058[b]	**0,001**
Gr4(Saline)	10	**0,189**±0,043	**0,190**±0,044	**0,001**±0,077[a]	0,958

DISCUSSION

Composite resin materials can change over time due to dietary habits, oral hygiene habits (brushing, flossing or use of mouthwash solutions, etc.) and various mechanical and chemical mechanisms. The composition and physical and chemical properties of the material are important in these changes.[14-16] In general, the physicochemical properties of the filler particles, including their size, concentration, shape, and the structure of the filler matrix, are among the most important factors that play a role in the wear resistance of the material.[17] The increasing aesthetic expectations and demands of patients have further encouraged dentists and dental material manufacturers to develop composite resin materials and new application methods. In aesthetic restorative dentistry, the aim is to achieve a lustrous and smooth restoration surface that mimics the enamel surface of the natural tooth, which is invisible to the eye and not felt by the patient's tongue.[18] Various finishing polishing systems have been proposed in the literature to increase the abrasion resistance of the restoration, ensure color stability, and achieve the desired smoothness.[19,20] In our study, bulk-fill composites, whose use

and popularity among dentists is increasing day by day due to their advantages that we can put a larger amount of resin at once and provide faster processing ease, were preferred instead of the incremental method, which is small and time-consuming. In the study, sandpaper (500, 600, 800, 1000, 1200 grit) was used to finish the composite specimens and DirectDia diamond-impregnated polishing paste containing 20% diamond powder was used for polishing. The advantages of the paste are that it cleans both phases of the resin composite material homogeneously, can be used on wet tooth surfaces, remains on the tooth surface during the procedure and can be cleaned quickly when rinsed.

As different irrigation solutions have different pH levels and chemical structures, they have different roughening effects on different materials. The effects of irrigation solutions and chelating agents on many tissues and materials such as root canal dentin, endodontic nickel-titanium files and bio-ceramic cements have been studied.[21,22] Many dental procedures and mouthwashes that cause Ra on composite resins have been investigated in various studies.[5,6,9-11] However, there is no study in the literature that investigates the Ra changes caused by endodontic irrigation solutions on composite resins.

Irrigation solutions have various effects on dentin, such as removing the smear layer, exposing dentin tubules, reducing dentin micro- and nano-hardness and creating dentin surface roughness.[23-25] Dentin surface roughness is a factor that plays an important role in the micromechanical bond of sealants. Ari et al. showed that 2.5% to 5.25% NaOCl caused a significant increase in dentin roughness.[21]

It has also been reported that EDTA has a detrimental effect on dentin Ra.[25]. Ari et al[21]'in 2004 reported a significant increase in Ra on root canal dentin when rinsed with 17% EDTA. Other dentin properties such as micro- and nano-hardness have also been reported to be altered by chelating agents.[23]

A study has shown that irrigation solutions cause changes not only in dentin but also in Portland cement (PC), a bioceramic.[24,26,27] The results of this study showed that NaOCl at a concentration of 5% significantly decreased the Ra of PC, whereas 20% CA significantly increased the Ra. In addition, the Ra and cyclic fatigue changes of irrigation solutions on files, which are the main mechanical expansion instruments in root canal treatment, have also been investigated in various studies.[28-31] One study examined the Ra values of 5.25% NaOCl before and after application to Protaper Next (PTN), Hyflex CM (CM), Hyflex EDM (EDM), WaveOne gold (WOG) and Trunatomy (TN) files. As a result, all rotary endodontic instruments tested showed an increase in Ra to varying degrees, with the least increase in Ra observed with TN and PTN instruments.[32]

High quality finishing and polishing of dental restorations is very important in prolonging the life of teeth and maintaining their aesthetics for many years.[33,34] The Ra of composite resins depends on some extrinsic factors, which are experience, skill and ability of the operator to apply the technique, are mainly related to the finishing and polishing processes and include any physical properties of the polishing tools. This is important for our study because some of the irrigation solutions (EDTA and CA) were found to increase the Ra of the composites in our study results. This affects the sealing and longevity of composite fillings and thus the long-term postoperative success of endodontic treatment.

Irrigation solutions used to remove the smear layer from the root surface. NaOCl is used to remove the organic component and EDTA is used to remove the inorganic component of the smear layer. As the smear layer is removed, the surface roughness will increase.[33,35] In our study, we investigated in vitro how resin restorations are affected by irrigation solutions in terms of Ra changes during endodontic treatment of teeth with composite restorations. While no statistically significant difference was observed in the Ra of the resin composite specimens after treatment with NaOCl and SS, the surface Ra values of the specimens immersed in EDTA and CA increased statistically significantly compared to the pre-treatment. Therefore, the null hypothesis of our study was rejected.

Microhardness, color, or Ra changes can occur on dentin and many materials after rinsing with various solutions.[20-22,33] There are many disadvantages of composite resins or roughness on the tooth surface, such as deterioration of the aesthetic appearance, staining of the tooth or restoration, more plaque and biofilm accumulation on the tooth surface than on the shiny surface, recurrent caries, secondary infection of root canal treated teeth, gingival irritation, septal pain, increased abrasion on the filling surface and discomfort caused by increased tactile sensation with the patient's tongue.[7,8] Limitations of the study included the in vitro nature of the study, which did not fully simulate clinical conditions. In addition, in future in vitro and in vivo studies, the use of different types and properties of composites and the examination of microhardness and color changes on composites will help us to better understand the effects of irrigation and chelating agents on resin composite restorations.

CONCLUSION

Our study showed that irrigation with chelating agents (EDTA and CA) resulted in an increase in Ra values on composite resin surfaces. It is recommended that an additional polishing step be performed on the resin composite restoration surface after completion of the root canal treatment to avoid the negative effects that may be caused by the formation of roughness after endodontic irrigation.

Etik Komite Onayı: Çalışmamızda solüsyonların kompozit rezinler üzerindeki pürüzlendirme etkisi araştırıldı. Çalışma, insanlardan veya hayvanlardan alınan hasta bilgilerini içeren herhangi bir tıbbi malzeme, görüntü veya anket içermediğinden etik kurul onayı gerekmemektedir.
Hasta Onamı: Çalışma, hastanın diseke edilmesine veya hayvanlardan parça alınmasına ilişkin herhangi bir tıbbi malzeme, görüntü veya anket içermediğinden bilgilendirilmiş onam alınmadı.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – C.T., F.Ö.; Tasarım – C.T.; Denetleme – F.Ö.; Kaynaklar – C.T.; Veri Toplanması ve/veya İşlemesi – C.T.; Analiz ve/veya Yorum – F.Ö.; Literatür Taraması – C.T.; Makaleyi Yazan – C.T.; Eleştirel İnceleme – F.Ö.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: In our study, the etching effect of solutions on composite resins was investigated. Ethics committee approval is not required as the study does not contain any medical materials, images or surveys containing patient information from humans or animals.
Informed Consent: Informed consent was not obtained because the study did not involve any medical materials, images, or surveys involving the patient being dissected or taken from animals.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept – C.T., F.Ö.; Design – C.T.; Supervision – F.Ö.; Resources – C.T.; Data Collection and/or Processing – C.T.; Analysis and/or Interpretation – F.Ö.; Literature Search – C.T.; Writing Manuscript – C.T.; Critical Review – F.Ö.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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Araştırma Makalesi *Research Article* DOI: 10.5281/zenodo.11058935

Evaluating the Effect of Resin-Reinforced Fiber Splint Application on the Stabilization of Mandibular Corpus Fractures: An in Vitro Study

Mandibular Korpus Kırıklarında Rezinle Güçlendirilmiş Fiber Splint Uygulamasının Stabilizasyon Üzerine Etkisinin Araştırılması: İn Vitro Çalışma

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ABSTRACT

Objective: This study aimed to evaluate the efficiency of a resin-supported fiber splint in the dental area as a fixation method in order to avoid the disadvantages of using a second plate in mandible corpus fractures

Methods: 24 cadaveric sheep hemimandibulae were randomly divided into four groups. The biomechanical stability of four different groups in which four different fixation methods were applied was evaluated. A single miniplate was used in Group A, and a double miniplate was used in Group B. In Group C, an arch bar was applied along the dental arch with a single mini-plate. In Group D, a single mini-plate was supported by fiber splinting along the dental arch.

Results: The average force values were found at the highest level in the single-plate arch bar group and the lowest in the single-plate group. Looking at the data shown, the single plate arch bar group showed the highest stability, and the single- plate group showed the lowest stability. The mean displacement values were highest in the single-plate arch bar group and lowest in the single-plate group. The aforementioned data coincides with the maximum force values.

Conclusion: It has been noted that the fiber splint application, which was used to avoid the disadvantages of the arch bar application, contributed positively to the stability of fracture fixation.

Keywords: Fracture, Mandible, Fiber Splint

ÖZ

Amaç: Bu çalışmanın amacı, mandibula korpus kırıklarında ikinci bir plak kullanımının dezavantajlarından kaçınmak için, bir fiksasyon yöntemi olarak dental bölgede uygulanan rezin destekli fiber splintin etkinliğini değerlendirmektir.

Yöntemler: 24 kadavra koyun hemimandibulası rastgele 4 gruba ayrıldı. 4 farklı fiksasyon yönteminin uygulandığı 4 farklı grubun biyomekanik stabiliteleri değerlendirildi. Grup A'da tek miniplak, Grup B'de çift mini-plak kullanıldı. Grup C'de tek mini-plak ile dental ark boyunca ark bar uygulanmıştır. D grubunda ise tek bir mini-plak dental ark boyunca fiber splint uygulaması ile desteklenmiştir.

Bulgular: Ortalama kuvvet değerleri tek plakalı arch bar grubunda en yüksek, tek plak grupta ise en düşük seviyede bulunmuştur. Gösterilen verilere bakıldığında, tek plakalı arch bar grubu en yüksek stabiliteyi, tek plaklı grup ise en düşük stabiliteyi göstermiştir. Ortalama yer değiştirme değerleri tek plak arch bar grubunda en yüksek, tek plak grupta ise en düşüktür. Söz konusu veriler maksimum kuvvet değerleri ile örtüşmektedir.

Sonuç: Ark bar uygulamasının dezavantajlarından kaçınmak için kullanılan fiber splint uygulamasının kırık fiksasyonunun stabilitesine olumlu katkı sağladığı kaydedilmiştir..

Anahtar Kelimeler : Fraktür, Mandibula, Fiber Splint

Geliş Tarihi/Received 23.10.2023
Kabul Tarihi/Accepted 17.12.2023
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Baş M.Z., Yalçın E. Evaluating the Effect of Resin-Reinforced Fiber Splint Application in Mandibular Corpus Fractures: an In Vitro Study. *Current Research in Dental Sciences*. 2024;34(2):116-121.

INTRODUCTION

Maxillofacial complex traumas represent a significant global health concern. Research has demonstrated that the corpus region has a substantial role in mandibular fractures.[1]

There are three forms of closed reduction that are available. The three methods utilized for maxillary fixation are internal maxillary fixation (IMF), external fixation, and splints. The use of IMF has yielded favorable outcomes, assessing fracture stability from a historical standpoint, and is commonly employed. The Erich arch bar is widely regarded as a highly favored instrument in closed reduction methodologies. To such an extent that closed reduction has frequently been used equally with the application of arch bars.[2] The disadvantages of this procedure include increased procedure time, only semi-rigid fixation, difficulty in ensuring oral hygiene, the risk of the surgeon being injured by wires during the procedure, and delayed recovery due to loose wires. Thus, an attempt has been made to develop alternative treatment methods to establish IMF.[3]

On the other hand, surgical treatment with open reduction and internal fixation provides rapid rehabilitation of occlusion, restoration of the anatomical bone morphology, rapid adaptation to social life, and preservation of periodontal tissues. The fixation method with open reduction provides the basic criteria for functional movements of the jaw with acceptable occlusion.[2] However, in mandibular body fractures, fixation with plates and screws is not required for IMF.[4]

At present, it remains unfeasible to advocate for the prioritization of conservative IMF above open reduction in the treatment of adults. Hence, it is imperative to conduct additional clinical investigations with extended periods of observation in adults in order to provide more accurate clinical guidelines for the use of conservative approaches for the management of mandibular fractures.[5]

In the original Champy technique, a single miniplate of 1mm thickness is sufficient for fixation. If a plate is to be placed on the superior border, it is recommended to place an additional plate on the inferior border to neutralize the torque forces.[6] In light of these studies, the researchers concluded that the use of conventional 4-hole plates was an ideal approach to treating mandibular corpus fractures.[6,7] This study aimed to evaluate the efficiency of a resin-supported fiber splint in the dental area as a fixation method, in order to avoid the disadvantages of using a second plate).

METHODS

Preparation of Specimens

The study was carried out on cadaver sheep mandibles. It is a cadaver material obtained commercially (meat-fish institutions, etc.), an ethics committee report is not required. Fresh 12 sheep mandibles that were15-20 months old and fed under similar conditions were obtained for the study. Mandibles were debrided from the surrounding soft tissue and then osteotomized at the midline level between the incisors, and 24 hemimandibles were obtained. The mandibles were preserved at -24 °C until the experiment. 24 hemimandibulae were randomly divided into 4 groups, each group including 6 samples. Osseosynthesis lines were drawn on the hemimandibulae. These points were marked and standardized with a fixed pencil marking the compression (basal region of the mandible) and tension (in the buccal cortex of the external oblique edge) regions defined by Champy. An experimental corpus fracture was created by vertical osteotomy between the premolar and first molar teeth with the help of a resiprocal saw (Figure 1).

Titanium flat miniplates of 1 mm thickness with 4 holes, and 6 mm bars and 2.0 mm diameter screws, 5mm in length were used for all groups (Trimed Titanium Implant System, Ankara, Turkey). The biomechanical stability was evaluated in 4 different groups, in which 4 different fixation methods were applied (Table 1). Miniplates were placed in the compression (mandible basal region) and tension (buccal cortex of the external oblique edge) lines defined by Champy.

Figure 1. An experimental corpus fracture was created by vertical osteotomy between the premolar and first molar teeth with the help of a resiprocal saw

Table1. Fixation Groups

Fixation Groups	
Group A	Single miniplate
Group B	Double miniplates
Group C	Single miniplate + Arch Bar
Group D	Single miniplate + Fiber Splint

Group A: 1 mm thick, 4-hole, 6 mm spaced titanium mini plate (Trimed Medical Co., Ankara, Turkey) and 4 titanium screws 2.0 mm in diameter and 5.0 mm in length (Trimed Medical Co., Turkey) were used.

Group B: Two 1 mm thick, 4-hole, 6 mm spaced titanium mini plates (Trimed Medical Co., Ankara, Turkey) and 8 titanium screws 2.0 mm in diameter and 5.0 mm in length (Trimed Medical Co., Ankara, Turkey) were used.

Grup C: 1.0 mm thick, 4-hole, 6 mm spaced titanium mini plate(Trimed Medical Co., Ankara, Turkey) and 4 titanium screws 2.0 mm in diameter and 5.0 mm in length (Trimed Medical Co., Turkey) were used. In addition, arch bar was applied along the dental arch (B. Braun, Aesculap, Tuttlingen, Germany).

Grup D: 1.0 mm thick, 4-hole, 6 mm spaced titanium mini plate(Trimed Medical

Co., Ankara, Turkey) and 4 titanium screws 2.0 mm in diameter and 5.0 mm in length (Trimed Medical Co., Turkey) were used.

In addition, a fiber splint was applied along the dental arch. The fiber splint was applied to the mandible following the manufacturer's instructions: After cleaning the tooth surfaces, orthophosphoric acid (Vocoid; Voco, Cuxhaven, Germany) was applied to the enamel of each tooth for 30 seconds. The tooth surfaces were sprayed with an air-water spray for 60 seconds. The tooth surfaces were air-dried. A bonding agent (Futurabond U, Voco, Cuxhaven, Germany) was applied to the tooth surfaces with the help of an applicator. The bonding was lightly air-dried. Each tooth surface was cured for 10 seconds with the aid of an LED light device (Valo Cordless, Ultradent, South Jordan, Utah, USA) with an output of 1000 mW/cm2. A 3mm-thick fiber splint (Construct, Kerr Corporation, Orange, CA, USA) was prepared adapted to the dental arch, and the bonding agent was applied. The fiber splint was fixed to the dental arch using flowable composite (Filtek Ultimate; 3M ESPE, St. Paul MN, USA) (Figure 2).

Figure 2. The fiber splint was applied to the mandible following the manufacturer's instructions

Loading Test

After the osteotomy and fixation of the jaws, the specimens were rigidly attached to the INSTRON 8872 servohydraulic tension-pressure testing device (Instron Corp., Norwood MA, USA) by means of a custom fixation device. The experiments were performed at a test speed of 5 mm/min, at room temperature (approximately 21 °C), and under standard atmospheric pressure. BlueHill Materials Testing 2 (Instron Corp., Norwood MA, USA) servohydraulic testing machine software was used to record and graph the resulting displacement and force data. In our study, all subjects were fixed to the experimental setup with the occlusal plane parallel to the ground. The experimental force was applied perpendicularly from the anterior of the fracture line, according to the cantilever beam model, positioning the lever arm at the level of the edentulous bone at the end of the premolars. A preliminary force of 10 N was applied to remove any gaps in the system and to make standard measurements, and then a linear load was applied to the specimens until the plate and screws showed deformation. The maximum force and maximum displacement data were recorded.

Statistical Analysis

IBM SPSS ver. 20 (IBM SPSS Corp., Armonk, NY, USA) was used for statistical analysis. The Kruskal-Wallis test was used to evaluate the difference between groups in terms of maximum strength. To evaluate the difference between groups in detail, pairwise comparisons were made with the Mann-Whitney U test (Table 2).

A homogeneity test was performed to understand the variance distributions of the maximum displacement data, and it was seen that the data were homogeneously distributed. Therefore, the data were analyzed using the one-way analysis of variance (ANOVA) test. Differences between groups were determined using Tukey's post-hoc test (Table 3).

Table 2. Pairwise statistical comparison of groups using the Mann-Whitney U test

Maximum force-pairwise comparison		
Single miniplate	Double miniplates	**0,002**
	Single miniplate + Arch Bar	**0,002**
	Single miniplate + Fiber Splint	**0,002**
Double miniplates	Single miniplate	**0,002**
	Single miniplate + Arch Bar	**0,004**
	Single miniplate + Fiber Splint	0,818
Single miniplate + Arch Bar	Single miniplate	**0,002**
	Double miniplates	**0,004**
	Single miniplate + Fiber Splint	0,065
Single miniplate + Fiber Splint	Single miniplate	**0,002**
	Double miniplates	0,818
	Single miniplate + Arch Bar	0,065

Table 3. Pairwise statistical comparison of groups using Tukey's test

Maximum displacement -pairwise comparison		
Single miniplate	Double miniplates	**0.009**
	Single miniplate + Arch Bar	**0.000**
	Single miniplate + Fiber Splint	**0.003**
Double miniplates	Single miniplate	**0.009**
	Single miniplate + Arch Bar	**0.004**
	Single miniplate + Fiber Splint	0.957
Single miniplate + Arch Bar	Single miniplate	**0.000**
	Double miniplates	**0.004**
	Single miniplate + Fiber Splint	**0.013**
Single miniplate + Fiber Splint	Single miniplate	**0.003**
	Double miniplates	0.957
	Single miniplate + Arch Bar	**0.013**

RESULTS

The displacement and maximum force values of four different fixation methods used in mandibular corpus fractures were converted to digitally recorded graphs.

The average values of all subjects in terms of maximum strength between the groups are shown in Graph 1. The average strength values were found at the highest level in the single-plate arch bar group and the lowest in the single-plate group. Looking at the data shown, the single plate arch bar group showed the highest stability, and the single plate group showed the lowest stability (Figure 3).

The mean values in terms of maximum displacement between all subject groups are shown in the Graph 2. The mean displacement values were highest in the single-plate arch bar group and lowest in the single-plate group. The aforementioned data coincides with the maximum force values. Single plate arch bar group is seen to have required the highest level of strength, and the single plate group has shown deformation at the lowest strength (Figure 4).

The Kruskal-Wallis test was used to evaluate the difference between the groups in terms of maximum strength, and the results showed statistically significant differences between groups ($p<0.05$). Pairwise comparisons were made with the Mann-Whitney U test to evaluate the difference between groups in detail.

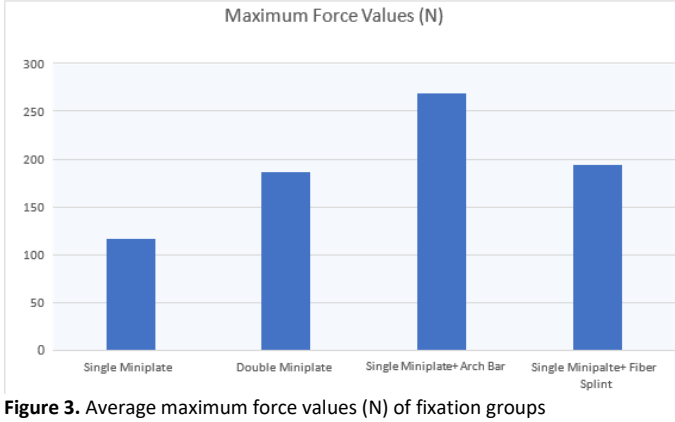

Figure 3. Average maximum force values (N) of fixation groups

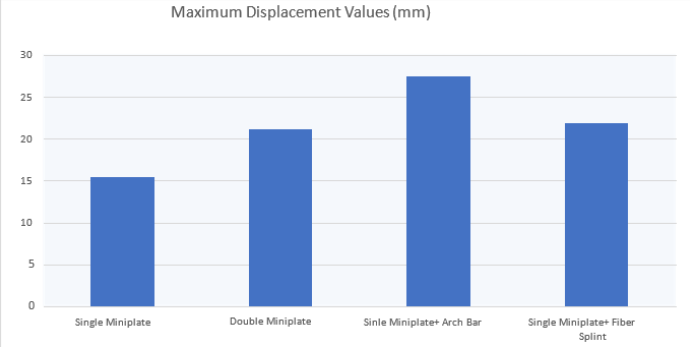

Figure 4. Average maximum displacement values(mm) of fixation groups

Pairwise comparisons were made with the Mann-Whitney U test to evaluate differences between two groups in terms of the maximum strength values in detail. In the evaluation, a statistically significant difference was found between group A and all other groups. Group A showed lower stability in terms of maximum strength required for displacement. Between group A and group B, group B was significantly more stable in terms of maximum strength. Between groups B and C, group C was found to be significantly superior in terms of maximum strength. However, no statistically significant difference was found between groups B and D in terms of maximum strength ($p = 0.818$). Although group C showed higher than average strength values, no statistically significant difference was found between group D and group C ($p = 0.065$).

As the results differed statistically (p 0.001), differences between groups were determined using Tukey's post -hoc test.

In the evaluation, while no statistically significant difference was found between groups B and D in terms of maximum displacement values ($p = 0.957$), there was a statistically significant difference between all other groups.

DISCUSSION

In the context of oral and maxillofacial surgery, plate and screw fixation systems are used in the treatment of facial fractures, orthognathic surgery, and reconstructive surgery.[8] Corpus fractures are one of the most common types of fractures in the mandible.[9] Although mandible fractures are common in the corpus region, in vitro biomechanical studies on this region are scarce. The biomechanical characteristics of rigid fixation systems depend on the interaction between plate, screw, and bone. The ideal in vitro test model should aid in the study of fixation systems in their entirety by providing appropriate physiological and anatomical conditions.[10] In an ideal in vitro test study, the test model that is structurally and morphologically closest to the human mandible should be selected.[11]

In numerous biomechanical studies related to mandible fractures, it has been recommended to use synthetic polyurethane mandible replicas as an ideal study model, as they mimic the cortex and cancellous layers of the mandible and can be standardized in shape, size, and density.[12,13] However, the complex anatomy of the human mandible and the fact that the differing thickness of the cortical bone play a role in the biomechanical behavior of fixation methods. In addition, synthetic mandible replicas pose a disadvantage since they cannot reflect the natural trabecular structure of the bone. Animal-derived mandibles are frequently used in biomechanical studies .[14,15,16] It is advantageous to use sheep-derived mandibles since they most closely resemble the human mandible in shape, structure, and mineralization.[17] Although the cadaveric mandible is the most suitable biomechanical model, certain legal procedures prevent such studies. Models are difficult to store and preserve in suitable environments, and there is a possibility of transmitting infectious diseases from these models.[18,19] Since there is resin-reinforced splint application in the fixation groups in our study, bonding agents must be chemically bonded with the natural dental tissue. For this reason, there was an obligation to perform the study on mandibles of either human or animal origin. Although the most ideal working model would be obtained from cadavers, because of the aforementioned negative aspects, sheep mandibles were used in the study.

In studies conducted after the treatment of mandible fractures, many researchers have reported that masticatory forces are lower than those of healthy individuals.[20,21] He social stated that the patient who was treated for a mandibular fracture could achieve masticatory function utilizing the anterior region rather than the molar region in the first few weeks. In the literature, it is seen that the maximum bite force in the incisal region does not exceed 120 N in the first 6 weeks.[22,23] The study was designed to replicate the bite force from the incisal region, which is in line with the existing literature.

Fibrous and cartilaginous callus formation, which occurs after the inflammatory period in fracture healing takes place over a period of approximately 4 to 6 weeks.[24,25] For this reason, the maximum bite forces occurring in the first six weeks are higher than the maximum force values determined in the biomechanical studies. It should be considered that these fixation methods used in mandible fractures will show insufficient stability.

It is seen that our average maximum strength values in all fixation groups exceeded 115 N. In particular, the single-plate fiber splint group was included as an alternative fixation method, and the average maximum force strength value was determined to be 193 N. Although this value is considerably higher than the maximum bite force values in the anterior region in the literature, it is thought that the single plate fiber splint group can provide sufficient stability in fracture fixation. In the literature, fixation methods differ regarding the treatment of mandibular corpus fractures. Champy claimed that fracture line fixation can be achieved with a single miniplate.[26] However, Arbağ et al.[27] report that the fixation technique applied with two miniplates placed in the compression and tension areas can neutralize the torsion forces and provide better stability. In studies, arch bars have been used to fix fractures in combination with open reduction using miniplates or as a singular treatment as intermaxillary fixation establishing closed reduction.[28,29]

IMF with an arch bar gives good results from a historical perspective when fracture stability is evaluated. The advantages of this procedure are the absence of surgical treatment, the less invasive procedure, the low sensitivity to professional experience to perform the treatment, and the low cost compared to other methods.[30] However, there are also disadvantages such as morbidity, malnutrition, and periodontal disease.[31] Although surgical treatment with open reduction and internal rigid fixation is more invasive than IMF, it has advantages such as anatomical reconstruction of osseous morphology by more efficiently reducing the fracture, rapid adaptation to social life, and preservation of periodontal tissue.[32]

The Erich arch bar is often used as a dental posterior circumdental ligature with wire. Because these wires pass between the teeth, causing periodontal damage, difficulties in maintaining oral hygiene, and orthodontic movements in the anterior teeth emerge. During the operation, the surgeon or the assistant may be at risk of exposure to bloodborne infectious pathogens such as HBV, HCV, and HIV as a result of percutaneous injury from wires.[33,34]

In order to avoid the negative properties of the ligature wire, clinical studies on resin-supported arch bar application devices are being conducted and reported in literatüre.[35,36] It is shown that the resin-supported fiber splint application is used as a stabilization tool during the recovery period in dentoalveolar traumas, especially in cases such as crown and root fractures, luxation, and avulsion of the teeth.[37,38]

When the literature was examined, it could not be determined that resin-supported fiber splint application was used in the treatment of mandible fractures.

Champy et al.[26] analyzed the biodynamics of the mandible with their 2D experimental tests. As a result of these studies, they determined the ideal osteosynthesis lines for the mandible corpus, symphysis. and angulus regions. Fracture healing

However, it is stated that the closer the single miniplate is positioned to the alveolous, the more stability will increase.[27] In cases where a single miniplate is positioned superiorly in mandibular corpus fractures, a more balanced stabilization is provided against the bite forces from the incisal region. Contrarily, positioned on the inferior border, the amount of bending in the plate will increase and the screws will not be loaded equally. Deformation will occur in the system in a short time.[39] Thus, all single miniplates should be placed at the superior border of the osteosynthesis line described by Champy rather than the basal margin of the mandible. In the double miniplate group, the second miniplate was applied to the basal margin of the mandible.

In cases where an IMF is not planned, it may be considered to support the single miniplate with a fiber splint to avoid difficulties in placing the second miniplate. Occlusion was not considered because the study was in the sheep's mandible. In clinical applications, the placement of the splint should be in such a way that it does not prevent occlusion. However, the negative effect to salivary flow in the oral region should be considered when applying fiber splints.

When evaluating if the number of screws, plate type, and thickness are among the contributing factors to stabilization in the studies on corpus fractures, it is seen that the screw diameter is not emphasized much, and monocortical screws with a diameter of 2.0 mm are preferred in most of the studies.[6,8,40]

In our study, we included the use of single and double miniplate groups with 5 mm monocortical screws as an internal fixation method, which are seen as one of the most common and valid treatment methods in isolated mandibular corpus fracture cases. In our study, we used 4-hole 2.0 mm plate and screw systems to achieve a standard in all fixation methods frequently used by maxillofacial surgeons. The findings of our study demonstrated a correlation between the maximum force values and the maximum displacement values, supporting the standardization of the experimental procedure. Nonetheless, no statistically significant difference was observed between the groups treated with fiber splint and double miniplate. The absence of a statistically significant difference between the two groups in relation to maximum strength substantiates this data.

Limitations

There are some limitations to the study. The study fiber splint application was performed on sheep jaws in a moisture-free environment. It should be considered that the adhesive used to perform this application in the oral region in a healthy way is affected by moisture.

The number of subjects was kept minimal due to the difficulties in the supply and storage conditions of sheep jaws. An increasing the number of subjects will make the study more meaningful.

CONCLUSION

It has been noted that the fiber splint application, which was used to avoid the disadvantages of the arch bar application, contributed positively to the stability of fracture fixation. However, single plate can be supported with a fiber splint to avoid the difficulty of a double plate application. The use of fiber splints in fracture fixation should continue to be investigated further in clinical practice.

Etik Komite Onayı: Çalışma kadavra koyun çeneleri üzerinde gerçekleştirildi. Ticari olarak (et-balık kurumları vb.) elde edilen kadavra materyalidir, etik kurul raporu gerekmemektedir.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – M.Z.B.; Tasarım – M.Z.B; Denetleme – S.C.K.; Kaynaklar – M.Z.B.; Veri Toplanması ve/veya İşlemesi – E.Y.; Analiz ve/veya Yorum – E.Y.; Literatür Taraması – M.Z.B; Makaleyi Yazan – E.Y.; Eleştirel İnceleme – M.Z.B.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: The study was carried out on cadaver sheep mandibles. It is a cadaver material obtained commercially (meat-fish institutions, etc.), an ethics committee report is not required.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept – M.Z.B.; Design – M.Z.B.; Supervision – M.Z.B..; Resources – M.Z.B.; Data Collection and/or Processing – E.Y.; Analysis and/or Interpretation – E.Y.; Literature Search – M.Z.B; Writing Manuscript – E.Y.; Critical Review – M.Z.B.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATURK UNIVERSITY PUBLICATIONS

Araştırma Makalesi *Research Article* DOI: 10.5281/zenodo.11056757

Evaluation of the Intraoperative and Postoperative Complications of Orthognathic Surgery

Ortognatik Cerrahi Operasyonu Sırasında ve Sonrasında Gelişen Komplikasyonların Değerlendirilmesi

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ABSTRACT

Objective: The aim of this study was to evaluate the incidence of preoperative and postoperative complications in patients undergoing orthognathic surgery.

Methods: The clinical records and radiographs of 112 patients who undergone orthognathic surgery between 2014 and 2021 were retrospectively analyzed. Patients' demographics, follow-up period, type of malocclusion and operation were recorded. All surgical complications were evaluated into two groups as intraoperative or postoperative complications.

Results: The mean age of 112 patients (69 female, 43 male) was 24.4 ± 5.5 (ranging from 16 to 47). The most frequent intraoperative complication was the bad split (5 cases, 4.5%), followed by severe hemorrhage due to rupture of facial artery (1 case, 0.9%), dissection of inferior alveolar nerve (1 case, 0.9%), and dental damage (1 case, 0.9%). The most common postoperative complication was the neurosensorial deficit (29 cases, 25.9%), followed by infection (6 cases, 5.4%), extraoral scar formation (5 cases, 4.5%), fracture of fixation material (2 cases, 1.8%), maxillary non-union (2 cases, 1.8%), postoperative nasal hemorrhage (1 case, 0.9%), and failure of fixation material (1 case, 0.9%). There were no fatal complications.

Conclusion: Although the wide range of complications related to orthognathic surgery is reported both in our study and the literature, the frequency of these appears to be uncommon. However, in order to manage the complications of the operation properly, through knowledge and experience are essential.

Keywords: Complication; Le Fort I osteotomy, Orthognathic surgery, Sagittal split osteotomy

ÖZ

Amaç: Bu çalışmanın amacı, ortognatik cerrahi uygulanan hastalarda operasyon sırasında ve sonrasında ortaya çıkan komplikasyonların insidansını değerlendirmektir.

Yöntemler: 2014-2021 yılları arasında ortognatik cerrahi operasyonu uygulanan 112 hastanın klinik kayıtları ve radyografileri retrospektif olarak incelendi. Hastaların demografik verileri, takip süresi, maloklüzyon ve operasyon tipi kaydedildi. Tüm cerrahi komplikasyonlar, operasyon sırasında ve sonrasında olmak üzere iki grupta incelenerek değerlendirildi.

Bulgular: 112 hastanın (69 kadın, 43 erkek) ortalama yaşı 24,4 ± 5,5 (16-47 arasında) idi. Operasyon sırasında en sık görülen komplikasyon kötü kırık oluşumuydu (5 vaka, %4,5) ve bunu fasiyal arter rüptürüne bağlı olarak görülen şiddetli kanama (1 vaka, %0,9), inferior alveolar sinir diseksiyonu (1 vaka, %0,9) ve dental hasar (1 vaka, %0,9) takip etti. Operasyon sonrasında en sık karşılaşılan komplikasyon ise nörosensoriyel bozukluktu (29 vaka, %25,9) ve bunu enfeksiyon gelişimi (6 vaka, %5,4), ekstraoral skar oluşumu (5 vaka, %4,5), fiksasyon materyalinin fraktürü (2 vaka, %1,8), maksillada osteotomi hattının kemikleşmemesi (2 vaka, %1,8), postoperatif nazal hemoraji (1 vaka, %0,9) ve fiksasyon materyalinin kaybı (1 vaka, %0,9) izledi. Hiçbir hastada hayatı tehdit edici bir komplikasyon ile karşılaşılmadı.

Sonuç: Bu çalışmada ve literatürde ortognatik cerrahi ile ilişkili olarak çeşitli komplikasyonlar bildirilse de, bu komplikasyonların görülme sıklığı azdır. Ancak, operasyonda ortaya çıkabilecek komplikasyonların uygun bir şekilde yönetilebilmesi için yeterli bilgi ve deneyime sahip olmak büyük önem taşımaktadır.

Anahtar Kelimeler : Le Fort I osteotomisi, Komplikasyon, Ortognatik cerrahi, Sagittal split osteotomy

Geliş Tarihi/Received 25.06.2022
Kabul Tarihi/Accepted 21.08.2022
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Tokuç B, Memiş S, Ankaralı DA, Hoşgör H, Coskunses FM. Evaluation of the Intraoperative and Postoperative Complications of Orthognathic Surgery. *Current Research in Dental Sciences*. 2024;34(2):122-127.

INTRODUCTION

Orthognathic surgery is a method used for treating dentofacial deformities and malocclusion. The aim of orthognathic surgery is to surgically reposition the facial skeleton, especially the maxilla and mandible, to restore a proper anatomical and functional relationship. With this surgical method, in addition to correcting malocclusions that cannot be corrected with orthodontic treatment, correction of facial aesthetics is also possible.[1]

The most commonly used surgical techniques for ensuring ideal jaw relations are Le Fort 1 osteotomy and mandibular bilateral sagittal split osteotomy (BSSO) in the maxilla and mandible, respectively. With Le Fort 1 osteotomy, it is possible to reposition the maxilla in three dimensions according to the cranial base. The treatment of various pathologies, such as maxillary hypoplasia or hyperplasia, transverse anomalies and malocclusions, obstructive sleep apnea, and craniofacial tumors, can be performed successfully with Le Fort 1 osteotomy.[2] Because BSSO is a safe surgical technique that allows movement in all directions in the repositioning of the mandible, it is now applied more frequently than other surgical techniques in the correction of dentofacial deformities in the mandible.[3]

Although there have been many scientific developments in terms of diagnosis, planning, surgical application, and materials, all of which have increased the applicability and reliability of these surgical techniques, various complications may still occur in the intraoperative and postoperative periods.[4] In the literature, the most common complications associated with Le Fort 1 osteotomy and BSSO are infection, hemorrhage, neurosensory disorders, bad split, postoperative malocclusion, wound dehiscence, fracture or loss of fixation materials, soft tissue injuries, extraoral scar formation, and periodontal or dental damage.[1,5,6] Factors affecting the emergence of all these complications include the age and gender of the patient, the amount of movement of the jaws, the surgeon's level of experience, and the type of craniofacial deformity.[7,8]

It is therefore of great importance to know the incidence rate and types of complications that occur in orthognathic surgery, both to prevent intraoperative and postoperative complications and to overcome them, when necessary, using appropriate management techniques. Accordingly, this study aimed to determine the incidence of complications that occur during and after orthognathic surgery.

MATERIALS and METHODS

The pre- and post-treatment clinical records, and panoramic and lateral cephalometric radiographs of patients who underwent orthognathic surgery in Kocaeli University, Faculty of Dentistry between 2014 and 2021 were retrospectively evaluated in this study. The study was approved by the ethics committee of the Kocaeli University, Faculty of Medicine, Kocaeli, Turkey (approval date: 10/03/2022; approval no.: 2022/83). It was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent forms were obtained from all patients who were followed up with.

Patients with complete panoramic and lateral cephalometric radiographs before and after orthognathic surgery and who had at least six months of regular clinical and radiological follow-up after treatment were included in the study. Patients with congenital craniofacial deformities, with a history of maxillofacial trauma, and who had undergone maxillofacial surgery before orthognathic surgery were excluded from the study. Panoramic radiographs of all patients included in the study were taken with the same device (Planmeca, Romexis, Finland) at 65 kVp, 5 mA, and 8.1 sec exposure time. Lateral cephalometric radiographs of the patients were obtained with the same device (Planmeca, Romexis, Finland) at 69 kVp, 5 mA, and 4.9 sec exposure time.

The study was conducted by analyzing the clinical and radiological data of 112 patients between the ages of 16 and 47 years who met the inclusion criteria. Patients' demographics, follow-up period, type of malocclusion, and type of operation performed were recorded. The type of malocclusion was determined based on the ANB angle (Class 1: $0° < ANB < 4°$; Class 2: $ANB \geq 4°$; Class 3: $ANB \leq 0°$) in the lateral cephalometric radiography image taken before treatment.[9] The period between the surgical procedure and the last control time was considered as the follow-up time. Patients were divided into three subgroups according to the surgical procedures performed: (1) combined Le Fort I osteotomy and BSSO; (2) Le Fort I osteotomy or BSSO; and (3) combined Le Fort I osteotomy and BSSO with genioplasty. Patients who underwent orthognathic surgery were divided into two subgroups:

- Those with intraoperative complications, which include bad split, intraoperative hemorrhage, nerve laceration or rupture, and dental or periodontal damage
- Those with postoperative complications, which include infection, fracture of the fixation material, dislocation of the fixation material, non-union, facial scar formation, postoperative hemorrhage, and neurosensory disorder

For the statistical analyses, normality was determined with using the Kolmogorov–Smirnov test. All data were analyzed descriptively and expressed as mean and median values (standard deviation) and minimum and maximum values. Categorical variables were expressed as numbers and percentages. All statistical analyzes were performed using statistical software (SPSS Statistics Version 25, IBM SPSS Corp., Armonk, NY, USA).

RESULTS

The mean age of the 112 patients included in the study was 24.4 ± 5.5 (range: 16–47 years). The mean follow-up period of the 69 female (61.6%) and 43 male (38.4%) patients was 25.8 ± 17.9 months (range: 6–79 months). Among the evaluated patients, 78 (69.6%), 26 (23.2%), and 8 (7.1%) were operated on to correct skeletal Class 3 malocclusion, skeletal Class 2 malocclusion, and skeletal anterior open bite, respectively. In terms of the type of operation that was performed, combined Le Fort I osteotomy and BSSO, Le Fort I osteotomy or BSSO, and combined Le Fort I osteotomy and BSSO with genioplasty were performed in 73 (65.2%), 29 (25.8%), and 10 (8.9%) cases, respectively. More specifically, only Le Fort I osteotomy was performed in 10 (8.9%) cases and only BSSO was performed in 19 (17.0%) cases.

The most common complication during orthognathic surgery was bad split, which occurred in 5 cases (4.5%). Other complications observed during the operation were severe hemorrhage due to facial artery rupture in 1 case (0.9%), inferior alveolar nerve rupture in 1 case (0.9%), and dental damage in 1 case (0.9%; Table 1).

The most common complication after orthognathic surgery was permanent neurosensory disorder, which occurred in 29 cases (25.9%). Of the permanent neurosensory disorders, 26 (89.7%) were observed in the inferior alveolar nerve, 2 (6.9%) in the infraorbital nerve, and 1 (3.4%) in the lingual nerve areas. Other postoperative complications were infection in 6 cases (5.4%), extraoral scar formation in 5 cases (4.5%), fracture of the fixation material in 2 cases (1.8%), non-union of the maxilla in 2 cases (1.8%), postoperative nasal hemorrhage in 1 case (0.9%), and dislocation of the fixation material in 1 case (0.9%; Table 1). The treatment methods applied for the management of intraoperative and postoperative complications are shown in Table 2.

Table 1. Frequency of intraoperative and postoperative complications

Complication	n (%)
Intraoperative complications	
Bad split	5 (4.5)
Facial artery hemorrhage	1 (0.9)
Inferior alveolar nerve dissection	1 (0.9)
Dental damage	1 (0.9)
Postoperative complications	
Neurosensory disorder	29 (25.9)
Infection	6 (5.4)
Extraoral scar	5 (4.5)
Fracture of fixation material	2 (1.8)
Non-union of maxilla	2 (1.8)
Dislocation of fixation material	1 (0.9)
Nasal hemorrhage	1 (0.9)

Table 2. Intraoperative and postoperative complications and treatment methods.

Intraoperative complications	Case	Treatment method
Bad split	1	Segments were fixed during the operation.
	2	Segments were fixed during the operation.
	3	Segments were fixed during the operation.
	4	Segments were fixed during the operation.
	5	Closed reduction was performed after the operation.
Facial artery hemorrhage	6	Cauterization was performed during the operation.
Inferior alveolar nerve dissection	7	Suturing was performed during the operation.
Dental damage	8	Root canal treatment was performed after the operation.
Postoperative complications	**Case**	**Treatment method**
Infection	9	Antibiotics were administered.
	10	Antibiotics were administered.
	11	Antibiotics were administered, and plates and screws were removed.
	12	Antibiotics were administered, and plates and screws were removed.
	13	Antibiotics were administered, and plates and screws were removed.
	14	Antibiotics were administered, and plates and screws were removed.
Extraoral scar	15	Scar revision was performed.
	16	No treatment was performed.
	17	No treatment was performed.
	18	No treatment was performed.
	19	No treatment was performed.
Fracture of fixation material	20	Reoperation was performed, and, in combination with an iliac bone graft, plates and screws were applied.
	21	Reoperation was performed, and plates and screws were applied.
Dislocation of fixation material	22	Reoperation was performed, and plates and screws were applied.
Non-union of maxilla	23	Reoperation was performed, and, in combination with an iliac graft, plates and screws were applied.
	24	Reoperation was performed, and plates and screws were applied.
Nasal hemorrhage	25	Nasal packing was performed on the day of the surgery.

DISCUSSION

The factors that affect the occurrence of orthognathic surgery complications include inadequate or inappropriate preoperative planning, the surgeon's failure to show the necessary sensitivity and attention during the procedure, the length of the surgical procedure, anatomical variations, and the surgeon's experience.[10] In this study, the complications observed in orthognathic surgery patients were evaluated by first dividing them into two groups: intraoperative and postoperative complications. The most common intraoperative complication observed was bad split, while the most common postoperative complication was permanent neurosensory disorder.

Within the related literature, the reported incidence rate of bad split is not very high, although it varies. Steenen et al.,[11] in their systemic review and meta-analysis, reported that the incidence of bad split was between 0.0% and 6.9%. In a study by Jiang et al.[12] of 964 cases, the incidence of patients with bad split was reported as 7.4%. In our study, the most common intraoperative complication was bad split, at a rate of 4.5%. Accordingly, the rate of bad split in this study can be evaluated as consistent with the rates reported in the literature.

There are various studies in the literature investigating factors that may affect the formation of a bad split, such as age, presence of third molar teeth, and gender. Eshghpour et al.[13] reported that the presence of an impacted mandibular third molar caused an increase in the incidence of bad split in elderly patients and women. In our study, none of the five cases with bad split had a third molar in the osteotomy line. However, it was noted that, at the time of the operation, two of the patients were in their fourth decade and three were in their third decade. The authors, therefore, suggest that independent of third molar teeth in the osteotomy line, the effect of advancing age, bone density, and the thickness of the ascending ramus bone cortex are the most likely causes of bad split. Thus, in elderly patients who have high bone density and a thin ramus, conducting detailed radiological examinations before procedures and paying as much attention as possible during osteotomies may reduce the incidence of such complications.

If a bad split occurs away from the surgical site and it is not possible to use diagnostic imaging techniques during the surgical procedure, it may not be possible to complete the surgical procedure in accordance with the current orthodontic planning of the patient. In such cases, following the end of the operation, the patient may need to be reoperated in light of data obtained using three-dimensional imaging methods. In the current study, four of the bad fractures reported were localized in the ascending ramus and condyle of the mandible, and one was localized in the anterior of the distal segment. In four of these cases, split bone segments were fixed with mini-plates, monocortical screws, and bicortical screws, and the operations were completed as planned before the procedures. In a bad split case including mandibular condyle, open reduction and internal fixation with an extraoral approach was recommended to the patient postoperatively. However, the patient refused this treatment method because of the possible risk of facial paralysis, and the patient's treatment was ended by providing the desired occlusion with closed reduction.

Orthognathic surgery procedures such as BSSO and Le Fort 1 are generally considered as safe. However, vascular complications—including, hemorrhage, thrombosis, arteriovenous fistula, and pseudoaneurysm—may occur during or after these procedures.[14] In a patient in our study, who underwent bimaxillary orthognathic surgery and simultaneous genioplasty, superficial facial artery bleeding was observed during the incision made on the skin for trocar entry to fixate the segments after BSSO. The artery causing severe bleeding was held with a clamp and cauterized with the help of a bipolar cautery, and the bleeding was brought under control. In the literature, it has been reported that penetration or blunt injury to the thin arterial structures during the surgical procedure may rarely cause damage to the arteries; later, pseudoaneurysm may develop due to this. For this reason, it is necessary to be careful that vascular structures that are likely to be damaged in orthognathic surgery, such as the internal maxillary artery, sphenopalatine artery, descending palatine artery, and facial artery, as damage to these may cause life-threatening postoperative

complications.[14] The use of piezo surgical devices instead of saws in orthognathic surgical procedures will reduce the possibility of damage to direct vascular structures. However, it is also possible that the inferior alveolar artery and vein may be damaged due to the penetration of sharp bone protrusions during the separation of osteotomy lines in the mandible. To reduce hemorrhage, it is very important for surgeons to pay maximum attention at every stage of orthognathic surgery and to see the surgical site clearly.

After sagittal split osteotomy was first defined by Trauner and Obwegeser,[15] modifications to this osteotomy were described by Dal Pont, Epker, and Hunsuck.[16] Initially, proximal and distal segments were provided with a wire placed around the ramus or by intermaxillary fixation in BSSO. However, rigid fixation with bicortical screws and mini-plates is currently used as a standard in BSSO and Le Fort I surgeries.[15,17] Osteosynthesis materials may need to be removed for reasons such as the patient's desire for removal, infection, irritation, pain, hot/cold sensitivity, and paresthesia.[18] In our study, the mini-plates and mini-screws of four patients were removed due to infection. Factors that may cause or contribute to the development of infection include the intraoral exposure of plates and screws, poor oral hygiene, and insufficient wound care.

Additionally, Dubron et al.[18] reported a positive correlation between an increase in the number of osteosynthesis materials used and the need for the removal of these materials. Verweij et al.[17] reported that the rate of bicortical screw removal after BSSO was less than that of mini-plates. In the current study, two of the patients who developed postoperative infection were treated successfully with only the use of oral antibiotics (i.e., amoxicillin + clavulanic acid), an anti-inflammatory (i.e., dexketoprofen trometamol), and mouthwash (i.e., chlorhexidine gluconate). In four patients, exposed fixation materials were removed under the use of oral antibiotics (i.e., amoxicillin + clavulanic acid) and uneventful healing was observed in these patients. In this study, it could be seen that personal oral care and postoperative hygiene directly affected infection risk, based on a review of the patients who developed infection. Additionally, the time of removal of the fixation materials was found to be important. If the infection develops in the postoperative sixth month or later, the fixation materials can be removed by observing the union of the osteotomy lines with the help of cone-beam computed tomography or conventional radiography; if the removal of the plates occurs within the first six months after the operation, open reduction and internal fixation or closed reduction may be required, depending on the case.

Davis et al.[19] reported that the primary determinant of surgical site infection was antibiotic use with the secondary variables being age, gender, medical comorbidities, smoking, duration of operation, and third molar tooth extraction. Davis et al.[19] and Van Camp et al.[20] reported the incidence of infection after orthognathic surgery as 8% and 14.6%, respectively. Posnick et al.[21] reported the incidence rate of surgical site infection as 1% in orthognathic surgery patients using cefazolin or cephalexin, in their retrospective study. In the same study, the simultaneous extraction of third molar teeth during BSSO was associated with surgical site infection, albeit with a low incidence rate. Gil et al.[22] found that long-term antibiotic use following to orthognathic surgery reduced infection risk.

Materials such as saws, burs, osteotomes, and mini-screws used for fixation during orthognathic surgery may cause pulp necrosis, mobility, fractures, discoloration of teeth, or loss of teeth.[23] In the current study, devitalization was observed in the relevant teeth after the procedure in one patient due to the positioning of one of the monocortical screws applied during the fixation of the distal and proximal segments after BSSO, close to the roots of the lower first and second molars. Endodontic treatment was applied to these teeth, and no complications were observed during the patient's two-year follow-up. In this case, due to the lack of strength in one of the monocortical screws during the placement of the mini-plates, it was replaced with emergency screws. The different length, diameter, and angle of the replaced screw caused it to be positioned closer to the tooth roots than it should have been. If a screw must be changed when such a situation occurs, positioning the fixation material differently—or preferring a different fixation method if that is not possible—may reduce the risk of dental damage. In cases where bicortical screws are used for the fixation of segments in BSSO, it is suggested to consider the position of existing teeth and to pay more attention to reducing dental damage risk.

In the literature, motor nerve and sensory nerve injuries have also been reported in relation to orthognathic surgery.[24] Neurosensory damage is observed more frequently in the mandible in these operations. Although the permanent or temporary involvement of the inferior alveolar nerve in orthognathic surgical procedures varies, it has been reported in the literature at rates of up to 99%.[24,25] Phillips et al.[26] observed an altered sensation in all patients in the first week of follow-up after mandibular surgeries, while this rate was observed as 85% in the sixth-month control. In our study, 23% of the patients had inferior alveolar nerve injury lasting more than 1 year and considered as permanent. Lee et al.[27] reported that the most common terms they used regarding the altered sensory states of patients were "tingling" and "numbness," in their study investigating sensory changes affecting the lower lip after orthognathic surgery.

Nerve damage may occur due to the incorrect positioning of bone osteotomy lines or fixation errors in ramus osteotomies during the separation or manipulation of the distal segment.[25] Posnick et al.[28] concluded that lingual nerve injury in patients undergoing BSSO is not associated with age, gender, simultaneous third molar extraction, or bicortical screw use, and reported the incidence of permanent lingual nerve injury as less than 1%. In our study, 1 patient developed permanent lingual nerve damage, which is a rate of less than 1%, consistent with the literature. Karas et al. [29] reported that 96% of patients who underwent Le Fort I osteotomy returned to preoperative feeling after 3 months. However, permanent infraorbital nerve damage was observed in 2.1% of all cases in our study. It should be kept in mind that these rates may vary depending on many factors, such as the amount of movement in the maxilla, the need for interpositional graft placement, the experience of the surgeon, and the number of samples calculated.

After Le Fort 1 osteotomy, the non-union of the maxilla is a rare complication. Imholz et al.[30] detected that osteotomy lines did not ossify in the maxilla in 4 (2.6%) of 150 patients who underwent Le Fort I osteotomy. This complication was observed in 2 cases (1.8%) in our study, similar to the rate reported in the literature. In one of the patients who experienced the non-union of the maxilla, fixation was restored by changing only infected plates and screws; in the other patient, who underwent maxillary vertical elongation, autogenous iliac bone grafting was performed to graft the space between the segments again. The maxilla and autogenous block were fixed with grafts, mini-plates, and mini-screws, and both patients showed uneventful healing over the course of at least two years of follow-up.

In the prevention and treatment of complications that develop during or after orthognathic surgery, the patient's anatomical structure, age, systemic status, and medication, as well as the biomaterials used in the surgery and the knowledge and experience of the surgeon performing it, are of great importance. To prevent or reduce complications, it is recommended to pay the utmost attention during the planning, application, and postoperative follow-up process of orthognathic surgery.

Etik Komite Onayı: Etik kurul onayı Kocaeli Üniversitesi, Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu (Onay tarihi ve sayısı: Tarih: 10.03.2022, Sayı: 2022/83) alınmıştır.
Hasta Onamı: Tüm hastalardan yazılı onam formu alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir- F.M.C.; Tasarım – B.T.; Denetleme – F.M.C.; Kaynaklar- B.T.; Veri Toplama ve/veya İşleme – B.T., S.M., D.A.A., FMC; Analiz ve/veya Yorum – B.T.; Literatür Taraması – B.T., S.M., D.A.A.; Makaleyi Yazan – B.T., S.M.; Eleştirel İnceleme – H.H., F.M.C.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was obtained from Kocaeli University, Non-Interventional Clinical Research Ethics Committee (Approval date and number: Date: 10.03.2022, Number: 2022/83).
Informed Consent: Written consent was obtained from all patients
Peer-review: Externally peer-reviewed.
Author Contributions: Concept - F.M.C; Design – B.T.; Supervision - F.M.C; Resources- B.T.; Data Collection and/or Processing - – B.T., S.M., D.A.A., F.M.C; Analysis and/or Interpretation – B.T.; Literature Search – B.T., S.M., D.A.A.; Writing Manuscript – B.T., S.M.; Critical Review – H.H., F.M.C.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Araştırma Makalesi *Research Article* DOI: 10.5281/zenodo.11058611

A Retrospective Assessment of Pediatric Dental Trauma Patients Before and During the COVID-19 Outbreak

Pediatrik Diş Travması Hastalarının COVİD-19 Salgını Öncesi ve Sırasında Retrospektif Olarak Değerlendirilmesi

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ABSTRACT

Objective: The aim of this study was to compare the number of patients admitted to the Department of Pediatric Dentistry at Atatürk University Faculty of Dentistry in 2020 due to dental trauma with the previous year, and to determine the causes and forms of trauma during the pandemic).

Methods: In this retrospective study, dental trauma records were evaluated. The number of patients admitted, their age, sex, type of trauma, location of the trauma, and the affected teeth were analyzed. The distribution of trauma cases over the years in terms of sex, dentition, jaw, and location was evaluated using Chi-square analysis.

Results: The incidence of dental trauma among the patients who visited our clinic in 2019 and 2020 was 0.35% and 0.83%, respectively. Enamel-dentin fractures from dental hard tissue injuries were the most common type of trauma in both years. No statistically significant differences were found in the distribution of trauma cases by year in terms of sex, dentition, jaw, and location ($p>0.05$).

Conclusion: The COVID-19 outbreak led to a reduction in dental trauma cases. However, it is noteworthy that dental traumas occurred more frequently in outdoor environments, despite restrictions on children going out due to the pandemic. Since no significant reduction in the frequency of dental traumas was observed during the COVID-19 outbreak in children, it is important to inform parents and children about avoiding certain risky behaviors and protection methods..

Keywords: COVID-19 outbreak, Pediatric dentistry, Dental trauma

ÖZ

Amaç: Bu çalışmanın amacı Atatürk Üniversitesi Diş Hekimliği Fakültesi Çocuk Diş Hekimliği Anabilim Dalı'na 2020 yılında diş travması nedeniyle başvuran hasta sayısını bir önceki yılla karşılaştırmak ve pandemi döneminde travmanın nedenlerini ve şekillerini belirlemektir.

Yöntemler: Bu retrospektif çalışmada diş travma kayıtları değerlendirildi. Başvuru yapan hasta sayısı, yaşı, cinsiyeti, travma tipi, travmanın yeri ve etkilenen dişler analiz edildi. Travma olgularının yıllara göre cinsiyet, diş, çene ve lokasyona göre dağılımı Ki-kare analizi kullanılarak değerlendirildi.

Bulgular: Kliniğimize 2019 ve 2020 yıllarında başvuran hastalarda diş travması görülme sıklığı sırasıyla %0,35 ve %0,83 idi. Diş sert doku yaralanmalarına bağlı mine-dentin kırıkları her iki yılda da en sık görülen travma tipiydi. Travma olgularının yıllara göre cinsiyet, diş yapısı, çene ve lokasyona göre dağılımında istatistiksel olarak anlamlı farklılık saptanmadı ($p>0,05$).

Sonuç: COVİD-19 salgını diş travması vakalarında azalmaya neden olmuştur. Ancak pandemi nedeniyle çocukların dışarı çıkması kısıtlanmasına rağmen diş travmalarının dış ortamlarda daha sık meydana geldiği dikkat çekiyor. Çocuklarda COVİD-19 salgını sırasında diş travmalarının sıklığında anlamlı bir azalma görülmediğinden, ebeveynlerin ve çocukların bazı riskli davranışlardan kaçınma ve korunma yöntemleri konusunda bilgilendirilmesi önemlidir...

Anahtar Kelimeler: COVID-19 salgını, Çocuk diş hekimliği, Diş travması

This study was presented as an oral presentation at the 2nd Turkish-Japanese Dentistry Congress which was held between 24-26 June 2021

Geliş Tarihi/Received	09.01.2023
Kabul Tarihi/Accepted	25.07.2023
Yayın Tarihi/Publication Date	15.04.2024

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E-mail: fatihs@gmail.com
Cite this article: Çelikel P, Öztürk Sheikholaemeh N, Şengül F, Simsek Derelioğu S. A Retrospective Assessment of Pediatric Dental Trauma Patients Before and During the COVID-19 Outbreak . *Current Research in Dental Sciences*. 2024;34(2):128-132

INTRODUCTION

Since January 2020, the new coronavirus disease (COVID-19) or Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has been a major global public health problem. SARS-CoV-2 belongs to the family of betacoronavirus, which can cause serious illness and death. A new type of coronavirus, called SARS-CoV-2, is a positive single-stranded, enveloped large RNA virus that infects humans and various animals.[1]

Some patients with SARS-CoV-2 infection exhibit varying symptoms, while most are asymptomatic individuals. In symptomatic patients, fever, cough, nasal congestion, fatigue, diarrhea, and upper respiratory tract infections are among the clinical manifestations of the disease. Because COVID-19 disease is transmitted through particles or droplets, the diagnosis and treatment of oral diseases carry a direct risk of infection in the clinical setting. For this reason, most dental clinics around the world have suspended routine oral/dental treatments for a while to prevent the spread of cross-infection and epidemic. However, treatment was carried out with precautions for dental problems requiring urgent treatment.[2-6] Dental procedures that can be considered urgent in Pediatric Dentistry were defined as cases of continuous and severe tooth pain, extraoral swelling, and dental trauma in the decision of the Turkish Ministry of Health's Coronavirus Science Board on April 1, 2020.[7]

Traumatic dental injuries, one of the dental treatments requiring immediate intervention, can be caused by a direct or indirect force to the tooth. Common etiological factors of traumatic dental injuries include falls, motor vehicle accidents, and sports injuries. The teeth most affected by trauma are maxillary central incisors, and if overjet increases, the risk of trauma for these teeth also increases. Dental traumas affecting permanent teeth are typically observed in the hard tissues (crown, crown-root fractures, and root fractures) and the periodontal support tissues (luxation and avulsion), whereas soft tissue injuries are more prevalent in primary dentition. Traumatic dental injuries can affect tooth development in children, resulting in complications such as root resorption, pulp necrosis, ectopic eruption, hypoplasias, and displacements.[8-12]

Whenever possible, it is crucial to avoid non-emergency dental procedures to minimize the risk of COVID-19 transmission. The curfew measures imposed in the Republic of Turkey on individuals aged between 0-20 and 0-18 have resulted in a decline in visits to dental clinics, except for emergency cases.[13]

In order to assess the impact of these restrictions on dental trauma cases, we conducted a retrospective study to compare the number, causes, and types of traumatic dental injuries in patients who applied to the Department of Pediatric Dentistry at Atatürk University Faculty of Dentistry in 2020 with those in the previous year. The null hypothesis of the study is that there is no effect of the COVID-19 pandemic on the distribution of traumatic dental injuries in terms of the sex, dentition, jaw, and location of the trauma among patients applying to our faculty between 2019 and 2020.

METHODS

In this study, the dental records of patients who applied to the Department of Pediatric Dentistry at Atatürk University Faculty of Dentistry due to dental trauma in 2019 and 2020 were examined. The study was approved by the Ethics Committee of the Atatürk University Faculty of Medicine Research (Approval Nr. 29.12.2022/22). This study was conducted in compliance with the Declaration of Helsinki. Written informed consent was obtained from each subject and their parents to record the trauma case. Dental trauma injuries were examined following WHO guidelines.[14] Information regarding the number of patients, age, sex, type and location of trauma, and teeth affected by trauma were evaluated from the dental records.

The number of patients, age, type of trauma, and distribution of teeth affected by trauma were analyzed separately for each year and compared statistically. The distribution of trauma cases over the years in terms of sex, dentition, jaw, and location of the trauma was also evaluated.

All statistical analyses were performed using Statistical Package for Social Sciences (IBM SPSS Corp., Armonk, NY, USA) version 26.0. Fisher's exact test was used to compare categorical data for 2 by 2 tables, while the chi-square test was used for larger tables, with a significance level of 0.05.

RESULTS

The number of patients seeking treatment for dental trauma at our clinic in 2019 was 103 (34 females, 69 males). In 2020, during the pandemic, this number decreased to 69 (24 females, 45 males). Although dental trauma was more common in males in both years, there was no statistically significant difference between the sexes (p=0.810, Table 1). The incidence of dental trauma among the patients who visited our clinic was 0.35% (84 out of 24,347 patients) in 2019 and 0.83% (69 out of 8,349 patients) in 2020. In this retrospective study, the mean age of children was 7.8±4.2 in 2019 and 7.4±4.3 in 2020. Dental traumas in 2019 involved 175 teeth, while in 2020, 132 teeth were exposed to trauma.

Table 1. Distribution of traumatic dental injuries between the pre-pandemic and pandemic periods in terms of the sex, dentition and jaw.

		2019	2020	p
Sex	Male	69	45	0.810
	Female	34	24	
Dentition	Primary	59	38	0.400
	Permanent	113	90	
Jaw	Maxilla	147	101	0.140
	Mandible	25	27	

The distribution of trauma cases by trauma types is presented in Figure 1. The most common types of dental hard tissue and pulp injuries in both 2019 and 2020 were enamel-dentin fracture (25% for 2019; 22% for 2020) and complex crown fractures (11% for 2019; 16% for 2020). Among periodontal tissue injuries, the most common injury was lateral luxation injuries (19% for 2019; 23% for 2020), followed by avulsion (8% for both years).

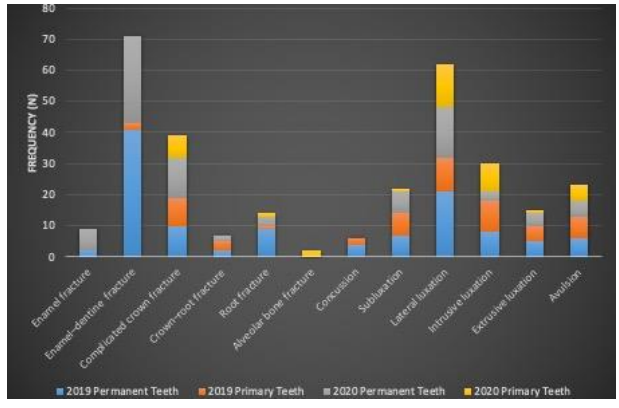

Figure 1. Distribution of trauma cases before and during the pandemic by trauma types.

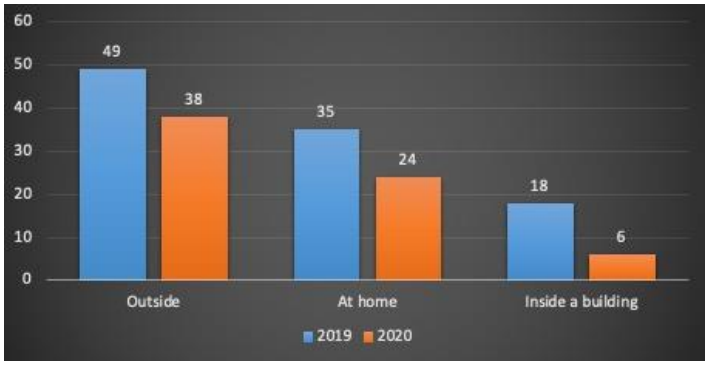

Figure 2. Distribution of trauma cases that occurred before and during the pandemic according to the location where they were observed

When the distribution of trauma cases according to the location of trauma (at home, outside, or inside) was examined (Figure 2), it was observed that 48% of traumas occurred outside in 2019, and this increased to 55% in 2020. There was no statistically significant difference between the years according to the location of the trauma cases (p=0.253).

While 34% of trauma cases in 2019 were observed in primary dentition and 66% in permanent dentition, these values shifted to 30% and 70%, respectively, in 2020. There was no statistically significant difference between the pre-pandemic and pandemic periods in terms of the dentition types in which trauma cases were observed (p=0.400, Table 1).

Upper central incisors were determined to be the most affected tooth by trauma in both primary and permanent dentition. While the highest number of traumatized teeth per person was 4 in 2019, it was determined to be 6 teeth in 2020. In addition, the mean number of traumatized teeth was 1.7±0.8 and 1.9±1.2 in 2019 and 2020, respectively. The incidence of dental trauma in patients who applied to our clinic was 0.72 teeth/100 children/year in 2019, and 1.58 teeth/100 children/year in 2020.

Upon examining the distribution of trauma cases according to the jaws in both years, it was observed that traumas were more frequent in the maxilla (85.5% in 2019, 78.9% in 2020), but no statistically significant difference was found between the two years (p=0.140, Table 1).

DISCUSSION

The COVID-19 pandemic has led to guidelines recommending postponement of non-essential dental treatments and prioritizing treatment for patients experiencing pain, swelling, bleeding, and trauma.[15] Pandemic-related restrictions, such as lockdowns, social distancing, and closure of schools and businesses has affected not only the incidence of dental caries but also traumatic dental injuries.[13] In this retrospective study, we aimed to evaluate the impact of pandemic-related restrictions on the number, causes, and types of traumatic dental injuries in pediatric patients.

It has been reported in the literature that there was a decrease in the number of patients presenting with trauma complaints during the Covid-19 period.[16-18] Although the number of patients admitted to our clinic due to traumatic dental injuries in 2020 compared to the previous year has decreased significantly, the incidence of trauma has increased. Similar to the study by Hahn et al.,[19] the increase in the incidence of trauma in patients who applied to our clinic in 2020 is due to the decrease in the number of patients who applied. This decrease may be attributed to pandemic-related restrictions, such as reduced outdoor activities, school closures, and decreased social interactions. However, curfews for those under 18 in Turkey did not seem to significantly affect the number of patients seeking treatment for dental trauma at our clinic.[13]

Although boys are generally more prone to dental trauma than girls, some researchers have reported that girls are at least as likely to be at risk as boys.[20] However, it is important to note that the majority of traumatic dental injuries in our study occurred in male patients, which is also consistent with previous studies.[21,22] The reason for this may be that boys engage in more risky and aggressive behaviors, such as participating in aggressive sports and displaying violent behavior.[23]

In many studies in the literature, it has been stated that the most common type of injury is uncomplicated crown fractures in permanent teeth and periodontal injuries in primary dentition.[24] In studies conducted during the Covid-19 period, it was stated that the most common type of trauma was crown fracture.[25,26] Similarly, in our study, the most common types of trauma in both years were enamel-dentin fractures in permanent teeth and lateral luxation injuries in primary teeth. The higher incidence of these types of injuries may be due to their association with falls and accidents that cause direct trauma to the teeth.

Dental injuries are typically observed on the anterior teeth, with a higher incidence in the upper incisors.[27] Similar to Covid-19 period literature, our findings show that the upper central incisors are the most commonly affected teeth by trauma in both dentition.[28,29] This can be attributed to their location in the front part of the jaw, which is less protected by the upper lip, as well as the lack of mobility in the upper jaw compared to the lower jaw. Furthermore, the prominent position of the upper central incisors in the arch and their susceptibility to direct trauma contribute to the high incidence of injuries [30].

It has been noted that traumatic dental injuries often occur in school, home, and outdoor environments [31]. In this study, it was observed that 48% of the traumas occurred in the external environment in 2019. Despite the curfew restrictions due to the pandemic, our findings imply that a majority of dental traumas in 2020 still occurred in external environments.

Finally, our study found no statistically significant difference in the distribution of traumatic dental injuries between the pre-pandemic and pandemic periods in terms of the sex, dentition, jaw, and location of the trauma. Therefore, the null hypothesis was accepted. This suggests that pandemic-related restrictions did not have a significant impact on the distribution of traumatic dental injuries in our patient population.

Our study has some limitations, including its retrospective nature and the reliance on dental records for data collection. In addition, we only included patients who presented to our clinic and may not have captured cases that were managed elsewhere or not reported at all. Future studies could use a prospective design and include a larger sample size from multiple clinics to provide a more comprehensive understanding of the impact of the pandemic on traumatic dental injuries.

CONCLUSION

While the COVID-19 outbreak led to a reduction in dental trauma cases, it is noteworthy that dental traumas occurred more frequently in outdoor environments despite restrictions on children going out due to the pandemic. Since no significant reduction in the frequency of dental traumas was observed during the COVID-19 outbreak in children, it is important to inform parents and children about avoiding certain risky behaviors and protection methods

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Etik Komite Onayı: Etik kurul onayı Atatürk Üniversitesi Tıp Fakültesi Araştırma Etik Kurulu'ndan (Tarih: 29.12.2022, Sayı: 2022/22) alınmıştır.
Hasta Onamı: Yazılı onam bu çalışmaya katılan tüm katılımcılardan alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir P.Ç., N.Ö.S., F.Ş., S.Ş.D., ; Tasarım –F.Ş., P.Ç. ; Denetleme –F.Ş., N.Ö.S.; Kaynaklar – P.Ç., N.Ö.S., F.Ş., S.Ş.D; Malzemeler –F.Ş., S.Ş.D.; Veri Toplanması ve/veya İşlemesi – P.Ç., N.Ö.S., F.Ş., S.Ş.D; Analiz ve/veya Yorum –F.Ş., S.Ş.D., ; Literatür Taraması – P.Ç., N.Ö.S., F.Ş., S.Ş.D.; Makaleyi Yazan – P.Ç., N.Ö.S. ; Eleştirel İnceleme – P.Ç., N.Ö.S., F.Ş., S.Ş.D.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was received from Atatürk University Faculty of Medicine Research Ethics Committee (Date: 29.12.2022, Issue: 2022/22).
Informed Consent: Written informed consent was obtained from all par ticipants who participated in this study
Peer-review: Externally peer-reviewed.
Author Contributions: Concept – P.C., N.O.S., F.S., S.S.D., ; Design – F.S., P.C. ; Supervision –F.S., N.O.S.; Resources – P.C., N.O.S., F.S., S.S.D; Materials –F.S., S.S.D.; Data Collection and/or Processing – P.C., N.O.S., F.S., S.S.D; Analysis and/or Interpretation –F.S., S.S.D., ; Literature Search – P.C., N.O.S., F.S., S.S.D. ; Writing Manuscript – P.C., N.O.S. ; Critical Review – P.C., N.O.S., F.S., S.S.D.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Araştırma Makalesi *Research Article* DOI: 10.54614/CRDS.2022.6236

Investigation of the Reasons Behind Preferring Faculty of Dentistry Atatürk University Among the Enrolled Students

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Atatürk Üniversitesi Diş Hekimliği Fakültesini Kazanan Öğrencilerin Meslek ve Fakülte Tercih Nedenlerinin İncelenmesi

ABSTRACT

Objective: To evaluate the reasons behind choosing Atatürk University Faculty of Dentistry among the enrolled students in the academic terms of 2019-2020 and 2020-2021.

Methods: The study was conducted by survey data collection method. The surveys were applied to a total of 202 students whom are enrolled in the faculty of dentistry for 2019-2020 academic year and a total of 168 students for 2020-2021 academic year. Descriptive, frequency analysis, and cross tables were used in statistical analysis of the data obtained.

Results: As a result of the analysis, it was found that the preference order of Atatürk University Faculty of Dentistry was 8.6 ± 5.5 for the students of the 2019-2020 academic term and 9.7 ± 6.1 for the students of the 2020-2021 academic term.

Conclusion: As a result of the answers to the questionnaire questions, it was found that the students whom are enrolled in our faculty in both terms preferred the dentistry profession and our faculty with prior knowledge, and that the pandemic period did not have a significant effect on their preferences such as profession, city, university.

Keywords: Choice of profession, Covid-19, Dentistry, Education

ÖZ

Amaç: Bu çalışmada, Atatürk Üniversitesi Diş Hekimliği Fakültesi'ni 2019-2020 ve 2020-2021 akademik dönemlerinde kazanan öğrencilerin meslek ve fakülte tercih nedenlerinin değerlendirilmesi amaçlandı.

Yöntemler: Çalışma anket ile veri toplama yöntemi ile gerçekleştirildi. Anketler 2019-2020 akademik döneminde diş hekimliği fakültesini kazanan toplam 202 öğrenciye, 2020-2021 akademik döneminde ise toplam 168 öğrenciye uygulandı. Elde edilen verilerin istatistiksel analizinde deskriptif, frekans analizi ve çapraz tablolardan yararlanıldı.

Bulgular: Yapılan analizler sonucunda Atatürk Üniversitesi Diş Hekimliği Fakültesi'nin tercih sıralamasının 2019-2020 akademik dönem öğrencileri için 8.6±5.5, 2020-2021 akademik dönem öğrencileri için ise 9.7 ±6.1 olduğu görüldü.

Sonuç: Anket sorularına verilen cevaplar neticesinde her iki dönemde de fakültemizi kazanan öğrencilerin diş hekimliği mesleğini ve fakültemizi önceden bilgi sahibi olarak tercih ettikleri; pandemi döneminin meslek, şehir, üniversite gibi tercihler üzerinde önemli bir etkisinin olmadığı sonucuna varıldı.

Anahtar Kelimeler: Covid-19, Diş hekimliği, Meslek seçimi, Öğrenci

Geliş Tarihi/Received 16.11.2021
Kabul Tarihi/Accepted 24.05.2022
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Özdoğan A, Sari O, Aslan D. Investigation of the Reasons Behind Preferring Faculty of Dentistry Atatürk University Among the Enrolled Students. *Current Research in Dental Sciences*. 2024;34(2):133-137

INTRODUCTION

Human life is a complex cycle dominated by many periods and turning points. In these periods, the transition from secondary education to higher education is one of the most crucial steps. As during this period, the individual is involved in a different education phase toward his lifetime profession. One's occupation is very critical for everyone as it is affecting his social life greatly and helping him to gain his identity and prove his existence.[1] Therefore, choosing the right profession is one of the key points of a person's life. Also, it is very important as it helps to a great extent in society survive. That's why; developed countries restructure their education systems to be in line with today's needs, and maximizing the number of qualified people and their efficiency. Their plans were guided by primary school students' interests and abilities.[2] Insufficient profession knowledge and unmatched abilities may hinder one's to be successful in his future career. Many factors may contribute in career choice including; working conditions, financial rewards, security and status, the nature of the profession, the ability to work with people, the use of personal or manual skills, and the interest in science and research.[3,4] In addition, our family, friends, role models and our environment, also have an impact. Dentists are playing such an important role in society as professional health workers.[5] Dental education has a very challenging, complex, stressful, and long-lasting university education process.[6] Due to the nature of the profession, dental education is considered to be very stressful because of the need for human communication, clinical practice and theoretical knowledge.[7-9] In addition, since this education process is a period in which theoretical and practical education continues together for 5 years, so accurate choice for the profession is very critical. It is an undeniable fact that the students who choose their profession will be highly motivated which will affect the education process positively. The aim of this survey study was to comparatively investigate the reasons for choosing the faculty of dentistry among the enrolled students in different academic terms, the factors that were effective in choosing the profession, and the knowledge about the dentistry profession. The hypothesis of the study was that the Covid-19 pandemic would negatively affect the career, city and university preferences of the students who were enrolled in the 2020-2021 academic term.

METHODS

This study was carried out with participation of a total of 370 students who were enrolled in Faculty of Dentistry Atatürk University in the academic terms of 2019-2020 and 2020-2021 and started their education life. 202 students from the 2019-2020 academic year (A) and 168 students from the 2020-2021 academic year (B) participated in the study. Repetitive and mid-term students were excluded from this study.

The study was carried out in 2 stages and with data collection method by questionnaire. In the 2019-2020 academic year, the questionnaires were administered by 2 researchers at the same time, dividing the students into 2 groups. The questionnaire consisted of 44 questions in total. The first 5 questions of the questionnaire consisted of questions about demographic information and the order of preference of the faculty of dentistry. The following 37 question section consisted of questions to determine the effective factors in the selection of the dentistry profession, prepared according to the Likert scale, and the last 2 questions were questions containing thoughts about the future. In the 2020-2021 academic year, the surveys were administered to students online through a single platform. In the survey applied in this period, in addition to the survey questions of the previous period, a section of 10 questions for the Covid-19 pandemic was added.

Statistical Analysis

SPSS 20 program (IBM SPSS Corp., Armonk, NY, USA) was used to evaluate the obtained data. Descriptive, frequency analysis, and cross tables were used to evaluate the data.

RESULTS

As a result of the statistical analysis, it was observed that the mean age of the population participating in the study was 19.16 ±1.59 years, and the distribution by gender was 59.5% female and 40.5% male. It was noticed that the preference order of Atatürk University Faculty of Dentistry was 8.6 ±5.5 for the group (A) and 9.7 ±6.1 for the group (B). In group (A) 54% of the student choose medical faculty as the first choice, while 39.6% of the student preferred dentistry faculty. While in group (B), 68.5% chose faculty of medicine and 28.6% chose faculty of dentistry. The second choice for the students if they wouldn't get accepted in the faculty of dentistry for group (A) were as the following; 30.2% pharmacy, 25.2% engineering, 19.8% medicine faculties. While for group (B) were as the following; 31.5% pharmacy, 23.2% medicine and 17.9% engineering. At the end of the questionnaire, there were 2 questions about the future expectations and the most challenging point in this profession. 39.6% from group (A) reported that it was the difficult education process, while 35.1% of group (B) students answered with job opportunities. To the question of what will make you happiest, both group (A) (37.1%) and group (B) (46.4%) students gave the answer to be beneficial to human health. The highest percentage of answers given by group (A) and group (B) students to the questions prepared according to the Likert scale of the questionnaire are shown in Table 1 comparatively, and the answers given to the questions examining the effect of the Covid-19 pandemic on the preferences of group (B) students are shown in Table 2.

DISCUSSION

Within the scope of the study, it was aimed to comparatively investigate the factors affecting the choice of profession and the reasons for choosing the faculty for the students who were enrolled in Faculty of Dentistry Atatürk University in different academic terms. According to the results of the study, it was observed that Covid-19 pandemic did not adversely affect students' career, city and university preference so the suggested hypothesis was initially rejected.

The family factor is one of the most important determinants of students' choice of city, department and university, especially due to their socio-economic status.[10] The socioeconomic and cultural level of the family is considered to be an important factor affecting the choice of the profession. Young family members with high economic and cultural level are supported in line with their abilities and interests, while those in families with unfavorable economic and cultural opportunities are directed to fashionable professions that will bring great profit or reputation in a short time.[11] In cases where family pressure is dominant and where the tradition of passing the profession from father to son is maintained, it is seen that there is pressure putted on the young member to continue his father's profession. It has been observed that the young member who has been always directed to a certain profession is going either to his father's profession or is trying to have his ideal profession by opposing his family. In the research, it has been shown that the socioeconomic level of the family and the educational status of the parents are effective in the choice of profession. On the other hand, Filter[12] concluded in his/her study on academically talented students that the family standard is not affecting their faculty choice. In the studies conducted to investigate the effectiveness of family guidance when choosing a profession, Köşker and Kaya[13] found that 58.4% of them were affected by family guidance; while this rate was 54.3% in

Table 1. Distribution of the highest percentage of responses to survey questions

		2019-2020 (A) Term		2020-2021 (B) Term	
No	**Question**	**Rate (%)**	**Answer**	**Rate (%)**	**Answer**
1	My family's guidance affected my choice for dentistry.	33.2	I agree	28.6	I'm undecided
2	The guidance of my close friends affected my choice for dentistry.	37.1	I do not agree	42.9	I strongly disagree
3	My family members influenced my profession choice.	33.7	I strongly disagree	23.2	I'm undecided
4	I think dentistry will meet my future expectations.	37.6	I agree	42.9	I agree
5	When choosing dentistry, I thought about future job opportunities.	42.6	I agree	45.2	Absolutely I agree
6	Financial income influenced my choice for dentistry.	40.1	I agree	32.7	I agree
7	I knew that manual dexterity have an important role in dental education.	55	I strongly disagree	66.1	Absolutely I agree
8	I considered my abilities while choosing dentistry.	29.7	I agree	29.8	Absolutely I agree
9	I think dentistry is a prestigious profession.	50	Absolutely I agree	54.2	Absolutely I agree
10	I think that dentistry is having its deserved value in society.	34.2	I'm undecided	35.1	I'm undecided
11	My score in the university exam affected my choice.	38.1	Absolutely I agree	58.9	Absolutely I agree
12	The university I will enroll in affected my choice.	27.2	I agree	48.2	Absolutely I agree
13	I searched a lot before choosing my future profession.	32.7	I agree	32.7	I'm undecided
14	The city factor played a role in my preference.	28.7	I strongly disagree	23.8	Absolutely I agree
15	My interest in the healthcare sector affected my choices.	37.6	Absolutely I agree	60.7	Absolutely I agree
16	I evaluated the working environment and conditions of the dentist.	48.5	I agree	35.1	I agree
17	I find that dentistry profession is sufficient for my future career goals.	37.6	I agree	33.9	I agree
18	My interest from the past was effective in my choice of dentistry.	22.8	I do not agree	26.8	I'm undecided
19	My past dental treatments affected my choice for dentistry.	43.1	I strongly disagree	58.3	I strongly disagree
20	The fact that the field of work is related to human health itself affected my choice.	29.7	I agree	39.3	Absolutely I agree
21	The moral value of the profession affected my choice.	35.6	I agree	26.8	Absolutely I agree
22	I think that my personality traits are compatible with the requirements of the profession.	35.6	I agree	36.9	I agree
23	I think that dentistry will satisfy me professionally.	39.1	I agree	36.3	I agree
24	The popularity of dentistry affected my choice.	37.6	I agree	39.3	I agree
25	I think that my success in my education life affected my choice.	47.5	I agree	43.5	I agree
26	I think that I am aware of the responsibilities required by dentistry profession.	54.5	I agree	50	I agree
27	I was aware that dental education is more costly than others in terms of finance.	50.5	I strongly disagree	70.8	Absolutely I agree
28	The technological tools used in dentistry had a positive effect on my choice for dentistry.	31.2	I agree	36.9	I'm undecided
29	I think that hours set for theoretical courses are sufficient.	35.6	I agree	35.1	I'm undecided
30	I think that hours set for practical courses hours are sufficient.	40.1	I agree	33.9	I'm undecided
31	I think practical courses in dentistry are beneficial.	42.6	Absolutely I agree	59.5	Absolutely I agree
32	I think dental learning is stressful.	37.1	Absolutely I agree	62.5	Absolutely I agree
33	I think dental education is stressful.	50.1	Absolutely I agree	40.5	Absolutely I agree
34	I think that dentistry education period is sufficient.	41.1	I agree	55.4	Absolutely I agree
35	I would like to have specialization or doctoral education after my undergraduate education.	60.4	Absolutely I agree	61.3	Absolutely I agree
36	I am happy that I chose dentistry.	34.2	Absolutely I agree	41.1	Absolutely I agree
37	If I had the opportunity to choose again, I would choose the faculty of dentistry again.	34.7	Absolutely I agree	41.1	Absolutely I agree

Table 2. Distribution of the answers given by the highest rate of 2020-2021 (B) term students to the questions about the impact of the Covid-19 pandemic on career choice and university preferences

No	**Question**	**Rate (%)**	**Answer**
1	The pandemic process has been effective in my career choice.	48.8	I strongly disagree
2	My perspective on dentistry has changed during the pandemic process, and this has had an impact on my choices.	57.1	I strongly disagree
3	During the pandemic period, the dedication of health workers and the responsibilities they took were instrumental in my choice of profession.	27.4	I strongly disagree
4	During the pandemic period, seeing how important the health is and the sanctity of helping people has been effective in choosing the health field.	26.2	Absolutely I agree
5	From the assignments given to dentists during the pandemic process (filiation, etc.) I was aware, and this was effective in my choice.	36.3	I strongly disagree
6	I was aware of the precautions dentists took in the working environment during the pandemic process, and this had an impact on my choices.	28	I strongly disagree
7	During the pandemic process, the case rates in the cities were effective in my choices.	66.7	I strongly disagree
8	The pandemic process will negatively affect education life.	72.6	I strongly disagree
9	I think that online education for dentistry will be effective and sufficient for theoretical lessons during the pandemic.	28	I am undecided
10	I think that online education for dentistry will be effective and sufficient for practical lessons during the pandemic.	66.1	I strongly disagree

Aydemir's[14] study. According to the results of the current study, 51% of group (A) and 26.8% in group (B) answered that family guidance was affecting their choice. Based on these results, it can be concluded that the socioeconomic level, educational status and current living conditions of the family is affecting the students in this process. Another factor that might affect the profession choice is the surrounding environment. In the current study, 55.5% of group (A) students and 74% of group (B) students were against the fact that the surrounding environment affected their choice for the faculty of dentistry. In contradiction with Köşker and Kaya,[13] the results of this study showed that the effect of close/familiar dentists on the profession choice is relatively less. The difference between the results of the 2 studies was related to the difference in the region of residence or the seasonal differences in which the study was conducted.

The fact that there are many job opportunities for professions in the field of health sciences and the value shown by the society to that profession have had a great impact on career choices. According to the studies, it has been shown that guarantying vacancy in these professions affects the students' choice.[15] According to the results of the survey study, the fact that dentistry profession is economically very advantageous, availability of job opportunities, being a future-oriented profession and following the technology were effective in choosing this profession. 68.8% of group (A) students answered that the profession is with good economic return that was in line with the result of the previous study; on the other hand, only 19 % of group (B) reported that. The fact that 46.4% of group (B) students which was the highest rate of answer given to the same question about "benefiting human health" suggests that the devoted work of health workers during the pandemic period was appreciated by the society, and this affect the students' choice toward the health sector. Also, the prestige of dentistry was

questioned and most of the participants (group A: 81.7%, group B: 84.2%) gave a positive answer, this result was in accordance with Z. B Al-Bitar et al.[16] It showed parallelism with his work on Jordan University students.[16] The high rate of positive response reveals the effectiveness of prestige and future career goals in choosing dentistry. Considering all these answers, it was thought that dentistry profession still maintains its popularity in the society and is among the most preferred occupations. It was found that reasons such as the interest in the health sector (group A: 69.3%, group B: 79.7%) and the fact that the field of study was human health (group A: 54%, group B: 60.1%) were among the reasons that affects the students' choice. Also, the fact that the healthcare field was preferred by the students with high scores in the university exams was in parallel with the results that showed that healthcare profession was on the top of their preference lists. But, it was thought that although group (B) students' answers weren't highly positive, the importance of healthcare profession increased highly during the pandemic period and great responsibilities taken by healthcare professionals to set an example for new generations.

Evaluation of the answers given by the participants showed that; I learned about the profession before the choice (group A: 56%, group B: 53.6%), I took my abilities into consideration while choosing (group A: 54%, group B: 56%), I evaluated the working environment and conditions (group A: 70.8%, group B: 68.4%), my past interest was affecting my choice (group A: 35.7%, group B: 32.8%), I am aware of the responsibilities required by the profession (group A: 76.8%, group B: 76.8%), I am aware that dental education is more costly than others (group A: 83.7%, group B: 94.6%). Highly positive answers were given to the questions that was about whether the students have obtained the necessary information about dentistry profession before choosing it and if they made a conscious choice or not. In addition, the fact that group (A) and group (B) answers were very close is supporting the idea.

Although the students responded positively to the question "I would choose the faculty of dentistry if I had the opportunity to choose again," (group A: 54.5%, group B: 70%) it was thought that the difference between them may be due to the differences between face-to-face and long-distance education, especially when considering that the rate of answers to the question that was evaluating the stress of the education term was (group A: 79.3%, group B: 73.2%). In this survey study, when the participants were asked about the necessity of doctoral and post-graduate studies the showed results were; positive for (group A: 77.7%, group B: 84.5%) and strongly agree for (group A: 60.4%, group B: 84.5%), which is similar to the study implemented by Küçükeşmen and Kırzıoğlu.[17] So, that was an evidence that the interest in postgraduate education in our country is increasing day by day, and that also showed that the number of qualified personnel will increase.

The opinions of the students about their current educational status were also included in the study. In which the results were found as the following: 78.7% of group (A) and 83.4% of group (B) answered that the current education term was sufficient, 57.9% of group (A) and 56.7% of group (B) responded that the theoretical lessons hours was enough, 63.9% of group (A), and 54.2% of group (B) reported that the practical hours were enough, 75.3% of group (A) and 74.5% of group (B) said that the practical courses were useful and 73.7% of group (A), and 85.1% of group (B) answered that they found that basic medical course should be taken. This showed that the students were satisfied with the current education plan. These results are compatible with a similar study[17] that showed that the education given in both our faculty and other faculties in our country is in accordance with the standards.

The SARS-COV2 epidemic, which started in Wuhan city of Hubei province of the People's Republic of China on December 31, 2019, affected the whole world. The epidemic reaching the level of pandemic (COVID-19) has greatly affected each country policy in managing the epidemic. Due to the high level of contagiousness, most countries have taken tough decisions to fight the epidemic, and as a result, disruptions have occurred in many sectors such as education, health and industry. Due to the rapid spread of the epidemic and its aggressive nature, it has been decided to continue the current training online making restrictions on all levels of education all over the world. The effectiveness of online distance education in professions where practical education is also intense, such as dentistry, and how successful it is a controversial issue. A survey study was conducted to examine the opinions of students in higher education institutions about online education during the 2020 pandemic process. In this study, the efficiency of practical and theoretical courses with the online education method during the pandemic process was questioned, 12.5 % of the students were productive for practical lessons, 87.5% were inefficient and for theoretical courses, 21.5% answered that it was efficient while 78.5% reported that it was unproductive. After the pandemic phase ended, the students were asked about which education system they would prefer, 90.3% of them wanted face-to-face education and 9.7% preferred to continue online education.[18] Students' anxiety about the quality of education they perceive should be evaluated. The pandemic phase affected the career choice of 31 students (18.4%) and 84 students (50%) preferred the healthcare sector because of recognizing the importance of health and the sanctity of helping people. Another important issue regarding the pandemic is that the pandemic is not affecting every city. Since the attendance periods of the students were also during the epidemic, the students could consider the rate of cases in cities in their city selection. In the survey study, only 10 students (6%) stated that the case rates in cities affected their choices. Since this number was quite low, it was concluded that the pandemic period did not affect the students negatively.

One of the limitations of this study was that the survey was conducted face-to-face for part of the participants and online for the other. This may have been reflected on the results of the survey, as group (B) students filled out this survey while having distance education and could not see the city, university, and faculty-based variables.

CONCLUSION

Students consider many factors when choosing a profession. The widespread use of technology for getting information about any profession allows the students to have preliminary information about the profession and make their right choice. The data obtained in the study revealed that the students who preferred our faculty in 2 different academic education terms chose it voluntarily and knowingly about dentistry profession and about our faculty. This conclusion made us recognize that the students will be more motivated and will have a more successful education life.

Etik Komite Onayı: Etik kurul onayı Atatürk Üniversitesi Yerel Etik Kurulu'ndan (Tarih: 07.07.2020, Sayı: 2020/24) alınmıştır.
Hasta Onamı: Yazılı hasta onamı bu çalışmaya katılan tüm öğrencilerden alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – A.O., O.S., D.A.; Tasarım – A.Ö., Ö.Ş., D.A.; Denetleme – A.Ö.; Kaynaklar – O.S., D.A.; Malzemeler – O.S.;Veri Toplama ve/veya İşleme – O.S., D.A.; Analiz ve/veya Yorum – A.Ö.; Literatür Taraması – D.A.; Makaleyi Yazan – A.O., O.S., D.A.; Eleştirel İnceleme – A.O.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Ethics Committee Approval: Ethics committee approval was obtained from Atatürk University Local Ethics Committee (Date: 07.07.2020, Number: 2020/24)
Informed Consent: Written informed consent was obtained from all students who participated in this study.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept – A.O., O.S., D.A.; Design – A.O., O.S., D.A.; Supervision – A.O.; Resources – O.S., D.A.; Materials – O.S.;Data Collection and/or Processing – O.S., D.A.; Analysis and/or Interpretation – A.O.; Literature Search – D.A.; Writing Manuscript – A.O., O.S., D.A.; Critical Review – A.O.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Derleme *Review* DOI: 10.17567/ataunidfd.993688

Covid-19 Pandemi ve Geriatrik Hastaların Protetik Açıdan Değerlendirilmesi

Covid-19 Pandemia and Prosthetic Consideraton of Geriatric Patients

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ÖZ

Yaşlanma vücudun hücre, doku ve organlarının etkilendiği bir süreçtir. Tüm bu değişimler yaşlı bireyler için hastalıklardan olumsuz etkilenme riskini de artırmaktadır. Vücut savunmasını sağlayan immun sistemin de yaşlanmasıyla, enfeksiyon, kanser gibi olumsuzluklar artar. Enfeksiyonlar birinci sıradaki ölüm nedeni olarak bilinmektedir.

COVID-19 sebebiyle kaybedilen insanların büyük bir kısmını yaşlılar oluşturmaktadır. Bu durum, yaşlı bireyleri, Covid-19 tedbirleri ile korunmaya çalışırken, yalnızlık duygusu, çaresizlik, korku ve kaygılarının artmasına da neden olmuştur.

Dünyada aksi veya benzer hassasiyeti içermeyen yönde uygulamalara rağmen, Türkiye de yaşlılara ve dezavantajlı gruplara tanınan öncelik ve koruma tüm yönleriyle değerlendirilmelidir. Yaşlı bireylerin pandemi önlemleri neticesinde izolasyon hareketsizliği ve çoğunluğunu oluşturdukları protetik ağız ve diş sağlığı sorunlarının ötelenme durumunun ivedi sonlandırma çözümleri bulunmalıdır.

Tüm dünyayı sadece sağlık alanında değil, sosyal ve ekonomik olarak da sarsan Covid-19 ile ilgili bilinen her şey zamanla değişebilir. Bu etkiler ve sonuçları ancak pandemi bitince, yeterli sayıda çalışma yapıldıkça, tam olarak anlaşılabilecektir.

Anahtar Kelimeler: Covid-19, Geriatrik Bireyler

ABSTRACT

Aging is the cell process by which tissues and organs are affected. All these changes increase the risk of being negatively affected by diseases for elderly people. With the aging of the immune system that provides the body's defense, negativities such as infection and cancer increase. Infections are known as the leading cause of death.

Despite similar sensitivities or otherwise free applications in the direction of the world, Turkey also recognized the priority and protection to the elderly and disadvantaged groups should be considered in all aspects. As a result of pandemic precautions of elderly individuals, urgent solutions should be found for the immobility of isolation and the postponement of prosthetic oral and dental health problems, of which they constitute the majority.

Everything known about Covid-19, which shook the whole world not only in the field of health, but also socially and economically, may change over time. These effects and consequences will only be fully understood when the pandemic is over and a sufficient number of studies are done.

Keywords: Covid-19, Geriatric İndividuals

Geliş Tarihi/Received 02.02.2021
Kabul Tarihi/Accepted 10.09.2021
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Fındık Aydıner S, Bayındır F. Covid-19 Pandemia and Prosthetic Consideraton of Geriatric Patients. *Current Research in Dental Sciences*. 2024;34(2):138-143

GİRİŞ

Yaşlanma, işlevselliğin, biyolojik olarak verimliliğin azaldığı, immün sistemde gerilemenin görüldüğü evrensel bir süreçtir.[1, 2] Kronolojik yaşlılık, toplumların tıbbi ve sosyal alanda gelişmişlikleriyle değişebilmektedir.[1] Türkiye'de 65 yaş üzeri bireyler yaşlı nüfus olarak kabul edilir.[3] Hindistan'da[4] ve Çin'de[5] 60 yaş ve üzeri, İngiltere'de[6], Amerika Birleşik Devletleri'nde[7], Almanya'da[8], 65 yaş ve üzeri bireyler yaşlı nüfusu oluşturur. Ancak sadece kronolojik yaşın yaşlı tanımında kullanılmasının doğru olmadığı da savunulmaktadır.[8] Her bireyin psikolojik, biyolojik, genetik faktörleri, sosyo-kültürel durumlarının kronolojik yaş ile birlikte değerlendirilmesi gerektiği rapor edilmiştir.[1] Dünya Sağlık Örgütü (DSÖ), yaşam süresinin uzamasına bağlı olarak yaşlılık kavramının değişebileceğini belirtmiştir. Daha önceleri 60 yaş ve

üzerini yaşlı olarak tanımlayan DSÖ, günümüzde 65 yaş ve üzeri bireylerin yaşlı olduklarını rapor etmiştir.[2] Teknolojinin insan yararına sunduğu birçok olumlu durum, sağlık alanındaki uygulamalar, bulaşıcı hastalıkların kontrol altına alınması, yaşlı nüfusun artması ile sonuçlanmaktadır.[9] 2019 yılında, dünyada, 700 milyon yaşlı nüfus olduğu tespit edilmiştir ve bu rakam, dünya nüfusunun % 9,3'ünü oluşturmaktadır.[9] Ülkemizde, 2019 yılında, Türkiye İstatistik Kurumu (TÜİK) 7 milyon 550 bin yaşlı nüfus olduğunu bildirmiştir.[3] Ölümlerin, gelişmiş ülkelerde % 86, ülkemizde % 78.7, oranında müzmin hastalıklardan kaynaklandığı bildirilmiştir.[9, 10] Covid-19 pandemisinin bu istatistiki verilere etki edeceği güçlü bir varsayım olup, özellikle araştırılması gereken bir gelişme olacaktır.[9]

Covid-19, beta-koronavirüs ailesinin alt grubu olan SARS-CoV-2'den kaynaklanmaktadır. Bu virüsler, zarflı, pozitif tek sarmallı büyük RNA virüslerdir. Çin'in Wuhan şehrinde, 2019 yılı Aralık ayında görülen ve deniz ürünleri pazarında hayvandan insana geçtiği düşünülen virüsün, insandan insana hızla bulaştığı rapor edilmiştir.[11, 12] Bu bulaş damlacıklar ya da doğrudan temas yoluyla olabilmektedir.[13-15] Fekal-oral yolla bulaş olduğu da rapor edilmiştir.[16]

Diş hekimliğinde kullanılan ultrasonik temizleyiciler, döner aletler, yüksek basınç ile su püskürten aeratörlerin oluşturduğu aerosoller (çapı 50 µm'den küçük parçacıklar) ciddi enfeksiyon tehdidi oluşturmaktadır.[17-21] Bu parçacıkların uzun süre havada kalabilmeleri sebebiyle diş kliniklerinde, enfeksiyon riski çoktur.[17, 20, 21] Bulaş riskinin en aza indirgenmesi adına salgın süresince katı protokoller uygulandı. Klinikler bu protokollere uygun hale getirildi.[17, 22]

Covid-19, asemptomatik olarak geçirilebilirse de[23]pnömoni ile ağır seyredebilen ve yoğun bakım ihtiyacı duyulabilen vakalar da az değildir.[24] Çocuklar dahil[25, 26] her yaş grubunu etkilediği bilinmektedir. Ancak en ciddi komplikasyonların bağışıklığı baskılanmış, kardiyo-vasküler hastalıkları, endokrin ve solunum rahatsızlıkları olan yetişkinlerde görüldüğü rapor edilmiştir.[27]

Birçok hastanın asemptomatik olarak hastalığı atlatması[24] virüsün yayılmasını önlemeye yönelik çabaları zorlaştırmaktadır. Ateş, halsizlik, nefes darlığı, baş ağrısı, kas ve kemik ağrıları hastaların hastaneye başvurma nedenleridir. Ayrıca ishal, mide bulantısı, göğüs ağrısı da görülmektedir. Vakaların %10' u için mekanik ventilasyon ve yoğun bakım ünitesi' ne yatış gerekebileceği rapor edilmiştir.[24] Pnömoni durumunda oksijen saturasyonunda azalma görülmektedir. Kötüleşen hastalarda akut solunum yetmezliği, akut böbrek hasarı, çoklu organ yetmezliği gibi ağır durumlar gelişmektedir.[24, 28, 29] Bu ağır durumlardan sorumlu tutulan sözde "sitokin fırtınası" proinflamatuar sitokinlerin aşırı üretilmesidir ve sitokinlerin hedef olduğu tedavi ile mortalitenin azaltılabileceği savunulmaktadır.[30]

Çok hızlı yayılan ve küresel bir tehdit olan Covid-19 bir yılı aşkın süredir insanların yaşam biçimlerine de müdahale etmiş bir virüstür.[30] Dünya Sağlık Örgütü (DSÖ) tarafından da 12 Mart 2020'de pandemi olarak isimlendirilmiş[31]ve bütün ülkelerin gündeminde ilk sırayı almıştır. Ne yazık ki bu virüs ile mücadele, sağlık çalışanlarının tek başına üstesinden gelebileceği bir durum değildir. Tüm insanlık hastalığa yakalanmamak için tedbirli davranmalıdır. 26 Mayıs 2020 tarihine kadar dünya çapında 5.404.512 kişide COVID-19 tespit edilmiş ve ölüm oranı %6.4 ile 343.514'e ulaştığı rapor edilmiştir. Amerika Birleşik Devletleri'nde 1.618.757 vaka ile doğrulanmış en yüksek sayı bildirilmiştir.[30, 32]

İngiltere' de yapılan bir araştırmaya göre Covid-19 ile ilişkilendirilmiş ölümlerin; çoğunlukla yaşlı olma, yoksunluk, diyabet, şiddetli astım gibi tıbbi durumlarda meydana geldiği rapor edilmiştir. Ayrıca siyah ve Güney Asya' lıların, beyaz etnik kökene sahip insanlardan daha yüksek risk altında olduğu saptanmıştır.[33]

Yaşlılar Neden Daha Çok Etkilendi?

Yaşlanma vücudun bütün hücre, doku ve organlarının etkilendiği, genetik, biyokimyasal, sosyal, ruhsal değişimler ve yaşam konforundaki azalmayla sonuçlanan bir süreçtir.[9] Tüm bu değişimler çok sayıda kronik hastalığın yaş ilerledikçe daha fazla görülmesine sebeptir. Ek olarak daha sık enfekte olan yaşlı bireyler için[34-36]hastalıklardan olumsuz etkilenme riski de yaşın ilerlemesiyle artmaktadır.[35, 37]Vücut savunmasını sağlayan immun sistemin de yaşlanmasıyla, enfeksiyon, kanser gibi olumsuz durumların artması ve otoimmün bozuklukların ortaya çıkması kaçınılmazdır.[38] 65 yaş üstü kişilerde her 3 kişiden 1' i için birincil ölüm nedeni olarak enfeksiyonlar gösterilmiştir.[39]Ayrıca sekonder risk faktörü olarak da ölüm sebepleri arasında sayılabilir. Bu durum immün sistemin de yaşlanması ve aşı etkinliğinin azalması ile açıklanmaktadır.[9]

Geriatrik bireylerde, atipik prezantasyonlar sebebiyle enfeksiyon ve birçok hastalığın tanısı geç konulmaktadır.[27, 40] Pnömoni teşhisiyle hastanede yatan geriatrik hastaların ilk üç günde vücut sıcaklığının düşük seyretme eğiliminde olduğu rapor edilmiştir.[41] Ayrıca gençlere kıyasla vücut sıcaklıkları da düşüktür.[42] COVID-19 tanısı konulmuş yaşlı bireylerde de gençlerdeki kadar ateş olmadığı rapor edilmiştir.[37]Ancak ateşin olmaması enfeksiyon olmadığını göstermemektedir.[42-44] Bu sebeple, yaşlılarda, timpanik sıcaklığın 37.3°C' den yüksek olduğu durumların, ateş yüksekliği olarak değerlendirilmesinin fayda sağlayacağını vurgulayan yazarlar mevcuttur.[41]

COVID-19' un yaşlı bireylerde konfüzyon, akut mental bozukluklar, hızlı soluma, kan basıncında düşme, yürümede güçlük, yutma zorluğu gibi atipik prezantasyonlarla başlaması tanının geç konulma sebeplerindendir.[40-45]Çin de yapılan bir araştırmada, yoğun bakımda yatan yaşlı bireylerde akut akciğer enfeksiyonu için atipik bulguların dispneden 6,5 gün önce ortaya çıktığı rapor edilmiştir.[41] Yoğun bakım ihtiyacı olmayan, genç bireylerde bu sürenin 2,5 gün olduğu bildirilmiştir.[46] Bu durum, atipik prezantasyonlar sebebiyle yaşlılarda hastalık çok ilerledikten sonra tanı koyulması ve fatal seyretmesine neden olabileceğini düşündürmelidir.[41, 46]

COVID-19 tedavi protokolünde mevcut, hidroksiklorin gibi ilaçların, yan etkileri ve ilaç etkileşim potansiyellerinin, geriatrik hastalarda enfeksiyon seyrini olumsuz etkileyebileceğini bildiren yazarlar da mevcuttur.[41, 47] Geriatrik hastaların bir kısmında karşılaştığımız demans, polifarmasi, duyusal kayıplar gibi durumların da anamnezi güçleştirdiği ve semptomları maskelediği bildirilmiştir.[40, 42]

COVID-19, yaşlıların çoğunluğunda ölümcül seyretmemekle birlikte, yoğun bakım ihtiyacı olanların ve ölen hastaların büyük kısmının geriatrik bireyler olduğu da bilinmektedir.[35, 41]

Fizyolojik bir süreç olan yaşlılık ile birlikte, temporomandibuler eklem, tükrük bezleri, periodontal dokularda değişimler oluşur. Dişi çevreleyen sert ve yumuşak dokularda kayıplar, alveol kret rezorpsiyonları ve diş kayıpları meydana gelir.[48] Azalan çiğneme etkinliğinin ve fonksiyonun geri kazandırılması için yaşlı bireylere protetik tedavi yaklaşımları uygulanmaktadır. Yaşlı bireyler, prostodontistlerin, hasta profilinin büyük kısmını oluşturmaktadır.

2007-2012 yıllarında, Helsinki'de yapılan bir araştırmada protetik diş tedavisi için başvuran bireylerin büyük çoğunluğunun 60 yaş ve üstü olduğu rapor edilmiştir.[49] Kanada Kuzeybatı Toprakları'nın Keewatin bölgesindeki üç toplulukta 60 yaş ve üstü bireylerin% 90'ını temsil ettiği düşünülen bir evrende yapılan bir araştırmada, çoğu kadın olmak üzere, yaşlıların üçte birinden fazlasının tamamen dişsiz olduğu rapor edilmiştir.[50] Türkiye' de 1990 yılında Sağlık Bakanlığı ve Dünya Sağlık Örgütü tarafından yapılan bir çalışmada, 65 yaş ve üzeri bireylerin %61,36 sının alt ve üst total protez kullandıkları rapor edilmiştir.[51, 52]

Pandemi sebebiyle Türkiye'de ve bazı ülkelerde acil ve zorunlu olmayan dental uygulamalar bir süreliğine askıya alındı.[17, 22] Yüksek hızda dönen el aletleri kullanılması yasaklandı.[17] Protetik diş tedavisinde sabit protezin yerinden çıkması ve travmatik ülserler tipik acil durumlardır.[17] Ülkemizde Protetik diş tedavisi açısından acil müdahale olarak; 'kanal tedavisi yapılacak ya da çekilecek ağrıyan dişlerin köprü sökümü, simantasyon ve protez vurukları' olarak belirlenmiş ve özel kliniklerde de bunların harici işlemler bir süreliğine ertelenmiştir.[53] Diş hekimleri ve

personellerinin damlacık ve aerosollere maruz kalma risklerini minimuma indirgemek için çekiş gücü yüksek aspirasyon sistemleri ve 4 elli diş hekimliği teknikleri kullanıldı.[17, 20, 21, 54] Dental kliniklerin bekleme salonlarında yığılma oluşmasını engellemek adına randevülü şekilde hasta kabulü yapıldı.[17, 22] Bu randevülerin bazı ülkelerde[17] sadece online olması sosyal ağlara aşinalığı olmayan yaşlı bireyler için dezavantaj olmuştur.

Türkiye' de ve bazı ülkelerde diş tedavilerinde acil müdahale önceliği ve diğer tedavilerin ertelenebildiği kadar ertelenmesi, protetik tedaviye başlamak için gerekli diğer tedavileri ile diş çekimleri yapılmış olduğu halde protezini yaptıramayan yaşlı bireylerin bir süre daha dişsiz kalmalarına sebep olmuştur. Bu durumun, zaten immün sistemleri zayıf olan yaşlı bireyler açısından olumsuz sonuçlara sebep olabileceğini göz ardı etmemek gerekir. Yeterli beslenmenin yaşlı bireyler için kritik önemi olduğu bilinmektedir. Bunun sağlanabilmesi için de çiğneme sisteminin etkili şekilde fonksiyonda olması gereklidir. Çiğneme etkinliği dişsiz bir ağızda sağlanamaz. Ağız sağlığına dikkat edilmemesi durumunda genel sağlık kötüleşebilir. Ancak bu viral hastalığın da yaşlı bireyleri olumsuz etkilemesi söz konusu olduğundan, uygulanan protokoller toplum sağlığı açısından gerekli hale gelmiştir. Ne yazık ki bu kısır döngü sebebiyle yaşlı bireyler sağlık için, sağlık fedakarlığında bulunmak durumunda kalmışlardır. Bu açıdan bakıldığında acil protetik tedavi kapsamında total dişsizlik ve hareketli protez ile tedavisi mümkün olabilecek kısmi dişsizlik durumları da ele alınmalıdır. Elbette pandemi süresince diş kesimi yapılacak işlemlerin ertelenmesi yerinde bir karar olmuştur. Zira diş kesimi sırasında oluşabilecek aerosol hem tedaviyi yapan hekim, hem yardımcı sağlık personeli hem de kliniğe giren hastalar açısından büyük risk teşkil etmektedir. Protetik tedavide, CAD/CAM gibi dijital teknolojilerin kullanımı ile klinik işlemler hızlandırılabilmektedir. Bilgisayarlı tasarım ve üretimin gerçekleştirebildiği bu sistemler ile geleneksel ölçülerin yerine intra oral tarayıcılar kullanılabilmektedir.[55, 56] Tek seansta protezin yapılabilmesi ile geçici kuron hazırlama gereksinimi de ortadan kalkmaktadır.[57] Yapılan çalışmalarda CAD/CAM sistemleriyle elde edilen restorasyonların uyumlarının da konvansiyonel yöntemlerdekine kıyasla daha iyi olduğu rapor edilmiştir.[55, 56] Ölçüler 'STL' formatında laboratuvara gönderilebilmekte ve çapraz enfeksiyon riskinin önüne geçilebilmektedir.[58,59] Ayrıca laboratuvarda restorasyonun yapımıyla ilgili harcanan zaman da azalmıştır.[57] Hekim ve hasta için de çok büyük bir zaman tasarrufu söz konusudur.[57] Pandemi döneminde de klinikte geçirilen sürenin azalması büyük önem arz etmektedir. Verilerin dijital ortamda arşivlenebilmesi de bu sistemlerin göz ardı edilemeyecek avantajları arasındadır.[60] Veri ve aşamaların depolanması, hafıza kaybı yaşayan geriatrik bireylerin protezlerini kaybetme durumunda veya kas kontraksiyonlarını kontrol edemeyen Parkinson hastalarının protezlerinin kırılması durumunda da çok büyük bir avantaj oluşturmaktadır. Tüm bu avantajları düşünülünce pandemi ile birlikte dijital yöntemlerin protetik tedavilerde daha çok kullanılması geriatrik hastaların ve protez uzmanlarının da işlerini büyük ölçüde kolaylaştırabilir. Bu gibi durumlarda sürekli başa dönüp her aşamanın tekrar yapılması hekim ve hasta açısından zaman kaybıdır. Dijital yöntemlerde depo edilen veriler sayesinde, ölçü ve kayıtların alınması sırasında kullanılan malzemelerin tasarrufu ülke ekonomisine de önemli sayılabilecek bir katkıdır. [61]

Diş hekimleri sterilizasyon ve dezenfeksiyon kurallarına pandemi öncesinde de uymak durumundaydılar. Ancak kliniklerde havalandırmanın önemi hususunda pandemi ile birlikte farkındalık oluştuğunu söyleyebiliriz. Klinik dizaynlarının tekrardan gözden geçirilmesi ve ülke genelinde havalandırması yetersiz olan kliniklerin yeniden düzenlenmesi de öncelikler arasında olmalıdır. Protez klinikleri ve diş laboratuvarları arasında katı dezenfeksiyon kurallarının uygulandığı ve iyi havalandırılan, ölçü ve ağız içi kayıtların dezenfeksiyonunun yapılacağı ayrı bir bölme oluşturulabilir. [62]

Protez uzmanları, tedavileri sırasında, hasta grubunun büyük bir kısmını oluşturan geriatrik bireylerin, psikolojik durumlarının pandemide nasıl etkilenebildiklerini göz önünde bulundurmaları önem arz eder. Protez uzmanları, yaşlıların ne istediğini, ne hissettiğini anlayabilmeli ve duygusal durumlarının genç yetişkinlere kıyasla daha fazla değişebileceğini, alınganlık sergileyebileceklerini de unutmamalıdır. Uzun süren dişsizlik durumu onları, pandeminin genel yükü ile birlikte daha fazla hassas hale getirmiş olabilir. Covid-19 'un asemptomatik olarak da geçirilmesi mümkün olduğundan protetik tedavi süresince koruyucu ekipmanla yaklaşmak ve katı kurallarla kliniğin havalandırılması ve dezenfeksiyonunun sağlanması bir zorunluluktur. [62]

Uygulanan Genel Politikalar

Bulaşıcılığı oldukça fazla olan Covid-19 enfeksiyonunun yayılımını engellemek için tüm dünyada hükümetler tarafından önlemler alındı.[63, 64] Temel hijyen kurallarına uyulması, maske kullanımı, sosyal mesafe (bireylerin birbirine olan mesafesinin minimum 2 metre olması) en temel tedbirler olmasına rağmen, birçok ülkede sokağa çıkma yasakları ve karantina uygulamaları yapılmıştır. İş dünyasında üretim faaliyetlerinin durması da bu tedbirler arasındadır.[64] Türkiye 'de İç İşleri Bakanlığı' nın 21 Mart 2020 tarihli genelgesinde[65] ek kronik rahatsızlıkları olan bireyler, 65 yaş ve üstü bireyler için sokağa çıkma yasağı ve karantina uygulandı. Bu tür önlemler, hastalıkların yayılmasını önleyici çabalardır.[64] Ancak yaşlı bireylerin sosyal ilişkilerden uzak kalması, günlük temel alışverişlerini yapamaması ve sağlık hizmetlerine ulaşmalarını güçleştirebilir. Hareket kısıtlılıklarını bakıcıları sayesinde aşabilen yarı bağımlı ve tam bağımlı yaşlılarımızın da bu kısıtlamalı günlerde, kayıt dışı çalışan bakıcılarının kendilerine ulaşması mümkün olmadığından mağdur olma olasılıkları mevcuttur.[64] Bakımları sırasında fiziksel mesafenin korunamaması da bağımlı yaşlılarımızın hastalığa yakalanma riskinin arttığı düşünülmektedir.[9] Ülkemizde Sağlık Bakanlığı' nın evde bakım hizmet ünitelerinin yaygınlaşması sayesinde bağımlı yaşlılarımızın sağlık hizmetine ulaşması ile bu alandaki sıkıntılar giderilmeye çalışılmıştır. Yüksek mortalite ve morbidite yaşlılarda tedbirlerin kaçınılmaz olduğunu göstermektedir. Virüs için etkin aşı uygulamaları yapılmadıkça yaşlı bireylerimize koruma ve izolasyon tedbirleri devam etmelidir.[64]

Ülkemizde vaka sayılarının tekrar artması sebebiyle 01.12.2020 tarihinde açıklanan İçişleri Bakanlığı Genelgesi[66] ile hafta sonları sokağa çıkma yasakları ve hafta içi 20 yaş altı, 65 yaş üstü için saat sınırlamaları uygulanmıştır. Yine aynı genelgede 65 yaş ve üzeri vatandaşlarımızın mağduriyetlerini gidermek için temel ihtiyaçları (ekmek, temel gıda vb.) oluşturulan Sosyal Destek Birimleri aracılığıyla karşılanmıştır. Yaklaşık 2 haftalık süreç sonunda bu kısıtlamaların da olumlu etkileri görülmüştür. Vaka sayıları Sağlık Bakanlığı'nın[67] verilerine göre düşerken, bu durum belli zaman dilimlerindeki kısıtlamaların da salgının seyrini değiştirebildiğini göstermiştir.

Aşılamada temel amaç, hastalıkların engellenmesi, bu hastalıklardan kaynaklanan ölümlerin önüne geçilmesidir. Sağlık, ekonomik ve sosyal kazanımları olan önemli bir hizmettir. DSÖ'nün de, hem maliyet etkinliği açısından hem de ölümlerin önlenmesi açısından aşılamanın, halk sağlığı için, kritik önem arz ettiğini belirtmiştir. [68] Sağlık Bakanlığı, Covid-19 için, hastalığa maruz kalma riski, ağır geçirme ihtimali ve toplumsal işleyişi göz önünde bulundurarak, aşı uygulanacak gruplarda öncelik sırası belirlemiştir.[69] Aşılama sürecine giren ülkemizde sırasıyla; sağlık çalışanları, yaşlılar, engelliler, koruma evlerinde kalanlar ve çalışanlar, 65 yaş üstü bireyler 1. aşamada aşılanması öngörülen gruplardır. [69] 18 Ocak 2021 itibariyle toplam 823.525 kişi aşılanmıştır.[70] Randevu sistemi kullanılarak, aşı kaydı ve Covid-19 önlemlerine uygun uygulama ortamları hedeflenmiştir.

Sosyal ve ekonomik olarak güçlük çeken, sahip olduğu şartlar gereği avantajlı olmayan grup olarak ifade edilen; kadınlar, çocuklar, gençler, yaşlılar, eski hükümlüler, göçmenler, engelliler olmak üzere gruplara ayrılan dezavantajlı gruplar[71] pandemi döneminde en çok etkilenen

bireylerdir. Bu tanıma en iyi uyan göçmenler dünya genelinde farklı uygulamalara maruz kalmışlardır. Zorunlu izolasyon, kamplarda kaderlerine terk edilme, kayıt sürelerinin uzamasına bağlı sağlık hizmetlerine erişememe vb. uygulamalar yaşadıkları sıkıntıları artırmıştır. Ülkemizde göçmenlere pandemi döneminde de gerekli mevzuat düzenlemesiyle güvencesi olmasa dahi Covid-19'a yönelik tanı, tedavi ve ilaç hizmetine ulaşmaları sağlanarak, toplum sağlığına uygun bir yaklaşım sergilenmiştir.[72]

Türkiye'de yaşlılara ve dezavantajlı gruplara tanınan öncelikler bahse konu iken, İtalya 'da, Covid-19 sürecinde yoğun bakım hizmetlerindeki kaynakların hasta sayısına göre az olduğu durumlarda, karar algoritmasının yaş ayrımcılığı ile yapılmasının, klinik etik öneriler olarak rapor edilmesi[73] ve bu görüşün tartışılması,[9, 74] Amerika' da ise bir eyaletin yöneticilerinden birinin, yaşlıların, evlatları için kendilerini feda etmelerini ve böylelikle ekonomik vatanseverlik yapabileceklerini söylemesi[9] ülkeler arasında insan hayatına olan yaklaşım farklılığını yansıtan bir tespit olma özelliğindedir.

Pandeminin toplum dinamiklerine yönelik tehditlerini, yönetmek adına çözüm olarak yaşlı popülasyonun feda edilebilirliğinin algısının oluşturulduğu ülkelerde geriatrik mortalite oranının artması sonucu iyi tahlil edilmesi gereken bir durumdur.

Pandemi Sürecinin Yaşlılar Üzerindeki Etkileri

Yaşlı bireyleri, Covid-19 tedbirleri ile korumaya çalışırken, yalnızlık duygusu, çaresizlik, korku ve kaygılarının dikkate alınması gerekmektedir.[9, 64] Başka virüslerin sebep olduğu salgın durumlarında bireylerin ve farklı grupların psikolojisini inceleyen çalışmalar mevcuttur.[64, 75] Bu çalışmalar, günümüzde yaşanan pandemi için de yol gösterici olacaktır. Toplumdaki etkilerini bütün olarak değerlendirmek, sağlık ve gelecek için çıkarımlar yapmak adına önem arz eder. SARS salgını sonrasında bireylerin anksiyete, depreyon, öfke izleri ve post travmatik stres belirtilerinin araştırıldığı evrende, %15'inde depresif bozukluklar ve %25'inde travma sonrası stres semptomları olduğu rapor edilmiştir.[76] Travma sonrası stres semptomları, uzun süreli karantinada kalmak ve daha fazla psikolojik stresle ilişkilendirilmiştir.[77] Sonuç olarak yaşlı bireylerin bu durumdan çok daha fazla etkilendiği ve psikolojik problemlere sebep olduğu açıklanmıştır.[64]

Yaşlıların uzun süreli hareketsiz kalması sarkopeniye sebep olacaktır. Sarkopeniye bağlı düşmeler ve buna bağlı sağlık sorunları da mağduriyetlerini artırır. Kendisinin ve sevdiklerinin salgından etkilenebileceğini düşünerek sağlık hizmetlerinden yararlanmayı reddetmesi de durumu vahim hale sokabilir. Tüm bu sebepler yaşlı bireylerde pandemi süresince komorbiditeyi kontrolsüz duruma sürükleyebilir.[9]

Günümüzde yaşadığımız pandemiyi, sadece sağlık açısından bir tehlike olarak görmemek gerekir. Çünkü ekonomik ve sosyal olarak da toplumları derinden sarsmıştır.[64]

Yapılan çalışmalarda toplumda 'sosyal mesafe'nin 'sosyal izolasyon'a dönüştürüldüğü belirtilmiştir.[9] Yaşlı yakınlarına böyle bir izolasyon uygulayan bireyler, virüsten daha tehlikeli durumlara sebep olabilir.[9] Yapılan çalışmalarda da, sosyal izolasyonun, majör depresif bozukluk, anksiyete, nörodejenerasyona ek olarak kalp rahatsızlığı ve ölüm riskini artırdığı bildirilmiştir.[78]

Pandemi sonrası değişen dünya düzeninin getirisi olan internet hizmetlerinden faydalanım konusunda da yine yaşlı bireylerin sanal platformlara aşinalığının az olması mağduriyeti, önemsenmesi gereken ayrı bir durum olarak karşımıza çıkmıştır. Dünyada yaş(lı) ayrımcılığı ve yaşlı bireylerin ulaşamadığı birçok temel ihtiyacı artıran pandemi, sekonder eşitsizlikleri de beraberinde getirmiştir.[9] Ülkemizde özellikle yaşlı, engelli insanlarımıza yönelik ev dağıtımını içeren sosyal yardım destek çalışmaları sanal platformlara erişimleri mümkün olmayanları bu mecburiyetin dışına taşıyarak toplumsal duyarlılığı artırmıştır.[9] Bu çalışmalara devlet unsurları, yerel yönetimler ve toplumumuzdaki duyarlı insanların katılım sağlaması ülkemizdeki dezavantajlı grupların başta yaşlılarımız olmak üzere hayatı idame ettirebilecekleri desteği almalarına sebep olmuştur.

DSÖ, pandemi süresince şiddet ve istismarın arttığını ifade etmiştir.[79] Dünya basınında yaşlı bireyler için pek çok olumsuz haber başlığının, pandeminin oluşturduğu kaygıyı ve anksiyeteyi artırabileceği de düşünülmektedir. Yaşlı bireyler, zihinsel sağlıklarını olumsuz etkileyecek kadar yalnızlık duygusu çekebilirler.[80, 81]

Hayatımıza aniden giren ve tüm dengeleri değiştiren, tamamen kontrolümüz dışında gelişen Covid-19' un sebep olduğu korku ve stresin olumsuz etkilerinin, kalıcı olmaması için yaşlı bireylerle sürekli iletişim halinde olmamız, mesafeyi koruduğumuz ziyaretlerde bulunmamız önem arz eder.[9] Ülkemiz insanının aile dayanışması, büyüklerine verdiği önem sebebiyle yaşlı insanlarımız dünya geneline kıyasla daha az etkilenmiş olabilir. Birçok ülkeye, insanlık, aile içi dayanışma ve büyüklerimize verdiğimiz destekle örnek olabilecek nitelikte, değerlerine ve büyüklerine bağlı bir milletiz.

SONUÇ

Tüm dünyayı etkileyen pandemi, toplumsal çıkarımlar edindiğimiz, bizi olağanüstü durumlara karşı daha da hazır hale getirmiştir. Her bir yaşlı insan bizim için tarihi mirastır, onların tecrübeleri ve fikirleri ile birçok sıkıntıyı hasarsız atlatabileceğimizi bilmeliyiz. Yaşlı insanlarımızın, yaşamlarını sağlıklı ve kaliteli biçimde sürdürmeleri için her birey duyarlı davranmalı ve üstüne düşen görevleri yapmalıdır.

Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – F.B.; Tasarım – F.B., S.F.A.; Denetleme – F.B.; Kaynaklar – S.F.A.; Veri Toplanması ve/veya İşlemesi –S.F.A.; Analiz ve/veya Yorum –S.F.A.; Literatür Taraması –S.C.K., N.K; Makaleyi Yazan – F.B., S.F.A.; Eleştirel İnceleme – F.B.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Peer-review: Externally peer-reviewed.
Author Contributions: Concept – F.B.; Design – F.B., S.F.A.; Supervision –F.B.; Resources –S.F.A.; Data Collection and/or Processing – S.F.A.; Analysis and/or Interpretation –S.F.A.; Literature Search –S.F.A.; Writing F.B., S.F.A.; Manuscript –F.B.,S.F.A.; Critical Review –F.B.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Derleme *Review* DOI: 10.17567/ataunidfd.981559

Diş Hekimliğinde İndirekt Kompozit Rezinler

Indirect Composite Resins in Dentistry

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ÖZ

Son yıllarda, adezyon teknolojisindeki gelişmeler, kavite preparasyon tekniklerindeki yeniliklerle beraber hekimlerin estetik ve uzun ömürlü restorasyonlara ilgisi artmış, bu sebeple birçok yeni restoratif materyal üretilmiştir. Bunlardan biri de indirekt kompozit rezinlerdir. İndirekt kompozitler, direk kompozitlere nazaran daha az polimerizasyon büzülmesi gösterir, aşınma direnci daha iyidir, daha ideal kontak oluşturur ve reaksiyona girmemiş artık monomer miktarı daha azdır. Ayrıca indirekt kompozitlerin ilave polimerizasyon teknikleriyle beraber mekanik özellikleri de geliştirilmiştir. Bütün bu avantajlarıyla beraber indirekt kompozit restorasyonlar, seramik restorasyonlara birer alternatif haline gelmiştir. Bu literatür derlemesinde, indirekt kompozitlerin gelişimi, kullanım alanları, mekanik ve fiziksel dezavantajları ele alınacaktır

Anahtar Kelimeler : İndirekt kompozit rezin, İnley-onley , Polimerizasyon

ABSTRACT

In recent years, with the advances in adhesion technology and the innovations in cavity preparation techniques, the interest of physicians in aesthetic and long-lasting restorations has increased, so many new restorative materials have been produced. One of these is indirect composite resins. Indirect composites show less polymerization shrinkage, better abrasion resistance, more ideal contact, and less unreacted residual monomer than direct composites. In addition, the mechanical properties of indirect composites have been improved with additional polymerization techniques. With all these advantages, indirect composite restorations have become an alternative to ceramic restorations. In this review of literature, the development, usage areas, mechanical and physical disadvantages of indirect composites will be discussed.

Keywords: Indirect composite resin, Inlay-onlay, Polymerisation

GİRİŞ

Restoratif diş hekimliğinin amacı diş dokusunda çürük, travma, aşınma gibi nedenlerle oluşmuş madde kaybını, fonksiyon, fonasyon ve estetikle beraber hastaya geri kazandırmaktır.[1] Bu kapsamda ideal bir restorasyon materyalinden dişin orjinal formunu koruyarak, çürük veya travma gibi nedenlerle oluşan madde kaybını restore etmesi, ideal kapanışı ve estetiği sağlaması beklenir.[2] Günümüzde modern diş hekimliğinde hastaların artan estetik beklentileri, hekimleri minimum doku uzaklaştırmaya, doğal diş rengini taklit edebilen materyallerle tedavi yöntemlerini kullanmaya yöneltmiştir.[3,4]

Direk estetik materyallerin temeli 1871 yılında silikat simanlar ile başlamıştır.[3,5,6] Daha sonra 1940'larda kullanılan akrilik rezinlerin yetersizlikleri sonucunda kompozit rezinler piyasaya sürülmüştür.[7] Kompozit rezinler 1962 yılında Bowen tarafından tanıtılmış ve günümüze kadar oldukça fazla gelişme göstermiştir.[8]

Bu süreçte Dr. Bowen Bis-GMA monomer yapısını bulmuş, 1955 yılında ise Buenocore rezinlerin diş sert dokularına bağlanmasını arttırmak için ortofosforik asiti ilk kez pürüzlendirme materyali olarak kullanmıştır. Bu iki önemli buluşla beraber diş hekimliğinde adezyon gelişmelerinin önü açılmıştır .[8,9]

Kompozit rezinler güçlü fiziksel ve mekanik özellikleri, yüksek çözünme dirençleri ile beraber estetik beklentileri de karşılamaları sebebiyle anterior ve posteriorda rutin olarak kullanılsa da henüz klinik özellikleri optimum seviyeye gelmemiştir.[6,10] Kompozit rezinlerin polimerizasyon sırasında hacminin %1-4, uzunluğunun %0.2-1.9 oranında azalmasına "polimerizasyon büzülmesi" adı verilir. Bu büzülme, diş ve kompozit rezin arasındaki bağlanma yüzeylerinde stres birikimine neden olur. Bu strese bağlı olarak kaviteyle restorasyon yüzeyi arasında mikro boşluklar oluşur ve zamanla marjinal adaptasyonda ciddi

Geliş Tarihi/Received 09.03.2021
Kabul Tarihi/Accepted 11.08.2021
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Baysal Canyurt M, Aybala Oktay E, Karaoğlanoğlu S. ndirect Composite Resins in Dentistry. *Current Research in Dental Sciences*. 2024;34(2):144-149

sorunlar meydana gelir.[11] Bütün bunların sonucu olarak kompozit rezinlerde zaman içerisinde mikrosızıntı, mikroçatlak, post operatif hassasiyet, bakteri geçişi, sekonder çürük ve pulpal enflamasyon gibi problemler meydana gelebilir.[11,12]

Kompozit rezinlerdeki polimerizasyon büzülmesi ve kenar sızıntına bağlı oluşan dezavantajları elimine etmek için indirekt kompozit sistemler geliştirilmiştir. Bu sistemler ağız dışındaki çalışma modelleri üzerinde tamamlanan restorasyonların, daha önceden hazırlanmış kavitelere yapıştırılma prensibine dayanır. [13,14,15] Bu derlemede, indirekt kompozit sistemlerin son yıllardaki gelişimi, kullanım alanları, mekanik ve fiziksel avantaj ve dezavantajlarıyla ilgili bir literatür taraması sunulacaktır.

Kompozit rezinlerde indirekt sistemlerin kullanımındaki esas amaç; materyalin polimerizasyon büzülmesinin önüne geçmek, diş dokusuna bağlantıyı arttırmak ve reaksiyona girmemiş artık monomer miktarını azaltarak restorasyonun mekanik özelliklerini geliştirmektir. Adeziv sistemlerdeki gelişmeler sayesinde son dönemde indirekt kompozitler başarıyla uygulanmaktadır. [16,17]

İndirekt kompozitler , tüm sınıf I ve sınıf II kavitelerde, kompozit endikasyonu olan bütün arka grup dişlerde , amalgam alerjisi olan bireylerde, estetik kriterlerin ön planda olduğu vakalarda, ara yüzey bölgesinde, basamak diş eti altındaysa ve geniş madde kayıplı dişlerde şayet kalan diş dokusu bağlanmayı destekleyecek miktardaysa kullanılabilir. Fakat yetersiz ağız hijyeni olan hastalarda, periodontal sağlığın iyi olmadığı durumlarda, kalan diş dokusu indirekt kompozit restorasyonun bağlanması için yeterli değilse, kavitede undercut varlığında ve bruksizm gibi parafonksiyonel alışkanlıkları olan hastalarda tercih edilmez. [18,19,20]

İlk nesil indirekt kompozitler Touati ve Mörmann tarafından posterior inley ve onleyler için 1980'lerde piyasaya sunulmuştur.[21] Direkt kompozit rezinler organik matris, inorganik doldurucu ve silan gibi bağlayıcı madde içerirler. İlk üretilen birinci nesil indirekt kompozitler direkt kompozit rezinlerle aynı içeriğe sahiptir ve aynı üreticiler tarafından benzer isimlerle üretilmiştir .[22]

Birinci nesil indirekt kompozitlerin mekanik ve fiziksel özelliklerini geliştirmek için birçok çalışma yapılmıştır. Zaman içerisinde polimer dönüşüm seviyeleri %6 ila %44 oranında arttırılmıştır. [23- 27] Bu kompozitlerin organik matrisi ve inorganik doldurucuları arasındaki bağ yetersizdir ve bu da marjinal boşluklara, mikrosızıntıya, fraktürlere, istenmeyen aşınma direncine neden olur.

Birinci nesil kompozitlerin klinikte problem yaratmaya devam etmesi ve alternatifi olan seramik restorasyonların ise karşıt dişte yarattığı aşınma, seramiğin kaybedilen yüzey düzgünlüğünün kazanılmasındaki zorluk, seramik restorasyonlardaki kırılganlık gibi kısıtlamaları ikinci nesil kompozitlerin ortaya çıkmasına neden olmuştur. Birinci nesil indirekt kompozitlerden farklı olarak ikinci nesil indirekt kompozitlerde polimerizasyon tekniğinde, yapı ve bileşenlerinde gelişmeler kaydedilmiş, ilave olarak indirekt kompozitleri fiberle güçlendirme seçeneği sunulmuştur.[28]

İndirekt Kompozitlerin Polimerizasyon Tekniğindeki Gelişmeler

İndirekt kompozit rezinlerin ışıkla polimerizasyon başladığında içeriğinde bulunan kamforakinon serbest radikaller oluşturmak üzere ayrışır ve polimerizasyonu başlatır. Bununla beraber yüksek çapraz bağlı polimer oluşur. Metakrilat grubunun % 25-50' sinin polimerize olmadan kaldığı görülür .[29] Bu sebeple sadece ışık kullanılması polimere dönüşümü yeterince sağlayamadığı için polimerizasyon için farklı çeşitli metotlar kullanılır.[30] Ekstraoral ek ışıkla polimerizasyonla bile polimere dönüşüm derecesi beklenen noktaya gelememiştir. Bu nedenle, ikinci nesil indirekt kompozitlerin polimerizasyonun istenene en yakın olması için ısı, vakum, basınç ve oksijensiz ortam gibi ekstra spesifik koşullar kullanılmıştır. [31]

Kullanılan ek polimerizasyon yöntemleri şöyledir;

a. Isı ile Polimerizasyon

İndirekt kompozitlerin polimerizasyonu için sıcaklık genellikle 120–140°C arasında kullanılır. Bu metottaa önemli olan uygulanan sıcaklık derecesinin kompozitin cama dönüşüm derecesinden yüksek olmasıdır. Cama dönüşüm ısısı, polimerik malzemelerin temel ayırt edici özelliğidir . Maddenin camsı özelliğini kaybedip visköz özellikler kazanmaya başladığı sıcaklık sınırıdır.[32] Bu işlem polimer zincirinin hareketliliğini arttırarak ekstra çapraz bağları azaltır ve böylece stres azalır .[33] Fakat fazla ısı uygulaması kompozitin yapısında bozunmaya neden olabilir. Isı, otoklavlarda, döküm fırınlarda ya da özel fırınlarda uygulanabilir.[34] Işıkla sertleşme sonrası ısı uygulaması artık monomer miktarını azaltır. Bunun iki sebebi vardır; birincisi artık monomer ısıyla beraber polimer bağına bağlanarak dönüşümü arttırır. İkincisi ise tepkimeye girmeyen monomerler ısıyla birlikte buharlaşır.[26] Isı ve ışık kombinasyonu daha iyi bir çift bağ dönüşümü için gereken termal enerjiyi artırır. İlk defa bu uygulama Charisma®' nın geliştirilmesi sürecinde Heraeus-Kulzer firması tarafından kullanılmıştır. Yalnızca ışıkla polimerize etmeye kıyasla, hem ışık hem ısıyla polimerizasyon ile beraber aşınma direncinin %35 arttığı gözlemlenmiştir. [35]

b. Nitrojen Atmosfer Polimerizasyon Yöntemi

Hava varlığı, oksijen barındırdığı için, polimerizasyonu engellediği gibi aynı zamanda kompozit restorasyonun translüsensliği ve opaklığında önemli bir rol oynar, kompozitte oksijen sıkışmasına, restorasyonun yüzeyinden yansıyan doğal ışığın kırınımına sebep olur. İçerde kalmış tüm havanın çıkartılması restorasyonun daha translüsent olmasını sağlar. Nitrojen basıncı tam da burada devreye girer, materyalin sertleşmesinden önce içinde kalan oksijeni ortadan kaldırır. Böylece materyalin, polimer dönüşüm derecesi, aşınma direnci artar ve materyal estetik beklentileri daha iyi karşılar. BelleGlass® ve Sculpture Plus® bu metodu nitrojen fanus içinde uygular. [22]

c. Soft Start ya da Yavaş Polimerizasyon Yöntemi

Soft tedavi, yani daha yavaş bir ışık ile polimerizasyonun daha yüksek polimerizasyona yol açtığı fikrini Mehl [35] ortaya atmıştır. Polimerizasyonun daha hızlı olması yeni oluşan polimerlerin daha erken ve hızlı katılaşmasına neden olabilir. Bunun sonucunda rijidite artar ve moleküllerin yayılması engellenir. Soft start yöntemi polimerizasyon büzülmesine bağlı oluşan stresi azaltır. Bu sistem hem belleGlass® hem de Cristobal® rezinlerde de kullanılır. [36,22]

d. Elektron Işın ile Polimerizasyon Yöntemi

Kompozitlerin mekanik ve fiziksel özelliklerinin geliştirilmesi için tercih edilen bir diğer metot elektron ışını uygulamasıdır. [37] Polieten, polikarbonat ve polisülfon gibi polimerler için kullanılmaktadır.[38] Bir polimer elektron ışınlanmasına maruz kalınca ortaya zincir kırılması ya da zincir bağlanması olarak tanımlanan iki reaksiyon çıkar. Bu uygulama doldurucu ve matris arasındaki bağı güçlendirir. Dolayısıyla, mekanik özellikleri güçlenir ve restorasyonun klinik başarısı artar. Bu metodun mümkün olabilecek dezavantajları polimer bozulması ve kompozitteki renklenmedir. Rutinde kullanım için pahalı bir yöntemdir. [22]

Fiber ile Güçlendirme

Smith tarafından 1960larda fiberle güçlendirilmiş kompozitler üretilmiştir. Bunlar; polietilen fiberler,[39] karbongrafite fiberler, ve cam fiberlerdir.[40-42] Ancak cam ve polyethylene fiberler diş hekimliğinde daha sık kullanılır. Fiber varlığı çatlak ilerlemesini durdurarak kompozitin yapısını güçlendirir. Rezin matris yapı fiberi sarar ve geometrik formunu düzenler. [43,44] Fiberler, bir uçtan öteki uca paralel şekilde olduklarından tek yönlüdür (unidirectional). Buna alternatif olarak, fiberler farklı yönlerde, örgü ya da çark şeklinde de düzenlenebilir.[43] Fiberin uzun ekseninin fibere uygulanan kuvvete dik olması daha güçlü olacağı anlamına gelir.[45]

Bir çok marka tarafından inley , onley , overley ve kron yapımında kullanılmak üzere farklı doldurucu içerikleri ve doldurucu oranlarıyla, farklı polimerizasyon teknikleri kullanılan çeşitli indirekt kompozitler üretilmiştir.

Artglass, Heraeusl-Kulzer tarafından 1995'te sunulmuştur**.** %70 yoğunlukta, 0.7 µ'lük baryumsilikat ve koloidal silika doldurucular içerir. Organik matrisinde UDMA bulunur. Çift fonksiyonlu moleküllerin yanı

sıra daha çok çift-bağlı dönüşüm sağlayan iki ile dört arası fonksiyonel grup içerir.[46] Ksenon stroboskop ışığıyla polimerize edilir. UniXS, Heraeus/Kulzer. Bu sistem 320 ile 500 nanometre , 4.5 watt gücünde ışın gönderir. Yüksek yoğun ışık, 80 milisaniyelik bir karanlığın ardından 20 milisaniye boyunca gönderilir. Bu sayede, polimerize olan rezin moleküller dinlenir ve reaktif olmayan çift-bağlı karbon molekülleri tepkimeye hazır hâle gelir.[47] Bu işlem polimerizasyon derecesini arttırır. Ayrıca akrilonitrit kopolimerin yani Kevloc , restoratif materyal ışık ile polimerizasyondan önce yüzeye uygulanarak metale bağlantı da sağlanabilir. [23]

Belleglass HP, 1996'da Belle de St. Claire tarafından sunulmuştur. 0.6µ'lük silanlanmış mikrohibrit doldurucular içerir. Dentin ve mine olmak üzere kullanılacak formları vardır. Mine kompoziti %74 yoğunluk, %63 hacimde borosilikat cam doldurucular Dentin kompoziti %78,7 yoğunluk ve %65 hacimde baryum cam doldurucular içerir. Organik matrisinde mine kompozitinde BİSGMA dentin kompozitinde TEGDMA bulunur. Beş farklı tonda mine rengi içerir. Dentin kompoziti %78,7 yoğunluk ve %65 hacimde baryum cam doldurucular içerir. Mine olarak kullanılanında ise, geliştirilmiş optik özellikler sağlayan %74 yoğunluk, %63 hacimde borosilikat doldurucu bulunur. Dentin rezin matrisi BİSGMA iken mine için TEGDMA metakrilat diüretanı ve alifatik dimetakrilatın karışımıdır. İki farklı ışık ile polimerizasyonme yöntemi vardır. Bu kademeli sistem tıpkı doğal dişlerde olduğu gibi gerilimlere dayanıklı daha opak dentin üzerine translüsent mineye olanak sağlar. Dentin kompozit, sıradan ışıkla, mine kompoziti ısıyla polimerize edilir. Polimerizasyon, 140°C ve 80psi bir fırında 20 dakika ısıtılmaya gerçekleşir. Ortam oksijensizdir ve nitrojen gazı basıncı mevcuttur. [47]

Sinfony, 3M ESPE tarafından sunulmuştur. Ultra ince parçalı cam veya cam-seramik doldurucular içerir. %40 ağırlıkta makrodoldurucu olarak, stronsiyum alimünyum borosilikat cam doldurucular içerir. Mikrodoldurucu olarak , % 5 ağırlıkta olarak oksihidrojen gazı alevinde üretilmiş, ana parçacık çapı 0.05µ'den az olan bir tür silikon dioksit amorfu olan pirojenik silica kullanılır. Pirojenik silika makrodol- durucuların arasını doldurur. Matris ise çok fonksiyonlu metakrilat monomerleri içerir. Özel sistem, iki polimerizasyon biriminden oluşur. Visio alfa, Visio beta. Visio alfa' da, bir halojen lamba bulunur, Visio beta dört tane floresan tüp kullanır. 400-550 nm ile polimerize olur. Alfa kaynağında polimerizasyon modu 15 saniye iken beta kaynağınınki 40°C'de 15 dakikadır.[48,49] Kullanılan diğer birim, iki metal halojen lamba içeren yüksek yoğunluğa sahip olan Hyper LII'dir. 250-600 nanometre arasında 150W 60 saniye uygulanır.[50] Bu materyalin iki farklı ışık kaynağıyla polimerizasyonu, mekanik özelliklerini güçlendirir. [51]

Targis, 1996'da Ivoclar Vivadent tarafından sunulmuştur. % 77 yoğunlukta trimodal ve 1µ boyutlu baryum cam doldurucular 0.25µ sferoidal silika doldurucular ve 0.015-0.05µ koloidal silika doldurucular bulunur. Matris ise konvensiyonel monomerler içerir. Targis, oksijen-inhibisyon tabakasının oluşumunu engellemek için gliserin jel Targis Gel ile kaplanır ve Targis Power Ivoclar Vivadent polimerizasyon cihazına yerleştirilir: İlk 10 dakika ışık emisyonu sağlanır, 25 dakikada sıcaklık 95°C ye yükselir ve 5 dakika soğumaya bırakılır.

SR Adoro, Ivoclar Vivadent tarafından sunulmuştur. % 63 ağırlıkta, kopolimer ve silikon dioksit dolcurucular içerir.

Targis sürekli güncellenen bir sistemdir ve şu anki uygulama SR Adoro'dur. Dentin ve mine kompoziti bu sistemin ana malzemeleridir. Bu sistemin ekstra malzemeleri arasında; metal iskelete bağlanmak için SR bağlayıcı, bir astar maddesi, dentin materyali, boyalar, insizal kesici diş ve opaklaştırıcı bulunur. SR bağlayıcı, yüksek derecede hidrofobik bir alifatik hidrokarbon zinciri ve metakrilat işlevli bir fosforik ester içeren bir monomer içerir. Dentin matrisi, BİSGMA veya TEGDMA yerine UDMA ve yaklaşık %63 ağırlıktaki kopolimer doldurucu içerir. Kopolimerler, mikrodoldurucu içeren bir kompozitin yaklaşık 10-30µm'lik parçacıklara ayrılması ve sonrasında bunların inorganik mikrodoldurucularla birleştirilmesiyle üretilir. Kopolimerler yüksek inorganik mikrodolduruculu homojen bir kompozit sağlar. Astar maddesi %49 ağırlıktaki baryum cam doldurucular içerir.

Solidex, Shofu tarafından sunulmuştur. %53 hacimli 1µ silikon dioksit ve inorganik alüminyum oksit doldurucular[52] ve seramik mikrofilamentler içerir. Matris ise %25 yoğunlukta çok fonksiyonlu rezin polimerleri ve %22 konvensiyonel rezinler / polimerizasyon başlatıcılar içerir. Sistemde metal primerler, servikal, insizal, body, opak kompozitler veya translüsent tonlar mevcuttur. 4 halojen lambalı Solidilite sistemiyle 55°C sıcaklık ve 420-480 nanometre dalga boyunda ilave ışık polimerizasyonu yapılır. Sublit polimerizasyon sistemi, şekillendirme sırasında modelden restorasyonu kaldırmadan, ilk veya kısa polimerizasyonlar için dizayn edilmiştir.

Sculpture plus, Pentron tarafından sunulmuştur. Nano-hibrit bir indirekt kompozit sistemdir. Doldurucular baryum borosilikat cam gibi silanlanmış doldurucular, nano boyutlu silika, zirkonyum silikat, başlatıcı, hızlandırıcı, stabilize edici ve pigmentler içerir. Matris kısmı PCBisGMA, EBPADMA, BİSGMA, UDMA ve HDDMA iki fonksiyonlu metakrilatlar içerir. Az miktarda A12O3 de içermektedir. Body, insizal, yarı opak, opak kompozitleri mevcuttur. Sculpture polimerizasyon sisteminde ışık hem polimerizasyonun öncesinde hem de polimerizasyon sırasında basınç altında otomatik uygulanır. İki polimerizasyon döngüsü, bir yapılandırma döngüsü ve bir de restorasyon tamamlandığındaki bir final döngüsünden oluşur. Nitrojen gazıyla sıkıştırılır ve otomatik olarak, 3 dakikalık yüksek yoğun ışık uygulaması sonrası takip edilen 5 dakikalık sıkıştırmadan oluşan toplamda 8 dakikalık bir uygulamadır.

Tescera ATL, Bisco INC tarafından sunulmuştur. Bu sistem diğer sistemlere kıyasla daha yüksek bir inorganik seramik mikrodoldurucu içerir. [53] Bu materyal hem kompozitlerin hem de porselenlerin avantajlarına sahiptir ve ikisinin de kısıtlılıklarını içermez. Doldurucular, organik matrise uygun bağlanması için silanlanmıştır. Mikrodoldurucuların konsantrasyonu arttıkça klinik performans da artmıştır. Eklenen 1µm'lik güçlendirme parçacıkları, çatlak önleyici olarak görev yapar. Dentin materyali %85 ağırlık, %73 hacimde yüksek doldurucu içeren bir hibrittir. Body ve insizal materyali güçlendirilmiş %70 ağırlıktaki mikrodoldurucudan oluşur. Bu kompozitin ortalama parçacık boyutu yaklaşık olarak 50 nanometredir. Bir ışık ve su altındaki bir ısı kabında polimerize edilir. Önde dentin kısmı, tabakalı yerleştirme sırasında boşluk ve kabarcıkları engellemek için ışık kabında 60psi sıkıştırılır. Işık kabında, ışığı ortama ve kompozit yüzeyine yansıtmaya ve dağıtmaya yardımcı beyaz bilyeler bulunur. Her tabaka 2 dakika boyunca ışıkla polimerize edilir. İkincil polimerizasyonları suya batırılmış ısı kabında gerçekleşir. Suda biriken artık oksijeni temizleyen bir sistemi mevcuttur. Final restorasyonu 10-13 dakika boyunca ışık ve ısıyla en yüksek 130°C olup basıncın salınmasından önce yaklaşık 90°C'ye düşer tam bir basınç 60psi döngüsü kullanılarak polimerize edilir. [54,55]

Paradigm, MZ100 3M ESPE tarafından sunulmuştur. CEREC restorasyonları için porselen bloklara alternatiftirler. Ultra ince zirkonya-silika doldurucu partiküller sol-gel işlemiyle, amorf silikada dağılmış nanoyapılı zirkonya oluşturur. %85 yoğunlukta ultra ince zirkonya-silika seramik doldurucu içerir. Yüksek çapraz bağlı polimer matrisi sağlamlaştırır. Matris BİSGMA, TEGDMA ve ternari başlatıcı sistemden oluşur. Doldurucu partiküller sferik şekillerdedir, ortalama boyutu 0.6 mikrometredir.

Vita ZetaLC, Vita Zahnfabrik tarafından sunulmuştur. Nano doldurucu partiküller yüksek translüsensi ve doğal bir ışık kırılımı sağlar. % 44.3 konsantrasyonunda çok fazlı feldspat cam hamuru ve silikon dioksit doldurucular içerir. Dentacolor, ortalama 40°C ve 350-500 nm dalga boyunda, ilave ışık polimerizasyonu yapar.

İKİNCİ NESİL İNDİREKT KOMPOZİTLERİN ÖZELLİKLERİ

1. Mekanik Özellikler

İkinci nesil indirekt kompozitlerde ekstra polimerizasyon yöntemleri ve inorganik doldurucu oranının artması bükülme dayanıklılığını ve

elastisite katsayısını yükseltmiştir. Her ne kadar polimer dönüşüm derecesi artsa da, polimer dönüşüm derecesinin artması her zaman daha iyi mekanik özellikler sağlamaz çünkü rezin matris oranı, doldurucu partiküllerin büyüklüğü, dağılımı ve oranı gibi mekanik özellikleri etkileyen diğer bir çok faktör vardır.

Doldurucu oranı arttıkça kompozitin mekanik özelliklerinin geliştiğine dair birçok çalışma yapılmıştır. [56,57] Örneğin, Chung ve arkadaşları, doldurucu oranıyla kompozit rezinlerin çapsal çekme dayanımı ve sertliği arasında pozitif bir ilişki olduğunu gözlemlemişlerdir.[58]

Doldurucu oranının olduğu gibi, doldurucu içeriği de kompozitin mekanik özelliklerinde etkilidir. Doldurucu içeriği ile kompozitin sertliği arasındaki pozitif ilişkiye dair, Neves ve arkadaşları [59] yaptıkları çalışmada, doldurucu içeriğinin sertlik değerini doğrudan etkilediğini belirtmişlerdir. Bu çalışmada, ikinci nesil kompozitler içerisinde daha düşük oranda inorganik içeriğe sahip indirekt rezin kompozitler örneğin, sırasıyla %50 ve %45-48, Sinfony®, Vita Zeta® daha düşük mekanik özellikler göstermişlerdir. [60] Kompozitin sertliğini etkileyen bir diğer faktör polimerizasyon yöntemidir. Miranda ve arkadaşları yaptığı çalışmada doldurucu içeriği diğerlerinden daha az olmasına rağmen, Targis®'in mikrosertliğinin indirekt kompozitler arasında en yüksek olduğunu belirtmiştir. Bunun nedeninin, polimerizasyon yöntemi ile mikrosertlik arasındaki ilişki olabileceğini söylemişlerdir.[22]

Doldurucu boyutu, şekli ve matrise olan bağlantısı kompozit rezinlerin aşınma direncini etkiler. Örneğin doldurucuların matrise bağlanması için yapılan kimyasal işlemin zamanla oluşan aşınma miktarını azalttığı belirtilmiştir.[6] Doldurucu boyutu ve indirekt kompozit rezinlerin aşınmalarıyla ilgili Bayne ve arkadaşları yaptığı çalışmada Concept®'in aşınma oranının belleGlass®'tan daha az olduğunu göstermiştir. Bunun sebebinin Concept®' deki mikrofill doldurucu kullanımı, küçük partikül boyutu ve doldurucu partiküller arası boşluk olabileceğini söylemişlerdir. Belleglass® ise, Artglass® ve Targis®'ten daha düşük aşınma direnci göstermiştir, bunun sebebinin ise doldurucu hacmi olabileceği belirtilmiştir.[62]

İndirekt materyaldeki aşınmanın gözle görülür şekilde artması çapraz bağın oluşturan karbon zincirlerin kontrolünü sağlayan multifonksiyonel monomerlerin birleşmesine bağlanabilir. Bu durum fiziksel ve mekanik özelliklerinin yanında aşınma direncinin de gelişmesine yardımcı olabilir. [46] Aynı zamanda BİSGMA konsantrasyonundaki bir değişikliğin de aşınma direncini geliştirebileceği bazı çalışmalarda belirtilmiştir. [22]

2. Optik Özellikler

İndirekt kompozit rezinlerin zamanla yüzeyinde oluşan bozulma ve sertleşme, kompozit rezin yapısında bulunan tersiyer aminlerin kimyasal reaksiyonları, doldurucu partiküllerin yüzeye olan hareketi sonucunda optik özelliklerinde değişme yani beklenmeyen bir renk stabilitesi gözlenir.[63]

Bu öngörülemeyen renk değişiminin sebebi, polimerizasyon şekli ve kalan çift bağ sayısıyla ilişkili olabilir. [22] Papadopoulos ve arkadaşları, indrekt kompozitlerle yaptıkları çalışmada hızlandırılmış yaşlandırmadan ve polimerizasyon sonra, indirekt kompozitlerin renginde açılma ve yeşil-sarı ya da yeşil-mavi renk değişimleri gözlemlemişlerdir fakat bu değişimlerin klinik olarak kabul edilebilir seviyede olduğunu söylemişlerdir. [64]

Yine renk değişimi ile ilgili Douglas indirekt kompozitlerde hızlandırılmış yaşlandırma ile yaptığı çalışmada Artglass, Zeta , Targis, Bellaglass HP hepsinin renk değişiminin kabul edilebilir sınırlarda olduğunu göstermiştir. Zeta, aralarında en az renklenmeyi gösterirken, Artglass ise ondan sonra gelmektedir. Targis ise yine kabul edilebilir sınırlarda olsa da, bu kompozitler arasında çalışmadaki en çok renklenen indirekt kompozit rezin olmuştur. [65]

Çulhaoğlu ve Zaimoğlu'nun renk değişimine dair çalışmasında, Douglas'ın sonuçlarına nazaran Bellaglass daha az reklenme göstermiştir. Bunun değişen doldurucu partikül ve doldurucu oranıyla ilişkili olabileceği belirtilmiştir. Yine aynı çalışmada yeni nesil Targis SR Adoro örnekleri, Douglas'ın çalışmasındaki eski nesil Targis'e nazaran çok daha iyi renk stabilitesi göstermiştir. SR Adoronun içeriği bunu açıklamaktadır. SR Adoro' nun yapısındaki kopolimer küçük parçalara bölünmüş polimerler daha parlak ve homojen bir yüzey sağlar bunun renklenmeyi azaltmış olabileceği söylenmiştir. Ayrıca UDMA monomeri kullanılmıştır, bu da BİSGMAVE TEGDMA aksine hidroksil grubu oluşturmadığı, su emilimi ve çözünürlüğü düşük olduğu için artan renk stabilizasyonuyla ilişkili olabileceği sonucuna varılmıştır. Bu çalışmada, doldurucu oranın artmasıyla ve seramik doldurucular kullanılmasıyla renk stabilitesinin azaldığı belirtilmiştir. [66]

3. Marjinal Adaptasyon ve Mikrosızıntı

İndirekt kompozitlerin geliştirilme nedenlerinin başında, direkt kompozitlerde görülen polimerizasyon büzülmesini ve buna bağlı mikrosızıntıyı azaltmak gelir. İndirekt kompozitlerin sağladığını düşündüğümüz bu klinik avantajları değerlendirmek adına mikrosızıntı ve marjinal adaptasyon konusunda bir çok çalışma mevcuttur.

Örneğin Scheibenbogen ve arkadaşları, direkt ve indirekt kompozit restorasyonları kenar bütünlükleri açısından iki yıllık klinik değerlendirmeye tabii tutmuşlar, indirekt restorasyonlarda %60 alfa skoru , direkt restorasyonlarda ise %40 alfa skoru belirlemişlerdir. [67] Yine buna benzer olarak Van Dijken ve arkadaşları ise direkt kompozit ve indirekt inley, onley restorasyonları 11 yıllık klinik değerlendirmeye almışlar, direkt kompozit restorasyonlarda kenar renklenmesi açısından %64 oranında, inley ve onley indirekt restorasyonlarda ise %93.2 oranında alfa skoru belirlemişlerdir. [68]

Şirin Karaarslan direkt ve indirekt kompozit restorasyonların bir yıllık klinik takibini yaptığı çalışmada, indirekt kompozit restorasyonların direkt kompozit restorasyonlara göre postoperatif hassasiyet, yumuşak doku sağlığı ve yüzey düzgünlüğü açısından istatistiksel olarak anlamlı sonuçlar gösterdiğini bildirmiştir. [69]

Puy ve arkadaşları, indirekt kompozit rezin inleylerin marjinal adaptasyonunu invitro ortamda SEM görüntülerinden değerlendirmiş, onlar da diğer çalışmalarda olduğu gibi kenar adaptasyonu açısından mükemmel sonuç alındığını bildirmişlerdir. [70]

İndirekt kompozit restorasyonların direkt kompozit restorasyonlara nazaran önemli derecede az mikrosızıntı gösterdiğini ve marjinal uyumunun daha iyi olduğuna dair benzer sonuçlar veren bir çok çalışma mevcuttur. [71- 73]

4. Yüzey Özellikleri

İndirekt kompozit rezinlerin yüzey pürüzlülüğü ile artan plak birikimi sekonder çürük oluşumu ile sonuçlanır. Bu yüzden indirekt kompozit restorasyolarda daha uzun klinik ömür için daha pürüzsüz yüzeyler ve iyi bir polisaj protokolü gerekir. Biofilm, plak birikmesi, iyi bitim yüzeylerine yani doldurucu boyutuna ve matris monomerine bağlıdır. Daha ağır ama küçük doldurucular daha pürüzsüz yüzeyler ortaya koyar ve bunun sonucu olarak da restorasyon yüzeyine daha az biofilm adezyonu gözlenir. Yüzey pürüzlülüğü 6–8 µ arasında değişir. Elmas macunla cilalama yapmak pürüzsüz bir yüzey oluşumuna yardımcı olur. Bakteri yapışmasına sebep olan bir diğer faktör de artık monomerlerin varlığıdır. Bu yüzden polisaj önem taşır. [74]

İndirekt kompozitlerin yüzey özellikleri diş yüzeyine bağlanmada da büyük rol oynar. Uygulanan yüzey pürüzlendirme işlemleri bağlanmayı direk etkiler. Pürüzlendirmede hidroflorik asit kullanımı, inorganik partiküllerin çözülmesiyle mikroyapısal bozulmalara sebep olur. [75]

Yüzey enerjisini artırmak için en iyi yöntem alüminyum oksit partikülleriyle 10 saniye kumlama yapmaktır. [76] Böylece rezin nonselektif degradasyona uğrar ve daha iyi adezyon gösterir. Bu konuda çalışan Soares'e göre kumlamanın ardından silan kullanımının daha iyi bağlanma sağladığını belirtmiştir. Genel itibariyle indirekt kompozitlerin bileşenleri benzer olduğundan, tüm materyallerde kullanılacak yüzey işlemlerinin aynı olmasında bir sakınca yoktur. [77]

SONUÇ

Bu literatür derlemesi bize göstermiştir ki, klinikte tercih edebileceğimiz çok sayıda indirekt kompozit sistemi mevcuttur. Bu sistemler ilave polimerizasyon teknikleriyle geliştirilen mekanik ve estetik özellikleriyle seramik restorasyonlara alternatif oluştururlar.

İndirekt kompozit restorasyonların fiziksel ve mekanik özelliklerini değerlendirmek için, uzun dönemde yapılmış klinik takip çalışmalarına ihtiyaç duyulmaktadır.

Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – S.C.K.; Tasarım – S.C.K., N.K., M.A.S; Denetleme – S.C.K.; Kaynaklar – S.C.K., N.K.; Veri Toplanması ve/veya İşlemesi – S.C.K., M.A.S.; Analiz ve/veya Yorum – S.C.K., N.K., M.A.S.; Literatür Taraması –S.C.K., N.K; Makaleyi Yazan – S.C.K., N.K.; Eleştirel İnceleme – N.K..
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Peer-review: Externally peer-reviewed.
Author Contributions: Concept – S.C.K.; Design – S.C.K., N.K., M.A.S; Supervision – S.C.K..; Resources – S.C.K., N.K.; Data Collection and/or Processing – S.C.K., M.A.S.; Analysis and/or Interpretation – S.C.K., N.K., M.A.S.; Literature Search –S.C.K., N.K; Writing Manuscript – S.C.K., N.K.; Critical Review – N.K.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Derleme *Review* DOI: 10.5281/zenodo.11058774

Is Insufficiently Keratinized Mucosa a Risk Factor for Periimplantitis? A Literature Review

Yeterince Keratinize Olmayan Mukoza Periimplantit İçin Bir Risk Faktörü mü? Literatür Taraması

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ABSTRACT

In this study, a literature review was conducted including human studies assessing keratinized presence and extent in PubMed and Scopus whether insufficiently keratinized mucosa s risk factor for periimplantitis or not. The end of this review, we concluded that . The KM is important for masticatory stresses in the tooth margin or crown, and results in esthetics that are more favorable, overall comfort, and simplified brushing. Therefore, the presence of KM in the surrounding dental implant (DI) space is important for the prevention of inflammation, plaque buildup, gingival recession, and occurring periimplantitis.

Keywords : Keratinized mucosa, Periimplantitis, Dental implants

ÖZ

Bu çalışmada, PubMed ve Scopus'ta keratinize varlığı ve yaygınlığını değerlendiren, yetersiz keratinize mukozanın periimplantitis için risk faktörü olup olmadığını değerlendiren insan çalışmalarını içeren bir literatür taraması yapılmıştır. Bu incelemenin sonunda şu sonuca vardık. KM, diş kenarındaki veya krondaki çiğneme stresleri için önemlidir ve daha olumlu estetik, genel konfor ve daha basit fırçalamayla sonuçlanır. Bu nedenle, çevredeki diş implantı (DI) boşluğunda KM'nin varlığı, iltihaplanmanın, plak oluşumunun, diş eti çekilmesinin ve ortaya çıkan periimplantitin önlenmesi için önemlidir..

Anahtar Kelimeler: Keratinize mukoza, Periimplantitis, Diş implantları

Periodontal Tissue

The periodontium involves specialized tissues that support and surround the teeth. These tissues maintain the teeth within the mandibular and maxillary bones. Periodontium is derived from Greek word ‘peri-’ and ‘odont-‘, which translate to "around the tooth", respectively.[1] The dental speciality that focuses on care and maintenance of dental tissue is periodontics. The periodontium provides the teeth with the gum support to facilitate regular function. The four components included within the periodontium are: gingiva, periodontal ligament (PDL), cementum, and the alveolar bone proper.

The periodontium supports the teeth while they are being used. It relies on the stimulation received in order to preserve its own structure. As a result, there is a continuous state of balance, which exists between the periodontal structures and their external forces. The gingiva or gum tissue is located under the tooth and guards the core of the tooth or bone.[2] It surrounds to the tooth and forms a tight junction that provides a germ and infection barrier. The outer and inner connective tissue make up an epithial layer that is keratinized. The inner layer are gingival fibroblasts and these cells are critical for wound healing and tissue repair. The gingiva is the first line of defense and visually demonstrates the inflammatory response by swollen, red and bleeding tissues. Even though these characteristics do not mean periodontal complications, it is recommended to have these symptoms checked to rule out any possible issues.[3-5]

In general, gums may differ in color an range from pink to red pigmented, and visually the gingivia are stippled. Gingiva vary based location and functionality and include two types: the attached and free gingiva. The attached gingiva is keratinized, adheres to tooth/bone, and varies in height from 3 to 12 millimeters. Free gingiva is adjacent to the attached gums, forms a collar at the epithelial base of the tooth (sulcus), and is unattached at a depth of 1-3 mm.[3]

The necessity of keratinized tissue around the teeth to maintain periodontal health has been debated for years.[5] Some studies suggests that keratinized tissue is needed for the preservation of periodontal

Geliş Tarihi/Received 08.07.2023
Kabul Tarihi/Accepted 22.09.2023
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Tezel Ö, Yeğinoğlu S, Tezel A. Is Insufficiently Keratinized Mucosa a Risk Factor for Periimplantitis? A Literature Review . *Current Research in Dental Sciences*. 2024;34(2):150-154

tissues.[4] It has been believed that approximately two millimeters of keratinized gum and ~ 1 millimeter of adherent tissue are required to ensure the stability of the periodontium.[5] Conversely, multiple reports have questioned this phenomenon and suggest that the maintenance of gingival health can happen without adherent keratinized mucosa.[6,7]

1) Peri-implant Tissue

Dental implants (DIs) are artificial roots produced to replace teeth. DIs offer durable infrastructure permanent or removable dentures made in accordance with your natural teeth.

Advantages of DIs:

- Better aesthetic appearance. DIs are indistinguishable from real teeth. DIs are permanent because they are attached to the bone.
- Speech: Improperly secured dentures may lead to slipping of the teeth resulting in difficulty in communication. Permanent DIs are an option to circumvent the issue of teeth slipping.
- Comfort. Since the implants form a whole with you, you do not feel the discomfort of removable prostheses.
- Simplify eating. Removable dentures may cause chewing difficulties and permanent DIs improve eating and chewing food with ease.
- Improved self-esteem. DIs enhance your confidence and improve your smile.
- Ease of Use. DIs reduce complications and the inconvenience of having to remove and clean dentures, as well as the necessity for cements.

Peri-implant tissue surrounds DIs and are classified into soft and hard tissue groups. The soft group, or peri-implant mucosa/tissue, is generated through the wound healing process. The healing process occurs following implantation. The soft tissue interface is important due to its capacity to form a biological seal around the implant, which protects against infection or foreign material.

The peri-implant mucosa is made up of keratinized oral, sulcular, and junctional epithelium that includes a connective tissue base layer. Hemidesmosomes and basal lamina are located within the implant and epithelium. This is also known as the "biological width" (1 mm + 0.97 mm). It consists of the supra-alveolar connective tissue and connecting epithelium. Clinically, there should be no progression within two millimeters of the tooth. A comparable association of bone to the soft tissues occurs about the DIs and/or teeth. Relapses in this association may contribute to early crest loss of bone.[8] The comparisons between the tooth/soft tissue interface and the peri-implant is shown in Table 1.

Table 1. Comparison between tissue around teeth and the peri-implant

Features	Peri-Implant Tissues	Tissues around Teeth
Gingival fibers	No implant insertion: fibers are parallel or circumferential to the long axis of the implant	Complex array of fibers inserting into the cementum about the crestal bone and onto the periosteum
Junctional epithelium	Hemidesmosome attachment to titanium	Hemidesmosome attachment to enamel
Connective tissue attachment	Structure rich in collagen with no fibroblasts and vascularity Variable and dependent on the implant depth positioning	organized collagen bundles perpendicular to the root cementum average 1-9 mm
Gingival sulcus depth	Variable and dependent on the implant depth positioning and abutment length and restoration margin	Shallow on around 2–3 mm
Blood supply	Less blood vessels and supply come from the underlying periosteum	Numerous vascular anastomoses between the vessels from the PDL space, and gingival connective tissue
Biological width	JE = 1.88 mm and CT = 1.05 mm	Junctional epithelium – 0.97 mm; CTA – 1.07 mm

DIs do not have root cementum, PDL, or bone like natural teeth.[9] Dental alveolar and gingival fibers link the gums to the tooth. These fibers are noticeable in the peri-implant. In healthy areas, the gingival boundary follows the contours of the cement-enamel junction, while the mucosal margin around an implant tracks the crest bone for multiple DIs or adheres to the proximal teeth tissue of single DIs. While the implant is rigidly fixed to the surrounding host bone, it is mobile within the tooth socket at the physiological limit. There has become an increased demand for DIs and good clinical practice has become a mainstay. Peri-implant health is fundamental for DI survival.

2) Keratinization and Its Clinical Significance

The epithelial layer of the attached gingiva is hard, resistant to trauma, and firmly attached to the underlying connective tissue. This durability is due to the formation of keratin in the upper layer of the epithelium (also called keratinized mucosa (KM)). Such differentiation is called keratinization.[10]

KM is the chewing mucosa found around dental implants. KM encompasses the peri-implant mucosal edge and the mobile mucogingival mucosa. KM is covered by an orthokeratinized squamous epithelium and consists of lamina propria (fibroblasts and fibrous connective tissue containing type I/III collagen).[11-13] Crest bone loss after tooth extraction has been suggested to cause a reduction in KM. The KM thickness in the facial region more prominent in DIs compared to the teeth (2.0 mm vs 1.1 mm, respectively).[12] A minimal amount of KM for maintenance of peri-odontal and -implant health around teeth and implants is controversial.[14-17] A few studies failed to link KM deficiency with inflammation of the mucosa,[18-22] while others have shown plaque deposition and marginal inflammation are more common at implant sites that have less than two millimeters KM.[23-27]

Lang and Löe [4] reported a relationship between keratin-attached gingival width and periodontal health. It is known that a minimum of 2 mm keratinized tissue and 1 mm of attached gingiva are considered healthy in more than 80% of the surfaces. Clinical inflammation has been demonstrated in areas with less than one millimeter of keratinized and attached gingiva. Lang and Löe (1972) [4] and Berglundh et al.[28] showed that the mobile gingival margin could give rise to microorganism entry into cavity. These results showed that 2 mm of keratinized tissue and 1 mm of adherence was adequate for gingival health.

Esfahanizadeh et al.[29] demonstrated KM width was inversely associated with Marginal Bleeding Index (MBI), Marginal Plaque Index (MPI), Marginal Gingival Index (MGI) ($P < 0.05$). No relationship was determined for width KM and age, sex, Probing Deep, oral hygiene rinses, tooth brushings, or dental status ($P > 0.05$).

Miyasato and colleagues demonstrated [30] that gingival margin health may be maintained at a KM less than one millimeter. No differences were found in terms of clinical inflammation for patients with reduced or enhanced KM.[30-33]

Lindhe and colleagues [34] assessed the peri-implant and tooth tissue reactions following plaque buildup. They showed that there was a similarity between DIs and natural teeth.

There are authors who think that KM is important in maintaining the long-term health of the soft/hard tissues around the implant, as well as claims to the contrary.[35-41] Two millimeters of keratinized gingiva and 1 mm of attached gingiva is sufficient to preserve healthy gums in natural teeth.[36,37]

Various studies have reported that patients with “inadequate” amounts of KM (< 2 mm) may have pain and other complications during daily oral hygiene procedures at DI sites. It has also been shown that more gingival recession may be linked to increased plaque, bleeding during probing, and bone loss.[22,23,32,37] Therefore, mucogingival surgeries with free gingival grafts have been suggested to increase the narrow band of keratinized tissue.

Conversely, some reports have shown a reduction in KM surrounding the DI does not adversely disturb the health or stability of tissues around the implant in those with good oral hygiene.[37,42,43] Evaluations of the need for KM around implants show that health maintenance and tissue stability is lacking[15,17] while others state that KM is positive in preventing inflammation.[12,37,44,45]

When the previous literature is evaluated, the frequency of DIs surrounded with KM at less than 2 mm varies between 23.8% and 74% [37,46] Many factors influence the attached gingiva width that surround natural teeth, including tooth location, inflammation or other reasons, including tooth position, high frenulum and muscle attachments.[37,47]

KM consists of the area from the gingival margin to the mucogingival line. It has been suggested that the width of the KM is greater than or equal to 2 mm and the attached gingiva ≥1 mm is sufficient for gingival health.[6,17] It has been reported that the adjacent mucosa to DIs consists of a 2 mm high (long) marginal connecting epithelial layer and a more apical connective tissue region about 1.5 mm high (long).[17]

Mammalian studies have shown similarities between soft tissue responses to plaque in the surrounding teeth and DIs.[25] Up to now, the impact of KM on peri-implant health has been consistently discussed.[21,25,46] In a clinical study, the effect of the presence of KM on peri-implant soft tissue health could not be proven. The effect of KM on plaque deposition has not been clarified.

Kungsadalpipob[7] is used with implants without keratinized mucosa, showed three times more plaque buildup in comparison to DIs containing KM. This result is in line other reports that have shown higher plaque scores at implant sites that do not contain keratinized mucosa.[6,7,23,32]

Reduced KM may contribute to an environment of poor hygiene and augmented predisposition to mechanical irritation/discomfort during daily oral hygiene procedures.[7] The lack of KM has been linked to mucosal recession. DIs lacking KM were enhanced threefold to mucosal recession (≥ 1 mm) in comparison to DI sites with KM.

Zigdon and Machtei[22] demonstrated an enhanced decline and reduced pocket formation in areas with less KM. The absence of KM may facilitate inflammatory components to apically migrate. Nevertheless, mucosal recession and its development at DI sites following restoration are strongly debated. Improper DI placement, KM deficiency, thin tissue or buccal bone, and loss of alveolar bone height need consideration for their relationship to mucosal recession in DIs.[7]

3) The Role of Quantity and Characteristics

Strub et al.[48] have been considered while the debate on the amount of keratinized implants were placed in an area without KM. A higher rate of plaque accumulation and peri-implantitis is expected compared to implants placed in an area with keratinized mucosa.[49]

Wenström et al.[21] hypothesized that a reduction in MK zones hinder correct oral hygiene and is insufficient to protect against distress while brushing or chewing, as well as bacterial plaque load.[20]

Provided adequate plaque control is achieved, it is compatible with peri-implant soft tissue health even in the absence of marginal keratinized tissue.[17,18,20]

Warrer et al.[38] on the other hand reported that a higher rate of attachment loss and gingival recession was observed for dental implants with insufficient keratinized mucosa as a result of ligature-induced plaque accumulation for 9 months around 30 implants placed. In this study, they suggested that “ligature-induced plaque accumulation” may also be associated with patients with “insufficient oral hygiene”.

Bouri et al.[31] in their study of 200 dental implants in 76 patients found that the amount of bleeding, plaque and gingival index, and alveolar bone loss during probing was higher for implants with insufficient keratinized mucosa (less than 2 mm) when compared to Dis with sufficient KM. It was reported that it was high and suggested that KM is necessary for the preservation of tissue stability.

Zigdon and Machtei[22] reported that KM surrounding the DIs can be critical in the early diagnosis of mucosal recession. These investigators suggested that patients with less than two millimeters of KM had higher plaque deposition associated with peri-implantitis over a 3-year period.

The peri-implant, which takes care of the important points between the soft tissue connection of DIs and teeth, if the peri-implant is keratinized content or is the most beneficial, and the same 2 mm threshold for soft tissue health and natural teeth is also valid for dental implants.[20]

Kim et al.[19] followed 276 dental implants for 13 months. No difference was observed in terms of gingival index, plaque index, and pocket depth for parts with insufficient amount of keratinized thickness, while marginal bone loss and gingival rates were higher than those with insufficient keratinized coating. Observation of birth reveals the necessity of a keratinized coating for the successful maintenance of dental implants.

Schrott et al.[20] evaluated a total of 307 implants in their studies in which the keratinized layer canal was examined separately in both lingual and buccal tissues for peri-implant tissues. In the results of the study, there was no component to evaluate the amount of keratinized coating in the buccal region, plaque accumulation and bleeding on probing. Conversely, cells with a higher rate of gingival emission were observed. In the lingual class, higher values were obtained than the plaque index and gingival index values in areas where the keratinized coating was insufficient. These values were discussed with the difficulties of oral hygiene practices in the lingual region.

Dental implants have a wide range of indications. It is very important to follow the desired successful results with implant treatment. Due to the popularity of implant-supported prostheses and the consumption of photographs, there are many studies in the literature. However, while there are various examinations evaluating the satisfaction levels of patients after implant treatment [13], the number of studies revealed by the amount of keratinized gingiva is quite vast in the literature.

Whether adequate amount of KM in dental implants is necessary for peri-implant health is debatable. In the literature, sufficient KM for peri-implant health has been documented to be ≥ 2 mm. When KM is < 2 mm, it may increase peri-implant health and may cause peri-mucositis/peri-implantitis.[12]

Studies have shown that peri-mucositis development is more common with a band of keratinized tissue less than 2 mm.[20,32,45] Periodontal destructions can occur when the structures are inadequate in the size of the keratinized tissue band and when the plaque is made appropriately.[7,10]

CONCLUSIONS

This study is not a meta-analysis study but a systematic review. The search process resulted in identifying 65 potential articles. The articles scanned were completed using different groups of different materialss and methods made between the years of 1972-2023. Since all articles have deficiencies and advantages over each other, future standardized studies are needed to say that keratinized gingiva is a definite risk factor for periimplantitis. With this the consensus report of the 2017 World Workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions recommended that the role of KM on long-term peri-implant tissue health is ambiguous. Despite this, KM may be necessary for overall oral comfort and to facilitate the removal of plaque. KM as a barrier fight against inflammation and gingival recession. The KM is important for masticatory stresses in the tooth margin or crown, and results in esthetics that are more favorable, overall comfort, and

simplified brushing. Therefore, the presence of KM in the surrounding DI space is important for the prevention of inflammation, plaque buildup, and gingival recession. Clinicians should be aware of this factor when placing dental implants at a particular site.

Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – A.T.; Tasarım – A.T; Denetleme – A.T; Kaynaklar – A.T.; Veri Toplanması ve/veya İşlemesi – S.Y.; Analiz ve/veya Yorum – S.Y.; Literatür Taraması –Ö.G.; Makaleyi Yazan – Ö.G.; Eleştirel İnceleme – Ö.G.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Peer-review: Externally peer-reviewed.
Author Contributions: Concept – A.T.; Design – A.T.; Supervision – A.T..; Resources – A.T.; Data Collection and/or Processing – S.Y.; Analysis and/or Interpretation – S.Y.; Literature Search –Ö.G.; Writing Manuscript – Ö.G.; Critical Review – Ö.G.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Olgu Sunumu *Case Report* DOI: 10.17567/ataunidfd.998934

Dudak Damak Yarıklı Bir Hastanın Protetik Tedavisinin Yenilenmesi

Prosthetic Retreatment of the Patient with Cleft Lip and Palate

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24. Uluslararası Türk Prostodonti ve İmplantoloji Derneği Bilimsel Kongresi'nde sözlü bildiri olarak sunulmuştur. (Dalaman/Muğla) (31 Ekim – 3 Kasım 2019)

Geliş Tarihi/Received 17.06.2021
Kabul Tarihi/Accepted 22.09.2021
Yayın Tarihi/Publication Date 15.04.2024

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Cite this article: Çetin T, Aslan U, Evren B, Türker ŞB. Prosthetic Retreatment of the Patient with Cleft Lip and Palate. *Current Research in Dental Sciences*. 2024;34(2):155-159.

ÖZ

Dudak-damak yarıkları embriyolojik ve erken fetal dönemdeki gelişim bozukluklarının sonucu olarak gelişmektedir. Dudak damak yarıklı bireylerin tedavisinin temel amacı hastaların estetik, fonksiyon ve fonasyon problemlerini tedavi etmektir. Protetik tedavi; uzun süreli takip ve multidisipliner ekip çalışması gerektiren dudak damak yarıklı yetişkin bireylerin tedavisindeki son aşamadır. Bu vaka raporunun amacı; uyumunu kaybetmiş sabit ve hareketli protezi bulunan dudak damak yarıklı hastanın yenilenen protetik tedavisinin aşamaları hakkında bilgi vermektir. Çift taraflı dudak damak yarığı bulunan ve Marmara Üniversitesi Diş Hekimliği Fakültesi'nde 17 yıl önce tedavi edilmiş olan 36 yaşındaki bayan hasta mevcut protezlerinin yenilenmesi talebiyle Marmara Üniversitesi Protetik Diş Tedavisi Anabilim Dalına başvurdu. Sabit-hareketli (bar ataşman tutuculu) protez kullanan hastanın sabit protezleri desimante edilip destek dişlerin vitalitesi kontrol edildi ve maksiller sol kanin dişinde mobilite tespit edildi. Vitalite kaybı olan maksiller sol kanin ve ikinci küçük azı dişlerine endodontik tedavi yapıldı. Defekt bölgesinde bar ataşman altında kalan yumuşak dokuda proliferasyon olduğu tespit edildi. Prolifere doku diyot lazer ile eksize edildi. Daha önceden prepare edilmiş maksiller sağ/sol kanin ve küçük azı dişlerine minör preparasyon yapıldı. Sağ ve sol destek dişler çapraz ark stabilizayonu için dolder bar ile birbirine splitlendi. Sabit protetik tedaviler ve hassas tutuculu bölümlü protez aşamaları tamamlanarak hastanın protetik rehabilitasyonu sağlandı. Hareketli ve sabit protezin birlikte kullanılması ile çiğneme kuvvetleri dengeli bir şekilde destek dişlere iletildi. İdeal oklüzyon sağlandı. Hareketli protezin bukkal konturuyla kabul edilebilir estetik elde edildi ve hasta memnuniyeti sağlandı. Sonuç olarak bu vaka ile anterior bölgede kemik defekti bulunan çift dudak-damak yarıklı hastalarda hassas tutuculu hareketli protetik restorasyonların uygulanması ile estetik beklentilerin karşılanmasının, çiğneme ve konuşma fonksiyonlarının rehabilitasyonun başarıyla sonuçlandırılabileceği görüldü.

Anahtar Kelimeler : Dudak damak yarığı, Hassas bağlantılı hareketli protez, Dolder bar

ABSTRACT

Cleft lip and palate develops as a result of embryological and early fetal developmental disorders. The main purpose of the treatment of patients with cleft lip and palate is to treat aesthetic, function and phonation problems. Prosthetic treatment is the final stage in the treatment of adults with cleft lip and palate requiring long-term follow-up and multidisciplinary teamwork. The aim of this case report was to give information about the steps of renewed prosthetic treatment with a cleft lip and palate who has fixed and removable prosthesis that had insufficient retention and stability. A 36-year-old female patient with bilateral cleft lip and palate, treated 17 years ago at Marmara University was referred to the Marmara University Department of Prosthodontics for the complaint of her existing prostheses. The intraoral examination revealed a problem according to the retention and stability of her removable denture. The fixed prosthesis of the patient was desemented and the vitality of the supporting teeth was checked. Mobility was detected in the maxillary left canine tooth. Endodontic treatment was performed on the maxillary canine and second premolar teeth that lost vitality. Soft tissue proliferation under the bar attachment was detected in the defect area. Proliferated tissue was operated by using diode laser. Minor preparation was performed on previously prepared abutment maxillary right / left canine and premolars. The right and left abutment teeth are connected by a dolder bar to obtain bilateral stabilization. The prosthetic rehabilitation of the patient was completed by the fixed prosthetic treatment and the partial removable denture with precision attachment. The chewing forces is transmitted to the support teeth in a balanced manner to provide ideal occlusion with using the removable and fixed partial dentures together. In conclusion, with this case, it has seen an acceptable aesthetic was provided with the buccal section of the removable partial denture to achieve patient satisfaction. The function, fonation and aesthetics of patients with bilateral cleft lip and palate can be rehabilated by using removable partial denture with precision attachment.

Keywords: Cleft lip and palate, Removable prothesis with precision attachment, Dolder bar

GİRİŞ

Maksillofasiyal deformiteler kongenital, travma, nekrozitan hastalıklar ve onkocerrahi kaynaklı olarak oluşabilir.[1] Kongenital bir anomali olan dudak-damak yarıkları bu grupta en sık görülen hastalıklardan biridir.[2] Dünya genelinde 600-700 canlı doğumdan birini etkilemektedir.[3] Dudak-damak yarıkları hem genetik hem çevresel faktörlerin yer aldığı karmaşık bir etiyolojiye sahiptir. Folik asit eksikliği, annenin yaşı ve annenin sigara içmesi gibi risk faktörleri yarıkların gelişimi ile ilişkilendirilmiştir.[4]

Estetik problemlere ek olarak, yarık dudaklı ve / veya damaklı bireyler, sınırlı çene-yüz büyümesi, konuşma anomalileri, yutma ve beslenme zorlukları, işitme kaybı ve / veya tekrarlayan kulak enfeksiyonları gibi önemli fonksiyonel morbidite geçirirler.[5] Çene yüz deformiteleri hastaları psikolojik ve fiziksel durumlarını olumsuz etkileyerek ciddi psikiyatrik, ailevi ve sosyal sorunlara da neden olabilir.[6]

Dudak damak yarığı tedavisinde multidisipliner bir yaklaşım tüm dünyada yaygın olarak kabul edilmektedir. Multidisipliner ekip genellikle plastik cerrahlar, maksillofasiyal cerrahlar, kulak burun boğaz uzmanları, konuşma terapistleri, odyologlar, ortodontistler, psikolog, sosyal hizmet uzmanları ve uzman hemşirelerden meydana gelmektedir.[7]

Dudak damak yarıklı bireylerin oral rehabilitasyonunda, malformasyonun sebep olduğu anatomik ve fonksiyonel değişikliklerin boyutu ve tedavi başlangıç yaşı önemlidir.[8] Dudak damak yarıklı hastaların rehabilitasyonunda, intraoral birincil tedavi yaklaşımı plastik cerrahi rekonstrüksiyonudur.[9] En ideal tedavi seçeneği kemik greftiyle ya da ortodontik olarak defekt alanının kapatılmasıdır.[10] Ancak doğumsal ya da edinsel çene yüz defektlerinin tedavisinde bazı durumlarda protetik restorasyonlardan yararlanılması gerekmektedir.[11] Dudak damak yarıklı hastalarda diş eksikliklerinin olduğu durumlarda ortodontik tedaviden sonra dişsel fonksiyonları sağlamak ve estetiği tamamlamak için son olarak protetik tedaviye ihtiyaç duyulur. Protetik tedavinin amacı; bireyin fonksiyonel ve estetik rehabilitasyonunu sağlamaktır.[12,13] Dudak damak yarığı olan hastalar için, protetik tedavi alternatifleri sabit diş destekli restorasyonlardan hareketli protezlere kadar çeşitlilik göstermektedir.[14,15] Mevcut doğal dişlerden, implantlardan ve diş-implant kombinasyonlarından yararlanılır.[16,17,18] Protetik endikasyonlar çene-diş ilişki durumlarına ve kalan dişlerin periodontal desteklik kalitelerine bağlı olarak çeşitlilik göstermektedir.[19]

Dudak damak yarıklı bireylerin protetik rehabilitasyonunda uygulanan tedavi seçenekleri konvansiyonel yöntemler dahilinde gerçekleştirilmektedir. Protetik tedavinin başka bir amacı ise ortodontik tedavi sonucu elde edilen kalan dişlerin ark üzerindeki konumlarının stabilizasyonunu sağlamaktır. Bu nedenle sağ ve sol ark stabilizasyonu önemlidir. Hastaya uygulanan protetik tedavinin sabit komponentleri ark stabilizasyonunu sağlarken hareketli protez destek dişlerin splintlenmesine indirekt olarak yardımcı olmaktadır.[42,43] Bu çalışmanın amacı; 17 yıllık klinik takibi yapılan ve destek dişlerin mevcut durumunu korumak amacıyla protetik tedavisi yenilenen hastanın tedavi basamaklarının anlatılmasıdır.

OLGU SUNUMU

Üst çenesinde çift taraflı dudak damak yarığı bulunan 36 yaşındaki bayan hasta maksiller sol kanin ve ikinci küçük azı dişlerindeki ağrı şikayetiyle Marmara Üniversitesi Diş Hekimliği Fakültesi Protetik Diş Tedavisi Anabilim Dalı'na başvurdu. Alınan anamnezde, çift taraflı dudak damak yarığıyla doğan hastada başarılı cerrahi tedaviyle defekt bölgesi yumuşak doku ile kapatıldığı tespit edildi. Mevcut dudak damak yarığı ile ilgili ailesel geçmiş sorgulandığında, ailesinde başka dudak damak yarıklı birey bulunmadığı, sigara, alkol veya herhangi bir ilaç kullanmadığı belirlendi.

Hastanın, fakültemizde 17 yıl önce hareketli bölümlü tedavisinin tamamlandığı ancak intraoral ve ekstraoral muayenelerde mevcut hassas tutuculu hareketli bölümlü protezinin retansiyon ve stabilitesini kaybettiği, sol kanin ve ikinci küçük azı dişlerinde dikey perküsyonda ağrı tespit edildi. Mevcut sabit protezlere destek olan dişlerde dişeti çekilmesi kaynaklı kök yüzeylerinde açılmalar ve çürükler olduğu tespit edildi (Resim 1). Hastanın premaksilla eksikliğine bağlı olarak dudak desteğinin olmadığı ve yarıktan dolayı dudakta skar dokusu olduğu belirlendi.

Resim 1. Mevcut protezlerin lateral görüntüsü

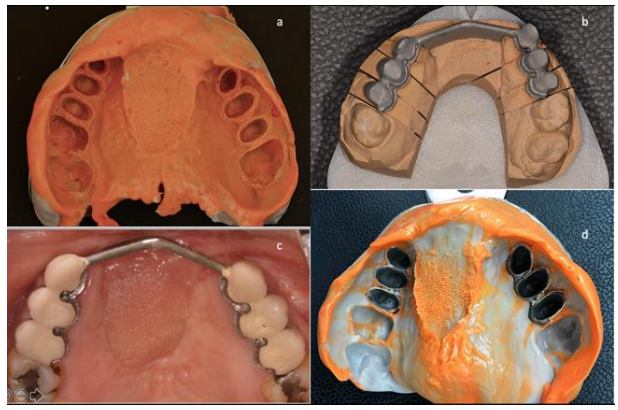
Yapılan radyolojik muayenede, hastanın maksiller sol kanin dişinde apikal lezyon tespit edildi. Defekt bölgesinin sağ ve solunda yer alan kanin ve küçük azı dişlerinin periodontal desteklerini kısmen kaybettikleri gözlemlendi (Resim 2). Tüm bu veriler doğrultusunda hastanın mevcut protezlerinin değiştirilmesine karar verildi. İlk olarak sabit protetik restorasyonlarının desimantasyonu yapıldı. Sabit protetik restorasyonlara bağlı hassas bağlantı ataşmanının altında kalan defekt alanında yumuşak doku proliferasyonu ve maksiller sol kanin ve ikinci küçük azı dişlerinde derin dentin çürüğü gözlemlendi (Resim 3). Preprotetik hazırlık amacıyla maksiller sol kanin ve ikinci küçük azı dişlerinin endodontik tedavisine ve prolifere dokunun lazer ile eksize edilmesine karar verildi.

Yumuşak doku ve endodontik lezyonların iyileşme prosedüründen sonra tekrar muayene edilen hastaya tutuculuk ve çift taraflı stabilizasyonun sağlanması için hassas tutuculu protez yapılmasına karar verildi. Fonasyona yardımcı olması ve periodontal desteklerini kaybetmiş endodontik ve restoratif tedavi görmüş destek dişlere gelen oklüzal yükün azaltılması amacıyla sert damaktan destek alan hareketli bölümlü protez planlandı.

Resim 2. Hastanın panaromik görüntüsü

Resim 3. Hastanın ağız içi görüntüsü

Defekt bölgesine komşu maksiller sağ/sol kanin ve küçük azı dişlerinin preparasyonları dişeti sınırında chamfer bitim çizgisi ile tamamlandı. Destek dişlerin restraksiyon işlemlerinin tamamlanmasının ardından kondansasyon tipi silikon (ZetaPlus Intro Kit L, Zhermack, Badia Polesine, İtalya) ile iki aşamalı ölçü alındı (Resim 4 a). Hastanın mevcut oklüzyonu esas alınarak kapanış tespit edildi. Artikülatöre alınan modeller üzerinde metal altyapılar ve sağ sol arkı birbirine bağlayan dolder bar ataşman hazırlandı. Restorasyona dahil edilen tüm destek dişlerin metal altyapılarının palatinaline indirekt tutucu olarak kullanılmak üzere frezeler yerleştirildi (Resim 4 b). Ağız içinde hazırlanan metal altyapıların ve ataşmanın uyumu kontrol edildi. Doku ve oklüzal ilişkilerinde problem tespit edilmedi. Porselen aşaması için restorasyonlar laboratuvara gönderildi. Dentin provada basamak ve doku uyumları kontrol edildi (Resim 4 c). İdeal sentrik oklüzyonu sağlamak için dişsel ilişkiler düzenlendi. Lateral ve protrüziv harekette tüberkül ilişkileri kontrol edildi ve gerekli aşındırmalar yapıldı. Estetik görünüm, dikey boyut, dudak desteği ve istirahat pozisyonundaki görünümleri son kez kontrol edildi. Sabit restorasyonlar ağız içinde ilgili yerlerinde iken hassas bağlantılı hareketli bölümlü protez hazırlanacak alanın ölçüsü prefabrik metal kaşık ve polivinil siloksan silikon (Zhermack Hydrorise Putty/Light Body. Zhermack, Badia Polesine, İtalya) ile ölçüsü alındı (Resim 4 d). Model hazırlandı. İkinci azı dişlerinde distal çevresel kroşeler yer alan plak şeklinde ana bağlayıcı üretildi. İskelet alt yapının provası (Resim 5), mum duvar hazırlığı, modellerin artikülatöre alınması, diş dizimi safhaları tamamlandı. Dişlerin estetik görünümü, dudak desteği ve hastanın fonasyonu dişli provada kontrol edildikten sonra protezin bitim aşamasına geçildi. Hareketli protezin mufla ile bitim aşamasından sonra ağız içinde son kez doku sınırları kontrol edildi. Yumuşak doku sınırlarında düzenleme yapıldıktan sonra cila yapılıp protez hastaya teslim edildi (Resim 6). Protezler ile hastanın estetik, fonksiyonel, fonetik ve psikolojik problemleri rehabilite edildi. 3 yıllık klinik takip sonucunda protezlerin uyumunda ve balansında herhangi bir problem gözlenmedi, hastanın beklentilerinin karşılandığı görüldü.



Resim 4. Sabit protetik restorasyon ölçüsü (a), Alt yapı ve hassas bağlantı ataşmanı (b), Porselen prova aşaması (c), Hareketli bölümlü protez ölçüsü (d)

Resim 5. İskelet altyapının görüntüsü

Resim 6. Protez bitim aşaması

TARTIŞMA

Çift taraflı dudak-damak yarıklı hastalarda ideal fonksiyon ve estetik görüntü oluşturmak çoğu zaman zorlu bir süreç olup dikkatli çalışma gerektirmektedir. Genellikle bu hastalarda dişlerde yerleşim anomalileri ve iskelet malformasyonu gibi karmaşık faktörler de mevcuttur.

Karmaşık durumlar protetik tedavi de dahil olmak üzere multidisipliner bir ekibin müdahalesini gerektirir.[20] Dudak damak yarığı olan bireylerin protetik tedavi, büyümenin tamamlanmasının ardından ortodontik ve cerrahi tedavilerden sonra yapılmaktadır.[21] Pek çok protetik tedavi seçeneği arasından seçim yapmak, hastanın özel klinik durumuna, temel şikayeti ve isteklerine dayanmaktadır. Klinik muayenede sadece diş durumlarını değil, aynı zamanda alveolar kemik şeklinin, skar dokusunun ve oronazal bağlantının değerlendirmesi gerekmektedir.[22,23] Dudak damak yarıklı bireylerde eksik dişlerin tamamlanması, çiğneme ve konuşma fonksiyonlarının düzeltilmesi ve optimal oklüzyon stabilizasyonu protetik tedavi ile sağlanabilir. [24] Tedavi planlaması yapılırken birçok faktör göz önüne alınıp bu faktörler doğrultusunda sabit ya da hareketli protezler planlanır. Sonuç olarak defekt bölgesinin büyüklüğü, pozisyonu, varsa mevcut dişlerin sayısı ve periodontal durumu ve hastanın sosyo-ekonomik ve psikolojik durumu vakanın planlanmasında etkilidir.[25]

Bu tedavide temel amaç, eksik yumuşak ve sert dokuların hacminin yerine konularak dudak desteğinin sağlandığı estetik olarak kabul edilebilir protetik rehabilitasyon sağlanmasıdır. Hastanın defekt bölgesinde alveolar doku kaybının fazla olması ve defekt bölgesine komşu dişlerde yeterli kemik desteğinin bulunmaması nedeni ile hastaya sabit protetik tedavi uygulanmamıştır. Dudak damak yarıklı hastalarda eksik diş sayısı, kalan kemik miktarı ve dudak desteği gibi etkenlerden dolayı çoğu zaman sadece sabit ya da sadece hareketli protezlerle başarılı bir protetik tedavi mümkün olmamaktadır.[26] Bu yüzden sabit ve hareketli protezlerin kombinasyonlarına başvurmak gerekmektedir.[27] Hochman'a göre kombinasyon protezlerin takılıp çıkarılabilen hareketli bölümleri ve mevcut dişler üzerindeki sabit kısım premaksillayı stabilize ederek defek bölgesindeki doku genişlemelerini önlemektedir.[28] Defekt bölgesinde vertikal ve horizontal kemik kaybının fazla ve mukozanın kıvrımlı olduğu durumlarda klasik sabit köprü protezlere gelen yükün destek dişlere zarar verdiği bilinmektedir.[29,30] Bu tip durumlarda defekt bölgesinin iki tarafındaki komşu destek dişler üzerindeki sabit protetik restorasyonların bar ataşmanla splintlendiği ve bu hassas tutuculu sistem üzerine yerleşen hareketli protezle hastalar tedavi edilmektedir.[30,31] Bu sabit-hareketli protez sisteminin temelini 1965 yılında Dr. James Andrews atmıştır.[32] Sabit ekstra koronal bar sistemi sayesinde, çiğneme işlevi sırasında hareketli protezin dikey hareketi minimuma indirilir, böylece çiğneme kuvvetinin etkisi artarken hareketten dolayı oluşacak yumuşak doku irritasyonu minimuma indirilir.[33,34] Bunların yanı sıra estetik bölgede görüntüyü kötü etkileyen kroşeler yer almaz.[35]

Sabit ve hareketli protezlere destek olması için implantlar planlamaya dahil edilebilir.[26] İmplant yerleştirmek için kemik yapının durumunun yeterli olmadığı ve komşu dişlerde çeşitli sebeplerle estetik düzenlemelere ihtiyaç duyuluyorsa geleneksel protezler yeterli bir tedavi seçeneği olabilmektedir.[36] Ancak protetik restorasyon için yeterli diş ve doku desteğinin bulunmadığı ve implant yerleşimi için maksiller bölgede yeterli kemik desteğinin bulunmadığı durumlarda zigomatik implantlardan faydalanılabilir. Bu implantlardan proteze yeterli destek sağlanabilir.[37] Bu vakada, hastanın premaksiller bölgede implant yerleştirmek için kemik yapısının olmaması ve mevcut dişlerinin splintlendikten sonra yapılacak hassas bağlantılı proteze yeterli desteği sağlayacağı düşünüldüğü için implant tedavisi planlamaya dahil edilmedi. Kantorowitcz, hareketli protezlere yeterli desteğin sağlanması için sabit protezler ikinci küçük azı veya birinci küçük azı dişine kadar uzatılması gerektiğini bildirmiştir.[38] Bu vakada hassas tutuculu hareketli proteze tutuculu sağlayan sabit protetik restorasyonlar 2. premolara kadar uzatılarak gerekli desteğin sağlanabileceği düşünüldü. Ayrıca protezin stabilizasyonuna katkı sağlaması için 2. büyük azı dişlerine yerleştirilen kroşelerden faydalanıldı.

Dudak damak yarıklı bireylerde en çok karşılaşılan problemlerden biri de yetersiz dudak desteği ve eksik dokular sebebiyle kötü estetiktir. Akrilik uzantılı hareketli bölümlü protezler defekt bölgelerindeki eksik dokuları telafi edebileceği için dudak damak yarıklı bireylerin tedavisinde sıklıkla tercih edilmektedir.[39,40,41] Bu vakada, kanin dişler arasındaki bölgede eksik dokuların telafisi için hassas tutuculu hareketli bölümlü protezin bukkal bölümü akrilikle kalınlaştırılarak kabul edilebilir estetik sağlanabildi.

SONUÇ

Dudak damak yarıklı hastaların tedavisi multidisipliner bir çalışma gerektirmektedir. Doğumdan itibaren başlayan tedavi prosedüründe birçok etken göz önünde bulundurulmalıdır. Son basamak olan protetik tedavide amaç çiğneme işlevinin, konuşma becerisinin ve estetik görünümün kabul edilebilir derecede hastaya kazandırmak, ortodontik tedavi sonucu elde oklüzyonun stabilizasyonunun sağlamaktır. Bu amaçlar doğrultusunda ilgili vakada mevcut dişlerin sabit protezlerle splintlenerek tutuculuk ve stabilizasyon sağlanmış, dudak-damak yarıklı bölgedeki doku kayıpları hassas tutuculu bölümlü protez ile rehabilite edilmiştir. 17 senelik kullanım sonrası meydana gelen komplikasyonlar elimine edilmiş ve hastada herhangi bir destek diş kaybedilmemiştir. Hastanın son 3 senelik klinik kontrollerinde herhangi bir komplikasyona rastlanmamıştır. Hasta estetik, fonksiyonel ve fonasyonel herhangi bir şikayette bulunmamıştır. Dudak-damak yarıklı bireylerin protetik tedavisinde uzun dönem prognoz çok önemlidir.

Hasta Onamı: Yazılı hasta onamı bu çalışmaya katılan hastalardan alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir – Ş.B.T.; Tasarım – Ş.B.T., T.Ç., Y.U.A.; Denetleme – Ş.B.T.; Kaynaklar – Ş.B.T., B.E.; Veri Toplanması ve/veya İşlemesi – T.Ç., Ş.B.T.; Analiz ve/veya Yorum – T.Ç., B.E.; Literatür Taraması –T.Ç., Y.U.A.; Makaleyi Yazan – T.Ç., Y.U.A.; Eleştirel İnceleme – Ş.B.T.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

Informed Consent: Written informed consent was obtained from patients who participated in this study.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept – Ş.B.T; Design – Ş.B.T., T.Ç., Y.U.A.; Supervision – Ş.B.T.; Resources – Ş.B.T., B.E.; Data Collection and/or Processing – T.Ç., Ş.B.T.; Analysis and/or Interpretation – T.Ç., B.E.; Literature Search –T.Ç., Y.U.A; Writing Manuscript – T.Ç., Y.U.A.; Critical Review – Ş.B.T.
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.

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