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Objective: The purpose of this study was to analyze the shear bond strength of orthodontic metal braces to restorative materials with various constituents and manufacturing methods after different surface conditioning methods.

Methods: The samples were prepared from Vita Mark II, Shofu Block HC, Brilliant Crios computer-aided design/computer-aided manufacturing blocks, and Gradia Direct composite restorative material, and they were exposed to 5000 thermal cycles. Fabricated samples were divided into 6 groups based on the surface conditioning method (n = 12): control (no conditioning); etching with hydrofluoric acid; sandblasting with aluminum oxide; tribochemical silica coating with CoJet sand; bur abrasion; Monobond Etch and Prime application. The surface characteristics of the restorative materials were analyzed with a scanning electron microscope. The universal adhesive was applied to the specimens, and orthodontic braces were bonded with a light-cure adhesive paste. After thermal cycling, shear bond strength values were measured, and the adhesive remnant index was recorded. Two-way analysis of variance and Tukey tests were used for statistical analysis.

Results: Both the surface conditioning method and the material type significantly affected shear bond strength values. In addition, the interaction between these variables was significant (P < .001). Control groups of all restorative materials had significantly the lowest shear bond strength values.

Conclusion: Surface conditioning methods significantly enhanced the shear bond strength. Control groups of Vita Mark II and Shofu Block HC demonstrated shear bond strength values lower than the acceptable limit, but the rest of the groups showed adequate adhesion (above 6 MPa). Consequently, clinicians can prefer Monobond Etch and Prime along with a universal adhesive as a safer surface conditioning method.

Keywords: Bond strength, CAD/CAM, orthodontic braces, restorative materials, surface conditioning

Öz

Amaç: Bu çalışmanın amacı, ortodontik metal braketlerin çeşitli bileşenlere ve üretim süreçlerine sahip restoratif materyallerle maksalama durumlarına (MBD) farklı yüzey işlemlerini sonrası analiz etmektir.

Yöntemler: Örnekler Vita Mark II, Shofu Block HC, Brilliant Crios CAD/CAM blokları ve Gradia Direct kompozit restoratif materyalinden hazırlanmıştır ve 5000 termal siklusa maruz bırakılmıştır. Hazırlanan örnekler, yüzey işleme yöntemine göre altı gruba ayrılmasıdır (n = 12): kontrol (işlem yok); hidrofluorik asit uygulaması; aluminyum oksit ile kumlama; CoJet kumu ile tribokimyasal silika kaplama; frez ile aşındırma; Monobond Etch and Prime (MEP) uygulaması. Restoratif materyallerin yüzey özellikleri tarama elektron mikroskobu ile analiz edilmiştir. Örneklerin universal adeziv uygulanması ve ortodontik braketler işıkla sertleşen adeziv pasta ile yapılandırılmıştır. Termal döngü sonrasıında MBD değerleri ölçülmüştür ve artık adeziv indeksi kaydedilmiştir. Istatistiksel analiz için iki yönlü ANOVA ve Tukey testleri kullanılmıştır.
INTRODUCTION

Adult patients seeking orthodontic treatment increase day by day owing to the advancements in orthodontic treatment options and the increase in aesthetic demands. According to a recent study adult patients with age ranging between 19 and 40 constitute 51.3% of orthodontic patients. In optimal conditions, orthodontic brackets are usually bonded to healthy tooth surfaces. However, an increase in the prevalence of direct and indirect restorations is observed in the adult population because of the predisposing malocclusion and other factors related to aging. The problem related to these restorations is that bonding braces to them with enough strength remains as a question mark since there are various types of restorative materials.

Over the last 2 decades, the use of dental computer-aided design/computer-aided manufacturing (CAD/CAM) systems became more common due to their advantages such as accuracy, speed, precision, and optimization of human errors. Due to these advantages, manufacturers are focused on developing tooth-colored CAD/CAM restorative materials with improved mechanical and aesthetic properties. First, the feldspathic ceramic CAD/CAM block that is highly aesthetic with good strength is introduced, but it had some disadvantages such as chipping, wearing the antagonist teeth, the requirement of firing, and challenge in occlusal adjustment and repair. Resin-matrix ceramic CAD/CAM blocks combining the resin composites and dental ceramics are produced to overcome known disadvantages of the felspathic ceramic CAD/CAM blocks. Additionally, resin-matrix ceramic CAD/CAM materials have the advantages of resin composites, including higher flexibility and easy and fast fabrication processes with better marginal adaptation.

The bond strength between orthodontic braces and restorative materials is important since brace failure is a common problem encountered in dental clinics. Each brace failure prolongs the duration of treatment for almost 18 days due to relapse in tooth movements, increases the number of appointments, and causes discomfort for the patient. For these reasons, it is critical to sustain enough bond strength between the orthodontic brace and the restorative material until the end of treatment. Therefore, as different restorative materials require different surface treatments to increase bond strength, various surface conditioning methods were proposed which can be classified as chemical or mechanical. As chemical methods, hydrofluoric acid, silane, and bonding agents can be applied. Hydrofluoric acid is applied especially on ceramics to make a porous surface by dissolving the glassy component and thereby maintaining a favorable surface for bonding. However, it requires a very careful application process since it can cause irritation or necrosis on soft tissue, in direct contact.

Silane application after hydrofluoric acid etching is reported to be the most reliable surface conditioning method for increasing bond strength of dental ceramics, but during the debonding process, dental ceramics might be damaged. Another chemical surface preparation method is the application of bonding agents and universal adhesives are the most recent with the ease of use and reliable bond strength to different restorative materials such as composite resin, ceramic, and zirconia. As mechanical methods, sandblasting with aluminum oxide, tribochemical silica coating, or bur abrasion can be preferred as the organic component of the restorative material increases. However, in repeated exposure, aluminum oxide and tribochemical silica coating may cause side effects on the respiratory tract and lungs, respectively. Furthermore, sandblasting with aluminum oxide or abrading with a diamond bur may cause the production of heat and stress resulting in chipping or cracking of the restoration.

Because of the need for a simpler and non-destructive method, manufacturers produced a new self-etching ceramic primer, Monobond Etch and Prime (MEP; Ivoclar Vivadent AG, Schaan, Liechtenstein). This chemical surface conditioner contains ammonium polyfluoride and trimethoxypropyl methacrylate providing gentle etching and simultaneous silanization, respectively. There are few studies about MEP’s efficiency in the adhesion of orthodontic braces to restorative materials. However, the bonding performance of orthodontic metal braces to resin matrix ceramics with the application of MEP along with a universal adhesive is not clarified. Since the bond strength of orthodontic braces adhered to the restorative material depends directly on the material composition, which the clinicians cannot be sure of through intra-oral examination, there is a requirement to define a suitable bonding protocol for all metal-free restorative materials, which can achieve enough bond strength to resist orthodontic forces with minimal damage to the surface of restorative material while debonding. Therefore, this study aimed to assess the influence of different surface conditioning methods along with a universal adhesive on the shear bond strength (SBS) of orthodontic metal braces to various restorative materials. The null hypotheses were that (i) restorative material does not affect the SBS and (ii) the surface conditioning method along with a universal adhesive does not influence the SBS.

MATERIAL AND METHODS

Specimens were prepared from four different restorative materials, including a feldspathic ceramic (Vita Mark II; Vita Zahnfabrik H. Rauter, Bad Sackingen, Germany), a hybrid ceramic (Shofu Block HC; Shofu Dental GmbH, Ratingen, Germany), a reinforced...
were randomly separated into 6 groups regarding the surface from each CAD/CAM block were fabricated with a micro-cutting machine (PRESI, Mecatome T180, France). In addition, 72 specimens, and was washed off and dried with an air spray for 10 seconds. After sandblasting, the specimens were treated with aluminum-oxide by a sandblaster (Airsonic mini sandblaster; Hager Werken, Duisburg, Germany) from a 10 mm distance, with a pressure of 2 bar, for 10 seconds. The sputter coated (Polaron SC7620; ThermoVG Scientific, Waltham, MA, USA) was applied to the specimens for 60 seconds. Hydrofluoric acid (HF): Hydrofluoric acid (9%; Ultradent, South Jordan, UT, USA) was applied to the specimens for 60 seconds. Sandblasting with aluminum oxide (AL): Samples were conditioned with aluminum-oxide by a sandblaster (Airsonic mini sandblaster; Hager Werken, Duisburg, Germany) from a 10 mm distance, with a pressure of 2 bar, for 10 seconds. Tribochemical silica coating with CoJet (CJ): Tribochemical silica coating was applied to the specimens, with CoJet grits (CoJet sand; 30 μm, 3M ESPE, Seefeld, Germany), using the same sandblaster with the same conditions. Bur abrasion (BUR): The samples were polished for 8 seconds using water-cooled 600-grit sandpaper since it simulates extra-fine diamond bur. Monobond Etch and Prime: Sample surfaces were conditioned with MEP, regarding the manufacturer’s instructions. Monobond Etch and Prime was rubbed on the samples with a micro brush for 20 seconds, left there for additional 40 seconds, and was washed off and dried with an air spray for 10 seconds. All sample groups, excluding MEP, were washed off for 30 seconds with deionized water and dried with an oil-free air spray directly after surface conditioning to remove the remnants. Then a universal adhesive (Single Bond Universal; 3M ESPE) was rubbed with an applicator tip on each sample surface, for 20 seconds and gently air-dried for 5 seconds, then polymerized with an LED curing light (Elipar Deep Cure; 3M ESPE) for 10 seconds as instructed by the manufacturer. After that, lower central incisor braces (Mini Master Metal Brace; American Orthodontics, Sheboygan, Wis, USA) were adhered to the samples using a light-polymerizing adhesive paste (Transbond XT; 3M Unitek, Monrovia, Calif, USA). While bonding the braces, a firm finger pressure was performed to provide evenly distributed adhesive layer thickness. The excessive adhesive paste around the brace was removed with an explorer and discarded. Then adhesive paste was polymerized using the LED curing light for 40 seconds, 1 mm above the sample, from 2 directions to obtain sufficient polymerization. The light intensity of the LED curing light was checked periodically with a curing radiometer. Following the polymerization, samples were immersed in distilled water at 37°C for 24 hours. For standardization purpose, all procedure was accomplished by a single operator who was blinded to the study groups. Before the SBS test, the samples were again exposed to the same thermocycling procedure to simulate intra-oral conditions.

The SBS of the groups were analyzed with an SBS testing device (MOD Dental, Esetron Smart Robotechnologies, Ankara, Turkey) by applying shear force (N) to the adhesive interface with 0.5 mm/min crosshead speed. The SBS data were calculated in MPa, by the following equation: debonding force (N)/area of the brace (9.34 mm²). After debonding of braces, adhesive remnants on the restorative materials were observed under a stereomicroscope at a magnification of 40X and were categorized based on the adhesive remnant index (ARI) as follows: 1, 100% remnant; 2, >90% remnant; 3, 10%-90% remnant; 4, 10% remnant; 5, no remnant of adhesive paste remained on the restorative material. After surface conditioning methods were applied, the surface characteristics of two samples from each restorative material (a total of 12 samples) were examined using a scanning electron microscope (SEM) (Apreo S; Thermo Fisher Scientific, Waltham, MA, USA). Gold sputter coated (Polaron SC7620; ThermoVG Scientific, West Sussex, England) samples were analyzed at 10 kV accelerating voltage, with 1000x magnification.

### Statistical Analysis

Statistical analysis was accomplished with software SPSS (Statistical Package for the Social Sciences) version 20.0 (IBM Corp.; Armonk, NY, USA). The data were analyzed through the Shapiro–Wilk and Kolmogorov–Smirnov tests to evaluate the normal distribution. A 2-way analysis of variance (ANOVA) test was conducted to assess the effect of restorative material type and surface conditioning method on SBS. For pairwise analyses, the
Tukey honestly significant difference (HSD) test was performed ($\alpha = 0.05$ for all tests).

**RESULTS**

Based on the 2-way ANOVA test (Table 2), both the surface conditioning method and the material type significantly influenced the SBS values ($P < 0.001$). In addition, the interaction between these 2 variables was detected to be significant ($P < 0.001$).

The SBS values of the orthodontic braces to the restorative materials after different surface conditioning procedures are presented in Table 3. According to the pairwise analysis, among the control groups, Gradia Direct specimens exhibited significantly the highest SBS values. There was no significant difference between restorative materials for BUR, HF, and MEP conditioning groups. Among AL and CJ conditioned groups, Vita Mark II specimens showed significantly the lowest SBS values.

When the SBS values obtained for restorative materials are analyzed, it is observed that Vita Mark II specimens demonstrated significantly higher values in HF and MEP groups, followed respectively by BUR, AL, CJ, and control groups. Shear bond strength values demonstrated by Shofu Block HC were significantly higher in CJ, AL, MEP, and HF groups followed by BUR and control groups. When the surface conditioning methods, applied to Gradia Direct specimens are compared, it is observed that significantly lowest values were obtained for the control group followed by the MEP group. However, there was no significant difference among the other conditioning methods. Surface conditioning methods favor the SBS values of Brilliant Crios significantly; however, no significant difference among surface conditioning methods was detected.

As presented in Table 4, Gradia Direct specimens conditioned with BUR or AL and Brilliant Crios specimens conditioned with CJ or AL had the highest incidence of score 1 (90%), while Vita Mark II specimens conditioned with CJ or AL had the lowest incidence of score 1 (50%) among surface conditioned groups. Control groups of Vita Mark II and Shofu Block HC have shown exclusively score 5 ARI score, and Brilliant Crios has shown a 90% score 5 ARI score, whereas Gradia Direct has shown evenly distributed ARI scores.

Scanning electron microscope micrographs of restorative materials after surface conditioning are demonstrated in Figures 1-4. The control groups of all restorative materials presented smoother surfaces compared to HF, AL, and CJ conditioning methods. The HF created microporosities in all the restorative materials, but Vita Mark II has an evident porous structure. The AL or CJ conditioning of the specimens resulted in sharp edges with a wavy pattern caused by elevation and depression areas, especially on Shofu Block HC, Gradia Direct, and Brilliant Crios. The BUR-conditioned Gradia Direct and Brilliant Crios specimens presented coarse finishing finishes while the other restorative materials had more homogeneous surfaces. In addition, MEP filled in the microporosities of the restorative materials making them seem smooth and glassy compared to the controls.

**DISCUSSION**

The present study investigated the influence of different surface conditioning methods on the SBS of orthodontic metal braces to different restorative materials along with a universal adhesive. Based on the findings of the present study, both the restorative material and the surface conditioning influenced the SBS significantly, and a significant interaction between 2 factors was found. Accordingly, both null hypotheses are rejected. Previous studies also revealed that the restorative material and the surface conditioning affect the SBS and even further that surface conditioning affect the SBS.
conditioning increases SBS significantly \((P < .001)\) which coincides with the results of our study.\(^28,29\) An increase in SBS associated with surface conditioning could be related to higher surface roughness that enhances the penetration of bonding agents.\(^30\)

Conventional adhesive systems require high technical sensitivity and more time, due to multiple application steps. Therefore, to overcome these disadvantages, universal adhesives which can be used in self-etch or etch-and-rinse modes in single-step are developed. In addition, they can be applied to different types of restorative materials to enhance bonding performance.\(^14\) Previous studies reported that universal adhesives can sustain adequate bond strength between orthodontic metal braces and resin composites even without extra surface conditioning which supports the findings of this study.\(^28,29\) In addition, ARI scores of the control group of Gradia Direct presented an even distribution proving high SBS between the adhesive resin and the restorative material.\(^2\) Furthermore, Essayagh Tourot et al\(^32\) concluded that SBS values between orthodontic metal braces and lithium disilicate ceramics, conditioned with universal adhesive, appear to be sufficient. However, in the present study, conditioning feldspar ceramic with a universal adhesive did not demonstrate adequate bond strength which is reported to be 6-8 MPa.\(^3,19\) Moreover, the ARI score of this group showed that no adhesive resin remained on Vita Mark II specimens. Therefore, an additional surface conditioning method is required to increase the SBS.

For conditioning glass ceramics, it is reported that the application of HF and silane is considered the gold standard.\(^15,34\) The HF creates surface roughness by the dissolution of the glassy phase as demonstrated in SEM images of Vita Mark II, in a previous study and the present study.\(^28\) This results in promoted micromechanical retention and thereby increases the SBS.\(^28\) El-Damanhoury and Gaintantzopoulou\(^35\) also suggested that conditioning with 9.6% HF and silane or bonding agent application afterward provides the highest SBS for ceramics. In the present study, after HF, the surface was conditioned with a silane-incorporated universal adhesive and the results showed that mostly HF promoted the SBS values observed for Vita Mark II. Also, regarding resin-matrix ceramic blocks (Shofu Block HC and Brilliant Crios) and direct composite resin (Gradia Direct), HF again significantly increased the SBS values. This is probably because HF etches the glassy filler component and creates micropores through the resin matrix which increases the surface energy and wettability of bonding agents.\(^27\) Although surface conditioning with HF along with silane or bonding agents proved to increase SBS, it may damage the
ceramic surface during debonding. In addition, clinicians should take safety precautions while using HF intraorally as it has a hazardous effect on soft tissues.

Mechanical surface conditioning methods can be considered as an alternative since hydrofluoric acid etching has potential side effects. One of these methods is sandblasting with aluminum oxide particles which results in micro-retentive porous surfaces. The other one is tribochemical silica coating which can increase bond strength by abrading the restorative material and producing micromechanical retention and by chemical bonding along with silane. Considering the SEM images of this study, both the AL and the CJ caused laminar porosities, with significant irregularities that possibly expanded the surface area and provided micromechanical interlocking. Regarding the SBS values, these methods increased the SBS significantly in all restorative materials that have resin components. Supportingly, according to the ARI scores, Gradia Direct specimens conditioned with AL and Brilliant Crios specimens conditioned with AL or CJ presented the highest incidence of score 1 related to high bond strength whereas Vita Mark II conditioned with AL or CJ had the lowest incidence of score 1, referring to lower bond strength. In previous studies that analyzed the SBS between metal braces and resin matrix ceramic blocks or direct resin composites, it was found that sandblasting provided the highest SBS values. In addition, Turos-Özguzman and Şişmanoğlu found that CJ enhanced SBS values for resin matrix ceramics significantly which is in line with the present study. This can be explained by that the silane inside the universal adhesive chemically bonds with both the silica and the methacrylate part of the resin matrix ceramics and the direct resin composite, resulting in an increase in SBS values.

Another mechanical surface conditioning method is surface abrasion using a diamond bur, which is practical in the clinic as it eliminates the need for an additional instrument. It creates macro and micro-retentive surfaces by forming deep grooves and scratches. In this study, the BUR method significantly increased the SBS values demonstrated by Gradia Direct and Brilliant Crios specimens; however, it was not successful for Vita Mark II and Shofu Block HC specimens regarding the SBS advancement. This might be because SEM images of Gradia Direct and Brilliant Crios specimens presented coarse polishing traces that could contribute to retention, while the SEM images of Vita Mark II and Shofu Block HC presented more homogeneous surfaces. The significant differences in SBS values found for different restorative materials are probably related to the variations in the chemical components, the type of organic matrix, the type of inorganic fillers and their ratios, and the manufacturing techniques. These are the factors that influence the materials’ properties and their reaction to different surface conditioning methods and thereby affecting the SBS. Considering this, relatively low SBS values demonstrated by Vita Mark II samples conditioned with AL, CJ, or BUR could be explained by its chemical composition which has glass ceramic, but no organic component. Still, all the mechanical conditioning methods enhanced the SBS values, and they were all clinically acceptable, above 6 MPa. However, they have possible adverse effects on restorative materials such as chipping, heat production, and residual stresses which might reduce bond strength or general respiratory tract irritations.

Monobond Etch and Prime, a self-etching ceramic primer can be used as a chemical conditioning method to eliminate the adverse effects of mechanical conditioning methods. Monobond Etch and Prime is produced to make the surface conditioning protocol easier for indirect restorative placement procedures. It simultaneously etches the restorative material with a mild acid (ammonium polyfluoride) and provides silanization (trimethoxypropyl methacrylate) in a single step. Previous studies on the SBS of metal braces to dental ceramic CAD/CAM blocks, including resin nanoceramic, resin composite, hybrid ceramic, feldspar ceramic, and reinforced glass-ceramic blocks, have reported that MEP’s efficiency is promising, better than the control group, but not as good as manufacturer instructions. Moreover, a recent study reported that it causes lower SBS values compared to the two separate steps of etching and silanization since MEP consists of a weaker acid (pH = 4.4). Therefore, in the present study, the MEP-conditioned specimens were conditioned with a universal adhesive which has a lower pH (pH = 2.7) value than ammonium polyfluoride (pH = 4.4) to evaluate if it increases SBS values. Based on the findings of this study, MEP application along with universal adhesive increased the SBS values as significantly as the manufacturer instructions for all materials, except direct resin composite. Still, all restorative materials, including direct resin composite, demonstrated sufficient SBS values for metal brace bonding.

Regarding the results of this study, it can be derived that MEP along with a universal adhesive could be a better option for surface conditioning to enhance adhesion between orthodontic braces and dental CAD/CAM blocks. Because of the problems related to other surface conditioning methods, referred earlier, MEP might be a safer alternative because it is not harmful for a short contact time. In addition, since it is not influenced significantly by contamination of saliva, there is no necessity to take precautions, which makes it also practical. Regarding the results of the current study and the previous studies about MEP’s performance on various dental CAD/CAM blocks with different compositions, it can be derived that MEP along with a universal adhesive can be a suitable surface-conditioning method, close to manufacturer instructions, for all tooth-colored CAD/CAM blocks that clinicians are not certain of the formulation.

There are various limitations associated with this study. Primarily, in vitro studies do not present an exact reflection of intra-oral conditions with regard to biofilm existence, masticatory forces, and thermal changes that can influence SBS. However, to simulate aging, samples were exposed to thermal cycling before surface conditioning and after bonding of the braces for 5000 cycles as administered in previous studies too. Furthermore, to simulate the diamond bur, sandpaper was used for surface conditioning as referred to in previous studies to achieve standardization, but this might have caused a smoother surface that can be observed on SEM images and decreased the SBS results. Further laboratory and clinical studies should be accomplished, eliminating these restrictions, to confirm the findings of this study. In addition, future studies can assess different restorative materials to make sure MEP is an appropriate surface conditioning method for all dental ceramic types. Moreover, surface roughness and surface wettability of the restorative materials can be evaluated after surface conditioning methods.

In conclusion, surface conditioning methods significantly enhance the SBS, but the amount of increase also depends on the restorative material. Application of a universal adhesive alone (control group) maintained adequate bond strength for light-cured micro-hybrid composite (Gradia Direct) and reinforced...
composite block (Brilliant Crios), but additional surface conditioning should be considered for feldspathic ceramic (Vita Mark II) and hybrid ceramic (Shofu Block HC) blocks which had SBS values below 6 MPa. As a safer and more practical method of surface conditioning, MEP along with a universal adhesive can be used on all restorative materials tested, with adequate adhesion of orthodontic metal braces.

**REFERENCES**


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Perspectives of Dentistry Students on Orthodontics Specialty in Career Choices

Diş Hekimliği Öğrencilerinin Kariyer Tercihlerinde Ortodonti Uzmanlığına Bakış Açıları

ABSTRACT

Objective: The aim of this study is to determine the perspectives of the third-, fourth-, and fifth-grade students in the faculty of dentistry on orthodontics specialty in career choices.

Methods: This epidemiological descriptive study was conducted by administering a 12-question questionnaire to 150 students (101 females and 49 males) enrolled in the third, fourth, and fifth grades of the faculty of dentistry. Out of the total of 150 students, 45 belonged to the third grade, 52 belonged to the fourth grade, and 53 belonged to the fifth grade. The collected data were subjected to the chi-square analysis.

Results: The mean age of 150 participants whose ages were between 20 and 27 years was 21.08 ± 1.98. It was observed that the opinions about orthodontic specialization did not differ according to the age, gender, and education period of the students. Of them, 41.9% thought that there would be a great need in the field of orthodontics in their career choice. The most preferred specialization areas in future were orthodontics (42.6%); prosthetic dentistry (17.6%); and oral, dental, and maxillofacial surgery (15.5%). The students stated that the most important reason for wanting to specialize in orthodontics was financial gain with a rate of 23.6%.

Conclusion: It was concluded that the opinions about the orthodontic specialization were generally positive, and the preference was mainly favorable. Factors such as clinical experience, financial gain, and interest in the specialty were found to be important in the selection of the specialty branch.

Keywords: Dentistry, orthodontics, career choices, specialty

ÖZ

Amaç: Bu çalışmanın amacı, diş hekimliği fakültesinin üçüncü, dördüncü ve beşinci sınıf öğrencilinin meslek seçimlerinde ortodonti uzmanlığında yönelik bakış açılarını belirlemektir.

 Yöntemler: Bu epidemiyolojik tanımlayıcı çalışma, diş hekimliği fakültesinin üçüncü, dördüncü ve beşinci sınıflarına kayıtlı 150 öğrenci (101 kadın ve 49 erkek) 12 soruluk bir anket uygulandı. Toplam 150 öğrenci 45'ı üçüncü sınıfta, 52'yi dördüncü sınıfta ve 53'ü beşinci sınıftaydı. Elde edilen veriler, K2 kare testi ile analiz edildi.

Bulgular: Yaşları 20 ila 27 arasında değişen 150 katılımcının yaş ortalaması 21.08 ± 1.98 idi. Ortodonti uzmanlığı ile ilgili görüşlerin öğrencilere yaş, cinsiyet, eğitim dönenine göre farklı göstermediği görülüyor (%>0.05). %41.9'lu öğrenci Ortodonti alanında ihtiyaç duyduğunu belirtti. Öğrencilerin Ortodonti alanında uzmanlaşma isteklerinin en önemli nedeni, %23.6 oranında maddi kazanç olduğu.

Sonuç: Ortodonti uzmanlığına yönelik görüşlerin genellikle olumlu olduğu ve bu alana kariyer tercihlerinde nispeten yüksek oranda yer aldığı sonucuna varıldı. Uzmanlık dalının seçiminde klinik deneyim, maddi kazanç ve uzmanlık alanı olan ilginin önemli faktörler olduğu belirlendi.

Anahtar Kelimeler: Diş hekimliği, ortodonti, kariyer seçimi, uzmanlık
INTRODUCTION

Career, in general terms, means advancing in a chosen line of work and as a result, taking responsibility, gaining status, and gaining prestige. It is the development of a person’s activities, responsibilities, attitudes, and behaviors in business life. The concept of specialization is defined as increasing productivity by concentrating on a limited area. Developing research skills and increasing clinical skills will benefit dentistry one step further by improving patient satisfaction and service level and reducing complication rates. In order to achieve these, post-graduate education becomes important. In cases where general dentistry is insufficient, continuing specialty training after the faculty of dentistry plays an important role. Students who graduate after undergraduate education can continue their graduate education if they are successful in the exams held throughout the country. The financial income to be obtained, the desire to work in a specific field, the interest of the dentist in specialty education, and the academic career option are effective in the selection of graduate education. However, it is a well-known fact that academicians, who are seen as role models, have a positive effect on students’ choice of specialization. In addition, although it is not very effective at the moment, it is thought that malpractice cases will be effective in the selection of graduate education in the future. Oral, dental, and maxillofacial radiology; oral, dental, and maxillofacial surgery; prosthetic dentistry; endodontics; restorative dentistry; pediatric dentistry; periodontology; and the department of orthodontics have been determined as areas that can be specialized in the ‘Bag Law’ No. 6225 published in the Official newspaper dated 26.04.2011 and numbered 27916, in our country. Orthodontics constitutes a small part of the dentistry curriculum and this has been going on for years. Aesthetic dentistry, the development of jaw and facial systems, developments in materials, and innovations in science and technology have had a positive impact on orthodontic expertise. Over the years, the number of graduates, the number of specialist applications, and the number of specialist physicians have increased. Variables such as financial gain, ease of work, and malpractice are effective in the selection of the field of specialization. Various studies have been conducted on the choice of specialization of dentistry students. There are various studies evaluating the motivation of dentistry students in different specialties, the criteria they pay attention to in selection, and their perspectives on specialties. Kaptı and Ozdogan conducted a study in which the students of the faculty of dentistry evaluated their motivation to specialize in the department of prosthetic dentistry, and it was determined that the thoughts about the department first started to form in the preclinical period and that factors such as the clinical experiences they had and the effect of the faculty members they took were effective in their career choices. In our country, no study has been found that examines the place of the department of orthodontics in the future plans and career goals of dentistry students.

In this study, it is aimed to determine the perspectives of the third-, fourth-, and fifth-grade students of the faculty of dentistry on orthodontics specialty in career choices. The aim of this study is to make the view of dentistry students in different education periods toward orthodontic specialization in career choices. The hypothesis of the study is orthodontics will be preferred among the first 3 departments when all factors are taken into consideration.

MATERIAL AND METHODS

This study was carried out with the participation of 150 students in total, third-, fourth-, and fifth-grade students studying at Istanbul Aydin University Faculty of Dentistry, Turkey in the 2020-2021 academic term. The study is an epidemiological descriptive study applied to mid-term and intern students actively continuing their education. Students who took a break from their education (inactive) were excluded from this study. Ethics committee approval was obtained from Istanbul Aydin University Non-Interventional Ethics Committee (Number: 2022/103). One hundred fifty individuals (101 females and 49 males) aged between 20 and 27 years were included in our study. Forty-five individuals were third-grade students, 52 individuals were fourth-grade students, and 53 individuals were fifth-grade students. The study was carried out by the method of data collection with a questionnaire. Data were collected using the Google Forms program. The survey questions in the research were prepared by analogy with the questions that Aksoy and Yankologlu used in their studies and were delivered to the participants online via a link. Consent was obtained from the participants before starting the survey. The questionnaire consisted of 15 questions in total. The first 3 questions consisted of questions about age, gender, and education period. The rest of the questionnaire comprised 10 questions that were designed using the Likert scale. These questions specifically pertained to clinical and specialized areas of orthodontics.

The last 3 questions are about the comparison and ranking of the orthodontics department with other departments.

The analysis of the obtained data was performed using the computer statistical package program Statistical Package for the Social Sciences (SPSS) version 20.0 (IBM Corp.; Armonk, NY, USA). Descriptive statistical methods and the chi-square test were used to evaluate the data. P < .05 was considered statistically significant. As a result of the power analysis using the ‘G Power 3.1.9.2’ package program, the effect size was 0.420, the alpha error was 0.05, while the power of the study was found to be 0.99 with the current sample size.

RESULTS

The mean age of the population participating in the study was 21.08 ± 1.98 years, and the participants were at least 20 and at most 27 years old. In this study, in which a total of 150 individuals participated, the female population was 101 (68.7%) and the male population was 49 (31.3%) (Table 1). According to the education period of the students; third graders comprised 30% (45), fourth graders 34.7% (52), and fifth graders 35.3% (53) (Table 2). According to the results of the chi-square test in the cross-assessment and independent samples, it was seen that the views on orthodontic specialization did not differ according to the age, gender, and education period of the students (Table 1). A high percentage of 56% of the students who participated in the study stated that they were aware of the orthodontics department during the pre-school period (Table 3). There was no significant difference in the answer given to this question between men and women (P = .138). There was no significant difference in the response given between the classes (P = .213) (Table 3).

The students reported that the least reason for why they meet with the orthodontics department is textbook (6%). Clinical experience was found to be the second most influential experience for
Table 1. Significance of gender distribution by age and grade.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
<th>n</th>
<th>%</th>
<th>Male</th>
<th>n</th>
<th>%</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18-24</td>
<td>38</td>
<td>32.8</td>
<td>78</td>
<td>62.2</td>
<td>.487</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25-29</td>
<td>9</td>
<td>26.5</td>
<td>25</td>
<td>73.5</td>
<td>.61</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grades</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.565</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>Third grade</td>
<td>12</td>
<td>26.7</td>
<td>33</td>
<td>73.3</td>
<td>.381</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>Fourth grade</td>
<td>19</td>
<td>36.5</td>
<td>33</td>
<td>63.5</td>
<td>.034</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fifth grade</td>
<td>16</td>
<td>30.2</td>
<td>37</td>
<td>69.8</td>
<td>.439</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Age, gender, and grades of the individuals participated in this study.

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24</td>
<td>116</td>
<td>77.3</td>
</tr>
<tr>
<td>25-29</td>
<td>34</td>
<td>22.7</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47</td>
<td>33.3</td>
</tr>
<tr>
<td>Female</td>
<td>103</td>
<td>66.7</td>
</tr>
<tr>
<td>Grades</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third grade</td>
<td>45</td>
<td>30.0</td>
</tr>
<tr>
<td>Fourth grade</td>
<td>52</td>
<td>34.7</td>
</tr>
<tr>
<td>Fifth grade</td>
<td>53</td>
<td>35.3</td>
</tr>
</tbody>
</table>

Postgraduate education has an important place in the field of dentistry, as in all professional branches. Although private clinical practices are popular due to the nature and historical development of the profession, with the changing specialty system in recent years, private fields of study have also begun to turn to and prefer specialist physicians. In addition, when considering academic careers, the number of dentists working as specialists, doctors, and academicians is increasing every day due to the increase in the number of universities in recent years. Factors such as the popularity of departments, needs of faculty members, financial gain, and comfortable working conditions play an important role in choosing a specialty. A situation similar to this significant increase in specialized education in our country is also found in other states. In a study conducted in Saudi Arabia, it was reported that orthodontic expertise in dentistry is gaining importance day by day.12 Specialty training has become a condition that should be in dentistry. New research focuses on what students pay attention to when choosing a department for specialized education.14

Methodologically, it was a survey study to gather the opinions of undergraduate students enrolled in a dentistry faculty. Moreover, it is aimed to evaluate the perceptions of knowledge and competence in the orthodontics department and their ranking according to other departments. The first-grade dentistry students usually were not included in the evaluation of students’ career choices in previous studies.15 Similarly, the third-, fourth-, and fifth-grade students were included in our study also considering the start of clinical orthodontic training.

In this study, it was questioned why the students of our faculty would prefer orthodontic specialization and it was predicted that it is for economical reasons, despite the fact that they look coldly at the expertise in this field due to the long-lasting treatments. While departments are preferred in the specialty exam applied in our country, orthodontics is generally the first or second preferred area. The fact that the average of the answers received to the question for preference ranking was found to be 5.05 in this study, statistically supporting this situation. Most of the students stated that they were most impressed by the clinical experience related to the orthodontics department, and it was seen that the fifth graders were more affected. This result may have been encountered because there was a difference of 2 years between third graders and fifth graders and 1 year between fourth and fifth graders in terms of clinical experience. In addition, students are uncertain about whether their first experience with orthodontics was positive or negative; but it was found that they mostly thought positively. It is known that students increase their stress levels toward clinical classes in studies,16 but in our study, it was seen that this stress did not form a negative opinion about orthodontics in individuals. In a study that evaluated the place of orthodontics in the future career planning of dentistry students, 10% of second-grade students and 14% of all fourth-grade students and fifth-grade students stated that the reason they wanted to specialize in the orthodontics department was a positive university experience.17 The answer given to the question in our study may have resulted from a positive university experience that supports this information.

Students stated that the most important criterion they paid attention to when choosing a specialty was their interest in the specialty. Although it is known that the cost of dental education is quite high, the cost of education was found to be the most insignificant criterion. This result is also consistent with similar studies.17,18 In all 3 grades, students consider that their interest in the specialty is the most important criterion for choosing a
Table 3. Evaluation of survey findings according to gender, grade, and age.

<table>
<thead>
<tr>
<th>Questions</th>
<th>All Individuals</th>
<th>Gender</th>
<th>Grade</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When did you learn orthodontics at first?</td>
<td>2021 (50.0%)</td>
<td>Male</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>A. Pre-school period</td>
<td>42 (20.7%)</td>
<td>25 (11.1%)</td>
<td>17 (21.3%)</td>
<td>22 (52.5%)</td>
</tr>
<tr>
<td>B. University preference period</td>
<td>14 (9.5%)</td>
<td>9 (6.3%)</td>
<td>5 (3.5%)</td>
<td>9 (21.7%)</td>
</tr>
<tr>
<td>C. University preference period-preclinical</td>
<td>9 (6.0%)</td>
<td>6 (4.2%)</td>
<td>3 (2.1%)</td>
<td>3 (7.3%)</td>
</tr>
<tr>
<td>D. Preclinical period</td>
<td>8 (5.3%)</td>
<td>5 (3.6%)</td>
<td>3 (2.2%)</td>
<td>3 (7.3%)</td>
</tr>
<tr>
<td>E. Clinic period</td>
<td>15 (10.5%)</td>
<td>9 (6.3%)</td>
<td>6 (4.4%)</td>
<td>6 (14.8%)</td>
</tr>
<tr>
<td>F. Others</td>
<td>20 (13.3%)</td>
<td>12 (8.0%)</td>
<td>8 (5.8%)</td>
<td>12 (29.3%)</td>
</tr>
<tr>
<td>2. Which introductory experience about the orthodontics department has impressed you the most?</td>
<td>322</td>
<td>.049</td>
<td>.006</td>
<td></td>
</tr>
<tr>
<td>A. Preclinical experience</td>
<td>28 (18.7%)</td>
<td>19 (12.5%)</td>
<td>9 (16.0%)</td>
<td>10 (23.3%)</td>
</tr>
<tr>
<td>B. Clinic experience</td>
<td>40 (26.7%)</td>
<td>23 (14.6%)</td>
<td>17 (36.2%)</td>
<td>13 (28.8%)</td>
</tr>
<tr>
<td>C. The academician who teaches the orthodontics</td>
<td>18 (12.0%)</td>
<td>11 (10.7%)</td>
<td>7 (14.9%)</td>
<td>10 (19.2%)</td>
</tr>
<tr>
<td>D. Textbook</td>
<td>11 (7.3%)</td>
<td>7 (6.8%)</td>
<td>4 (8.5%)</td>
<td>4 (8.5%)</td>
</tr>
<tr>
<td>E. Journal or website of dentistry</td>
<td>9 (6.0%)</td>
<td>6 (5.9%)</td>
<td>3 (6.4%)</td>
<td>3 (6.4%)</td>
</tr>
<tr>
<td>F. Others</td>
<td>44 (29.3%)</td>
<td>35 (34.0%)</td>
<td>9 (19.1%)</td>
<td>34 (29.3%)</td>
</tr>
<tr>
<td>3. How should the orthodontics specialty exam be?</td>
<td>576</td>
<td>.024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Dus</td>
<td>54 (36.0%)</td>
<td>33 (32.0%)</td>
<td>21 (44.7%)</td>
<td>25 (55.6%)</td>
</tr>
<tr>
<td>B) Audition</td>
<td>50 (33.0%)</td>
<td>36 (35.0%)</td>
<td>14 (29.8%)</td>
<td>11 (24.4%)</td>
</tr>
<tr>
<td>C) A foreign language exam is sufficient</td>
<td>20 (13.3%)</td>
<td>14 (13.6%)</td>
<td>6 (12.8%)</td>
<td>5 (11.1%)</td>
</tr>
<tr>
<td>D) The average of scores in central exam like ALES and graduation grades</td>
<td>16 (10.7%)</td>
<td>13 (12.6%)</td>
<td>6 (12.8%)</td>
<td>5 (11.1%)</td>
</tr>
<tr>
<td>E) Degree in dental education or who entered the top 3</td>
<td>10 (6.7%)</td>
<td>7 (6.8%)</td>
<td>3 (6.4%)</td>
<td>6 (5.4%)</td>
</tr>
<tr>
<td>4. How would you rate your experience with orthodontic treatment?</td>
<td>262</td>
<td>.014</td>
<td>.138</td>
<td></td>
</tr>
<tr>
<td>A. Mostly positive</td>
<td>21 (14.0%)</td>
<td>16 (15.5%)</td>
<td>5 (10.6%)</td>
<td>4 (8.9%)</td>
</tr>
<tr>
<td>B. Positive</td>
<td>39 (26.0%)</td>
<td>30 (29.1%)</td>
<td>9 (19.1%)</td>
<td>20 (44.4%)</td>
</tr>
<tr>
<td>C. Little positive</td>
<td>27 (18.0%)</td>
<td>16 (15.5%)</td>
<td>11 (23.4%)</td>
<td>2 (4.4%)</td>
</tr>
<tr>
<td>D. Undecided</td>
<td>45 (30.0%)</td>
<td>30 (29.1%)</td>
<td>15 (31.9%)</td>
<td>16 (35.6%)</td>
</tr>
<tr>
<td>E. Little negative</td>
<td>12 (8.0%)</td>
<td>9 (8.7%)</td>
<td>3 (6.4%)</td>
<td>2 (4.4%)</td>
</tr>
<tr>
<td>F. Mostly negative</td>
<td>6 (4.0%)</td>
<td>2 (1.9%)</td>
<td>4 (8.5%)</td>
<td>1 (2.2%)</td>
</tr>
<tr>
<td>5. How do you evaluate the department of orthodontics in terms of education and social environment?</td>
<td>897</td>
<td>.640</td>
<td>.169</td>
<td></td>
</tr>
<tr>
<td>A) Very well</td>
<td>54 (36.0%)</td>
<td>38 (36.9%)</td>
<td>16 (34.0%)</td>
<td>21 (46.7%)</td>
</tr>
<tr>
<td>B) Well</td>
<td>46 (30.7%)</td>
<td>29 (28.2%)</td>
<td>17 (36.2%)</td>
<td>12 (26.2%)</td>
</tr>
<tr>
<td>C) Medium</td>
<td>40 (26.7%)</td>
<td>28 (27.2%)</td>
<td>12 (25.5%)</td>
<td>11 (24.4%)</td>
</tr>
<tr>
<td>D) Bad</td>
<td>6 (4.0%)</td>
<td>5 (4.9%)</td>
<td>1 (2.1%)</td>
<td>1 (2.2%)</td>
</tr>
<tr>
<td>E) Very bad</td>
<td>4 (2.7%)</td>
<td>3 (2.9%)</td>
<td>1 (2.1%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>6. What is your general perception about the future needs of the orthodontics department?</td>
<td>381</td>
<td>.001**</td>
<td>.158</td>
<td></td>
</tr>
<tr>
<td>A. Mostly positive</td>
<td>41 (27.3%)</td>
<td>30 (29.1%)</td>
<td>11 (23.4%)</td>
<td>6 (13.3%)</td>
</tr>
<tr>
<td>B. Positive</td>
<td>62 (41.3%)</td>
<td>40 (38.8%)</td>
<td>22 (46.8%)</td>
<td>30 (66.7%)</td>
</tr>
<tr>
<td>C. Little positive</td>
<td>25 (16.7%)</td>
<td>15 (14.6%)</td>
<td>10 (21.3%)</td>
<td>3 (6.7%)</td>
</tr>
<tr>
<td>D. Undecided</td>
<td>16 (10.7%)</td>
<td>14 (13.6%)</td>
<td>6 (12.8%)</td>
<td>4 (8.9%)</td>
</tr>
<tr>
<td>7. What do you think is the most important area in dentistry?</td>
<td>968</td>
<td>.693</td>
<td>.201</td>
<td></td>
</tr>
<tr>
<td>A. Oral, dental, and maxillofacial radiology</td>
<td>7 (4.7%)</td>
<td>5 (4.9%)</td>
<td>2 (4.3%)</td>
<td>2 (4.4%)</td>
</tr>
<tr>
<td>B. Prosthodontics</td>
<td>26 (17.3%)</td>
<td>16 (15.5%)</td>
<td>10 (21.3%)</td>
<td>7 (15.6%)</td>
</tr>
<tr>
<td>C. Oral, dental, and maxillofacial surgery</td>
<td>38 (25.3%)</td>
<td>27 (26.2%)</td>
<td>11 (23.4%)</td>
<td>14 (31.1%)</td>
</tr>
<tr>
<td>D. Pedodontics</td>
<td>10 (6.7%)</td>
<td>8 (7.8%)</td>
<td>2 (4.3%)</td>
<td>2 (4.4%)</td>
</tr>
<tr>
<td>E. Endodontics</td>
<td>5 (3.0%)</td>
<td>3 (2.9%)</td>
<td>2 (4.3%)</td>
<td>2 (4.4%)</td>
</tr>
<tr>
<td>F. Periodontology</td>
<td>6 (4.0%)</td>
<td>4 (3.9%)</td>
<td>2 (4.3%)</td>
<td>2 (4.4%)</td>
</tr>
<tr>
<td>G. Orthodontics</td>
<td>57 (38.0%)</td>
<td>39 (37.9%)</td>
<td>18 (38.3%)</td>
<td>16 (35.6%)</td>
</tr>
<tr>
<td>H. Restorative dentistry</td>
<td>1 (0.7%)</td>
<td>1 (1.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>8. What is the first department you dream of specializing in?</td>
<td>577</td>
<td>.247</td>
<td>.434</td>
<td></td>
</tr>
<tr>
<td>A. Oral, dental, and maxillofacial radiology</td>
<td>3 (2.0%)</td>
<td>2 (1.9%)</td>
<td>1 (2.1%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>B. Prosthodontics</td>
<td>26 (17.3%)</td>
<td>18 (17.5%)</td>
<td>8 (17.0%)</td>
<td>12 (26.7%)</td>
</tr>
<tr>
<td>C. Oral, dental, and maxillofacial surgery</td>
<td>23 (15.3%)</td>
<td>17 (16.5%)</td>
<td>6 (12.8%)</td>
<td>8 (17.6%)</td>
</tr>
<tr>
<td>D. Pedodontics</td>
<td>14 (9.3%)</td>
<td>8 (7.6%)</td>
<td>6 (12.8%)</td>
<td>3 (6.7%)</td>
</tr>
<tr>
<td>E. Endodontics</td>
<td>4 (2.7%)</td>
<td>3 (2.9%)</td>
<td>0 (0.0%)</td>
<td>1 (2.2%)</td>
</tr>
<tr>
<td>F. Periodontology</td>
<td>13 (8.7%)</td>
<td>11 (10.7%)</td>
<td>2 (4.3%)</td>
<td>5 (11.1%)</td>
</tr>
<tr>
<td>G. Orthodontics</td>
<td>65 (43.3%)</td>
<td>41 (39.8%)</td>
<td>24 (51.1%)</td>
<td>16 (35.6%)</td>
</tr>
<tr>
<td>H. Restorative dentistry</td>
<td>2 (1.3%)</td>
<td>2 (1.9%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
</tr>
</tbody>
</table>

(Continued)
speciality; but the fourth grades made this choice with a higher percentage. Fourth graders are more enthusiastic because they have just started clinical education and may have chosen this option more.

The present study has identified that the top three departments that students consider specializing in are orthodontics; oral, dental, and maxillofacial surgery; and prosthetic dental treatment, respectively. It has been reported in the literature that orthodontics took the first place in the studies, followed by oral, dental, and maxillofacial surgery. In our study, it was found that women students dream of specializing in the departments of oral, dental, and maxillofacial surgery; orthodontics; and pedodontics with a much higher rate than men. Dhima et al. showed that, unlike our study, men preferred the department of oral and maxillofacial surgery more than women. In a similar study conducted in our country, it was found that women wanted to specialize more in the department of oral and maxillofacial surgery.

In the comparison between the fourth and fifth grades, there was no significant difference and no significant relationship between their desire to specialize in orthodontics. Students in both classes preferred the orthodontics department in the third place.

It is seen that the most effective department in terms of dentistry is the department of oral, dental, and maxillofacial surgery, followed by the department of prosthetic dentistry. In a study in which the general impact on dentistry was questioned, orthodontics and oral, dental, and maxillofacial surgery departments ranked first among the specialties with an equal percentage. In our study, the branch of orthodontics ranks fifth among 8 areas of specialization. In a similar study conducted in our country, the orthodontics department is ranked (fourth) similar to our study in terms of dentistry. In our country, the orthodontics department is in the last place in terms of its effectiveness in dentistry and patient care.

When we questioned whether the orthodontics department will be needed in the future in our study, it was seen that the answer was quite positive. In our country, the incidence of angle class I, II, III, and IV malocclusions is 82.7% in the Mediterranean Region, 72% in the Aegean Region, 24.4% in the Eastern Anatolia Region, 63.4% in the South East Anatolian Region, 53.4% in the Central Anatolia Region, 38.1% in the Black Sea Region, and 65.6% in the

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### Table 3. Evaluation of survey findings according to gender, grade, and age. (Continued)

<table>
<thead>
<tr>
<th>Questions</th>
<th>All Individuals n (%)</th>
<th>Female n (%)</th>
<th>Male n (%)</th>
<th>χ²</th>
<th>Male</th>
<th>Female</th>
<th>χ²</th>
<th>Grade</th>
<th>All n (%)</th>
<th>Male</th>
<th>Female</th>
<th>χ²</th>
<th>Grade</th>
<th>All n (%)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. In which specialization do you think you can earn more financially?</td>
<td>A. Oral, dental, and maxillofacial radiology</td>
<td>1 (0.70%)</td>
<td>1 (1.0%)</td>
<td>0 (0.0%)</td>
<td>0.000</td>
<td>0 (0.0%)</td>
<td>1.19</td>
<td>0</td>
<td>1 (0.9%)</td>
<td>0 (0.0%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Prosthodontics</td>
<td>22 (14.70%)</td>
<td>17 (16.5%)</td>
<td>5 (10.6%)</td>
<td>10 (22.2%)</td>
<td>7 (13.5%)</td>
<td>5 (9.4%)</td>
<td>20</td>
<td>17.2%</td>
<td>2 (5.9%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Oral, dental, and maxillofacial surgery</td>
<td>31 (20.70%)</td>
<td>24 (23.3%)</td>
<td>7 (14.9%)</td>
<td>12 (26.7%)</td>
<td>6 (11.5%)</td>
<td>13 (24.5%)</td>
<td>23</td>
<td>19.8%</td>
<td>8 (23.5%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Pedodontics</td>
<td>6 (4.00%)</td>
<td>3 (2.9%)</td>
<td>3 (6.4%)</td>
<td>1 (2.2%)</td>
<td>2 (3.8%)</td>
<td>3 (5.7%)</td>
<td>3</td>
<td>2.3%</td>
<td>3 (8.8%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Endodontics</td>
<td>7 (4.70%)</td>
<td>5 (4.9%)</td>
<td>2 (4.3%)</td>
<td>1 (2.2%)</td>
<td>5 (9.6%)</td>
<td>1 (1.9%)</td>
<td>3</td>
<td>2.3%</td>
<td>4 (11.8%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F. Periodontology</td>
<td>7 (4.70%)</td>
<td>4 (3.9%)</td>
<td>3 (6.4%)</td>
<td>1 (2.2%)</td>
<td>5 (9.6%)</td>
<td>1 (1.9%)</td>
<td>5</td>
<td>4.3%</td>
<td>2 (5.9%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>G. Orthodontics</td>
<td>75 (50.00%)</td>
<td>48 (46.6%)</td>
<td>27 (57.4%)</td>
<td>19 (42.2%)</td>
<td>30 (57.7%)</td>
<td>16 (49.1%)</td>
<td>61</td>
<td>52.6%</td>
<td>14 (41.2%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H. Restorative dentistry</td>
<td>1 (0.70%)</td>
<td>1 (1.0%)</td>
<td>0 (0.0%)</td>
<td>1 (2.2%)</td>
<td>0 (0.0%)</td>
<td>0</td>
<td>0</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Which specialization do you think is the most important for patient care?</td>
<td>A. Oral, dental, and maxillofacial radiology</td>
<td>9 (6.00%)</td>
<td>6 (5.8%)</td>
<td>3 (6.4%)</td>
<td>1 (2.2%)</td>
<td>4 (7.7%)</td>
<td>4 (7.5%)</td>
<td>8</td>
<td>6.9%</td>
<td>1 (2.9%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. Prosthodontics</td>
<td>14 (9.30%)</td>
<td>11 (10.7%)</td>
<td>3 (6.4%)</td>
<td>7 (15.6%)</td>
<td>4 (7.7%)</td>
<td>3 (5.7%)</td>
<td>11</td>
<td>9.5%</td>
<td>3 (8.8%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Oral, dental, and maxillofacial surgery</td>
<td>32 (21.30%)</td>
<td>21 (20.4%)</td>
<td>11 (23.4%)</td>
<td>12 (26.7%)</td>
<td>9 (17.3%)</td>
<td>11 (20.8%)</td>
<td>28</td>
<td>24.1%</td>
<td>4 (11.8%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. Pedodontics</td>
<td>13 (8.70%)</td>
<td>8 (7.8%)</td>
<td>5 (10.6%)</td>
<td>4 (8.9%)</td>
<td>5 (9.6%)</td>
<td>4 (7.5%)</td>
<td>10</td>
<td>8.6%</td>
<td>3 (8.8%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Endodontics</td>
<td>6 (4.00%)</td>
<td>4 (3.9%)</td>
<td>2 (4.3%)</td>
<td>5 (11.1%)</td>
<td>1 (1.9%)</td>
<td>0 (0.0%)</td>
<td>5</td>
<td>4.3%</td>
<td>1 (2.9%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F. Periodontology</td>
<td>16 (10.70%)</td>
<td>10 (9.7%)</td>
<td>6 (12.8%)</td>
<td>7 (15.6%)</td>
<td>6 (11.5%)</td>
<td>3 (5.7%)</td>
<td>12</td>
<td>10.3%</td>
<td>4 (11.8%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>G. Orthodontics</td>
<td>55 (36.70%)</td>
<td>41 (39.8%)</td>
<td>14 (29.8%)</td>
<td>7 (15.6%)</td>
<td>21 (40.4%)</td>
<td>27 (50.9%)</td>
<td>39</td>
<td>33.6%</td>
<td>16 (47.1%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H. Restorative dentistry</td>
<td>5 (3.30%)</td>
<td>3 (2.9%)</td>
<td>2 (4.4%)</td>
<td>2 (3.8%)</td>
<td>1 (1.9%)</td>
<td>3</td>
<td>2.6%</td>
<td>2 (5.9%)</td>
<td>0</td>
<td>25-29</td>
<td>.000*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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*Chi-square test.* **P < .05; *P < .01. Bold values denote statistically significant changes.

---

Marmara Region. Considering that the prevalence of malocclusion is quite high, it is seen that the students’ opinions on this subject are correct. Based on the responses of the students, they consider orthodontics as the most lucrative specialization, followed by prosthetic dentistry. The results of different studies conducted in other countries do not support our study; oral, dental, and maxillofacial surgery department comes first and orthodontics department comes second. They considered the department of restorative dentistry as the department with the least financial gain. In other studies, the department with the least financial gain was stated as oral, dental, and maxillofacial radiology. The department of prosthetic dentistry, which is the most desired field among students, and the department of oral, dental, and maxillofacial surgery, which ranks second, are behind the orthodontics department in terms of financial gain. In our study, the answer given by the students to the question of the most important criterion they pay attention to in the selection of the specialty branch confirms this result.

Considering the internship difficulties of students in faculties, we know that especially intern students look away from their expertise in that branch. In this case, we believe that the order of preference and popularity of orthodontics will increase if students can better explain all the advantages of orthodontic specialization, its technological side, its field of interest and the fact that it is the most prone to multidisciplinary work.

According to the results of our study, the opinions about the orthodontic specialization were generally positive and the preference was in a good place. Factors such as clinical experience, financial gain, and interest in the specialty were found to be important in the selection of the specialty branch. Moreover, opting to become an expert and selecting a specific department is a highly personal choice influenced by the student’s experiences and interests during their undergraduate years. Additionally, job prospects and financial considerations regarding specialized training play significant roles in the decision-making process for choosing a specialization.

Hakem Değerlendirmesi: Dişبالغımız.


Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

REFERENCES


Is There Any Association Between Health Literacy Level, Periodontal Status, and Adverse Pregnancy Outcomes in Pregnant Women?

Hamilelerin Sağlık Okuryazarlığı Seviyeleri ile Periodontal Durumları ve İstenmeyen Hamilelik Sonuçları Arasında İlişki Var mı?

ABSTRACT

Objective: As a part of general health, the periodontal health status of the pregnant women is not only important for pregnancy but also utmost for antenatal and postnatal life of a fetus. This study aimed to determine the health literacy level of pregnant women and to demonstrate the association between health literacy level, periodontal status, and adverse pregnancy outcomes compared to nonpregnant women.

Methods: A total of 216 participants (pregnant/nonpregnant = 104/112) were included in this cross-sectional study. Health literacy level was determined using a self-completed Turkish Health Literacy Scale, 32-item questionnaire. Plaque index, gingival index, bleeding on probing, probing depth, and clinical attachment level were recorded. The records of pregnant women were evaluated for preeclampsia, preterm delivery, and low birthweight. Statistical significance was set at \( P < .05 \).

Results: The health literacy level, plaque index, gingival index, and bleeding on probing values were higher in pregnant women (\( P = .022, P = .007, \) and \( P = .034 \) respectively). While a positive correlation was observed between health literacy level and birthweight, a negative one was found between periodontal parameters, either birthweight or birth week (\( P < .05 \)). Nevertheless, there was not any association between health literacy level and periodontal parameters (\( P > .05 \)).

Conclusion: Our results showed that health literacy level was higher in pregnant women without any effects on periodontal status. Given the unique conditions of pregnancy, our study provides remarkable data that may help establish oral health care during pregnancy routinely for both pregnant women and caregivers.

Keywords: Health literacy, maternal health, periodontal status, periodontal indices, pregnancy outcomes

ÖZ

Amaç: Genel sağlıkın bir parçası olan periodontal sağlık, gebelerde sadece gebeler için değil, fetüsün antenatal ve postnatal yaşamı için de son derece önemlidir. Bu çalışmaların amacı, gebeliklerin sağlık okuryazarlık (SOY) düzeyini belirlemek ve gebinin SOY düzeyi ile periodontal durumu ve istenmeyen gebelik sonuçları arasındaki ilişiği araştırmaktır.

Gereç ve Yöntem: Bu kesitsel çalışmaya toplam 216 katılımcı (gebe/gebe olmayan = 104/112) dahil edildi. SOY düzeyleri, katılımcılar tarafından doldurulan Türkiye SOY Ölçeği-32 kullanılarak belirlendi. Plak indeks (PI), gingival indeks (GI), sondalamada kanama (SK), sondalama derinliği (SD) ve klinik atışman seviyesi (KAS) klinik parametreleri kayıt alınındı. Gebelerin rutin jinekolojik kayıtları preeklampsı, erken doğum ve düşük doğum ağırlığı açısından değerlendirildi. İstatistiksel anlamalılık \( p < .05 \) olarak belirlendi.

Bulgular: Gebelerde SOY, GI ve SK değerleri daha yüksekti (örneğin, \( P = .022, P = .007, P = .034 \)). SOY ile doğum ağırlığı arasında pozitif bir korelasyon gözlenırken, periodontal parametreler ile
INTRODUCTION

Health literacy (HL) can be described as “the ability of people to use, process, and understand basic health-related information and services to make educated medical decisions.” According to the comprehensive definition, “HL is linked to literacy and requires people’s knowledge, motivation, and skills. Similarly, they can access, understand, evaluate, and act on this information to make daily decisions. As a result, people can help prevent disease and promote health to maintain or improve quality of life throughout their life.”

Low level of HL is a global problem that requires attention, as the World Health Organization presents HL as one of the most critical determinants of health. Considering the well-documented outcomes that HL affects individual’s accessibility to healthcare services/providers and overall health status; it can be anticipated that low levels of HL is associated with both insufficient self-care habits and mortality. Low levels of HL lead to an increased incidence of disease and thus a global burden on the economy. The first survey on HL in 8 European countries showed that approximately 47% of the population in these countries had low levels of HL. Inadequate or limited HL is a widespread problem also in Turkey, with studies reporting that 52%-82% of adults have basic or below-average HL skills. In Greece and Bulgaria, which border Turkey, inadequate and problematic levels of HL are 45% and 62%, respectively.

HL is essential in several target populations, such as pregnant women. This term is considered a critical component that allows women to participate in self-care and childcare activities. Before, during, and after pregnancy, a mother’s medical conditions and health knowledge significantly affect her child. Research has shown that women with suboptimal HL have a poor understanding of medical instructions and medication labels and do not take their medications properly. In addition, previous studies have shown that low levels of HL is associated with unplanned pregnancies and negatively affects women’s health care and child care. Research on HL during pregnancy is limited in the literature. A recent large-scale study of HL conducted in 775 pregnant women found that 15.5% of the participants had inadequate, 41.7% had borderline, and 42.8% had adequate HL.

Pregnancy-related immunological changes increase the mother’s susceptibility to infections, including periodontal disease. Periodontal diseases can increase the risk of adverse pregnancy outcomes such as preeclampsia, preterm birth, and low birthweight (LBW). Thanks to this bidirectional relationship between periodontal disease and pregnancy, periodontal health is paramount for overall health. Moreover, based on the fact that the mother is a role model for the baby in terms of oral hygiene requirements, it can be stated that pregnant women have an important place in the establishment of the concept of periodontally healthy society.

In this study, it was assumed that HL in pregnant women has a positive effect on decision-making regarding both maternal and child health care. Therefore, this research evaluated HL levels (HLLs) in pregnant women, outlined the relationship between HL, periodontal status, and adverse pregnancy outcomes, and compared the results with nonpregnant individuals.

MATERIAL AND METHODS

The Ethics Committee for Non-Interventional Clinical Research of Istanbul Aydin University (Date: 14.02.2019, Number: 2019/40) approved this descriptive, cross-sectional study design according to the principles outlined in the World Medical Association Declaration of Helsinki. Also, all participants were informed about the study and informed consent forms were obtained before the baseline.

Study Population and Sample Size

The sample size was calculated based on the clinical outcome of a similarly designed study. Gingival index (GI), described below as a variable, was evaluated as the primary outcome of the study. Seventy-two subjects per group would provide 85% power to detect a true difference of 0.99 in mean GI between groups with a 0.32 mean SD. The study included 104 pregnant women (aged 23-37 years) in their second trimester and 112 nonpregnant (aged 21-40 years) participants between July 2020 and December 2020. The participants in the both study groups were fulfilled the inclusion criteria were as follows: (1) being native Turkish speakers; (2) being systemically healthy; (3) having no previous pregnancies, also, no miscarriage, dilatation and curettage; (4) having a total of ≥20 teeth, except the third molars; (5) having no disability affecting daily self-performed oral care; (6) having no periodontal treatment within the last 6 months; (7) no use of antibiotics, anti-inflammatory drugs, or other drugs affecting the periodontium within the last 6 months; and (8) consent to participate in the study. Pregnancy status is the only inclusion criterion that differentiates the groups. A history of systemic disease or the use of medications that could affect periodontal status was considered as an exclusion criterion.

Data Collection Form and Evaluation of the TSOY-32 Questionnaire

All participants received a 2-part form with questions on age, education level (primary/middle/high college or university/post graduate), monthly income (low/middle/upper), frequency of brushing (at least once a week/once a day/twice a day), and flossing (yes/no) as the first part.

All patients completed the Turkey Health Literacy Scale, 32-Item Questionnaire (TSOY-32) as the second part of the form. The TSOY-32 was developed by Okyay et al based on the theoretical structure of the European Health Literacy Survey Questionnaire study. This self-report scale with 32 items was developed to
measure the HL of individuals over 15 years of age. Participants’
responses were recorded on a 5-point Likert scale ranging from 1
(extremely difficult) to 4 (extremely easy). Code 5 was used for the
response “I have no idea.” The overall HLL score was calculated
using the following formula:

\[ \text{HLL} = [\text{Questionnaire mean} - 1) \times (50/3)] \]

The HLL scores, ranging between 0 and 50, were classified
according to cutoff points as inadequate (0 < HLL ≤ 25), problem-
atic limited (25 < HLL ≤ 33), adequate (33 < HLL ≤ 42), and excel-
lent (42 < HLL ≤ 50). Four dimensions of HL in health care, disease
prevention, and health promotion were assessed: access/obtain
information relevant to health, understand information relevant
to health, process information relevant to health, and apply/use
information relevant to health.

Clinical Examination Measures
All clinical examinations were performed by a single calibrated
examiner (SEM). To assess intraexaminer reliability, whole-mouth
probing depth (PD) scores were measured twice 5 days apart in 5
subjects who did not participate in the study. The first and second
measurements were 98.80% compatible with each other, and the
Cohen’s kappa value was 0.95, which means that the strength of
agreement is “almost perfect.”

Clinical periodontal parameters were recorded at the mesio-
buccal, mid-buccal, distobuccal, mesiopalatal, mid-palatal, and
distopalatal sites of all teeth present, except the third molars.
The parameters consisting of plaque index (PI),15 GI,16 bleeding
on probing (BoP), PD, and clinical attachment level (CAL) were
recorded using a University of North Carolina periodontal probe
(PCPUNC15, HuFriedyGroup, Chicago, Ill, USA).

PI, ranging between 0 and 3, ascertains the thickness of micro-
bial dental plaque along the gingival margin. The 6 aforesaid sites
were scored for PI. The PI level of a patient is defined as the mean
value of the sum of given scores.15 The interpretation of the PI
scores is as follows:

0: No plaque
1: A thin plaque layer at the gingival margin, only detectable
by scraping with probe. Undetectable with naked eyes.
2: Moderate layer of plaque detectable with naked eyes.
3: Abundant plaque along gingival margin and interdental
areas.

The GI records gingival inflammation, and similar to PI, 6 sites
each tooth were scored. The mean value of the sum of given
scores ranges between 0 and 3 and gives the patient’s GI level.15
The scores of the GI and their clinical meanings are as follows:

0: Healthy gingiva, no inflammation and bleeding, no
discoloration.
1: Mild inflammation, slight erythema without bleeding.
2: Moderate inflammation, erythema with bleeding.
3: Severe inflammation with a tendency for spontaneous
bleeding, severe swelling.

BoP was calculated with the ratio of the number the sites with
bleeding following probing to the number of all sites and showed
as a percentage. The distance from the gingival margin to the
base of the gingival sulcus/periodontal pocket is defined as PD,
while the distance from the cementoenamel junction to the base
of the gingival sulcus/periodontal pocket is described as CAL.

Follow-Up and Evaluation of Adverse Pregnancy Outcomes
The following information on pregnant women and their babies
who participated in the study was obtained from obstetricians
through consultation:

• To determine whether the mother was diagnosed with pre-
eclampsia during pregnancy,
• In which week of pregnancy the birth took place,
• Birthweight of the newborn.

The following clinical data were considered in conjunction with
the above information when evaluating adverse pregnancy
outcomes.

In a normotensive patient, an increase in systolic blood pres-
ture to ≥ 140 mmHg or diastolic pressure to ≥ 90 mmHg with
any following occasions after 20 weeks of gestation is defined as
preeclampsia. These occasions are listed as proteinuria; plate-
let count <100 000/μL; impaired liver function, as evidenced by
abnormally elevated liver enzymes up to twice the normal con-
centration or persistent severe right upper quadrant or epigastic
pain; renal failure with a serum creatinine level >1.1 mg/dL (97.2
μmol/L) or double serum creatinine; pulmonary edema; or new-
onset cerebral or visual disturbances.17

The preterm birth is defined as babies born alive before 37 weeks
of gestation are completed. According to the WHO, LBW is
defined as a birthweight of less than 2500 g (up to and includ-
ing 2499 g).

Statistical Analysis
The data obtained from the participants were transferred to
the Statistical Package for the Social Sciences, version 24.0
(IBM Corp.; Armonk, NY, USA) program for statistical analysis.
Descriptive analyses were performed on the transferred data
and obtained descriptive values were displayed as minimum
and maximum values, mean, SD, frequencies, and percentages.
The Shapiro–Wilk test was used to check whether the quantita-
tive variables had a normal distribution, and since \( P < .05 \),
the distribution was accepted as not normal. For this reason, non-
parametric statistical tests were used in data analysis. Means
were calculated for the abovementioned 2 study groups were
calculated with the Mann–Whitney \( U \)-test and chi-
square test, respectively. Bivariate relationships among HLL,
periodontal parameters, and adverse pregnancy outcomes were
evaluated using Spearman’s correlation. Statistical significance
was established at the \( P < .05 \) level.

RESULTS
Table 1 shows an intergroup comparison of pregnant and non-
pregnant participants’ demographic characteristics and oral
health behaviors. As shown in Table 1, the mean age of partici-
pants in both groups was similar (\( P > .05 \)). The results showed
that the majority of participants in both groups had a college/
university or higher education degree and a middle income,
with no statistically significant differences between groups
(\( P > .05 \)). Moreover, the intergroup comparisons showed that
the frequency of toothbrushing and daily flossing were statisti-
cally similar (\( P > .05 \)). About 61.5% of pregnant women and 57.1%
of nonpregnant women brush their teeth twice daily. However, it

must be noted that these frequencies are not ideal. In addition, a considerable number of pregnant and nonpregnant participants did not floss daily (Table 1).

The periodontal status of the patients included in the study is shown in Figure 1A. Based on these data, periodontally healthy individuals in the total population are 3.7%. When we examine the patients in the groups in terms of their periodontal status, it can be seen that about 85% of pregnant women and about 43% of nonpregnant women suffered from gingivitis. Regarding periodontal parameters, as the objective indicators of gingival inflammation, the GI and BoP values of pregnant participants were significantly higher than those of nonpregnant women (P = .007 and P = .034, respectively). In contrast, no significant differences were found for other clinical periodontal parameters (Figure 1B).

As shown in Table 2, pregnant women had higher HLL than nonpregnant individuals (P = .022). The results of pregnant women showed that 23.1% had problematic-limited, 30.8% had adequate, and 46.1% had excellent HLL. In comparison, 50% of the nonpregnant group showed problematic-limited, 35.7% adequate, and 14.3% excellent HLL. Intergroup comparisons of the mean scores for the 4 subdomains of HLL were also presented in Table 2. The mean scores for accessing, understanding, and using information relevant to health were higher in pregnant women in the general HL subdomain and in the disease prevention and health promotion subdomain. However, all dimensions of the health-care subdomain were similar between the groups (P > .05).

Obstetricians assessed the pregnant participants to determine the adverse outcomes, and the according to these data, only 3 in 104 pregnant women were diagnosed with preeclampsia. Twenty-four of the 104 babies were preterm and LBW, born at an average of 35 weeks and weighting 2166.66 ± 208.16 g at birth.

Correlation analysis between HLL and periodontal parameters showed no significant bivariate correlations in all participants (P > .05) (Table 3). Similar to this, the results of the correlation analysis performed only in pregnant participants showed no statistically significant correlation between HLL and any periodontal parameter in this group (P > .05) (Table 3). On the contrary, a significant positive correlation was found between HLL and the infant birthweight (r = .465, P < .01). Furthermore, there were significant negative correlations between maternal periodontal parameters and infant birthweight and also birth week (P < .05).

**DISCUSSION**

To our knowledge, few studies are investigating the relationship between HLL and periodontal status in pregnant women.18,19
The findings of this preliminary study, conducted in pregnant and nonpregnant Turkish women, included data on HLL, periodontal status, and adverse pregnancy outcomes.

As a concept that influences a person’s health-care decisions and actions, the HLL can predictably affect oral health, like its potential impact on overall health. There is growing evidence of an association between periodontal status, a key component of oral health care habits, and adverse pregnancy outcomes.21 The potential association between periodontal status, a key component of oral health care habits, and adverse pregnancy outcomes is a topic that continues to be the focus of periodontal medicine.22

Advances in the medical treatment of preterm infants have made significant progress, and the survival rate of these infants with LBW (less than 2500 g) has increased.23 Developmental delays are more likely to occur later in life.24,25 Motor and cognitive function are 2 critical areas of delay,26 and several studies have shown cross-sectional links between motor and cognitive deficits in preterm and LBW infants.27,28 The link between periodontal disease, prematurity, and LBW has been shown in several studies.29,30 The expecting mother must understand the importance of education and oral health to avoid these negative consequences.

The pregnant women showed higher HLL compared to the nonpregnant individuals. Pregnancy can positively influence the motivation of the mother in health issues to achieve the best results for both the mother and child. From this perspective, maternal HLL is an interesting topic, both for its direct positive contribution to maternal and infant health and for its indirect contribution to the maintenance of periodontal health.

Low HLLs negatively affect women’s behavior with regard to contraception, health care, and childcare, highlighting a possible link between HLL and adverse pregnancy outcomes.31 Research on periodontal disease and its negative repercussions on pregnancy demonstrates the importance of periodontal health for both mother and baby.20 We expected that an increase in HLL in pregnant women would have a more beneficial effect on periodontal status. However, our study did not show a direct relationship between clinical periodontal parameters and HLL. The negative impact of periodontal/oral diseases on general health is a proven fact. However, this proven fact remains largely unknown to the Turkish public.

Our study also indicates that HLL had no effect on promoting the importance of oral health and the need to maintain it. One of the notable findings of this study was that both education and income level were not associated with HLL and periodontal status. Several studies have indicated that these characteristics are significantly positively correlated with HLL.4,11,12 About 50% of pregnant women in our population had more than higher education, and 70% had a balanced income. While a higher level of education is believed to make people more competent at gathering and processing information in any subject, the small sample size of this pilot study may have contributed to this difference. For this reason, it can be seen as an indication that education alone is not sufficient to gain knowledge in a particular area, such as health, but other aspects are also involved.

As our findings show, HLL did not have an effect on periodontal parameters. Oral health care habits are generally expected to be more common in individuals with a high HLL. However, our study

### Table 2. Data of Health Literacy Levels and Its Subdomains

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Pregnant Mean ± SD</th>
<th>Nonpregnant Mean ± SD</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Minimum-Maximum)</td>
<td>(Minimum-Maximum)</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>39.67 ± 6.18 (30.07-48.00)</td>
<td>33.44 ± 5.87 (20.00-47.33)</td>
<td>.022</td>
</tr>
<tr>
<td>Access/obtain information relevant to health</td>
<td>41.99 ± 7.06 (31.25-50.00)</td>
<td>35.71 ± 6.27 (27.08-47.92)</td>
<td>.038</td>
</tr>
<tr>
<td>Understand information relevant to health</td>
<td>42.31 ± 5.85 (33.33-50.00)</td>
<td>35.57 ± 6.96 (20.83-50.00)</td>
<td>.012</td>
</tr>
<tr>
<td>Process information relevant to health</td>
<td>33.81 ± 7.52 (22.92-45.83)</td>
<td>31.70 ± 7.13 (22.92-50.00)</td>
<td>.519</td>
</tr>
<tr>
<td>Apply/use information relevant to health</td>
<td>40.22 ± 6.27 (29.17-50.00)</td>
<td>31.25 ± 8.25 (18.75-45.83)</td>
<td>.008</td>
</tr>
<tr>
<td>Health Care</td>
<td>42.63 ± 7.64 (29.17-50.00)</td>
<td>38.10 ± 7.70 (29.17-50.00)</td>
<td>.116</td>
</tr>
<tr>
<td>Understand information</td>
<td>42.31 ± 6.33 (33.33-50.00)</td>
<td>36.01 ± 8.89 (20.83-50.00)</td>
<td>.068</td>
</tr>
<tr>
<td>Process information</td>
<td>32.37 ± 7.64 (25.00-45.83)</td>
<td>31.55 ± 8.91 (20.83-50.00)</td>
<td>.720</td>
</tr>
<tr>
<td>Apply/use information</td>
<td>42.33 ± 8.08 (25.00-50.00)</td>
<td>36.90 ± 8.93 (25.00-50.00)</td>
<td>.068</td>
</tr>
<tr>
<td>Disease prevention and health promotion</td>
<td>41.35 ± 7.88 (25.00-50.00)</td>
<td>33.33 ± 0.69 (20.83-50.00)</td>
<td>.009</td>
</tr>
<tr>
<td>Access/obtain information</td>
<td>42.31 ± 5.85 (33.33-50.00)</td>
<td>35.12 ± 0.70 (20.83-50.00)</td>
<td>.015</td>
</tr>
<tr>
<td>Process information</td>
<td>35.26 ± 7.91 (20.83-45.83)</td>
<td>31.85 ± 0.58 (12.50-50.00)</td>
<td>.325</td>
</tr>
<tr>
<td>Apply/use information</td>
<td>37.18 ± 7.31 (25.00-50.00)</td>
<td>25.60 ± 12.21 (08.33-45.83)</td>
<td>.011</td>
</tr>
</tbody>
</table>

*Means-Whitney U-test. **Bold values shown presented on table are significant

### Table 3. Correlation Analysis Among Health Literacy Levels, Clinical Parameters, and Pregnancy Outcomes

<table>
<thead>
<tr>
<th>Pregnant women (N = 184)</th>
<th>PI</th>
<th>GJ</th>
<th>PD</th>
<th>BoP</th>
<th>CAL</th>
<th>HLL</th>
<th>Birthweight</th>
<th>Birth week</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI</td>
<td>-.</td>
<td>-.</td>
<td>.642**</td>
<td>-</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
</tr>
<tr>
<td>GJ</td>
<td>.738**</td>
<td>.212</td>
<td>.672**</td>
<td>.173</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
</tr>
<tr>
<td>PD</td>
<td>.600**</td>
<td>.212</td>
<td>.672**</td>
<td>.173</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
</tr>
<tr>
<td>BoP</td>
<td>.569**</td>
<td>.220</td>
<td>.672**</td>
<td>.173</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
</tr>
<tr>
<td>CAL</td>
<td>.624**</td>
<td>.218</td>
<td>.672**</td>
<td>.173</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
</tr>
<tr>
<td>HLL</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
</tr>
<tr>
<td>Birthweight</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
</tr>
<tr>
<td>Birth week</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
<td>-.</td>
</tr>
</tbody>
</table>

Correlation coefficient values by Spearman’s correlation test.
BoP, bleeding on probing; CAL, clinical attachment level; GJ, gingival index; HLL, health literacy level; N, count; PD, probing depth; PI, plaque index.

P<.05, **P<.001.
showed that high HLL did not influence the oral health care habits of pregnant women.

As an objective indicator of the level of oral hygiene, the PI scores were similar in both groups, which is another finding supporting the above result. Consequently, our findings showed that GI and BoP were higher in pregnant women, reflecting increased periodontal inflammation, although PI scores were similar in both groups. The excessive periodontal inflammatory response to local factors in pregnant women can be explained by physiological hormonal changes specific to this period. These findings suggest that oral health in pregnant women is still considered a separate component of general health. Because oral health is part of overall health, the implementation of oral health programs can increase awareness among pregnant women before and during pregnancy. Close collaboration between health care providers, educators, policymakers, the commercial sector, and women is essential to raise awareness of oral health. In addition to the HLL, additional appropriate scales must be developed to highlight the association between oral health and health literacy.

The positive relationship between HLL and birthweight further demonstrates the importance of HLL because, as mentioned above, the motor and cognitive functions of preterm and LBW newborns are slower than those of infants of the same age. As a result, HLL in pregnant women is a phenomenon that affects the postpartum period, as well as the prenatal and perinatal periods. A negative correlation between periodontal parameters and birthweight and week of delivery suggests that maternal periodontal health is essential for an uncomplicated pregnancy.

The most noticeable result of this study was that there were significant positive differences in the access, understanding, and use of relevant information for disease prevention and health promotion among pregnant women. However, this improvement did not change the processing of information. There are many speculative reasons why women may not receive and interpret health information during pregnancy. Since pregnancy only covers the last 9 months of a woman’s life, it is reasonable to assume that this is a short period during which detailed medical information can be processed. As pregnant women become more attached to themselves and their unborn child and become more accessible, these educational programs become increasingly crucial. It is important to plan these programs during puberty. Therefore, these assumptions require further research to clarify the process.

A significant limitation of this study is the small sample size of the population. More research should be carried out with a large number of pregnant women. Pregnant women are important role models for their children in forming habits at a certain age. Education, information sessions, and follow-up initiatives to improve oral health awareness among pregnant women are critical for influencing and shaping their children’s oral health.

Given the limitations of this study, our findings revealed that pregnancy had a positive impact on HLL. Interestingly, while such beneficial improvements reduced the prevalence of adverse pregnancy outcomes, they still had no impact on the periodontal health of pregnant women. Additionally, findings of this study underscore the importance of educational initiatives to promote awareness of better oral health-care practices and to preserve periodontal health in pregnant women. These findings highlight the significance of developing novel and practical strategies to improve general and oral health care during pregnancy.


Frequency of Direct Composite Restorations to Anterior Teeth After Orthodontic Treatment: A Retrospective Study

Ortodontik Tedavi Sonrası Anterior Dişlere Direkt Kompozit Restorasyon Uygulama Sıklığı: Retrospektif Bir Çalışma

ABSTRACT

Objective: The aim of this study was to evaluate the frequency rate of applied direct composite restorations to the upper anterior teeth of patients to improve the aesthetic appearance after orthodontic treatment.

Methods: Records of 1080 patients whose orthodontic treatment was completed in the last 5 years were examined. In total, 104 patients with direct composite restorations of their upper anterior teeth because of a tooth-size discrepancy, tooth-shape malformation, missing lateral incisors, missing central incisors, black triangles, and transposition after orthodontic treatment were identified. Information such as gender, age, Angle classification, and which tooth or teeth were restored and for what reason were recorded. Mean ± standard deviation or n (%) was used for the descriptive variables and the chi-square test was used for the categorical variables. Statistical significance was accepted as $P < .05$.

Results: In the present study, the frequency rate of direct composite restoration to the upper anterior teeth was found to be 9.6% among all patients whose orthodontic treatment was completed. When the reasons for restoration were evaluated, the most common reasons were determined as tooth-size discrepancy (60.6%), malformation (18.3%), and missing lateral incisors (14.4%). In patients with direct composite restorations, the most common reason for restoration in the right (65.2%) and left canine (66.7%) teeth were missing lateral incisors; in the right (80.6%) and left (74.3%) central and right (77.8%) and left (78.7%) lateral teeth, the tooth-size discrepancy was detected.

Conclusion: In some orthodontic cases, direct composite restorations are needed for an appropriate aesthetic appearance.

Keywords: Anterior diastema, direct composite restoration, orthodontic treatment

ÖZ

Amaç: Bu çalışmanın amacı, ortodontik tedavi sonrası estetik görünümü iyileştirmek için hastalarının üst ön dişlerine uygulanan direkt kompozit restorasyonların sıklığını değerlendirilmekti.

Yöntemler: Son beş yıl içinde ortodontik tedavi tamamlanan 1080 hastanın tüm kayıtları inceledi. Ortodontik tedavi sonrası diş-boyut uyuşma zıı, diş-şekil bozukluk, lateral diş eksikliği, santral diş eksikliği, siyah üçgen oluşumu ve transpozisyon nedeniyle üst anterior dişlerine diret kompozit restorasyon yapılmış 104 hastaya tespit edildi. Cinsiyet, yaş, Angle sınıflandırması, hangi diş veya dişlerin ne sebeple restore edildiği gibi bilgiler kaydedildi. Tanımlayıcı değişkenlerin için ortalamalar ± standart sapma veya n (%), kategorik değişkenler için chi-kare testi kullanıldı. İstatistiksel anlamalılık $P < .05$ olarak kabul edildi.

Bulgular: Bu çalışmada ortodontik tedavi tamamlanan tüm hastalar arasında, üst ön dişlerine diret kompozit restorasyon yapılmış %9,6 olarak bulundu. Restorasyon nedenleri değerlendirildiğinde, en sık olarak diş-boyut uyuşma zıı (%60,8), diş-şekil bozukluğu (%18,3) ve lateral diş...
INTRODUCTION

The main purpose of orthodontic treatment is to restore the health of teeth and periodontium by eliminating malocclusion and improving the dentofacial appearance.¹ To eliminate malocclusion and to provide an ideal occlusion, it is necessary to restore the tubercle–fissure relationship and overjet–overbite of the dental arches. To accomplish this, the mesiodistal size discrepancies of teeth between the lower and upper dental arches should also be eliminated. This tooth-size discrepancies are determined with conventional and digital calipers or digital scanning of 3-dimensional models of the mesiodistal widths of the teeth.² To achieve the goals of orthodontic treatments in patients with tooth-size discrepancies, either removing material from the teeth in the same arch (interdental stripping) or adding material (composite restorations or porcelain veneers) to the teeth in the opposite arch may be required.

Due to tooth size/shape anomalies, tight contact between the front teeth cannot always be achieved after orthodontic treatments. When such situations are detected, a restorative intervention may be required to optimize results.³ In minor intervention, direct composite restorations are often preferred because of the high success rate. In a recent study,⁴ the annual failure rate of anterior direct composite restorations applied after orthodontic treatment was found to be 2.59%. Material chipping and wear were the most common reasons for failure and most of them were classified as repairable. Direct composite restorations are simple, fast, and cost-effective and do not require extensive preparations that could damage healthy tooth structures.⁵

A multidisciplinary approach should be followed to correct the malformation in the anterior region after orthodontic treatment. For best results, it is important to include a restorative dentist on the team.⁶ However, it is not known to what extent patients need treatment with a multidisciplinary approach with a restorative dentist. To know this, it is important to know the frequency of direct composite application in an orthodontic clinic.

Guidelines for obtaining informed consent for orthodontic treatment require patients to obtain adequate information about the proposed treatment.⁷ As part of the process, patients should be informed of the need for restorative treatment and the potential risks/benefits of treatment. Therefore, knowing the reasons for direct composite application in the orthodontic clinic after the treatment is also important to inform patients.

Although case series and success rates have been evaluated in the studies, no study on the frequency rate of direct composite application has been found in the literature. Determining the need for restorative treatment after orthodontic treatments provides guidance to the clinician in planning the final stage of orthodontic treatment. The aim of this study was to evaluate the frequency rate of direct composite restorations applied to the upper anterior teeth of patients to improve the aesthetic appearance after orthodontic treatment. Determining the applied reasons for the restorations was a secondary purpose. The null hypothesis was that there is no requirement for orthodontics and restorative dentistry collaboration in orthodontic treatment management.

MATERIAL AND METHODS

Photographs and panoramic x-rays of 1080 patients, whose orthodontic treatment was completed in the last 5 years (between January 2015 and January 2020) in the Orthodontic Clinic of the Çukurova University, Faculty of Dentistry, were examined. Ethical approval of the study was obtained from Çukurova University Faculty of Medicine Clinical Research Ethics Committee (Date: 10.01.2020, Number: 95th Meeting, 44th Decision). The present study was a retrospective archive study. The files of the patients whose orthodontic treatment was completed but who were referred to restorative dental treatment to achieve the appropriate esthetic appearance were selected from the archive. Of these patients, those with direct composite restorations to their upper anterior teeth were determined. The exclusion criteria from this study were as follows:

- Patients with cleft lip and palate,
- Patients with craniofacial anomalies,
- Patients with oligodontia.

As a result, 104 patients out of 1080 patients were included in the present study. Reasons for applied direct composite restorations were determined as follows (Figure 1):

- Tooth-size discrepancy (Fig. 1A)
- Tooth-shape malformation (Fig. 1B)
- Missing lateral incisors (Fig. 1C)
- Missing central incisors (Fig. 1D)
- Black triangle formation (Fig. 1E)
- Transposition (Fig. 1F)

The gender, age, Angle classification (Class I, II, III), which teeth from the anterior 6 teeth were filled, the reason for filling, and who the patient’s orthodontist was were recorded.

Statistical Analysis

The IBM Statistical Package for the Social Sciences 22.0 software package (IBM Corp.; Armonk, NY, USA) was used for data analysis. Age was presented as mean ± standard deviation and statistics of descriptive variables as n (%). The chi-square test was used to analyze categorical variables. Statistical significance for all analyses was accepted as P < .05.

RESULTS

All post-treatment records of the 1080 patients, whose orthodontic treatment was completed, were examined. It was observed...
that 104 patients (9.6%) had direct composite restorations done to their upper anterior teeth. Of these patients, 66 (63.5%) were female and 38 (36.5%) were male. The mean age of these patients was 20.4 ± 4.6 years. It was observed that 20 (19.2%) patients were under the age of 18.79 (76.0%) patients were aged 18-28, and 5 (4.8%) patients had the age of 29 and above. Table 1 presents the reasons for the direct composite restorations.

The evaluation in terms of gender showed that the Angle classification and the reasons for restoration were similar for men and women (Table 2). There was no gender difference regarding the teeth (Table 3).

Restorations regarding tooth-size discrepancies were similar ($P = .402$) for all Angle classifications (Class I, II, III): 66% for Angle Class I, 54% for Class II, and 71.4% for Class III. Missing lateral incisors were the only statistically significant reason for the

**Table 1. Reasons for Applying Direct Composite Restorations**

<table>
<thead>
<tr>
<th>Reason</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth-size discrepancy</td>
<td>63</td>
<td>60.6</td>
</tr>
<tr>
<td>Tooth-shape malformation</td>
<td>19</td>
<td>18.3</td>
</tr>
<tr>
<td>Missing lateral incisor</td>
<td>15</td>
<td>14.4</td>
</tr>
<tr>
<td>Missing central incisor</td>
<td>3</td>
<td>2.9</td>
</tr>
<tr>
<td>Black triangle formation</td>
<td>2</td>
<td>1.9</td>
</tr>
<tr>
<td>Transposition</td>
<td>2</td>
<td>1.9</td>
</tr>
</tbody>
</table>

**Table 2. Evaluation of Potential Risk Factors by Gender**

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Female</th>
<th>%</th>
<th>Male</th>
<th>%</th>
<th>P</th>
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<tr>
<td>Below 18</td>
<td>12</td>
<td>18.2</td>
<td>8</td>
<td>21.1</td>
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<tr>
<td>From 18 to 28</td>
<td>50</td>
<td>75.8</td>
<td>29</td>
<td>76.3</td>
<td></td>
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<tr>
<td>Above 28</td>
<td>4</td>
<td>6.1</td>
<td>1</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Angle classification</td>
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<tr>
<td>Class I</td>
<td>30</td>
<td>45.5</td>
<td>17</td>
<td>44.7</td>
<td>.937</td>
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<tr>
<td>Class II</td>
<td>32</td>
<td>48.5</td>
<td>18</td>
<td>47.4</td>
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<tr>
<td>Class III</td>
<td>4</td>
<td>6.1</td>
<td>3</td>
<td>7.9</td>
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<tr>
<td>Tooth-size discrepancy</td>
<td>38</td>
<td>57.6</td>
<td>25</td>
<td>65.8</td>
<td>.409</td>
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<tr>
<td>Tooth-shape malformation</td>
<td>12</td>
<td>18.2</td>
<td>7</td>
<td>18.4</td>
<td>.976</td>
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<tr>
<td>Missing lateral incisor</td>
<td>11</td>
<td>16.7</td>
<td>4</td>
<td>10.5</td>
<td>.391</td>
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<tr>
<td>Missing central incisor</td>
<td>2</td>
<td>3.0</td>
<td>1</td>
<td>2.6</td>
<td>.907</td>
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<tr>
<td>Black triangle formation</td>
<td>2</td>
<td>3.0</td>
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<td>.279</td>
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<tr>
<td>Transposition</td>
<td>1</td>
<td>1.5</td>
<td>1</td>
<td>2.6</td>
<td>.690</td>
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</table>

**Figure 1.** Reasons for direct composite restoration after orthodontic treatment. Intraoral view before orthodontic treatment on the left, during orthodontic treatment in the middle, and after composite restorations on the right. Why direct composite restoration was performed in each patient was explained: (A) Tooth-size discrepancy; because of diastema in the upper lateral and central teeth after orthodontic treatment. (B) Tooth-shape malformation; due to upper lateral teeth with narrow mesiodistal width. (C) Missing lateral incisor; due to congenital upper lateral tooth deficiency. (D) Missing central incisor. (E) Black triangle formation; due to loss of papillae between the upper central teeth. (F) Transposition; due to the transposition of the left canine and lateral.
composite restoration. In addition, it was observed that the percentage of composite restorations was higher in Angle Class II patients (24.0%) compared to Class I (4.3%), due to missing lateral incisors ($P = .022$).

The number of direct composite restorations after orthodontic treatment was similar ($P = .951$) among clinicians (13 different clinicians in total). In addition, the medians of the number of teeth were equal (a maximum of 2 teeth out of 6 in 1 patient).

In patients with direct composite restoration, the most common reason for applications in the right and left canine teeth were missing lateral incisors (Table 4). Composite materials were used for recontouring the teeth.

### DISCUSSION

Anterior direct composite treatments are frequently used for tooth enlargement, gap closure, and reshaping of teeth. In this study, the clinical frequency and application indications of patients who were treated with anterior tooth composites after orthodontic treatment were evaluated. According to the results of this study, the null hypothesis was rejected. This study showed that restorative treatment is needed to provide an appropriate esthetic appearance, especially in the maxillary anterior region.

In the present study, patients were classified as cases of tooth-size discrepancy (Bolton discrepancy), tooth-shape malformation (peg-shaped or narrow lateral incisors), missing lateral incisors or central incisor teeth, transposition cases, and cases with a black triangle. The study determined that Bolton discrepancy was a primary reason for composite applications, with 60.6% of the total composite restorations being applied after orthodontic treatment. This is consistent with studies that mention a 5% tooth-size discrepancy in the general population. Evaluating the 1080 orthodontic treatment patients, it was observed that composite resin was applied to 63 patients, which agrees with the literature. However, it should be noted that composite restoration is not performed in every case of Bolton discrepancy. Other options for Bolton discrepancy in orthodontic practice are interproximal reduction (IPR), tooth extraction decision, angulation-inclination changes in teeth, or maxillary molar rotation.

In various studies, differences in the intermaxillary teeth ratios were investigated in ethnic, gender, and malocclusion groups. Some studies found maxillary tooth material excess in Class II malocclusions and mandibular tooth material excess in Class III malocclusions, while other studies found no significant difference. This study also investigated whether there was a relationship between the first Angle classification and tooth-size discrepancy, no significant difference was found.

According to this study, the second reason for the application of direct composite restorations is tooth-shape malformation (18.3%). The peg-shaped lateral tooth is one of the leading tooth-shape malformations. In the present study, this percentage was 1.75% in patients whose treatment was completed. According to a meta-analysis, the prevalence of peg-shaped lateral incisor in the general population is 1.8%, while it was 2.7% in orthodontic treatment patients, and it is 1.35 times more common in women. In our study, peg-shaped lateral incisor rates were also 1.71 times higher in women. It is stated that the percentage of unilateral (0.8%) or bilateral peg-shaped lateral incisor is approximately equal, which is similar to the percentage observed in our study. No relationship was observed between the peg-shaped laterals with the gender or the Angle classification.

In the present study, missing lateral incisors were the third-highest cause for applying direct composite restoration (14.4%). In the case of missing lateral incisors, there are 2 types of treatments in orthodontics: opening or closing the gap. If the gap is closed in the case of congenitally missing lateral incisors, repositioning the canines into the lateral incisor space may well produce an esthetical unsatisfactory result, therefore composite restoration is applied.

If the gap of the missing lateral incisor is closed with mesialization of the canine, the posterior teeth are also located mesially, and a Class II relationship is established. Space closure is indicated in cases of the mesial eruption of the canines or mesial drift within the supporting zone. This may be the reason why the percentage of composite restorations due to the lack of lateral incisors is higher in Class II. On the contrary, orthodontic space opening is preferred in cases of Class I malocclusion, where extractions in the lower arch are not indicated, and in patients with Class III malocclusion, retrognathic profile.

Another finding of the study concerns space closure in patients with missing central incisors. Replacing the central incisor with a lateral incisor, to close the gap due to the smaller mesiodistal width, requires the use of composite materials.

The other indication for composite restorations after orthodontics is black triangles. A black triangle is a gap seen at the cervical embrasure below the contact point of some teeth where the papilla is missing (Figure 1). When teeth are crowded and overlapped, the papilla is not able to grow in the contact area between them. After aligning teeth by orthodontic treatment, this lack of papillae between the teeth becomes visible as a black triangular space. This usually occurs due to root deviation of adjacent teeth either naturally or due to improper orthodontic treatment.
Triangular-shaped incisor crowns and long, narrow teeth are all etiological factors for black triangles. In the case where the crowns are triangular-shaped, IPR of enamel between the triangular crowns will broaden the contact area. Changing the contact point gingivally leads to reduced open gingival embrasures. Typically, 0.5-0.75 mm of enamel is removed with IPR to correct black triangles.

Other low-percentage composite restorations were transposition cases. Tooth transposition is defined as the positional interchange of two adjacent teeth within the same quadrant. Its incidence is approximately 0.4%, which is similar to the incidence in our orthodontic population. It occurs more commonly in the maxilla than the mandible. The maxillary permanent canine has been reported as the tooth most frequently involved in transposition.

The evaluation in terms of gender concluded that the reasons for direct composites and Angle classification were similar for men and women. In cases of missing lateral incisors, the percentage of composite restorations is higher in Angle Class II patients compared to Class I. The lack of difference in other groups might be the low number of patients selected for this study. The percentage of clinicians who made a restorative treatment decision after orthodontic treatment was similar. It is seen that different orthodontists in the same clinic provide 9.6% of their patients with composite restorations after orthodontic treatment. The reason for this might be that, because of their interactions in the same clinic, the physicians have a similar opinion regarding the ideal orthodontic treatment, and the opinions of the consulted restorative dentists are also related.

Direct composite restorations made to the anterior teeth require regular control of the patient. There may be breaks, ruptures, discoloration, or complete falls on the edges of the composite fill. However, today, the success of direct composite restorations is increasing at a level that cannot be ignored. This is caused by both the improved adhesive systems and the color and physical properties of composite fillings that better reflect the properties of the teeth. Compared to prosthodontic treatment, the advantage of contemporary dental composites as a minimally invasive procedure for tooth shape corrections is the minimum loss of dental hard tissue. In a previous study, the failure rate after 5 years of reshaping the anterior teeth and closing diastemas with direct composite restorations was 84.6%. More than 90% of the restorations were clinically categorized as excellent or good. Moreover, failed restorations were successfully repaired, and 100% functional endurance was achieved. Another study reported that restorations placed after orthodontic treatment showed a 93% success rate after a 4-year follow-up. Therefore, the treatment with direct composite restorations is considered an appropriate alternative to indirect restorations.

The percentage of direct composite restorations in patients whose orthodontic treatment was completed was 9.6%. Direct composite restorations after orthodontic treatment are widely used as an option with minimal invasive effects, providing anterior teeth with an aesthetic smile, and achieving the ideal arch size and stability. This reveals the importance of a multidisciplinary approach in orthodontic treatment.

Informed Consent: Academic permission was obtained from Çukurova University Faculty of Dentistry Orthodontics Department on 10.01.2020 for the patient information and photographs used in this study.

Peer-review: Externally peer-reviewed.


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Declaration of Interests: The authors declare that they have no competing interest.

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Disinfection Effect of Gaseous Ozone on Candida albicans and Enterococcus faecalis: A Randomized Clinical Trial in Infected Primary Molars

Gaz Halindeki Ozonun Candida albicans ve Enterococcus faecalis Üzerindeki Dezenfekte Edici Etkisi: Enfekte Süt Azı Dişlerinde Randomize Bir Klinik Çalışma

ABSTRACT

Objective: The current clinical randomized study's primary purpose was to investigate the antimicrobial efficiency of gaseous ozone on primary teeth root canals.

Methods: The included teeth were randomly divided into three groups, and in each group, the root canal therapies of 12 primary teeth were done. In group 1, 2.5% sodium hypochlorite was applied as an irrigation agent. In group 2, 0.9% sterile saline solution was combined with 80 seconds OzonyTronX® application. In group 3, 2.5% sodium hypochlorite was applied as an intracanal medicament in combination with 80 seconds OzonyTronX®. Microbial analyses assessed the colonization of Candida albicans and Enterococcus faecalis before and after the procedure.

Results: Thirty-six primary molars of 36 completely healthy patients (aged 5-10) were included in the study. The results revealed that the percentage decrease in the number of C. albicans was higher in group 3 (99.3%). This decrease was statistically higher than group 1 (96.1%) and group 2 (94.2%). Group 1 showed better results in eliminating the viable C. albicans versus group 2 (P = .033). The decrease in the number of E. faecalis was higher in group 3 (99.4%) compared to group 1 (99.1%) and group 2 (98.7%) (P = .006). Although the percentage of the unviable microorganisms was higher in group 1, there was no statistical difference versus group 2 (P > .05).

Conclusion: Using gaseous ozone alone or in combination with sodium hypochlorite may enhance the success of the antimicrobial stage of primary root canal therapies. It could be an alternative to toxic chemical agents such as highly concentrated sodium hypochlorite.

Keywords: Dentistry, disinfection agents, ozone, pediatric dentistry, primary teeth, root canal treatment

ÖZ

Amaç: Bu çalışmada ozon gazının süt dişi kök kanalları üzerindeki antimikrobiyal etkinliğinin incelemesi amaçlanmıştır.

Yöntemler: Dahil edilen dişler rastgele three gruba ayırdı ve her grupta 12 süt dişinin kök kanal tedavisi yapıldı. Grup 1de irrigasyon aşını %2,5 NaOCl uygulandı. Grup 2de %0,9 steril salin solusyonu 80 saniye OzonyTronX® uygulaması ile kombine edildi. Grup 3te %2,5 NaOCl köklü olarak %80 saniye OzonyTronX® ile kombinasyon halinde uygulandı. Mikrobiyel analizler ile işlemden önce ve sonra C. albicans ve E. faecalis’in kolonizasyonu değerlendirildi.

INTRODUCTION

Tooth caries in primary teeth may occur rapidly, and the progressive character of the lesions reveals pulpal damage in a shorter time compared to permanent teeth. Once the pulp is infected, removing the pulp tissue to avoid disseminating the infection through the surrounding tissue and mainly to the germ of the permanent tooth in the neighborhood is the preferable choice in appropriate cases.12 This treatment, named root canal therapies in primary teeth, reveals differences compared to permanent dentition due to the root canal anatomies, larger and enhanced dentinal tubules, accessory canals, and root tip bifurcation. Furthermore, these differences make it impossible to disinfect the root canal of a primary tooth through instrumentation.3 The root resorption degrees and the germ in the neighborhood of the periapical area are also challenging parts of primary root canal treatments.4 Numerous types of infectious agents can colonize in root canals, and the studies assessing primary root canal microbiota revealed that anaerobic strains form the main microorganism population of primary teeth with necrotic pulp.3,5 Accordingly, Enterococcus faecalis (E. faecalis) and Candida albicans (C. albicans) are the main strains isolated from the infected root canals.6-7 An appropriate disinfection procedure should be applied to achieve a successful root canal treatment, and this protocol consists of 2 main components: mechanical preparation and chemical irrigation.8,9 In primary teeth, the presence of the lateral and accessory canals and the complexity of root canal anatomy make it impossible to reach all the microbial residuals and remove them by mechanical approaches.3 By this means, chemical irrigants take a significant part of the root canal disinfection procedure in the primary dentition.4,20,31 Various disinfection and irrigation agents have been used, and sodium hypochlorite (NaOCl) has been preferred as a gold standard in this area.12-15 Though this agent shows an effective antimicrobial activity, it still has some disadvantages that restrict its use in pediatric patients. The excessive use of NaOCl causes cytotoxic effects and inflammatory responses such as edema, severe pain, ecchymosis, and paresthesia.2,3,8 Hence, the search for ideal root canal disinfection agents remains to be a necessity in root canal treatment of primary teeth.3,6,17 Ozone is an alternative non-invasive antibacterial, antiviral, and antifungal agent preferred in reducing the number of caries-causing bacteria. Ozone reveals the antimicrobial effect by effectively oxidizing the bacterial cell wall and cytoplasmic membrane.16-22 Accordingly, it has been used in medicine and dentistry in various areas such as wound healing, caries management, cavity disinfection, root canal therapies, tooth hypersensitivity therapies, temporomandibular joint disorders, and oral diseases.23

In literature searches, studies investigating the antimicrobial effect of gaseous, aqueous, and oiled forms of ozone versus NaOCl, and various disinfection agents have been detected.2,4,24 However, these studies were mainly held on ex vivo conditions, and the application was held on permanent teeth.17-29 In the literature review, no study was detected to assess the antimicrobial effect of gaseous ozone and combined use of it with NaOCl versus the use of NaOCl alone in primary teeth, in vivo. The main purpose of the current study was to investigate the antimicrobial effect of gaseous ozone and the combined use of ozone gas with NaOCl in the disinfection of primary root canals, in vivo, and to find a safe and effective alternative to NaOCl disinfection agents used in deciduous root canal therapies. The study hypothesized that the antimicrobial efficiency of gaseous ozone would be higher than the other groups compared.

MATERIAL AND METHODS

Ethical Approval

The study protocol was approved by Ethical Committee of Ankara University Faculty of Dentistry (Date: 26.10.2010, Number: 3/6). The research was conducted in full accordance with the World Medical Association Declaration of Helsinki, with all amendments. The study was designed in accordance with STROBE guidelines. The legal representatives of the participants and the patients were informed of the study design, and informed consent was obtained from them. All treatment procedures were completed for each patient admitted to our clinics, whether they were a part of the study or not. All the participants were informed that they were free to leave the study if they did not want to attempt the treatment sessions at any time interval.

Case Selection

The study population was detected by G*Power Software based on an effect size of 0.5, an alpha significance level of 5% (0.05), and a beta of 20% (0.20) to achieve an 80%.30 Accordingly, a total of 36 mandibular second primary molars of 36 children aged between 5 and 10, with no systemic illnesses [American Society of Anesthesiologists -I] were included in the study. Including criteria were as follows: pediatric patients with no use of an antimicrobial agent in the last 3 months, teeth with positive responses to percussion and palpation, no sinus tract and intra-oral, extra-oral swelling, teeth with no pathological and physiological mobility, and restorable with stainless steel crown. Additionally, in radiographical examinations, the selected teeth needed to show the Res(l) and Res (1/4) scores according to the root resorption scoring system (Figure 1).31 No radiolucency in the peri-radicular tissue and no internal–external root resorption were also among the including criteria. However, the teeth with lesions only in 1/3 percent of the bifurcation area were also included in the study.

The patients who are not compatible with including criteria, who cannot adopt the dental treatments, and with whom rubber-dam isolation was not possible were excluded from the study. The included teeth were randomly divided into three groups, and in each group, the root canal therapies of 12 primary teeth were done. The flowchart of the study design is described in Figure 2.
In group 1 (control group), 2.5% NaOCl was applied as an irrigation agent.

In group 2 (study group), 0.9% sterile saline solution was combined with 80 seconds OzonyTronX® application.

In group 3 (study group), 2.5% NaOCl was applied as an intracanal medicament in combination with 80 seconds OzonyTronX®.

**Ozone System**

OzonyTronX®, developed in 2005 in Germany, was formed by a central unit, a plasma probe, and an applicator. High-frequency impulses are sent from the central unit to the applicator via a connector. OzonyTronX® is not a generator that produces gaseous ozone. The oxygen molecules (O₂) in the atmosphere are divided into atomic oxygen when the probe contacts the application area. This atomic oxygen combines with O₂ and forms O₃, a highly effective disinfection agent. OzonyTronX® has different probes that differ by application areas. The probe used in narrow (2 cm³) and curved areas such as root canals and periodontal defects was preferred in the study. According to company recommendations, ozone at a concentration of 100 μg/mL (level 5, 40 seconds) was used with a blue probe for disinfection procedures of root canals. The use of gaseous ozone for 20-120 seconds in dental practices was approved by Medical Device Authority (MDA) and Technical Inspection Association (TUV). Accordingly, in the current study, the application was made twice (80 seconds) to obtain the maximum disinfection effect.

**Clinical Procedures**

The root canal length was assessed with a phosphor plaque sensory system using a standard parallel technique (Digora® Soredex, Soredex Medical Systems, Helsinki, Finland) (Figure 3). Regional alveolar inferior block anesthesia was applied, and rubber-dam isolation was done. The plaque and other bacterial accumulations were cleaned off with pumice and a micro-brush. The external surfaces of the teeth, clamps, and rubber liner were also wiped using 0.12% chlorhexidine (CHX; Klorhex™, Drogsan, Ankara, Turkey), 3% H₂O₂ (60 seconds) (Carlo Erba, Emmendingen, Germany), 5.25% NaOCl (60 seconds) (Wizard™, Istanbul, Turkey). The remedies of NaOCl were removed using 5% sodium thiosulfate (HT1005, Sigma-Aldrich Chemie GmbH, Taufkirchen, Germany), and sterile saline solution was used to wash the operation place. The coronal cavity access was performed using a sterile diamond bur (Meisinger 801-16, Germany), and the first samples of microorganisms were taken by sterile paper points placed 2 mm shorter than the root canal length for 60 seconds. The samples

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**Figure 1.** The root resorption degrees for mandibular deciduous molars.

**Figure 2.** Flowchart of study design.
were taken from the largest (distal) canal of the tooth, and meanwhile, the other canal orifices were closed by sterile cotton pellets. The paper points were placed in sterile tubes containing 2 mL reduced transport fluid and transported to Gazi University Faculty of Pharmacy Department of Pharmaceutical Microbiology laboratories. After the first samples were obtained, the mechanical preparation was done with ISO 30 K files (Golden Star Medical, Guangdong). The chemical applications were performed after the mechanical applications were made in both study and control groups.

In Group 1, 10 mL 2.5% NaOCl application followed the mechanical preparation. After 2 mL 0.9% saline application, the second samples were taken by placing a sterile cone in the largest canal of the tooth (distal canal for 60 seconds). The mesiobuccal and distobuccal canals were closed with a sterile cotton pellet while the samples were taken. After the application, the root canal filling was completed with a calcium hydroxide-containing paste (Tg-Pex™, London, England), glass ionomer cement (Ionofoil U, Voco, Cuxhaven, Germany) was placed, and the teeth were restored with a Stainless-Steel Crown (3M ESPE, Seefeld, Germany).

In Group 2, the canals were irrigated with 10 mL 0.9% sterile saline. Ozone treatment (OzonyTronX with CA probe) was applied for 80 seconds, and 2 mL 0.9% saline application was performed. Finally, the second samples were taken by the method described in group 1, and the canal treatment was completed the same as mentioned in group 1.

In Group 3, the disinfection of root canals was done using 10 mL, 2.5% NaOCl, and ozone treatment for 80 seconds, and 2 mL 0.9% saline application was performed. Finally, the second samples were taken by the method described in group 1, and the canal treatment was completed in the same manner as mentioned in group 1. The materials used in the study are listed in Table 1. The clinical procedures are shown in Figure 4.

The Microbial Analyses
The microbial samples were obtained by using a sterile paper point. After the coronal cavity was prepared and the disinfection agents were applied, the initial and the last root canal microbiota was obtained by placing a paper point in the root canals for 60 seconds. These paper points were immediately placed in sterile tubes containing RTF and transported to the pharmaceutical microbiology laboratories.

The colonization of C. albicans and E. faecalis was assessed by 10 times diluting the samples in PBS (Phosphate buffered saline) and inoculating the samples in MacConkey agar in 3 parallel lines. The identification of microorganisms was made by API (micro-organism identification) kits (Biomerieux, Marcy-I’Étoile, France), and the values of alive microorganisms were assessed macroscopically in colony-forming unit (CFU)/mL, in a microaerophilic atmosphere (Anaerocult C), 37°C, following the incubation of 48 hours (Arendorf & Walker 1979).

Statistical Analysis
Statistical Package for the Social Sciences (SPSS) version 21.0 for Windows (IBM Corp.; Armonk, NY, USA) was used to analyze the study results. Whether the distribution of continuous-measure variables was close to normal was investigated using the Shapiro–Wilk test, and the homogeneity of variances was investigated with the Levene test. Descriptive statistics are shown as mean (standard deviation). The effectiveness of the irrigation agent was evaluated with the Wilcoxon Sequential Sign Test using pre-post-irrigation data for in-group comparison. The difference between the groups was also evaluated by performing the Kruskal–Wallis test separately on the microbiological data obtained before and after the application. If there was a significant difference due to the Kruskal–Wallis test, the groups causing the difference were determined by Conover’s non-parametric multiple comparison test.

RESULTS
In Table 2, the results of the descriptive statistical analyses of the values of C. albicans and E. faecalis prior to the application and following the applications were shown in Log CFU. According to the study results, the number of viable microorganisms was significantly reduced compared to the initial samples in all groups ($P < .05$).

However, according to the Kruskal–Wallis analyses in which the initial microorganism values versus the values obtained following

<table>
<thead>
<tr>
<th>Table 1. The Materials and Chemical Agents Used in the Study</th>
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<tbody>
<tr>
<td><strong>Material</strong></td>
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</tr>
<tr>
<td>Ultracain D-S ampul</td>
</tr>
<tr>
<td>Saline solution</td>
</tr>
<tr>
<td>Sodium hypochlorite</td>
</tr>
<tr>
<td>NaOCl</td>
</tr>
<tr>
<td>Glass ionomer cement</td>
</tr>
<tr>
<td>Gaseous ozone</td>
</tr>
<tr>
<td>Stainless steel crown</td>
</tr>
<tr>
<td>Reduce transport fluid</td>
</tr>
</tbody>
</table>
the antimicrobial treatment applications were compared, the number of viable microorganisms revealed higher values in the ozone group (Table 3, Figures 5 and 6).

The Wilcoxon signed-rank test determined the decrease of the antimicrobial treatment applications were compared, the number of viable microorganisms revealed higher values in the ozone group (Table 3, Figures 5 and 6).

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The Wilcoxon signed-rank test determined the decrease of the antimicrobial treatment applications were compared, the number of viable microorganisms revealed higher values in the ozone group (Table 3, Figures 5 and 6).
to the results, NaOCl revealed better results than diode laser application. Diode laser was superior to ozone, Endosafe, and PAD groups. The efficiency of ozone was similar to the Endosafe and PAD applications. This study has also revealed that NaOCl application was superior to ozone application in terms of root canal disinfection efficiencies.

However, in an in vivo study, Ajeti et al.24 (2018) assessed the disinfection efficiencies of 0.9% NaCl, 2.5% NaOCl, and 2% CHX combined with gaseous ozone. The last group (2% CHX combined with gaseous ozone) revealed superior results compared to the groups studied. The results of this study were different from our findings. However, Ajeti et al.24 studied the effect of the combined use of CHX and ozone versus NaOCl. The additional antimicrobial effect of CHX may enhance the efficiency of ozone gas, and the success of ozone-CHX versus NaOCl could be attributed to the effect of CHX use.

In another previous study, Agarwal et al.3 (2020) compared the antimicrobial efficiency of ozone, green tea, and saline in 60 primary teeth with a single root, in vivo. The microbial samples were taken before treatment, after the irrigation, and on the third day after the treatment. The results showed that the antimicrobial effect of ozone application was superior to green tea and saline treatments. The result of this study was different from the findings of the current study we held. This difference might be attributed to the fact that, in the study by Agarwal et al.3 the antimicrobial effect of ozone was compared to saline and green tea. The comparison between ozone and NaOCl was not made in this study, and the results might be changed if the study groups were enlarged, including the application of NaOCl.

The study was held on clinical conditions; although clinical studies are more respectable than in vitro studies, environmental and biological factors may affect the study results. The findings might differ if the study was supported with an in vitro trial stage. Repeating the treatment in a larger patient population may enhance the reliability of the study. Furthermore, only the gaseous form of ozone was obtained and used in the current study. However, different ozone forms, such as oiled ozone and ozonated water, could affect the study results. These could be mentioned as the limitations of the current study.

Based on our findings, ozone gas could be an alternative agent in pediatric patients with fear and anxiety, thanks to the disinfection effect with short application time in infected root canals. Furthermore, ozone gas could be an aid to NaOCl in endodontic treatment, thanks to its enhanced antibacterial efficiency when used following mechanical instrumentation. However, long-term follow-up clinical studies are needed to assess the effect of ozone gas application on the success rate of endodontic treatment of primary teeth with periapical/furcation lesions.

Figure 5. (A) C. albicans and E. faecalis amounts isolated from root canals before irrigation. (B) C. albicans and E. faecalis amounts isolated from root canals after irrigation.

Figure 6. The decrease of viable microorganisms in percentage after the final irrigation compared to before irrigation.


Declaration of Interests: The authors declare that they have no competing interest

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REFERENCES

The Effect of Tea Tree Oil as a Denture Cleanser on the Surface Roughness of an Acrylic Resin

Protez Temizleyici Olarak Çay Ağacı Yağının Akrilik Rezinin Yüzey Pürüzlülüğü Üzerindeki Etkisi

ABSTRACT

Objective: This study aims to evaluate the effect of using tea tree oil and chemical agents in denture cleaning on the surface roughness of acrylic resin dentures.

Methods: A total number of 40 acrylic resin samples (65 mm x 10 mm x 3 mm) were prepared for the study. After the samples were enumerated, their roughness values were determined and they were randomly divided into groups (n=10) and kept in Protefix, Corega, tea tree oil, and distilled water. The time period for the immersion in the solutions was established as 20 minutes. The roughness values were measured again after 720 immersions. The data thus obtained were evaluated using two-way analysis variance and post hoc Tukey's test.

Results: As a result of the variance analysis, it was determined that the liquid used and the immersion time were not statistically significant (P > .05).

Conclusions: It is exciting that natural oils have an important place in people's lives in all aspects and that we can use them in denture cleansing. The surface roughness of base materials is important for both aesthetics and microbiology. Dentists have to consider the effects of tea tree oil on the surface roughness of base material.

Keywords: Acrylic resin, denture cleaners, surface roughness, tea tree oil

INTRODUCTION

In the oral environment, tartar, plaque, and stain formation are observed on dentures as well as on teeth. Conditions that can vary from patient to patient such as the surface properties of dentures, duration of use, oral hygiene, dietary habits, and saliva components point out to possible variations in
the resulting deposits on dentures. Individuals that fail to maintain denture hygiene may, as a result, develop halitosis, denture stomatitis, and other mucosal infections.

Denture stomatitis refers to inflammatory and erythematous formations in the oral mucosa in contact with the base. This condition, dominated by Candida Albicans fungi, was reported to feature colonizations mostly on the inner surface of the base plate.

Denture cleaning can be achieved by mechanical or chemical methods employed individually or in combination. Brushing, ultrasonic cleaners, and microwave ovens can be used for this purpose as mechanical methods. Chemically, denture cleaning can be performed with the use of disinfectants, enzymes, diluted acids, alkaline peroxides, and alkaline hypochlorites.

These chemical agents should not cause any chemical, physical, or mechanical changes on the dentures. Since the dentures will need to be cleaned numerous times with such agents during their period of effective use, it is important that they should offer good efficacy and not damaged dentures.

Given the fact that the users of dentures are mostly of advanced age, it should be foreseen that they will not be able to achieve sufficient denture cleaning through mechanical means. In addition, the microbiological efficiency of mechanical cleaning can be ranked rather low. For these reasons, it is often recommended to hold dentures in chemical solutions, as they offer a method to facilitate denture cleaning. Effervescent tablets are the most commonly recommended chemical agents. Users are urged to keep their dentures in solutions prepared with agents in tablet or powder form. This method can also be stated to complement chemical cleaning with micro-mechanical cleaning owing to the release of oxygen in the solution containing such a tablet or powder.

These products, when used regularly, can remove lightly attached food residues and mucin, but their efficacy falls short in removing settled, thickened plaque.

Tea tree oil was reported as an ideal disinfectant for topical applications as it can easily penetrate the skin and offer antimicrobial efficacy against a wide range of microorganisms without causing irritation. This substance is found in numerous products such as toothpaste, mouthwash, soap, facial cleansers, shampoo, and moisturizer in different concentrations or without dilution.

Plants belonging to the genera *Leptospermum*, *Melaleuca*, and *Kunzea* from the Myrtaceae family are known as “tea tree.” These plants do not share any similarities with the true tea plant (*Camellia sinensis*) in terms of taste, smell, and composition. The essential oils present in the leaves of these plants are called “tea tree oil.” The plants known as “tea tree” and the essential oils obtained are denominated as follows: *M. cajuputi* (swamp tea tree, paperbark tea tree), *Cajuput oil*, *Kunzea ericoides*, Kanuka oil, *Melaleuca quinquenervia* (broad-leaved tea tree, broad-leaved paperbark), *Niaouli oil*, *Leptospermum scoparium*, Manuka oil, *Melaleuca alternifolia* (Australian tea tree), and Australian tea tree oil (ATTO).

Patients using toothpaste containing tea tree oil were observed to enjoy improvements in hygiene and the condition of periodontium.

Good surface properties are required in the materials to be utilized in dental treatments to prevent plaque retention and stain formation, as well as to provide an aesthetic appearance. These materials should be shiny and smooth. Plaque retention was reported in the presence of surface roughness greater than 0.2 μm.

Although there are a large number of studies examining the effects of denture cleaning solutions on the mechanical and physical properties of acrylic resins, the literature does not offer any studies conducted with the aim of investigating the effects of antibacterial solutions prepared with tea tree oil on the surface roughness of acrylic resins. Our study aimed to evaluate the effect of the use of tea tree oil solutions on the surface roughness of acrylic resin dentures. The hypothesis of the study is that the use of denture cleaners prepared with tea tree oil will change the surface roughness values of acrylic resins at a lesser degree than the common denture cleaners currently available in the market.

**MATERIAL AND METHODS**

Ethics committee approval was received for this study from Atatürk University Faculty of Dentistry (Date: 21.04.2022, Number: 51).

About 40 acrylic resin samples were prepared in dimensions of 65 mm x 10 mm x 3 mm in accordance with ISO:1567. The present study employed heat-polymerized acrylic resin (Meliodent, Heraeus Kulzer, Hanau, Germany). In order to prepare standardized samples, a wax model (Cavex Set Up Regular, Cavex Holland BV, Haarlem, The Netherlands) was put into a muffle with common methods and this step was followed by wax removal. Heat-polymerized acrylic resin (Meliodent, Heraeus Kulzer) was prepared in line with the manufacturer’s recommendations, placed in a muffle, and polymerized. Information on the manufacturer and place of manufacture of the materials used in this procedure is given in Table 1.

After polymerization, any excess around the samples was removed and the samples were polished appropriately. In order to remove residual monomer, the samples were kept in distilled water at 37°C for 48 hours. The samples were randomly divided into 4 different groups according to the solution used (n = 10).

The initial and 10-day roughness values of the samples were measured with a profilometer (Surtronic 25; Taylor Hobson, Leicester, UK). In this study, the measurement length was set at 2.5 mm and the cutoff value at 0.25 mm. The surface roughness value of each sample was calculated by averaging out measurements repeated in 3 different areas on the surfaces of the sample.

The chemical denture cleaning agents used in the study were Corega (Glaxo Smith Kline, Ireland) and Protefix (Helago-Pharma

<table>
<thead>
<tr>
<th>Material</th>
<th>Manufacturer</th>
<th>Place of Manufacture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meliodent</td>
<td>Heraeus Kulzer</td>
<td>Germany</td>
</tr>
<tr>
<td>Protefix</td>
<td>Helago-Pharma GmbH</td>
<td>Germany</td>
</tr>
<tr>
<td>Corega</td>
<td>Glaxo Smith Kline</td>
<td>Ireland</td>
</tr>
<tr>
<td>Tea tree oil</td>
<td>Toroslar Doğal ve Kozmetik Ürünler A.Ş</td>
<td>Turkey</td>
</tr>
</tbody>
</table>

**Table 1. Information on Manufacturers of Denture Cleaners and Acrylic Resins Used in the Study**

GmbH An der Schleifmühle 2, Germany), which are easily accessible in our country and belong to the alkaline peroxide group. These denture cleaning agents are available in the market in the form of effervescent tablets. While Corega and Protex effervescent tablets were prepared with 1 tablet each placed in 200 mL lukewarm water in line with the recommendations of the manufacturer, tea tree oil was used in its pure form as obtained through herbal distillation (Taurus Natural & Cosmetics Inc., Turkey). About 15 mL of tea tree oil was added to 85 mL of water. This concentration was used in the present study due to the significant efficacy reported for a tea tree oil concentration of 15%. 17 The samples in the control group were kept in the distilled water.

In the literature, the immersion times employed in similar studies for solutions vary from 5 minutes to 8 hours.18,19 In order to compare the results accurately, all the solutions used were kept for an equal period of time.18,20,21 Acrylic resin samples and solutions were kept in 100 mL capped plastic containers.

As the solutions are to be renewed once every 8 hours18 and 72 immersions of 20 minutes each will be completed in 1 day, the samples were immersed in the solutions for a period of 10 days to simulate 720 individual uses.18 Baseline measurements and 10th-day measurements were evaluated using two-way analysis variance (ANOVA) and post hoc Tukey’s test (α = .05).

Statistical Analysis
The data obtained in this study were evaluated with two-way ANOVA and Tukey’s post hoc comparisons at a significance level of P < .05 Statistical Package for Social Sciences (SPSS) version 20.0 software (IBM Corp.; Armonk, NY, USA).

RESULTS
An examination of the results of the analysis of variance employed for the evaluation of collected data statistically indicated that the liquid used and immersion time were not significant (P > .05), while the interaction between the liquid used and immersion time was significant (P < .05).

The minimum, maximum, and average levels and standard deviation results of the values obtained are shown in Table 2.

The surface roughness values were observed to have increased the most after 10 days in the samples immersed in Protexfix, followed by samples immersed in Corega, and to have changed on a decreasing trend in samples kept in tea tree oil.

An evaluation of the results of the post hoc Tukey multiple comparison test assessing the roughness values by individual solution (Table 3) and immersion time (Table 4) established that the difference between the surface roughness values was not statistically significant (P > .05).

DISCUSSION
A decrease was found in the surface roughness values of acrylic resins kept in tea tree solution, which can be used as a denture cleaner, but the hypothesis of the study was rejected because this decrease was not found to be statistically significant.

Efforts to eliminate plaque and ensure hygiene surely play an important role in the longevity of removable dentures. Tablets used for these purposes generally do not contain abrasives and they achieve the cleaning effect with surfactant and antimicrobial activity with hydrogen peroxide, alkaline peroxide, radical oxygen, and peracetic acid.22 It has been reported that the activity that occurs in the solution of alkaline or hydrogen peroxides in water causes dissolution in the organic matrix in the polymer structure.21 It has also been reported that the roughness of the acrylic base increases with the use of chemical cleaning tablets.24 In the present study, it was determined that the chemical cleaning agents are used to increase the surface roughness values of acrylic, which may be due to the dissolution they create in the acrylic structure.

In this study, a significant increase was observed in the roughness values following the exposure of heat-polymerized base to denture cleaners;25 but in another study, it has been reported that heat-polymerized resins exposed to chemical cleaning agents have less surface roughness changes than injection-molded thermoplastic resins.26 The fact that the change in the roughness values was not statistically significant in the present study may be attributed to the use of heat-polymerized acrylic.

Even though studies employing cleaners available in the market as effervescent tablets indicate a significant increase in the roughness values of polymethyl methacrylate resins,27 there are also studies that conclude that surface roughness does not vary with the use of Corega tablets.19,27 In the present study, although
surface roughness increased in the Corega group, such increase was not statistically significant.

The present study measured surface roughness with a profilometer as in numerous other evaluations of resin roughness. What we express as “Ra” refers to the surface roughness parameter. The use of this device is significant in that it secures the comparability of the results with those of the other studies. In addition, its ease of measurement and calculation can be considered as an advantage. However, there is a perceived disadvantage in the two-dimensional nature of the resulting measurement.

Higher surface roughness increases microorganism retention. It has been reported that the microorganism colonization on the base decreases when Ra is below 0.2 µm. In the present study, it was found that tea tree oil, unlike chemical agents, reduced surface roughness. Such reduction may be attributed to oil adherence on already rough surfaces. On the other hand, the decrease in the control group suggests water absorption. Any decrease in roughness leads to a decrease in colonization.

The majority of the patients using dentures are of advanced age. Accordingly, chemical agents are often preferred for geriatric patients with neuromuscular dysfunction and lack of manual dexterity, who cannot physically perform denture cleaning. Although these chemical cleaners offer strong antimicrobial efficacy, microorganisms developing resistance has heightened the need for the use of natural plant extracts. Vegetable oils with antimicrobial and antifungal effects are added to toothpaste and mouthwash.

A study conducted to investigate the effect of a paste containing tea tree oil on oral microflora and periodontal health reported improvements in hygiene and the condition of the periodontium among patients using the paste. Positive results have been obtained in terms of antifungal activity with the addition of tea tree oil to Viscogel-GC soft lining material.

In a study comparing the antimicrobial efficacy of tea tree oil with that of chlorhexidine gluconate and fluconazole on acrylic resin, it was reported that tea tree oil was equally effective on Candida with chlorhexidine and superior to fluconazole. The critical value of the present study lies in its estimation that the decrease in surface roughness values and the reduction of bacterial colonization in acrylic samples exposed to tea tree oil solution. Its effect of reducing surface roughness also suggested that its antimicrobial superiority might be maintained without any loss.

In a study evaluating the effect of the incorporation of tea tree oil in soft linings on the proliferation of Candida albicans, it was found that tea tree oil was significant in heat-polymerized acrylic resin. In another study, it was stated that the antifungal activity of 15% tea tree oil was equally effective on Candida and superior to fluconazole. The critical value of the present study lies in its estimation that the decrease in surface roughness values of the base material compared to denture cleaners. However, although the antifungal efficacy of tea tree oil has been investigated in comparison to chemical agents before, our study will offer guidance to the preference of tea tree oil in scientific research, since no such study has been undertaken on the evaluation of resulting changes in surface roughness.

In the present study, it was observed that, among cleaning solutions, Protefix and Corega increased while tea tree oil decreased the roughness.

It is important for the patients using dentures to be guided by their physicians in denture cleaning. They should know about the materials that can increase surface roughness. While informing the patients, we should prioritize cleaning agents that change the surface properties of dentures either slightly or none at all, offer the best antifungal and antibacterial efficacy, and contain the least amount of chemicals or are entirely made up of herbal content. Within the limits of this study, it was observed that tea tree oil reduced prosthetic surface roughness, while chemical agents were found to increase surface roughness in the 10-day evaluation. The present study will be a guide for physicians to recommend tea tree oil more commonly as a substance that we found to reduce the surface roughness value when compared to chemical agents.

Ethics Committee Approval: Ethics committee approval was received for this study from Atatürk University Faculty of Dentistry (Date: 21.04.2022 Number: 51).

Informed Consent: No informed consent was required since this study is an in vitro study.

Peer-review: Externally peer-reviewed.


Declaration of Interests: The authors declare that they have no competing interest.

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Hakem Değerlendirmesi: Diş bağımızsız.


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Coronavirus Disease 2019 Pandemic Management Performance of 4 Different Orthodontic Health-Care Institutions Held by Public, Private, and Foundation Systems in Turkey: A Preliminary Study

ABSTRACT

Objective: This article presents a comparison of the coronavirus disease 2019 pandemic management activities between different health-care institutions providing orthodontic treatment services.

Methods: Patients from 1 public university, 1 oral and dental health center affiliated to the Ministry of Health, 1 foundation university, and 2 private dental practices in Bursa and Bolu were asked to complete a questionnaire about the problems they experienced with their ongoing treatments during the coronavirus disease 2019 quarantine process. Descriptive statistics with percentages were performed, and the institutions were compared in terms of their performance in managing the pandemic process based on the answers.

Results: The questionnaire was answered by 1108 people. The comparisons between institutions revealed the superiority of private practices in appointment arrangement frequency by having appointments within 1 month by 19.8%, in communication skills with 4.04 mean value, and in anxiety management by 3.08 mean value of anxiety frequency about treatment elongation when evaluated with a 5-point Likert scale. The rate of not being informed about pandemic management was highest in foundation universities.

Conclusion: The quarantine and coronavirus disease 2019 pandemic showed to have an impact on orthodontic treatments. In private practices, the patient–doctor interaction was more effective. Private practices have the lowest anxiety levels. Only private practices used video calls for communication. Doctors in affiliation applications had an important role in the overall welfare of the people. However, this operation had a deteriorious impact on orthodontic appointments and treatment options.

Keywords: COVID-19, delivery of health care, orthodontics

ÖZ

Amaç: Bu makale, ortodontik tedavi hizmeti veren farklı sağlık kurumlarını arasındaki COVID-19 pandemi yönetimi faaliyetlerinin bir karşılaştırmasını sunmaktadır.

Yöntemler: 1 devlet üniversitesi, Sağlık Bakanlığı’na bağlı 1 ağız ve diş sağlığı merkezi (ADSM), 1 vakif üniversitesi ve Bursa ve Bolu’daki 2 özel ortodontist muayenehanesinde tedavi gören hastaların COVID-19 karantina sürecinde devam eden tedavilerinde yaşadıkları sorunlar hakkında bir ankette doldurularları istendi. Descriptif istatistikler yapıldı ve kurumlar, verilen yanıtlara göre pandemi sürecini yönetimdeki performansları açısından karşılaştırıldı.
INTRODUCTION

Coronavirus disease 2019 (COVID-19) pandemic is a worldwide public health crisis, and dental proficiency is one of the highest risk areas for COVID-19 contamination, considering the hazards associated with aerosol-generating procedures. At the beginning of the pandemic, orthodontists struggled to balance their own safety with their duty to their patients. Turkey’s first case of COVID-19 has been confirmed on March 11, 2020. In Turkey, as a first response to the pandemic, the Ministry of Health regulatory authorities has ordered an obligatory postponement of all non-emergent procedures with the inclusion of orthodontic treatments on March 27 and updated the regulations on April 1. According to the COVID-19 advisory guideline of the Ministry of Health, emergent treatment services for orthodontics are defined as “cutting or removing the brackets and the archwire causing ulcerations of the oral mucosa and/or infections” and “application of feeding plate to newborns with cleft lip and palate.”

In Turkey, orthodontic health-care services are maintained by public and private providers. While public orthodontic care service is provided through the government by national health-care systems in public university hospitals and oral and dental health centers (ODHC), private health care is maintained by private hospitals or self-employed practitioners and private nonprofit foundation universities.

In Turkey, orthodontic patients were treated by both postgraduate orthodontic specialists and postgraduate students. A graduate dentist who wants to be a specialist can continue their post-graduate education via 2 programs: specialization and doctorate program. However, while graduate students who continue specialization education program are entitled as research assistants, graduate students who continue specialized education in dental practices in Bursa and Bolu in Turkey. Patients being sent to 2200 patients who were being treated at 1 public university, 1 oral and dental health center affiliated to the Ministry of Health (ODHC), 1 foundation university, and 2 private centers (ODHC), private health care is maintained by private hospitals or self-employed practitioners and private nonprofit foundation universities.

Accordingly, the current study aims to evaluate the public and private sector performances preliminarily, under the light of the questionnaire results obtained from four different institutions across the key domains of management of the pandemic. The null hypothesis is “There was no difference between the institutions in terms of pandemic management activities.”

MATERIAL AND METHODS

This study was approved by the Biruni University Ethics Committee (Date: 28.05.2020, Number: 40–28).

During the quarantine measures, a questionnaire form consisting of 11 questions, 3 of them (Q1, 2, 3) were demographic and 8 of them (Q4–Q11) were related to the pandemic process, on the basis of systematic literature review and through discussions with clinicians to be answered by the orthodontic patients (Table 1).

A Google Forms questionnaire (Google LLC, Mountain View, Calif, USA) was sent to 2200 patients who were being treated at 1 public university, 1 oral and dental health center affiliated to the Ministry of Health (ODHC), 1 foundation university, and 2 private dental practices in Bursa and Bolu in Turkey. Patients being sent the form were not considered whether they were treated by a faculty member or Ph.D. students or research assistants. However, all patients in ODHC and private practices were treated by a specialist. The link for the questionnaire was sent by WhatsApp Messenger (WhatsApp Inc., Menlo Park, Calif, USA). Consent was obtained from the families of the patients who were under 18 years of age.

Participants were asked about demographic information, whether or not their orthodontist informed them about pandemic management and their ongoing orthodontic treatment, and if they have gotten in contact with their doctor in case of a problem with their treatments—if yes—which communication tool they have used, whether or not the orthodontist has managed to solve their problem remotely, and how long it took to get an appointment at the practice. Also, participants were asked if they have consulted another orthodontist in case of an
Table 1. Questionnaire Applied to Orthodontic Patients

<table>
<thead>
<tr>
<th>Q1: What is your gender?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) Male</td>
</tr>
<tr>
<td>( ) Female</td>
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<table>
<thead>
<tr>
<th>Q2: How old are you?</th>
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</thead>
<tbody>
<tr>
<td>( ) 6-12 years</td>
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<tr>
<td>( ) 12-18 years</td>
</tr>
<tr>
<td>( ) 18-36 years</td>
</tr>
<tr>
<td>( ) 36 years and above</td>
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</table>

<table>
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<tr>
<th>Q3: In which institution does your orthodontic treatment continue?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) Public university</td>
</tr>
<tr>
<td>( ) Foundation university</td>
</tr>
<tr>
<td>( ) Private clinic</td>
</tr>
<tr>
<td>( ) Oral and dental health centers affiliated to the Ministry of Health</td>
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<table>
<thead>
<tr>
<th>Q4: How long did you not get an appointment during the COVID-19 pandemic?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) 0-1 month</td>
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<tr>
<td>( ) 1-1.5 months</td>
</tr>
<tr>
<td>( ) 1.5-2 months</td>
</tr>
<tr>
<td>( ) 2-2.5 months</td>
</tr>
<tr>
<td>( ) 2.5-3 months</td>
</tr>
<tr>
<td>( ) 3 months and above</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Q5: During the COVID-19 pandemic process, did you go to a health institution for urgent treatment?</th>
</tr>
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<tbody>
<tr>
<td>( ) Yes</td>
</tr>
<tr>
<td>( ) No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q6: Have you been able to contact your doctor when you needed it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) I did not find any need to contact my doctor</td>
</tr>
<tr>
<td>( ) Never</td>
</tr>
<tr>
<td>( ) Rarely</td>
</tr>
<tr>
<td>( ) Sometimes</td>
</tr>
<tr>
<td>( ) Often</td>
</tr>
<tr>
<td>( ) Always</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q7: If you were able to contact your doctor, was your doctor able to solve your problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) No answer</td>
</tr>
<tr>
<td>( ) Never</td>
</tr>
<tr>
<td>( ) Rarely</td>
</tr>
<tr>
<td>( ) Sometimes</td>
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<tr>
<td>( ) Often</td>
</tr>
<tr>
<td>( ) Always</td>
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<table>
<thead>
<tr>
<th>Q8: How did you mostly contact your doctor during the COVID-19 pandemic process?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) I have not managed to contact my doctor</td>
</tr>
<tr>
<td>( ) SMS</td>
</tr>
<tr>
<td>( ) WhatsApp</td>
</tr>
<tr>
<td>( ) Social media</td>
</tr>
<tr>
<td>( ) Videoconference</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q9: Have you gotten help from another orthodontist/dentist to solve your problem apart from your own doctor during the COVID-19 pandemic?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) No answer</td>
</tr>
<tr>
<td>( ) I have not managed to contact my doctor</td>
</tr>
<tr>
<td>( ) SMS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q10: Did your doctor inform you about pandemic management?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) Yes</td>
</tr>
<tr>
<td>( ) No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q11: Have you ever worried about the prolongation of your treatment process?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) Never</td>
</tr>
<tr>
<td>( ) Rarely</td>
</tr>
<tr>
<td>( ) Sometimes</td>
</tr>
<tr>
<td>( ) Often</td>
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<td>( ) Rarely</td>
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</tr>
<tr>
<td>( ) Often</td>
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<tr>
<td>( ) Always</td>
</tr>
</tbody>
</table>

COVID-19, coronavirus disease; ODCH, Oral and dental health centers
affiliated to the Ministry of Health; SMS, short message service.

Table 2. Demographics of Respondents

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>330</td>
<td>29.8%</td>
</tr>
<tr>
<td>Female</td>
<td>778</td>
<td>70.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12 years</td>
<td>60</td>
<td>5.4%</td>
</tr>
<tr>
<td>12-18 years</td>
<td>416</td>
<td>37.5%</td>
</tr>
<tr>
<td>18-36 years</td>
<td>558</td>
<td>50.4%</td>
</tr>
<tr>
<td>36 years and above</td>
<td>74</td>
<td>6.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institution</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public university</td>
<td>397</td>
<td>35.8%</td>
</tr>
<tr>
<td>Oral and dental health center affiliated to Ministry of Health</td>
<td>48</td>
<td>4.3%</td>
</tr>
<tr>
<td>Foundation university</td>
<td>199</td>
<td>18.0%</td>
</tr>
<tr>
<td>Private practice</td>
<td>464</td>
<td>41.9%</td>
</tr>
</tbody>
</table>

TABLE 2: Demographics of Respondents

Statistics were performed for Q1, 2, 3. The Shapiro–Wilk test was applied to test the normality of distribution and P was found to be >0.05. Thus, nonparametric tests were performed.

The comparison of behaviors between 4 institutions were analyzed with Fisher’s exact test for Q4 and 5 and Q8, 9, 10 and Kruskal–Wallis and Mann–Whitney U-test were used for Q6, 7, and 11. Statistical analysis was performed with MedCalc statistical software, Version 12.7.7. A value of P < 0.05 was considered statistically significant. Post hoc power analysis was performed using the online ClinCalc post hoc power calculator.

RESULTS

Among the 2200 patients who were sent the questionnaire, 1108 people answered the questionnaire. The response rate was 50.36%. 5.4% of participants’ ages were between 6 and 12 years, that of 37.5% were between 12 and 18 years, that of 50.4% were between 18 and 36 years, and that of 6.7% were 36 years and over (Q1). Most of the patients were female (Q2). The distribution of patients’ treatment institutions was as follows: 464 in private practices (41.9%), 397 in public university (35.8%), 199 in foundation university (18%), and 48 in ODCH (4.3%) (Q3) (Table 2).

When comparative statistics were evaluated, there was a statistically significant difference in terms of the distribution of all parameters according to the institution providing treatment service (Table 3).

The comparison between institutions revealed that private practices were the easiest to create appointments, and they had significantly higher rates of making an appointment for emergencies within 1 month. Similarly, they had the smallest rate of postponing appointments for more than 3 months (Q4). 10.75% of all participants reported going for an emergency appointment during quarantine measures. The rate of patients requiring an emergency appointment was lower in private practices (Q5). The rate of those who could not contact their doctor during quarantine measures was highest in foundation university when compared with private practices and public university (Table 3). The percentage of those who stated that they could contact their doctor was not significantly different between the rest (Q6) (Table 4). When asked if the treatment provider was able to solve the problem that was faced, the answers revealed similar results of satisfaction for all institutions, with a significantly lower rate in the foundation university (Table 4). The most chosen answer was “My problem was always solved” option, with a significantly important dominance among all possible answers (Q7). While the most frequently used tool was telephone (38.1%) and WhatsApp (28.8%), social media (0.5%) and videoconference (0.6%) were the most rarely used methods to communicate (data not shown on tables). The use of WhatsApp was high at the foundation university, while the public university

Emergency and how worried they were about the elongation of their treatments. The questionnaire was available to complete from June 1 to July 1, until the beginning of “back to work policy.” A 5-point Likert scale was performed for the sixth, seventh, and 11th questions.

Statistical Analysis

Responses were obtained and tabulated in Microsoft Excel (Microsoft, Redmond, Wash, USA) for statistical analysis. Descriptive
have been able to contact your doctor when you needed it? (Q6)

Did your doctor inform you about pandemic management? (Q10)

COVID-19 pandemic, the rate of not being informed about pandemic management was highest in the foundation university (Q10). With this questionnaire, the level of anxiety of the respondents was also evaluated. When the anxiety levels about the delay of ongoing treatment of all participants were checked overall, the anxiety levels were listed as follows: 25.5%; always present; 19.7%: frequently present; 20.3%; sometimes present; 77%: rarely present; and 16.9% never present (data not shown on tables). Foundation university patients had the highest and private practices, and ODHC contacted patients mostly by phone. Videoconferencing was not used for communication purposes in any institution other than private practices (Q8). The rate of patients stating that they got help from another orthodontist/dentist to solve their problem—because they needed help—was the highest with patients receiving treatment at the foundation university and lowest in private practices. Participants stating that they got help from another orthodontist/dentist was highest at the public university (Q9). During the COVID-19 pandemic, the rate of not being informed about pandemic management was highest in the foundation university (Q10). With this questionnaire, the level of anxiety of the respondents was also evaluated. When the anxiety levels about the delay of ongoing treatment of all participants were checked overall, the anxiety levels were listed as follows: 25.5%; always present; 19.7%: frequently present; 20.3%; sometimes present; 77%: rarely present; and 16.9% never present (data not shown on tables). Foundation university patients had the highest and private practice
patients had the lowest rate of anxiety about elongation of their treatment duration (Q11).

The calculated power for this study according to post hoc pairwise comparisons in terms of Q6 and Q7 of ODHC was found to vary between 92.7% and 95.9%. The calculated power being greater than 80% indicated that the sample size is sufficient for the study.

**DISCUSSION**

In Turkey, orthodontics is a recognized dental specialty, and orthodontic treatments are primarily held by these specialists. According to the latest published data, there are 52 public universities, 661 ODHC, 14 foundation universities, and 10 775 private practices.7-9 Even if all institutions tried to follow the restrictions and guidance as precisely as possible, differences in action to some extent are inevitable. Thus, this present study aims to shed light on this subject. It is the first detailed survey study comparing and guidance as precisely as possible, differences in action to some extent are inevitable. Thus, this present study aims to shed light on this subject. It is the first detailed survey study comparing some extent are inevitable. Thus, this present study aims to shed light on this subject. It is the first detailed survey study comparing private practice vs. foundation university

When the comparative differences between different institutions were examined, there were results worth addressing. According to Hancock et al’s study,11 there was a significant difference between private and public care in terms of the speed of getting an appointment. Our study showed parallel results. Private practice patients were able to arrange emergency appointments more easily compared to others. The first reason for the private practices being more accessible may be due to the Ph.D. students’ responsibility of providing treatment was not active because of the regulations. Secondly, this may be related to the disadvantage the ODHC had. Since the treatment providers at the ODHCs were assigned to work for “COVID-19 filiation application,” they were not able to provide treatment service to their continuing orthodontic patients.

The study about the impact of the COVID-19 pandemic on appointments revealed that 25.1% of patients would attend an appointment only in case of emergency. The percentage of patients who required an emergency appointment in our study was lower than that reported in Cotrin et al’s results.12 In addition, the present study allowed for a comparison between institutions and showed the rate of patients requiring emergency appointments were significantly lower in private practices. The significant difference of shorter intervals between appointments in private practices can be the reason for this result as continuing to have regular visits will decrease the necessity for emergency appointments.

The systematic review by Basu et al12 on the comparative performance of private and public health-care systems concluded that the private sector is not superior to the public sector in terms of efficiency. However, the public sector appears frequently to lack timeliness and hospitality toward patients. Our findings indicated that the inability of participants to reach their doctors was notably more prevalent at Foundation University, while the differences in this aspect between other institutions were not statistically significant. This observation provides partial corroboration to the earlier mentioned systematic review. The variation in communication frequency can be attributed to the regulations applied on Ph.D. students in foundation universities, which restrict them from serving healthcare services and canalize them to pursue their education online. Actually, the same situation was valid for the Ph.D. students in public universities, as well. However, in contrast to foundation universities, most of the Ph.D. students in public universities are appointed as academic staff. Government regulations required the academic staff to work without any permission to have a leave of absence or to quit because of these particular circumstances of COVID-19. Contrary to all these factors, the highest rate of not being informed about pandemic management shows that this specific university could not manage this situation well. It is not appropriate to generalize this finding to all foundation universities. The next aspect was highly related to the previous one. We were curious about the ability to solve the encountered problems if a communication was possible to be made. Findings showed us similarity between differences in institutions in terms of availability and creating contact. After contact, patients considered their problems to be solved in all institutions except in the foundation university, with a significantly lower rate of solutions to problems. Still, it should be noted that even though there was a significant difference in the comparison between institutions, the ability to solve problems was high in foundation the university, as well. These two findings support each other. Both suggest that communication is a key domain and doctor–patient relationship is the most essential contributing factor to patient fulfillment.13

Not only communication but also the communication method is also significant. Remote communication methods prevent spread of the virus by reducing the physical contact between doctors and patients.14 In this perspective, the utilization of innovative communication tools including phone calls, videoconferencing, messaging via WhatsApp or social media, and e-mails to maintain long-distance care draws attention as an effective opportunity for face-to-face service.15-16 Petruzzii et al19 confirmed the use of WhatsApp as a good option for teledentistry. Guidice et al19 reported that using WhatsApp for monitoring patients limits human contact and decreases the risk of virus dissemination. Currently, WhatsApp is the most commonly used application.20 Consistent with these reports, in the present study, the most used communication tools during the quarantine measures were the phone and WhatsApp. Videoconferencing was used only by private practices and was the least preferred tool among all the communication utilities. This may be due to the poor resolution of imaging.

As our data revealed, the patients being treated at the foundation university had the highest rate of getting help from outside

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**Table 4. Post Hoc Comparison of Q6-Q7 and Q11**

<table>
<thead>
<tr>
<th>Post Hoc Pairwise Comparisons</th>
<th>Q6</th>
<th>Q7</th>
<th>Q11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public university vs. private practice</td>
<td>.536</td>
<td>.993</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Public university vs. oral and dental health center affiliated to Ministry of Health</td>
<td>.600</td>
<td>.202</td>
<td>.641</td>
</tr>
<tr>
<td>Public university vs. foundation university</td>
<td>&lt;.001</td>
<td>.005</td>
<td>.035</td>
</tr>
<tr>
<td>Private practice vs. oral and dental health center affiliated to Ministry of Health</td>
<td>.899</td>
<td>.191</td>
<td>.172</td>
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<tr>
<td>Private practice vs. foundation university</td>
<td>&lt;.001</td>
<td>.004</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Oral and dental health center affiliated to Ministry of Health vs. foundation university</td>
<td>.005</td>
<td>.005</td>
<td>.152</td>
</tr>
</tbody>
</table>

*P* < .008 Mann–Whitney U-test (Bonferroni correction)
institutions. This may be due to the previously mentioned restrictions in Q7. This situation contributes to our understanding of the reason for the rate of getting help from other institutions being the lowest at the public university. The second reason may be economical. The study about the utilization of dental services suggests that the Turkish health insurance system is mainly based on government plans, and this prevents people from using relatively expensive private dental services.21 We believe that the possibility of public university patients hesitating to seek help from other institutions may be due to their economic status. Finally, the rate of those who got help from another orthodontist/dentist to solve their problem—because they needed help—being lowest at private practices may be due to private practices being able to maintain their routine appointment schedules.

A study that compares public and private hospital care service quality in Turkey shows a lack of communication between the patients and the hospital personnel in Turkish public hospitals.22 Consistently, this present study showed that doctors in private practices informed patients about pandemic management more than in other institutions. This higher rate of communication could be justified by the private sector being keen on providing a better quality service to be able to compete with the market.22

According to a study about the factors affecting duration of orthodontic treatment, every missed appointment tends to elongate the treatment by 1.09 months.23 This is a predictable outcome and patients usually are able to make this assumption and get worried about the prolongation of treatment process. Peleso et al23 reported that 48.7% of orthodontic patients worried about delays in their treatment. When the proportion of participants stating “always and often experiencing anxiety about the delay in treatment” were evaluated together, our results were 45.2%. Thus, they are compatible with the aforementioned study. Furthermore, the present study compared anxiety levels among patients between institutions. Foundation university patients had the highest anxiety rate about elongation of treatment duration. Also, as previously discussed, the foundation university had the lowest rate of adequately informing patients. We believe these two findings may be associated with each other and lack of communication may have resulted with the high rate of anxiety.

Evaluating overall, the null hypothesis was rejected, and findings showed that there were differences between pandemic management activities between institutions. Also, our study was not free of problems: First, the participants whose treatments were continuing in different institutions were not represented in equal numbers, and this caused a weakness in homogeneity. If participation to the survey were similar from each health care institution, different findings could have been obtained. Secondly, although the sample size of the study is not small, the number of institutions where the patients received treatment is not enough to make a general assumption. Advantages and disadvantages may be specific to the institutions where the research was conducted. However, despite the limited data, this work provides a preliminary snapshot of the pandemic management activities of different health-care institutions in Turkey by being the study with the largest sample size on the matter so far. Still, for more comprehensive results, further studies are needed.

The quarantine measurements have had an impact on treatment-providing institutions and patients. The research presented here confirms that the relationship between patient and doctor in private practices was more dynamic in terms of communication about pandemic management. In addition to that, the slightest anxiety level was identified in private practices as well. Communication by video calls was only existent in private practices. Although orthodontic procedures were influenced contrarily by filiation applications, specialists in this methodology served a valuable role in the prosperity of general society overall. Ease of communication and having regular appointments stand out as a critical dimension in service quality. There was a negative correlation between pandemic management by adequately informing patients and anxiety levels. A continuum of periodic appointments showed to decrease anxiety. In view of all that has been mentioned so far, one way supposes that creating safe ways to continue patients’ treatments under every possible circumstance is important.

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Craniofacial Growth Differences in Individuals with Skeletal Class III and Class I During Different Growth Periods

ABSTRACT

Objective: The purpose of this study is to compare the craniofacial growth of individuals with skeletal class III and class I structure at different stages of growth periods.

Methods: The study includes 266 untreated individuals with class I and class III malocclusion admitted for orthodontic treatment. The individuals were divided according to their genders—male and female—and growth periods based on the hand–wrist films. The differences between the growth periods and sex groups of class I and class III individuals were statistically evaluated.

Results: In the study, there was no difference between class I and class III in terms of anterior and posterior cranial base length. The cranial base angle was shown to be lower in class III individuals than in class I individuals. Effective maxillary length (Co–A) is significantly lower in class III patients than in class I individuals. Mandibular growth dimensions of the class III and class I groups are similar in the early period however, differences between the two groups increase in later periods. Craniofacial and mandibular sizes were larger in class I and class III males than females. We found that protrusion of the maxillary incisor and retrusion of the mandibular incisor become increasingly evident as development progresses.

Conclusion: In class III and class I individuals, the amount of maxillary and mandibular growth is similar in the early stages of development, whereas in class III individuals the skeletal discrepancy is intensified in the later stages of development.

Keywords: Malocclusion, Angle class III, cephalometry, pubertal growth

ÖZ

Amaç: Bu çalışmanın amacı, iskeletsel sınıf III ve sınıf I yapıya sahip bireylerin farklı büyüme dönemlerindeki kraniyofasiyal büyüme farklılıkları karşılaştırmaktır.


Sonuç: Sınıf III ve sınıf I bireylerde maksilla ve mandibuların büyüme miktarları gelişimin erken safhalarında benzerken sınıf III bireylerde gelişimin ilerleyen safhalarında iskeletsel uyumsuzluk şiddetlenmektedir.

Anahtar Kelimeler: Maloklözyon, Angle sınıf III, sefalometri, pubertal büyüme
INTRODUCTION

Class III anomalies may arise from the interrelationships of den-toalveolar and craniofacial structures and their combinations. Spalj et al reported that 43% of class III individuals had a mandibular protrusion, 19.6% had maxillary retrusion, and 4.7% had both protrusion and retrusion. Although the prevalence of class III anomalies varies based on ethnicity, it is around 12% in the Asian population and approximately 1% in the European American population.

Genetics, congenital, and environmental factors are among the factors that cause class III anomalies. Class III anomalies may also occur due to environmental factors such as congenital anatomical defects, syndromes, nasal congestion (nasal obstruction), sinusitis, septum deviation, mouth breathing due to hypertrophic tonsils and adenoids, tongue size, and position, and forced anterior positioning of the mandible due to premature contacts.

Class III cases typically have a negative ANB (A point, nasion, B point) angle. Increased posterior cranial base (S-Ba) length, decreased anterior cranial base (SN) length, and cranial base angle (SNBa), increased face height, increased mandibular length (Co-Gn), corpus (Go-Gn) and ramus (Ar-Go) size, a glenoid fossa more anteriorly located, protrusive maxillary incisors, and retrusive mandibular incisors. In individuals with class III skeletal structure, Wits values decrease over time, and there is an increase in maxillomandibular difference and lower face height.

The growth and development characteristics of craniofacial structures may show different trends in different malocclusions. In studies with class III individuals, the SNBa is smaller. S-Ba increased, maxillary SNA and Co-A dimensions decreased, whereas mandibular dimensions (Co-Gn), gonial angle, and lower face height increased, with protruded maxillary incisors and retrusive mandibular incisors.

The cranial base, especially the anterior skull base, which forms the ethmoid–maxillary complex with the upper midface, has great importance in craniofacial growth and development. It is said that a disorder in SN growth will often be coupled by midfacial insufficiency. In individuals with class III malocclusions, the posterior cranial base (S-Ba) horizontal growth is insufficient due to early fused synostosis, and thus the condyles and glenoid fossa are located more anteriorly with a smaller SNBa angle. In the study of Reyes et al, the SNBa angle was reported to be smaller in class III individuals, while the lower anterior face height was found to be higher in advanced stages of development.

According to Ochoa and Nanda, changes in growth and development in boys take approximately 2 years longer than in girls. Maxillary growth slows down after 12 years of age in girls, and mandibular growth slows down after 14 years of age. In males, growth continues until the age of 16 years. Mitani et al compared class III individuals with prognathic mandibles with class I individuals, and their growth rates were found to be similar until puberty but changed in later periods.

In class III individuals, growth potential and shape are important in the decision and success of orthodontic treatment. Considering that the majority of orthodontic treatments are performed during the growth period, identification of the craniofacial growth behavior will be helpful in choosing the right mechanics and timing of treatment in class III patients, especially in terms of the intermaxillary relationship. The HO hypothesis of this study was determined that there is no difference in the dimensional and angular values of craniofacial structures between class I and class III individuals and genders at different growth periods. This study aims to compare the craniofacial growth of individuals with skeletal class III and class I at different growth periods.

MATERIAL AND METHODS

This retrospective and cross-sectional study was conducted on lateral cephalometric and hand–wrist films of 268 applicants for orthodontic treatment. Individuals were chosen from the orthodontics department’s archive using the patient registration program (FileMaker Pro). This study was approved by Gazi University Clinical Research and Ethics Committee (Date: 26.10.2011, Number: 318).

The following criteria were taken into account in the selection of individuals included in the study, who have not received orthodontic treatment, have no congenital tooth deficiency, skeletal class I (ANB: 0-4˚) and class III (ANB < 0˚) have an anomaly class I individuals with a balanced facial structure and class III individuals with concave facial structure, individuals without any syndrome, craniofacial anomaly, and cleft lip–palate.

In this study, the individuals were first divided into 2 main groups, skeletal class III (n = 133) and class I (n = 133). Then, these groups were also classified according to their genders as male and female. These groups were divided into 4 subgroups based on the growth periods (prepubertal, pubertal, postpubertal, and adult) determined based on the hand–wrist films (Table 1). The values are the amount of the difference values between the 2 periods (Δ1: difference value between pubertal and prepubertal periods, Δ2: difference value between postpubertal and pubertal periods, Δ3: difference value between adult and postpubertal periods).

The lateral cephalometric and hand–wrist films belonging to the groups were taken in x-ray machines (MORITA, J. Morita MFG. CORP., Kyoto, Japan) under standard conditions with a magnification difference of 1.1 mm. Lateral cephalometric films were first scanned with a scanner (EPSON Scanner PerfectionV700) at 300 dpi resolution and transferred to the computer. Later the measurements were done with the digital cephalometric analysis program of Dolphin Imaging Software (version 11.0, Dolphin Imaging and Management Solutions, Calif, USA). 188 lateral cephalometric radiographs belonging to 96 individuals randomly selected from both groups were measured using intraclass correlation coefficient (ICC) for a second time after 3 weeks from the completion of the measurements, to evaluate individual error control and intraexaminer reliability.

In this study, 25 cephalometric parameters, 13 angular, 11 linear, and 1 proportional, were evaluated. SN, S-Ba, Wits, Co-A, Co-Gn, N-ANS, ANS-Me, N-Me, S-Go, U1–NA, L1–NB length measurements, BaSN, NsAr, SarGo, ArGoMe, SNArGoMe, SNA, SNB, ANB, SN/GoGn, U1/SN, U1/NA, IMPA, L1/ NB, angular measurements, and SGo/NMe proportional measurements were carried out (Figure 1).

Statistical Analysis

The Statistical Package for the Social Sciences version 15.0 software (SPSS Inc.; Chicago, IL, USA) was used to analyze the study’s data. The NCSS PASS 2008 software program was used to do a power analysis on the study’s sample size was analyzed. For this purpose, information about the variables of interest (SNB, ANB) from other similar studies was used as a reference. As a result
Table 1. Chronological and Skeletal Age Range and SD Values According to Growth Period and Genders

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Growth Period</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
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<td>0.71</td>
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</tr>
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</table>

F: female; M: male.

Figure 1. Reference points and measurements used in cephalometric analysis.

**Sella (S):** Geometric midpoint of the sella turcica, **Nasion (N):** The most anterior point of the frontonasal suture, **Ba (Ba):** The lowest and most posterior point in norma lateralis at the junction of the endocranial surfaces of the basis occipitalis, **Point A (Subspinal point) (A):** The deepest point of the concavity on the middle contour of the alveolar process, between the spinal nasalis anterior and the prosthion, **B point (Supramental point) (B):** Deep point on the alveolar process between the infradentale and pogonion in the mandibular symphysis, **Spina Nazalis Anterior (ANS):** The most extreme point of the maxillary bony prominence at the anterior base of the nose, **Condyle (Co):** The highest and most posterior point of the mandibular condyle, **Articulare (Ar):** The point where the posterior border of the mandibular condyle intersects with the skull base bone base image, **Gonion (Go):** The point where the bisector of the angle between the mandibular and ramal planes intersects the mandible, **Menton (Me):** The lowest point of the lower border of the mandibular symphysis, **Gnathion (Gn):** Midpoint of Menton and pogonion points, **Pogonion (Pg):** The most anterior point of the mandibular symphysis in the sagittal direction, **U1:** The apex of the cutting edge of the upper most anterior central incisor, **U1a:** Root tip of the upper most anterior central incisor, **L1:** The apex of the cutting edge of the lower most anterior central incisor, **L1a:** Root tip of mandibular most anterior central incisor
<table>
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<th>Class</th>
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<th>Standard Deviation</th>
<th>Adult Mean</th>
<th>Standard Deviation</th>
</tr>
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<tbody>
<tr>
<td>Class III</td>
<td>SNA (mm) M</td>
<td>78.7 3.1</td>
<td>9.5 4.7</td>
<td>91.7 4.9</td>
<td>8.1 4.1</td>
<td>98.7 5.5</td>
<td>9.3 4.1</td>
<td>108.6 8.2</td>
<td>8.5 4.1</td>
</tr>
<tr>
<td>Class III</td>
<td>SNA (mm) F</td>
<td>77.6 2.9</td>
<td>9.5 4.7</td>
<td>90.6 4.1</td>
<td>8.0 4.2</td>
<td>96.6 4.9</td>
<td>9.1 4.1</td>
<td>106.6 6.9</td>
<td>8.5 4.1</td>
</tr>
<tr>
<td>Class III</td>
<td>SNA (mm) P</td>
<td>78.7 3.1</td>
<td>9.5 4.7</td>
<td>91.7 4.9</td>
<td>8.1 4.1</td>
<td>98.7 5.5</td>
<td>9.3 4.1</td>
<td>108.6 8.2</td>
<td>8.5 4.1</td>
</tr>
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<td>Class I</td>
<td>SNA (mm) M</td>
<td>78.7 3.1</td>
<td>9.5 4.7</td>
<td>91.7 4.9</td>
<td>8.1 4.1</td>
<td>98.7 5.5</td>
<td>9.3 4.1</td>
<td>108.6 8.2</td>
<td>8.5 4.1</td>
</tr>
<tr>
<td>Class I</td>
<td>SNA (mm) F</td>
<td>77.6 2.9</td>
<td>9.5 4.7</td>
<td>90.6 4.1</td>
<td>8.0 4.2</td>
<td>96.6 4.9</td>
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<td>106.6 6.9</td>
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<tr>
<td>Class I</td>
<td>SNA (mm) P</td>
<td>78.7 3.1</td>
<td>9.5 4.7</td>
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<td>8.1 4.1</td>
<td>98.7 5.5</td>
<td>9.3 4.1</td>
<td>108.6 8.2</td>
<td>8.5 4.1</td>
</tr>
<tr>
<td>Class III</td>
<td>SNA (mm) M</td>
<td>78.7 3.1</td>
<td>9.5 4.7</td>
<td>91.7 4.9</td>
<td>8.1 4.1</td>
<td>98.7 5.5</td>
<td>9.3 4.1</td>
<td>108.6 8.2</td>
<td>8.5 4.1</td>
</tr>
<tr>
<td>Class III</td>
<td>SNA (mm) F</td>
<td>77.6 2.9</td>
<td>9.5 4.7</td>
<td>90.6 4.1</td>
<td>8.0 4.2</td>
<td>96.6 4.9</td>
<td>9.1 4.1</td>
<td>106.6 6.9</td>
<td>8.5 4.1</td>
</tr>
<tr>
<td>Class III</td>
<td>SNA (mm) P</td>
<td>78.7 3.1</td>
<td>9.5 4.7</td>
<td>91.7 4.9</td>
<td>8.1 4.1</td>
<td>98.7 5.5</td>
<td>9.3 4.1</td>
<td>108.6 8.2</td>
<td>8.5 4.1</td>
</tr>
</tbody>
</table>

(Continued)
Table 2. The Significance of the Differences Between the Measurement Values Belonging to the Class I, Class III Groups and Genders (Continued)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Class I Females</th>
<th>Class I Males</th>
<th>Class III Females</th>
<th>Class III Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1/SN (˚)</td>
<td>M</td>
<td>104.1 ± 5.2</td>
<td>101.5 ± 6.9</td>
<td>105.3 ± 10.5</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>106.4 ± 5.5</td>
<td>104.0 ± 7.9</td>
<td>103.2 ± 6.8</td>
</tr>
<tr>
<td>U1/NA (˚)</td>
<td>M</td>
<td>25.9 ± 5.5</td>
<td>21.9 ± 7.5</td>
<td>20.0 ± 6.4</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.2 ± 1.5</td>
<td>3.4 ± 2.1</td>
<td>5.2 ± 3.5</td>
</tr>
<tr>
<td>L1/NB (˚)</td>
<td>M</td>
<td>18.8 ± 6.5</td>
<td>24.5 ± 5.6</td>
<td>25.5 ± 5.8</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3.3 ± 1.3</td>
<td>2.3 ± 0.7</td>
<td>4.7 ± 2.1</td>
</tr>
<tr>
<td>LiSN (˚)</td>
<td>M</td>
<td>-0.3 ± 0.9</td>
<td>-0.5 ± 1.2</td>
<td>-0.5 ± 0.8</td>
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<tr>
<td></td>
<td>F</td>
<td>3.1 ± 2.2</td>
<td>4.2 ± 1.9</td>
<td>4.7 ± 2.1</td>
</tr>
</tbody>
</table>

- \( P < 0.05 \) was accepted as the level of statistical significance.
- \( \beta \) is the probability of the familywise error rate.
- \( \alpha \) is the probability of the type I error.

RESULTS

A total of 266 individuals were included in this study. The growth periods, genders, chronological and skeletal age range values of the groups, and sample size of individuals in the groups are shown in Table 1. The intraexaminer reliability levels of the measurements for each selected parameter were assessed by using intraclass correlation coefficient (ICC). These values were close to the exact value of 1.00. In the power analysis performed after the study for \( \alpha = 0.05 \) and considering the number of individuals in each group, the power was found to be between 0.87 and 1.00 for the ANB variable and between 0.99 and 1.00 for the ANB in 4 different periods.

The conformity of the quantitative variables considered in the study to the normal distribution was examined using the Shapiro–Wilk test and graphical methods. For statistical comparison of independent groups (the comparison of class III and class I in each period and in each gender group, the comparison of males and females in each period and in each class), “Independent sample t-test” was used for normally distributed variables and the “Mann–Whitney U-test” was used for non-normally distributed variables. The difference between 2 independent groups and the previous growth period and the next growth period (\( \Delta \)) in each gender group in each class showing the difference between periods was evaluated with the “Independent sample t-test” for variables that normally distributed, and with the “Mann–Whitney U-test” for variables that do not normally distributed. For all statistical analyses, a value of \( P < 0.05 \) was accepted as the level of statistical significance.

The S-N and S-Ba dimensions were found to be larger in class III males than females in the pubertal and adult periods, and the S-N size in the postpubertal period. S-N dimensions were found to be larger in class I males than females in the pubertal, pubertal, and postpubertal periods. Statistically significant increases were observed in the S-N dimensions (\( \Delta 1 \) and \( \Delta 2 \)) in class III males and (\( \Delta 1 \) and \( \Delta 2 \)) in class I males, as well as in the S-Ba dimensions (\( \Delta 1 \) and \( \Delta 2 \)) in class III females. Cranial base angle (BaSN) and saddle angle (NSAr) were found significantly smaller in prepubertal class III males than class I males, and in class III females compared to class I females. BaSN was observed to be significantly smaller in males in the class III group in adults than in females (Table 2 and 3, Figure 2).

The SArGo in the pubertal period, and the ArGoMe in the adult period were found to be larger in class III females than in class I females. While a significant decrease was observed in the SArGo value in the \( \Delta 1 \) and the ArGoMe value in the \( \Delta 2 \) in the class III males, a significant increase in the SArGo value in the \( \Delta 2 \) was observed in the class I males. The SNArGoMe was found to be smaller in prepubertal period class III females than in class I females and in adult period class III males than in females. When the amount of change between the periods was compared, a significant increase was observed in the \( \Delta 1 \) in class III females (Table 2 and 3, Figure 3).

The SNA angle was found to be smaller in prepubertal class III males than females. In terms of SNA, a significant decrease was observed in class III females in the \( \Delta 1 \), while a significant increase
was observed in the Δ3. The SNB angle for males and females in the class III group was found to be larger in the prepubertal and adult periods compared with the class I males and females. While a significant decrease was observed in class III females in the Δ1, a significant increase was observed in class III males in the Δ3.

The ANB and Wits values were found to be smaller in prepubertal, pubertal, postpubertal, and adult periods for class III females and males than for class I females and males. When the amount of change in ANB and Wits values between the periods were compared, significant decreases were observed in class III males and females in the Δ3 (Table 2 and 3, Figure 4).

The Co-A dimension was determined to be smaller in class III males and females than in class I males and females in the growth periods. A significant increase was observed for class III and class I males in the Δ1, for class I females in the Δ2. The Co-Gn dimension of the adult females and males in the class III group was found to be larger than the females and males in the class I group. Besides, it was found that Co-A and Co-Gn dimension was larger in class III males than females in all growth periods. Significant increases were observed in Co-Gn size for class III males in the Δ1, Δ3, for class III girls in the Δ1, Δ2, Δ3, and for class I males and class I females in Δ1 and Δ2 (Table 2 and 3, Figure 4).

Table 3. Changes of Measurements According to Class I, Class III Groups and Genders Between Growth Periods

<table>
<thead>
<tr>
<th></th>
<th>Δ1 (Pubertal–Prepubertal)</th>
<th>Δ2 (Postpubertal–Pubertal)</th>
<th>Δ3 (Adult–Postpubertal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class III</td>
<td>Class I</td>
<td>Class III</td>
</tr>
<tr>
<td>S-N (mm)</td>
<td>M</td>
<td>2.7*</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>2.3</td>
<td>1.1</td>
</tr>
<tr>
<td>S-Ba (mm)</td>
<td>M</td>
<td>3.6**</td>
<td>3.0**</td>
</tr>
<tr>
<td></td>
<td>F</td>
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<td>1.7</td>
</tr>
<tr>
<td>BaSN (˚)</td>
<td>M</td>
<td>2.1</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>2.1</td>
<td>0.9</td>
</tr>
<tr>
<td>NSAr (˚)</td>
<td>M</td>
<td>2.0</td>
<td>2.4</td>
</tr>
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<td>F</td>
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<tr>
<td>SArGo (˚)</td>
<td>M</td>
<td>-5.5**</td>
<td>-2.0</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>ArGoMe (˚)</td>
<td>M</td>
<td>3.7</td>
<td>0.5</td>
</tr>
<tr>
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<td>F</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td>SNArGoMe (˚)</td>
<td>M</td>
<td>0.2</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>4.4**</td>
<td>0.1</td>
</tr>
<tr>
<td>SNA (˚)</td>
<td>M</td>
<td>0.7</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>-2.5*</td>
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</tr>
<tr>
<td>SNB (˚)</td>
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<td>0.7</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>-2.7*</td>
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</tr>
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<td>ANB (˚)</td>
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</tr>
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<td></td>
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</tr>
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<td>Wits (mm)</td>
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<tr>
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<tr>
<td>Co-A (mm)</td>
<td>M</td>
<td>6.2***</td>
<td>6.0***</td>
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<td>2.2</td>
</tr>
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<td>Co-Gn (mm)</td>
<td>M</td>
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<td>10.3***</td>
</tr>
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<td>F</td>
<td>7.4***</td>
<td>4.0***</td>
</tr>
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<td>SN/Co-Gn (˚)</td>
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</tr>
<tr>
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<td>F</td>
<td>3.9*</td>
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</tr>
<tr>
<td>N-ANS (mm)</td>
<td>M</td>
<td>3.0**</td>
<td>3.2**</td>
</tr>
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<td>F</td>
<td>3.2**</td>
<td>2.7*</td>
</tr>
<tr>
<td>ANS-Me (mm)</td>
<td>M</td>
<td>7.2***</td>
<td>7.3***</td>
</tr>
<tr>
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<td>F</td>
<td>8.9***</td>
<td>3.1</td>
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<tr>
<td>N-Me (mm)</td>
<td>M</td>
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<td>10.3***</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>12.2***</td>
<td>5.5*</td>
</tr>
<tr>
<td>S-Go (mm)</td>
<td>M</td>
<td>7.9***</td>
<td>6.3***</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>5.2**</td>
<td>3.9*</td>
</tr>
<tr>
<td>SGo/NMe (%)</td>
<td>M</td>
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</tr>
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<td>F</td>
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<td>0.5</td>
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<tr>
<td>U1/SN (˚)</td>
<td>M</td>
<td>-0.2</td>
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<tr>
<td>U1/NA (˚)</td>
<td>M</td>
<td>-0.9</td>
<td>3.1</td>
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<tr>
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<td>F</td>
<td>3.5</td>
<td>0.4</td>
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<tr>
<td>U1/NA (mm)</td>
<td>M</td>
<td>1.2</td>
<td>1.9*</td>
</tr>
<tr>
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<td>F</td>
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</tr>
<tr>
<td>IMPA (˚)</td>
<td>M</td>
<td>-2.5</td>
<td>-0.5</td>
</tr>
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<td>F</td>
<td>-0.4</td>
<td>1.5</td>
</tr>
<tr>
<td>L1/NB (˚)</td>
<td>M</td>
<td>-1.4</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>1.4</td>
<td>2.7</td>
</tr>
<tr>
<td>L1-NB (mm)</td>
<td>M</td>
<td>-0.4</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>1.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

F, female; M, male.

*P < .05, †P < .01, ‡P < .001. Δ1: difference value between pubertal-prepubertal period. Δ2: difference value between postpubertal-pubertal period. Δ3: difference value between adult-postpubertal period.
Furthermore, the SN/GoGn angle was observed to be smaller in class III females than in class I females in the prepubertal period, and class III males were significantly smaller than females in the adult period. It was found that there was a significant increase in class III males in the $\Delta_1$. While the ratio of SGo/NMe was found to be smaller in class III males in the prepubertal period than in females, it was found to be larger in the adult period. Furthermore, there were significant increases in class III males in the $\Delta_2$ and in class I females in the $\Delta_3$.

**Figure 2.** SN, SBa, and BaSN changes of class III and class I individuals according to growth periods.

**Figure 3.** NSAr, SArGo, ArGoMe, SNArGoMe changes in class III and class I individuals according to growth periods.
The N-ANS, ANS-Me and N-Me dimension was found to be greater in class III and class I males than females in the growth periods. The ANS-Me and N-Me dimensions were found to be smaller in the prepubertal period in class III females compared to class I females. Besides, there was a significant increase in class III and class I males, females in the ∆1. There was also a significant decrease in N-Me in class I females and males in the ∆1, in the class III females in the ∆2, and in the class I males in the ∆3 (Table 2 and 3, Figure 5).

The U1/SN, U1/NA angles and U1-NA length were found to be greater in class III females than in class I females in the pubertal, postpubertal, and adult periods, while the L1/NB angle was significantly smaller in adult periods. In addition, U1/NA angle and U1-NA length, IMPA, L1/NB angles, and L1-NB length were found to be greater in class I males than females. In terms of IMPA, a significant increase was observed in class III males in the ∆2, while there was a significant decrease in the ∆3 (Table 2 and 3, Figure 6).

DISCUSSION

Chronological or bone age is used in studies related to growth and development. While there are studies based on chronological age when creating age groups, there are also studies based on bone age or using other methods. Besides the chronological ages of all individuals included in this study, maturation periods were determined by looking at the left hand–wrist radiographs and the Greulich–Pyle atlas, and groups were formed according to their bone age.
to the skeletal maturation periods as prepubertal, pubertal, post-pubertal, and adult periods.23

Cranial Base Relationships
Bacetti et al reported that the glenoid fossa is located more anteriorly, with a reduced BaSN in class III individuals.12 According to Reyes et al,11 the BaSN in class III cases is smaller than in normal individuals in all age groups. While it was observed to be between 129° and 131° in normal individuals, it was found between 121° and 124° in class III cases.11 In this study, the BaSN was smaller in class III individuals than in class I individuals, and in males compared to females (Table 2, Figure 2). Therefore, the H0 hypothesis of this study was rejected.
While Guyer et al\(^2\) found the value of the saddle angle to be similar between class I and class III individuals, Ellis and McNamara\(^1\) stated that a decrease in Saddle angle is a class III cranial base feature. In this research, in accordance with other studies, the saddle angle (NSA) was found statistically smaller in class III group than class I group especially in the prepubertal and pubertal periods.

In Sanborn's study with class III individuals aged 16–18 years, reported that the Gonion point is located more anteriorly than the skull base and upper face, and the gonial angle (ArGom) is greater in class III individuals (133.6\(^\circ\)) than in class I individuals (123\(^\circ\)).\(^9\) Guyer et al stated that the gonial angle is approximately 5\(^\circ\) larger in class III than class I.\(^1\) Wolfe et al reported that the gonial angle was higher in males than females in the class I and class III groups.\(^2\) Although smaller values of the gonial angle were found in males than females in this study, there were no statistically significant differences. Because the vertical angular dimensions measured in this study are in the optimal angle values (SN/GoGn:30.1-35\(^\circ\)) (Table 2, Figure 3).

Maxillary and Mandibular Skeletal Relationships

Studies have reported that SNA and CoA are smaller in class III individuals.\(^2\) Guyer et al compared the SNA values in this study with Steiner norms,\(^28\) it was found that the SNA values in the class I group were smaller. In this study, SNA values were found to be 79.6\(^\circ\)-81.2\(^\circ\) in class I males and 79.3\(^\circ\)-81.5\(^\circ\) in females. This study finding indicates that there is no difference in the SNA angle between class III and class I individuals, except gender variations. Since the SNA value can be affected by the inclination of the SN plane and the degree value is smaller than mm value, no statistical difference was found.

When we compared the SNB values in this study with Steiner norms,\(^28\) it was found that the SNB values were smaller. In this study, SNB values in the class I group were found to be 77.2\(^\circ\)-78.6\(^\circ\) in class I males and 76.9\(^\circ\)-79.1\(^\circ\) in females. Miyajima et al reported that the SNB angle in class III females increased by approximately 3\(^\circ\) from early mixed dentition to adulthood.\(^10\) In class III females in this study, the SNB value first decreased by 2.7\(^\circ\) (in the \(\Delta 1\)) and increased in the following periods (in the \(\Delta 2\) and \(\Delta 3\)). The highest increase was observed in class III males and in \(\Delta 3\) (4.5\(^\circ\))(Table 3, Figure 4).

Guyer et al reported that the Co-Gn dimension was 3-6 mm longer in class III individuals than in class I individuals.\(^2\) Reyes et al\(^11\) reported that the amount of growth was higher in class III individuals than in class I individuals. Besides, they reported that the greatest increases in mandibular dimensions occurred in class III individuals approximately 1 year after class I individuals. In males with class III anomalies, the highest increase in Co-Gn dimension occurs between the ages of 12-13 (4.2 mm), with an average increase of 2.9 mm.\(^11\) Similarly, in this study, the highest increase was observed in the \(\Delta 1\), and this increase was 10.4 mm in males and 7.4 mm in females on average. When the Co-Gn findings of class I individuals were compared with McNamara norms\(^29\) (105-131 mm in class I boys, 103.3-121.6 mm in girls), the Co-Gn sizes in this study were found to be smaller. Considering the Co-Gn averages of this study, it was found between 110.3-125.5 mm in class I males and 106-118.3 mm in females (Table 2, Figure 4).

Intermaxillary Relationships

Wolfe et al stated that ANB and Wits values were smaller in class III individuals and became more severe in the negative direction over time.\(^2\) In this respect, some cases stated that growth can be better evaluated with the Wits measurement, which is measured from the occlusal plane and is not affected by vertical direction changes.\(^9,26\) Chen et al stated that the class III structure was formed before the age of 8 years, and that more vertical and transversal changes were observed in the following period.\(^27\) In the study of Rutli et al, a worsening over time of the skeletal characteristics (ANB, SNB angle, Wits, mandibular length) of class III malocclusion was described.\(^30\) Compatible with these studies, this study also observed that the class III anomaly was exacerbated in both females and males in ANB and Wits measurements in the \(\Delta 3\). In class III individuals, even if the orthodontic treatment is finished in the early growth period, the mandibula will continue to grow in later growth periods and the risk of relapse should be taken into consideration and appropriate clinical measures should be taken (Table 3, Figure 4).

Studies in the literature stated that the morphological characteristics of mandibular prognathism occur before the pubertal growth spurt, and this situation is maintained in the following period.\(^20,31\) Zegan et al in class III individuals found statistically significant differences with several characteristics between the prepubertal (<14 years) and pubertal-postpubertal (>14 years).\(^31\) While there is no difference in mandibular dimensions in the prepubertal and pubertal periods, there are obvious differences in the transition from postpubertal to the adult period. This should be taken into account in treatment planning. In order to prevent the possible risk of relapse due to continued growth until late periods, for example, the duration of treatment can be prolonged, or class 3 elastics can be used to control mandibular growth. Thus, the orthodontist will be able to create a more effective treatment plan by taking some clinical measures.

Vertical Facial Relationships

In the Sanborn study, SN/GoGn values were reported as 33.17\(^\circ\) in class III individuals and 28.97\(^\circ\) in class I individuals.\(^2\) On the other hand, Wolfe et al stated that class III individuals have a hyperdivergent growth pattern with increased mandibular plane angle.\(^2\) In this study, the average of SN/GoGn is 30.1\(^\circ\)-34.2\(^\circ\) in class III males, 31.2\(^\circ\)-35.2\(^\circ\) in females, 30.9\(^\circ\)-34.4\(^\circ\) in males in class I group, 32.4\(^\circ\)-35\(^\circ\) in females. It is seen that they have similar and optimum values (Table 2). According to Ochoa and Nanda, the SN/GoGn angle decreases from 6 to 14 years of age in individuals with class I occlusion.\(^31\) In this study, decreases are observed in the \(\Delta 2\) (Table 3).

Dentoalveolar Relationships

In individuals with class III malocclusion, the upper incisors are protrusive, and the lower incisors are retrusive as a result of dentoalveolar compensation.\(^2,10,13,14\) In this study, it was observed that proclinations increased in the upper incisors in general during the 4 developmental periods, and there was significant retroclination in the lower incisors in class III cases (Table 2, Figure 6).

In conclusion, we infer the following:

- The craniofacial and especially the mandibular dimensions are larger in class I and class III males than in females.
The cranial base angle and effective size of the maxilla (Co-A) are smaller in class III individuals than in class I individuals.

In Class III individuals, maxillary incisors are protrusive, and mandibular incisors are retrusive.

Although the growth rates between class III and class I individuals in the early period (Δ1) of the maxilla and mandible are similar, these differences intensify in the later periods (Δ3). It was found that the growth rate of the mandible was higher than the growth rate of the maxilla.

The class III intermaxillary relationship worsened over time. Mandibular growth was found to continue into late growth periods, especially in males.

In class III individuals, even if orthodontic treatment is completed in the early growth period, the mandible will continue to grow in later growth periods, and the risk of relapse should be considered, and appropriate clinical measures taken. These results reveal the importance of early diagnosis and treatment in class III individuals.

REFERENCES


Evaluation of the General Level of Knowledge about COVID-19 Infection of Parents Who Visited a Pedodontics Clinic during the COVID-19 Pandemic

COVID-19 Pandemisi Esnasında Pedodonti Klinikine Başvuran Ebevcenlerin COVID-19 Enfeksiyonu İle İlgili Genel Bilgi Düzeylerinin Değerlendirilmesi

ABSTRACT

Objective: It is predicted that droplet-transmitted diseases will cause pandemics in the future, as they had in the past. In order to control possible pandemics, people need to be aware of diseases that can be transmitted through droplets. For these reasons, this questionnaire study aimed to assess parents' general knowledge and attitudes of pediatric patients who visited the pediatric dental clinic during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: In this study, the questionnaire was applied to 450 parents of children who visited the pediatric dental clinic for routine pediatric dental examination. The data analysis of our study was performed using the Statistical Package for the Social Sciences version 23.0 software program (SPSS Inc.; Chicago, IL, USA). Percentages and frequencies of responses to questions were obtained.

Results: Most parents were found to have adequate knowledge about the transmission routes and symptoms of COVID-19 infection. 95.1% of parents stated that dentists should use protective equipment (mask, glasses, protective clothing) during aerosol procedures. About 98.8% of parents agreed that parents and patients in dental clinics should wear their masks to cover the nose and mouth during a COVID-19 pandemic.

Conclusion: We think that participants were aware of masks, social distancing during the pandemic, and the symptoms and transmission routes of COVID-19 infection.

Keywords: COVID-19, dentistry, pandemic, protective equipment

ÖZ

Amaç: Gelecekte geçmişi olduğu gibi damlacık yolu ile bulaşan hastalıkların pandemilere sebep olacağı öngörülmektedir. Olası pandemilerin kontrol altında alınabilmesi için insanların damlacık yolu ile bulaşıklDebugEnabled hastalıklara karşı bilinçlenmesi önemlidir. Çalışmamızın amacı COVID-19 pandemisi sürecinde çocuk diş hekimliği klinikine başvuran çocuklara diş rahatsızlığı ve tedavisi konusunda bilinçlendiğini, tedaviye ilişkin bilgi düzeyini, oral hekimliğin önemi ve tedavi uygulamalarını değerlendirilmesidir.

Yöntemler: Çalışmamızda çocuklara diş hekimliği kliniklerinde diş hekimliği klinikleri, diş hekimliği tedavisi ve tedavi uygulamaları konusunda bilinçli olmaları ve tedavi uygulamaları konusunda bilgi düzeylerini değerlendirilmesi amaçlanmıştır.

Bulgular: Ebevcenlerin çocuklarının COVID-19 enfeksiyonunun bulaş yollarını ve tedavileri hakkında bilgi düzeylerinin yeterli olduğu gözlemlemiştir. Ebevcenlerin %95.1'i hekimlerin aerosollu işlemlerde koruyucu ekipman (maske, gözlik, koruyucu kıyafet) kullanımı gerektiğiğini bildirmiştir. Ebevcenlerin %98.8'i COVID-19 pandemisi esnasında diş hekimlikte ziyaretçilere ve hastaların maske kullanımı ve bu navegadoru kapatmak gerektiğiğini belirtmiştir.

Sonuç: Katılımcıların pandemi döneminde maske ve mesafe konusunda bilinçlendiğini ve COVID-19 enfeksiyonunun belirtileri ile bulaş yolları konusunda bilgi sahibi olduklarını düşünmektedir.

Anahtar Kelimeler: COVID-19, diş hekimliği, pandemi, koruyucu ekipman
INTRODUCTION

On March 11, 2020, the World Health Organization (WHO) announced that the coronavirus disease 2019 (COVID-19) novel coronavirus outbreak had reached a critical juncture, warranting classification as a global pandemic and a matter of international public health concern. During the pandemic, many countries took various measures to try to prevent COVID-19 from spreading. Similar pandemics have occurred in the past, and many prevention have been taken in this pandemic. The primary strategy has been to reduce the burden on the health-care system (especially beds and ventilators, etc.) and to find ways to slow the spread of viral pathogens. These precautions include implementing rules such as social distancing, hand hygiene, and wearing masks.

During the COVID-19 pandemic, it was observed that protective measures such as social distancing and the use of masks were generally taken. On the other hand, a group of people were observed who thought there was no need to take these protective measures, did not wear masks, and ignored social distancing. Likewise, during this pandemic period, there have also been people who avoided going to any hospital.

It is predicted that droplet-transmitted diseases will cause pandemics in the future, as they have in the past. In order to control possible pandemics, it is important to increase people’s awareness of droplet-transmitted diseases. Therefore, it is essential to determine the level of public knowledge about COVID-19. In addition, parents are a particular group, and their behavior is important. Therefore, parents, especially parents of children with systemic diseases, need to have a high level of knowledge to protect their children from pandemics individually. Although the COVID-19 vaccine has been found and the number of cases has decreased, people with chronic and systemic diseases are still at risk of COVID-19. Coronavirus disease 2019 infection in children shows symptoms similar to adults, but symptoms may be milder. This situation is of great concern to pedodontists due to aerosol exposure during dental treatment and close working.

This questionnaire study aimed to assess the general knowledge and attitudes of parents of pediatric patients who visited the Pediatric Dental Clinic during the COVID-19 pandemic.

MATERIAL AND METHODS

The present questionnaire study was approved by the local ethics committee for clinical research at Tokat Gaziosmanpaşa University (Date: 21.10.2021, Number: 83116987-863, Registration Number: 21-KAEK-222).

This prospective study was administered to the parents of pediatric patients (aged 0—14 years) who visited the Pediatric Dental Clinic of Tokat Gaziosmanpaşa University Faculty of Dentistry for routine pediatric dental examination between 28.10.2021 and 24.12.2021. The inclusion criteria were as follows: mentally healthy parents and children, parents who could complete/understand the questionnaire, and agreed to participate in the study. Questionnaires with incomplete answers were recorded as missing data and excluded from the study.

Before inclusion in the questionnaire study, written informed consent was obtained from the parents indicating that they agreed to participate in the study. The parents completed the questionnaires in the waiting room before the dental examination of the participant’s child. Privacy and confidentiality were strictly upheld, with no disclosure of individual outcomes.

A questionnaire consisting of 3 sections was prepared for this study. In the first part of the questionnaire, there are questions about socio-demographic information; in the second part, there are 10 questions about the evaluation of parents’ level of knowledge about COVID-19 infection; and in the third part, there are questions that include 5 written questions in the second part translated into visual questions. The purpose of adding the third section to the questionnaire was to determine the consistency of the participants’ answers while filling out the questionnaire.

The adequacy of the content of the questionnaire and the accuracy of the answers were evaluated by 2 pediatric dentists and 1 oral diagnostician before the study, taking into account the guidelines of the Ministry of Health of the Republic of Turkey titled “Guidelines for working in health institutions and infection control measures” and the guidelines published by the WHO. A Turkish language expert evaluated the clarity of the understanding of the questions. Based on the comments made by these experts, the questionnaire was designed with 15 questions and questions to obtain demographic data. A pilot test was conducted to assess the accuracy and clarity of the questions. Fifteen parents completed the questionnaire. After each questionnaire was completed, parents were asked if any questions needed to be understood while filling out the questionnaire. The questionnaire was finalized according to the feedback.

Power Analysis

The number of participants was calculated using the G-Power sample size calculator (Universitat Kiel, Germany). A precision of 3%, a population size of 10,000, and a 95% confidence interval were used, and the minimum required sample size was calculated as 385. The effect size was derived from the reference.

Statistical Analysis

The data obtained in our study were analyzed using the Statistical Package for the Social Sciences version 23.0 software program (SPSS Inc.; Chicago, IL, USA). Percentage and frequency values of the answers to the questions were obtained.

RESULTS

A total of 485 parents participated in the study and completed the questionnaires. However, 35 questionnaires were excluded from the analysis due to missing information. Consequently, 450 questionnaires were considered for evaluation. The distribution of responses to the questionnaires is presented in Tables 1–3, showing frequencies and percentages.

About 84.2% of the participants were young adults between 20 and 44 ages. About 19.1% of the participants graduated from primary education, 53.1% from secondary education, and 27.8% from higher education (Table 1).

In our study, a high proportion of participants (88.1%) and their children (94.1%) did not have any systemic disease (Table 1).

A high rate of participants correctly answered questions about the symptoms (Q1, Q3) and transmission routes (Q2) of COVID-19 infection. Details of the data of the answers to these questions are given in Table 2.
A high proportion of participants correctly answered questions about mask use (Q4, Q5) and social distance (Q8) (Table 2).

To the question, “Q6. What mask should the dentist wear when applying aerosolized (water-scattering) procedures during the COVID-19 pandemic?” 62.9% of the parents answered as specialty masks and 35.1% as surgical masks (Table 2).

To the question, “Q7. During the COVID-19 Pandemic, do dentists need protective clothing, masks, and glasses in aerosol (water-scattering) procedures?” 95.1% of the participants answered yes (Table 2).

To the question, “Q8. Should there be a social distance of at least 1 meter between seats in waiting rooms of dental clinics during the COVID-19 pandemic?” 95.1% of the parents answered yes, it has not changed, while 40.7% answered yes, it has increased (Table 2).

Table 1. Frequency and Percentages of Sociodemographic Data of Parents

<table>
<thead>
<tr>
<th>PART 1: Questions About Parents’ Sociodemographic Information</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-44</td>
<td>379</td>
<td>84.2</td>
</tr>
<tr>
<td>45-54</td>
<td>54</td>
<td>12</td>
</tr>
<tr>
<td>55-74</td>
<td>17</td>
<td>3.8</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>279</td>
<td>62</td>
</tr>
<tr>
<td>Male</td>
<td>171</td>
<td>38</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary education</td>
<td>86</td>
<td>19.1</td>
</tr>
<tr>
<td>Secondary education</td>
<td>239</td>
<td>53.1</td>
</tr>
<tr>
<td>Higher education</td>
<td>125</td>
<td>27.8</td>
</tr>
<tr>
<td><strong>Gender of the child you brought to our clinic today</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>248</td>
<td>55.1</td>
</tr>
<tr>
<td>Male</td>
<td>202</td>
<td>44.9</td>
</tr>
<tr>
<td><strong>The age of the child you brought to our clinic today</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2.2</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>3.11</td>
</tr>
<tr>
<td>4</td>
<td>29</td>
<td>6.44</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
<td>11.1</td>
</tr>
<tr>
<td>6</td>
<td>33</td>
<td>7.33</td>
</tr>
<tr>
<td>7</td>
<td>49</td>
<td>10.9</td>
</tr>
<tr>
<td>9</td>
<td>52</td>
<td>11.55</td>
</tr>
<tr>
<td>10</td>
<td>53</td>
<td>11.8</td>
</tr>
<tr>
<td>11</td>
<td>39</td>
<td>8.66</td>
</tr>
<tr>
<td>12</td>
<td>99</td>
<td>22</td>
</tr>
<tr>
<td>13</td>
<td>35</td>
<td>7.8</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
<td>1.1</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>0.6</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>The number of siblings of the child you brought to our clinic today</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>35</td>
<td>7.8</td>
</tr>
<tr>
<td>1</td>
<td>116</td>
<td>25.8</td>
</tr>
<tr>
<td>2</td>
<td>156</td>
<td>34.7</td>
</tr>
<tr>
<td>3</td>
<td>99</td>
<td>22</td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td>7.8</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>1.1</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>0.6</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Does your child have any chronic diseases diagnosed by a doctor? (More than 1 option can be selected.)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>447</td>
<td>94.1</td>
</tr>
<tr>
<td>Hypertension (high blood pressure)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2</td>
<td>0.4</td>
</tr>
<tr>
<td>Asthma/coag</td>
<td>12</td>
<td>2.5</td>
</tr>
<tr>
<td>Cancer</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Immune system diseases</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Heart diseases</td>
<td>3</td>
<td>0.6</td>
</tr>
<tr>
<td>Others (Specify ...)</td>
<td>10</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Do you have any chronic diseases diagnosed by a doctor? (More than 1 option can be selected.)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>422</td>
<td>88.1</td>
</tr>
<tr>
<td>Hypertension (high blood pressure)</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>9</td>
<td>1.8</td>
</tr>
<tr>
<td>Asthma/coag</td>
<td>16</td>
<td>3.4</td>
</tr>
<tr>
<td>Cancer</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Immune system diseases</td>
<td>2</td>
<td>0.4</td>
</tr>
<tr>
<td>Heart diseases</td>
<td>6</td>
<td>1.3</td>
</tr>
<tr>
<td>Others (Specify ...)</td>
<td>13</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Table 2. Frequency and Percentages of Data on Parents’ Level of Knowledge About COVID-19 Infection

<table>
<thead>
<tr>
<th>PART 2: Questions Related to the Evaluation of Parents’ Level of Knowledge About COVID-19 Infection</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q1. What are the symptoms of COVID-19 infection? (More than 1 option can be selected.)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>450</td>
<td>13.3</td>
</tr>
<tr>
<td>Cough</td>
<td>440</td>
<td>13</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>441</td>
<td>13</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>290</td>
<td>8.6</td>
</tr>
<tr>
<td>Vomiting</td>
<td>244</td>
<td>7.2</td>
</tr>
<tr>
<td>Runny nose</td>
<td>219</td>
<td>6.5</td>
</tr>
<tr>
<td>Sore throat</td>
<td>376</td>
<td>11.1</td>
</tr>
<tr>
<td>Redness of the eyes</td>
<td>229</td>
<td>6.8</td>
</tr>
<tr>
<td>It may occur without symptoms</td>
<td>275</td>
<td>8.1</td>
</tr>
<tr>
<td>Joint or muscle pain</td>
<td>406</td>
<td>12</td>
</tr>
<tr>
<td>I don’t know</td>
<td>13</td>
<td>0.4</td>
</tr>
<tr>
<td>Inhalation of respiratory droplets during coughing, sneezing, breathing</td>
<td>450</td>
<td>14.7</td>
</tr>
<tr>
<td>Saliva</td>
<td>392</td>
<td>17</td>
</tr>
<tr>
<td>Eye</td>
<td>202</td>
<td>8.7</td>
</tr>
<tr>
<td>Blood</td>
<td>180</td>
<td>7.8</td>
</tr>
<tr>
<td>Fecal–oral route</td>
<td>173</td>
<td>7.5</td>
</tr>
<tr>
<td>Contact with a sick person</td>
<td>383</td>
<td>16.5</td>
</tr>
<tr>
<td>Contact with surfaces</td>
<td>358</td>
<td>15.5</td>
</tr>
<tr>
<td>where the virus is alive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexually transmitted</td>
<td>175</td>
<td>7.6</td>
</tr>
<tr>
<td>I don’t know</td>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>Yes</td>
<td>369</td>
<td>82</td>
</tr>
<tr>
<td>No, it has not changed</td>
<td>8</td>
<td>1.8</td>
</tr>
<tr>
<td>I don’t know</td>
<td>73</td>
<td>16.2</td>
</tr>
<tr>
<td>Yes</td>
<td>440</td>
<td>97.7</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>1.5</td>
</tr>
<tr>
<td>I don’t know</td>
<td>4</td>
<td>0.8</td>
</tr>
<tr>
<td>N95</td>
<td>45</td>
<td>10.4</td>
</tr>
<tr>
<td>FFP2</td>
<td>6</td>
<td>1.4</td>
</tr>
<tr>
<td>Surgical mask</td>
<td>267</td>
<td>62.1</td>
</tr>
<tr>
<td>Cloth mask</td>
<td>44</td>
<td>10.23</td>
</tr>
<tr>
<td>I don’t know</td>
<td>68</td>
<td>15.82</td>
</tr>
<tr>
<td>Yes</td>
<td>445</td>
<td>98.8</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>I don’t know</td>
<td>3</td>
<td>0.7</td>
</tr>
<tr>
<td>Yes</td>
<td>428</td>
<td>95.1</td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>2.6</td>
</tr>
<tr>
<td>I don’t know</td>
<td>10</td>
<td>2.3</td>
</tr>
<tr>
<td>Yes</td>
<td>438</td>
<td>97.3</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>0.8</td>
</tr>
<tr>
<td>I don’t know</td>
<td>8</td>
<td>1.9</td>
</tr>
</tbody>
</table>

To the question “Q10. Has your tooth brushing frequency changed during the COVID-19 pandemic?” 59.1% of the parents answered no, it has not changed, and 38.2% answered yes, it has increased (Table 2).

Visual questions (Q11-15) in the third section on masks, protective equipment, and social distancing were answered correctly at
When the answers given to the picture questions and the written questions corresponding to these picture questions were examined, it was seen that the answers were compatible with each other (Table 3).

### DISCUSSION

In our study, the general knowledge level of the parents who visited the pediatric dental clinic during the COVID-19 pandemic was evaluated about COVID-19 infection. It is seen that our participants, most of whom are healthy and young adults with an intermediate level of education, have sufficient knowledge about COVID-19.
COVID-19 infection and the measures to be taken to protect against this infection, and they know that COVID-19 infection shows symptoms similar to adults in children, but the symptoms may be milder.

In the study conducted by Ceyhan et al,9 most participants stated that the symptoms of COVID-19 infection were fever, shortness of breath, and dry cough. Similarly, in our study, participants chose fever, cough, and shortness of breath as the most common symptoms of COVID-19 infection. In the study conducted by Kasemy et al,10 participants stated that fever was the main symptom among the symptoms of COVID-19 infection. Similarly, in our study, fever was the most frequently selected symptom among the symptoms of infection.

In our study, the most frequently selected ways to transmit COVID-19 infection were coughing, sneezing, inhaling respiratory droplets during breathing, salvia, and contact with a sick person. In the study conducted by Al-Hanawi et al,11 the majority of participants stated that the transmission of infection occurs through respiratory droplets when infected people cough and sneeze. In the same study, 43.77% of the participants stated that people should use surgical masks to prevent infection. Similarly, in the study by Bates et al,12 47.2% of the participants stated that ordinary citizens should wear surgical masks. In the study conducted by Onal et al,13 91.6% of the participants it was stated that they used their masks to cover their mouth and nose. In the present study, most participants stated that it is necessary to wear a mask to cover the mouth and nose during the pandemic and that the type of mask to wear is a surgical mask.

In the study by Ahmed et al,14 60% of the parents they were reported that dentists should use personal protective equipment. In the study by Sürme et al,15 almost all participants felt safe because the physician’s protective clothing could prevent COVID-19 transmission. In the study conducted by Farsi and Farsi,16 82.4% of the parents stated that using personal protective equipment by dentists and ancillary staff is essential, and 77.7% of the participants answered that all visitors should use masks outside the treatment. Our study also observed that the parents knew that physicians should use protective equipment and special masks during aerosolized procedures.

In the study conducted by Farsi and Farsi,16 participants stated that paying attention to social distancing in patient waiting rooms is very important. In our study, it was observed that the parents knew that social distancing should be kept in the clinics’ waiting rooms.

In the present study, it was determined that participants had a high level of knowledge about COVID-19 infection. When the answers given to the visual questions and the written questions corresponding to these visual questions were examined, it was seen that the answers were compatible with each other. Therefore, the answers given by the participants to the questions are consistent.

A study conducted by Karaarslan et al17 observed that the frequency of tooth brushing of adults increased significantly during the pandemic. In this study, it was reported that the first reason for the increase in tooth brushing frequency during the pandemic period was that individuals thought there was a relationship between COVID-19 infection and oral hygiene and that good oral hygiene would reduce the risk of infection. The second reason was that individuals feared their oral health would deteriorate because they could not visit the dentist due to the pandemic. According to the authors, first, these findings show that tooth brushing behavior is a multidimensional phenomenon influenced by perceived risks and benefits. Second, people engaged in inappropriate precautionary behaviors not mentioned or documented in the literature as a method of infection control to cope with a new disease. Third, perceived COVID-19 risk is positively associated with a positive response to toothbrushing behavior. Fourth, individuals’ toothbrushing behavior changed rapidly and dramatically during the pandemic. Fifth, oral health care has not been separated from general health care during the pandemic, and oral health should be seen as a component of general health. Sixth, the pandemic can contribute to raising awareness of the importance of oral health.15

In the study conducted by Campagnaro et al18 in June 2020, when the number of cases was high in Brazil, it was reported that 83.5% of children brushed their teeth during the pandemic. In our study, it was observed that the frequency of tooth brushing of both parents and children tended to increase rather than decrease. In addition, in our study, the tooth brushing frequency of children increased slightly more than that of their parents. This may be due to parents acting as the primary practitioners or supervisors of children’s daily oral care and the possibility of not receiving dental treatment during the pandemic.19

The main limitation of this study is its single-center design. This situation may have limited the generalizability of the results to the whole population. Despite this limitation, the results of the study show parents’ general level of knowledge about COVID-19 infection provides valuable information.

The participants have become aware of masks and distancing during the pandemic and know the symptoms and transmission routes of COVID-19 infection.

Ethics Committee Approval: Ethics committee approval was received for this study from the Tokat Gaziosmanpaşa University Clinical Research Local Ethics Committee (Date: 21.10.2021, Number: 83116987-863, Registration Number: 21-KAEK-222).

Informed Consent: Written informed consent was obtained from parents who participated in this study.

Peer-review: Externally peer-reviewed.


Declaration of Interests: The authors declare that they have no competing interest.

Funding: The authors declared that this study has received no financial support.


Hasta Onamı: Yazılı hasta onamı bu çalışmaya katılan ebeveynlerden alınmıştır.
REFERENCES


The Childhood Bruxism: Literature Review

Çocukluk Dönemi Bruksizmi: Bir Literatür Derlemesi

ABSTRACT

Bruxism is an activity characterized by tightening or creaking of the teeth that occurs most frequently during sleep. It may occur at night or in the daytime. Patients typically clench their teeth during the day, and they grit their teeth at night. Although its etiology is not entirely understood, it can be said that factors such as stress, nutritional deficiency, allergic diseases, unhealthy behaviors, and malocclusion predispose to the presence of bruxism. The treatment of childhood sleep bruxism is a multidisciplinary approach involving pediatricians, pedodontists, and other practitioners in the healthcare field. This study summarizes childhood bruxism, its etiological causes, diagnosis, and potential current options for treatment.

Keywords: Bruxism, teeth grinding, parafunctional habits, diagnosis, treatment

INTRODUCTION

A typical movement problem called bruxism is characterized by teeth grinding or clenching. Sleep bruxism (nocturnal bruxism) and diurnal bruxism are the 2 categories (awake bruxism). Even while diurnal and sleep bruxism appears to have different etiologies, their impact on teeth may be comparable. Although healthy children and adults routinely experience bruxism, it is also frequently documented in kids with cerebral palsy and mental retardation. In children, the reported prevalence of bruxism ranges from 3.5% to 40.6%. While in adults, it ranges from 8% to 31.4%. In the pediatric population, bruxism is seen as a typical parafunctional condition linked to alterations in teeth. Children start grinding their teeth between the ages of 4 and 8 on average. Due to mixed dentition, the prevalence of bruxism is higher between the ages of 10 and 14 and then declines. However, because sleep bruxism may be a result of the continuous physiological development of the central nervous system, it can be challenging to evaluate bruxism in children.

Even though it is thought of as a benign and self-limiting illness in youngsters, bruxism can deteriorate orofacial features if it gets bad enough. Additionally, it was believed that some bruxist patients would benefit from sleep bruxism. This mechanism improves the upper respiratory tract’s airway patency and acts defensively by promoting salivation, which guards against tooth erosion. However, bruxism can have several adverse effects on the stomatognathic system if it is not controlled, including aberrant tooth wear, tension headaches, pain or exhaustion in the chewing muscles, and temporomandibular disorders.
ETIOLOGY
Harmful Habits and Malocclusion
It is thought that these behaviors help kids deal with psychological and emotional challenges such as stress, worry, and tension. In this situation, sleep bruxism might be a method for the kid to unwind at night. According to Drumond et al, sleep bruxism was 50% more common in kids who bit their nails and 30% more common in kids who bit objects. They added that girls had a 22% lower prevalence of sleep bruxism. In a different study, oral respiration was assessed together with gender, breastfeeding style, pacifier use, bottle or finger sucking, nail biting, and other factors. It was shown that only oral respiration was statistically associated with sleep bruxism. Children who breathe orally during sleep are 2.71 times more likely to grind their teeth at night. A study by Zapata et al concluded that the risk of developing bruxism in children who use pacifiers is 7 times higher and that the risk of developing lip bites is 2.2 times more prone than those with posterior crossbites to bruxism. Bruxism is brought on by regional causes like traumatic occlusion, early contact, protruding restorations, tooth cysts, and ectopic eruption. The development of bruxism is supported by malocclusions, calculus, mobility, lip deformity, gingival hyperplasia, and other occlusal physiology-related variables. According to a study, the 2 oral behaviors that sleep bruxism sufferers have in common are breastfeeding and bottle feeding. Although at a young age, these behaviors are not hazardous. When they are kept up for a long time, they may result in malocclusions and other oral health issues. In their study, Zapata et al found that 12.6% of bruxist patients utilize feeding bottles and pacifiers in addition to 23.13% using solely feeding bottles. Simões-Zenari and Bitar observed a relationship between bruxism and pacifier use, lip biting, and nail biting and concluded that the risk of developing bruxism in children who use pacifiers is 7 times higher and that the risk of developing lip bites is 5 times higher. These studies indicate that the presence of certain harmful habits increases the likelihood of bruxism occurring.

Psychological Factors
Repeated teeth grinding as you sleep, which is triggered by stress and worry, is thought to be the primary cause of bad sleep. The most frequent emotional element in children was stress from regular restlessness and worry. These elements may hinder the development of the facial skull complex and harm the Temporomandibular Joint (TMJ), muscles, periodontium, and other structures. In research, children who reported being agitated and tense during the day had a statistically greater frequency of bruxism (42.7%) than children who reported being calm (22.6%). According to Manfredini et al, demographic factors may have an impact on a person’s mental state, which may lead to sleep bruxism. A 2017 study from Brazil found that emotional elements like stress, anxiety, and personality features have an impact on several behaviors in bruxist patients. A statistically significant association between sleep bruxism and psychosocial factors, particularly between bruxism and personality traits of stress, anxiety, and tension, was discovered in a 2015 study. Neuroticism, perfectionism, aggression, higher sensitivity to stress, and coping mechanisms were found to be connected with an increased chance of developing bruxism, according to Serra-Negra et al and Restrepo et al. Children with sleep bruxism had high levels of stress linked to psychological responses, according to a case-control study involving 360 patients aged 7-10 years. Another study found that maternal stress had a significant impact on children’s behavior and sleep bruxism. According to studies, parental stress leads to emotional and/or psychological issues in children, and anxiety symptoms can lead to bad dental habits like nail biting.

Genetics
According to a study, the HTR2A gene polymorphism plays a significant role in the development of sleep bruxism. On the other hand, a meta-analysis in 2014 by Lobbezoo et al that looked at 10 studies examining the connection between genetics and bruxism concluded that bruxism is partially inherited genetically.

Parasite/Allergy
Immunoglobulin E (IgE) levels are elevated in cases of allergies and parasitic intestinal infections; hence, it was decided that oral symptoms were present. Additionally, it has been noted that eosinophilia and bruxism are closely related to IgE levels. Studies show that compounds known as non-specific proteins, which have toxic effects and are released from parasites at different stages of life, are typically connected to bruxism caused by intestinal parasites. However, research examining this idea has produced varying conclusions. While there was no difference in the presence of intestinal parasites between patients aged 6-11 who had bruxism and those who did not, according to Brazilian researchers, Indian researchers concluded that these parasites may be the cause of the onset of bruxism in children aged 3-6 years.

Nutrition/Cigarette
Adult studies have revealed that smokers experience bruxism more frequently. The impact of cigarette smoke on bruxism in children has so been researched. According to a study, children who are exposed to high amounts of smoking are more likely to develop bruxism than those who are exposed to moderate or low levels. In a different study, it was hypothesized that dietary elements such as caffeine, tea, chocolate beverages, soft drinks, and smoking could lead to bruxism by stimulating the central nervous system and escalating stress and anxiety.

Diseases
Nutritional deficiencies, parasite infestations, Down syndrome, gastrointestinal issues, allergic reactions, pharmacological side effects, mental retardation, and cerebral paralysis are some of the systemic problems connected to bruxism. Patients with neurological diseases getting neuroleptic and anticonvulsant medication have shown signs of bruxism. Patients using stimulant medications including levodopa, amphetamines, and antidepressants frequently experience bruxism. Gastroesophageal reflux and bruxism have been linked in a 2018 study; long-term gastroesophageal reflux has been observed to induce severe tooth wear in patients with bruxism. Since dentists are the ones who usually notice tooth wear, when bruxism patients exhibit any symptoms of pathological tooth wear as a result of erosion, dentists should thoroughly assess systemic conditions like dietary practices, oral hygiene, and gastroesophageal reflux to further understand reflux symptoms. An investigation into the prevalence of bruxism and its associations with age, gender, intellectual handicap level, and trisomy 21 chromosomal abnormalities was conducted in 2007 among a group of Mexican children with Down syndrome. In the 57 patients (36 normal, 11 with mosaicism, and 5 with translocation) included in the study, bruxism was observed to be prevalent at a rate of 42%. According to a report, there is no appreciable
variation in bruxism prevalence between the sexes. There is no discernible difference between children with special educational needs at various levels, according to research. The various forms of trisomy 21 were discovered to significantly differ from one another, though. Five times more probable than children without mosaicism, children with Down syndrome who also have mosaicism are more likely to have bruxism.42

In a study including kids with autism, it was discovered that the prevalence of bad oral habits was almost twice as high in these kids (87.3%) as compared to typically developing kids (49.3%). Object biting (44.7%), mouth breathing (26.7%), and bruxism (54.7%) were the 3 behaviors that autistic kids were most likely to engage in. This is thought to enhance the likelihood of malocclusions.43

**Diagnosis**

The clinical identification and evaluation of bruxism is a difficult process. It is crucial to observe the patient or their parent or caregiver to spot bruxism. One of the reasons parents look for expert assistance is teeth grinding as they sleep.44 This highlights the need and necessity of educating patient families more. It is advised that medical professionals speak clearly and use appropriate terminology to ensure proper communication with parents or carers during anamnesis and treatment.45

According to the findings of a cross-sectional study conducted on 1325 parents in 5 distinct Brazilian regions, 57.3% of respondents had no idea what sleep bruxism was and 60.0% had no idea what its causes were.45 In rare instances, sleep bruxism may go unnoticed by parents. Examples of these circumstances include not sharing a bed, children’s sleep bruxism symptoms not being severe, and the onset of tooth wear.46

In the clinical diagnosis of bruxism, symptoms such as occlusal and/or incisal abrasion, pulp hypersensitivity, destruction of periodontal tissues, mobility, temporomandibular joint pain and disorders, cusp-restoration fractures, masseter hypertrophy, and headache are frequently observed.47 It may cause pseudo-class III development by accelerating the resorption of primary teeth and causing changes in the eruption time of permanent teeth.48 Also, clinical features of sleep bruxism include masticatory muscle hypertrophy, indentations on the lip or tongue, and linea alba on the cheek.48 However, they can also be consequences of functional promoter activity such as swallowing.49

Sample questions directed to patients or parents in the diagnosis of bruxism are shown in Table 1.

**TREATMENT**

Children’s sleep bruxism is treated using a multidisciplinary strategy that involves pedodontists, pediatricians, and other medical specialists.50 Orthodontic treatments, bite aligners, and restorative operations are frequently carried out by dentists. Bite plates are used to minimize muscle activity and to relieve the patient. Therefore, in more severe situations, the occlusal surface is shielded from deterioration.51 Occlusal alignment, orthodontic bracketing, an interdental splint, psychotherapy, and exercises are advised if bruxism has caused harm to the stomatognathic system. On the best strategy, there is still no agreement, though.52 Rapid expansion therapy is used to treat children with bruxism in sleep apnea syndrome situations to widen the airways, enhance breathing, and lessen parafunction.53

For the treatment of bruxism in the adult population, studies have looked at the use of pharmacological drugs such as analgesics, anti-inflammatoryatories, muscle relaxants, benzodiazepines, catecholamine precursors, and beta-adrenergic antagonists. There is not a single medicine that is effective and safe enough to use on kids.54 However, both adult and pediatric populations may benefit from short-term (<6-12 weeks) medication use. Diazepam is a benzodiazepine with an intermediate and long half-life that is used to treat several some money ailments, including anxiety, muscle spasms, seizures, and sleep disturbances.55

In a 2019 study, the effectiveness and safety of short-term diazepam use on the management of sleep bruxism in healthy children were assessed. A total of 109 children with sleep bruxism were randomly assigned to 1 of 3 groups in this double-blind, randomized, placebo-controlled clinical experiment. These groups each received low- or moderate-dose benzodiazepines for 2 weeks or a placebo. The severity of sleep bruxism was evaluated at baseline and then again at weeks 2, 8, and 12. The long-term control of sleep bruxism in children was not observed to be improved by short-term diazepam use over a placebo. In both groups, bruxism drastically decreased after using diazepam for 2 weeks. The severity of bruxism thereafter reverted to approximately pre-treatment severity in all groups; therefore, this impact is just temporary.56

Although the use of several pharmacological drugs has been recorded, the research by Yap and Chu57 indicates that there are only controlled clinical studies demonstrating the effectiveness of clonidine, L-dopa, and clonazepam in the treatment of sleep bruxism.58 The long-term use of agents in this field is constrained by side effects, which include certain psychological negative consequences and the possibility of addiction. The most widely employed benzodiazepine in this area is clonazepam.59

Another treatment choice is psychological counseling. Behavioral therapy procedures are part of psychological treatment and are used to treat behaviors, manage environmental factors, and lessen stress in patients.60

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**Table 1. Examples of Questions Directed to the Patient and/or Parents in the Diagnosis of Bruxism**

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Sometimes</th>
<th>Generally</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you grind your teeth while sleeping?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has anyone heard you grind your teeth while you sleep?</td>
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<tr>
<td>Do you notice that you grit your teeth when you wake up?</td>
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<tr>
<td>Do you have jaw pain or jaw fatigue when you wake up?</td>
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<tr>
<td>Have you ever felt your teeth shake when you woke up?</td>
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<tr>
<td>Do you have pain in your teeth and/or gums when you wake up?</td>
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<td></td>
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<tr>
<td>Do you have pain in your temples when you wake up?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have a lock in your jaw when you wake up?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever noticed that you grind your teeth during the day?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever noticed that you grind your teeth during the day?</td>
<td></td>
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</tbody>
</table>
CONCLUSION
Bruxism is a complex condition with an unknown etiology that is now regularly observed in both adults and children. This condition has to be identified to be treated. The awareness of parents on this problem closely relates to their capacity to diagnose bruxism in youngsters. According to studies, parents are ignorant of bruxism. These findings imply that parents should get an education to lessen the prevalence and severity of bruxism.

Peer-review: Externally peer-reviewed.


Declaration of Interests: The authors declare that they have no competing interest.

Funding: The authors declared that this study has received no financial support.

REFERENCES
Self-Adhesive Resin Cements

ABSTRACT

Fixed prosthetic restorations are most preferable restorations in dentistry. Because of that, cements used for bonding fixed restoration become popular in recent years. Clinicians prefer cements with good mechanical properties, that are easy to use, that are biocompatible, and with different color options. For this purpose, self-adhesive resin cements have been developed. Self-adhesive resin cements are cements that aim to combine the ease of application of traditional cements with the good mechanical properties and esthetic advantages of composite resin cements, reducing the clinical application steps and thus minimizing technical sensitivity-related errors. This review aims to evaluate the use, clinical procedures, characteristics, and development of self-adhesive resin cements.

Keywords: Adhesion, self adhesive resin, cement
SELF ADEZIV REZIN SIMANLAR

Self adeziv rezin simanlar ilk kez 2002 yılında piyasaya sürülmüş-tür. Günümüzde diş hekimliğinde kullanımı oldukça yaygın hale gelmiştir. Self adeziv rezin simanların genelkele simanların uygulama kolaylığı ile kompozit rezin esaslı simanların iyi mekanik özellikleri ile estetik özellikleri ile birleşimeyi amaçlayan, klinik uygulama basamaklarını azaltan ve özellikle de teknik hassasiyetdeki yanakları hala indiren simanlardır. Self adeziv rezin simanlar, asitleme ve ilave bir adeziv ajan uygulama gerektirmeden diş sırt dokusunu demineralize ederek diş dokusuna infiltrlike olabilen simanlardır.3-7


Self Adeziv Rezin Simanların Mekanik Özelliği Üzerine Çalışmalar


Petropoulou, A. ve ark25 su emiliminin ve suda çözünebilirliğin konvansiyonel simanlarda self adeziv simanlardan daha düşük olduğunu söylemişlerdir. Pan, Y. ve ark26 self adeziv rezin simanların konvansiyonel rezin simanlara göre daha fazla sahip olduğu ve suda daha fazla çözünebilgiğini bildirmişlerdir. Almecida, C. M. ve ark27 self adeziv rezin simanların 6-12 aylık süreye bağlı bağlı simanın azalmayığını, polimerizeyson profily analizine göre dönüşüm derecesini optimize etmek için etkili olup olmadığını, sürenin önderinden daha fazla fazla çözünebilğini bildirmişlerdir. Kirsten, M. ve ark28 iCEM'de (Heraeus Kulzer, Hanau, Germany) iCEM'deki pH nötralizasyonunu daha düşük bulmuşlardır. Roedel ve ark29 iCEM'deki hidrofilik higroskopik genişlemesi ve pH nötrleştirmeye davranışının higroskopik genişlemesi üzerinde önemli bir etkisi sahip olduğunu söylemişlerdir.

Sekondar çıraklar, restorasyonların başarısız olması ve değiştiirilmesi neden olur.30 Flor salınımı yapan simanlar çırak ilerlemesine önleyebilir. Bu durumun etkisi uygulanan siman veya simanın dayanıcılığına, suda çözünebilirliğine ve su emilimine, su emilime dayanımı, suda çözünebilirlik, su emilime ve suda çözünebilirlik simanda stresle neden olur ve bunun sonucunda restorasyonun aşırlımasına veya kırmızmasına neden olabilir.3

Self Adeziv Rezin Simanın Flor Salınımı Üzerine Çalışmalar

Sekondar çıraklar, restorasyonların başarısız olması ve değiştiirilmesi neden olur.30 Flor salınımı yapan simanlar çırak ilerlemesine önleyebilir. Bu durumun etkisi uygulanan siman veya simanın dayanıcılığına, suda çözünebilirliğine ve su emilimine, su emilime dayanımı, suda çözünebilirlik, su emilime ve suda çözünebilirlik simanda stresle neden olur ve bunun sonucunda restorasyonun aşırlımasına veya kırmızmasına neden olabilir.3

Bitter ve ark34 fiber postları self adeziv rezin siman kullanarak yapıtırmışlardır ve simanları bağlanma dayanımını inceledikleri çalışmalarında; başarısızlığı dentin ve yapıştırma ajan arasındaki başarısızlık, post ve yapıştırma ajan arasındaki başarısızlık, her ikisi kombinasyon içinde başarsızlık ve post içi kompozit ve post içi kompozit başarısızlık olarak sınıflandırılmışlardır. Araştırmacılar çalışmaların sonucunda çırak başarısızlığın dentin ve siman arasında meydana geldiğini, dentin ve siman arasındaki bağlanma dayanımını Smart Cem ve Relay Unicum'de daha yüksek olduğunu bildirmişlerdir. Özlek ve ark36 2 yeni fiber post sisteminin (FiberSite Post
## Tablo 1. Self Adeziv Rezin Simanların Mekanik Özellikleri Üzerine Yapılan Bazı Çalışmalar

<table>
<thead>
<tr>
<th>Araştırmacı-Yıl</th>
<th>Kullanılan Simanlar</th>
<th>Sonuç</th>
<th>Araştırmacı-Yıl</th>
<th>Kullanılan Simanlar</th>
<th>Sonuç</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furuchi, T. ve ark –2016</td>
<td>G-Cem (GC, Leuven, Belgium), BeautiCem SA (Shofu Inc, Kyoto, Japan), Maxcem Elite (Korr Italia Srl,Scafati, Italy), Clearfi SA Luting(Kuraray Dental Co.Ltd., Osaka, Japan), Relyx Unicem 2</td>
<td>Self adeziv rezin simanlarının mekanik özellikleri ve arasında direncini değerlendirilmiştir. Eğilme dayanımı ve yüksek siman olarak Beutimic SA ve Relyx Unicem 2 bulunmuştur. Tüm simanlardaki aşınma miktarları benzer bulunmaktadır, simanlardaki termal ekspansiyonun katısalı Relyx Unicem'de daha düşük iken Maxcem Elite'de daha yüksek bulunmuştur.</td>
<td>Pathak, S. ve ark-2016</td>
<td>Rely X Luting 2(3M ESPE, St Paul, MN, USA), Relyx U200 (3M ESPE,Neuss,Germany), SmartCem2 (Caulk-Dentsply, Milford, DE, USA)</td>
<td>Relyx U200 ile yapıtırlırmın kronlarnaltı retansiyon miktarı daha yüksek bulunmaktadır. SmartCem2(self adeziv rezin siman) ve Relyx Luting 2 (RGMIC) simanlardındaki retansiyon miktarlarına anlamlı bir farklık olduğu bildirilmiştir.</td>
</tr>
<tr>
<td>Roedel ve ark-2016</td>
<td>Relyx Unicem 2 (3M Deutschland GmbH, Neuss,Germany), iCem [ Heraeus Kulzer, Hanau, Germany], VariolinkEsthetic DC(Ivoclar Vivadent, Schaan, Liechtenstein), Maxcem Elite (Korr Italia Srl,Scafati, Italy), Acid etching +Relyx Unicem</td>
<td>Self adeziv rezin simanların ph nötralizasyonu, hidrofilliklik ve higroskopik genleşme stresi değerlendirilmiş. iCem diki higroskopik ekspansiyonu daha yüksek, iCem diki ph nötralizasyonunun daha düşük bulunmuştur.</td>
<td>Mohgaddas, M. ve ark - 2017</td>
<td>Relyx ARC (3M ESPE, St. Paul, MN, USA), Relyx Unicem (3M ESPE, Seefeld, Germany), Acid etching +Relyx Unicem</td>
<td>Self adeziv simanın sinek ve dentine bağlanmasına asit ve primer uygulamasının bağlanma dayanması etkisi incelendirmiştir. Self adeziv siman siman ve konvansiyonel rezin siman arasında farklı bulunmaktadır, minuye uygulanan simanlar prime olarak bağlanan simanın etkilemedebili asit ve primer uygulanan asit ve primer bağlanma dayanması azaltıldığı bilgildir.</td>
</tr>
<tr>
<td>Almeida, C. M. ve ark –2018</td>
<td>SmartCem2 (Caulk-Dentsply, Milford, DE, USA), BisCem( Bisco, Schaumburg, USA), SoTo PP (SDI, Bywater, Australia), Relyx U100 (3M-ESPE,St. Paul, USA), YCEM (Yller Biomaterials, Pelotas, Brazil)</td>
<td>Uzun süreli bağlanma dayanımı ve bazı özellikleri(dentindeki demineralizasyonun paternini, ph miktarını, monomerrlerin polimerine dönüşüm orannını, eğilme dayanımı ve elastik modülünü) değerlendirilmiştir. 6-12 aylık surece simanların bağlanma dayanması azaltılmıştır. BisCem ve SmartCem’in bağlanma dayanması en düşük olduğu bildirilmiştir.</td>
<td>Pan, Y. ve ark -2018</td>
<td>Multilink, Duolink (Bisco Inc., Schaumburg, USA), Nexus (Kerr, Orange, USA), Multlink Speed (Ivoclar Vivadent, Schaan, Liechtenstein), Bisco (Bisco Inc., Schaumburg, USA), Maxcem (Korr, Orange, USA)</td>
<td>Yaşlandırma işleminden sonra yüzey morfolojisini ve monomerrlerin özellikle monomer, polimer, absorbsiyonu ve suda çözünürülkerlik değerlendirilmiştir. Araştırmalarca self adeziv rezin simanları konvansiyonel rezin simanlara göre daha fazla su absorbsiyonu olduğunu ve daha fazla çözünürülkerlikini göstermiştir. Self adeziv rezin simanlarının mekanik özelliklerinin daha düşük olduğu bildirilmiştir.</td>
</tr>
<tr>
<td>Shafiei, F. ve ark 2019</td>
<td>Panavia SA Luting Plus (Kuraray Noritake Dental Inc, Japan), Bifix SE (Voico GmbH,Cuxhaven, Germany), %35 ortofosforik asit</td>
<td>Self adeziv simanla alttleme ve süresinin düşündüğü bağlanma dayanımı ve yüzeyin morfolojisini üzerine etkisi incelendirmiştir. Çalışmanın içinde dentin ve dentin yüzeyinde bağlanma dayanması arttırdığını ve daha az teknik hassasiyet gerektirdiği bildirilmiştir.</td>
<td>ve Ceyto Blanco Post) 2 farklı self adeziv rezin (Panavia SA ve Maxcem Elite) siman başlanma dayanımı incelendikleri çalışmada, Maxcem Elite (Kerr Italia Srl, Scafati, Italy), self adeziv rezin simanın, Panavia SA (Kuraray Noritake Dental Inc, Japan) self adeziv siman simanın daha yüksek bağlanma dayanımı gösterdiği, post tipinin bağlanma dayanımı üzerinde önemli bir etkiye sahip olduğunu bulduklarar. Bu çalışmanın aksine literatürdeki birçok çalışmadan Panavia SA self adeziv rezin siman Maxcem Elite self adeziv rezin simanın daha yüksek bağlanma dayanımı göstermiştir.36-38 Aktemur, T, S ve ark39 Relyx Unicem (3M ESPE, Seefeld, Germany) self adeziv rezin simanın, Clearfil SA (Kuraray Dental Co.Ltd., Osaka, Japan) ve G-Cem (GC, Leuven, Belgium) self adeziv rezin simanına göre daha yüksek bağlanma dayanımı gösterdiiğini bildirilmiştir.</td>
<td></td>
<td></td>
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</tbody>
</table>
Zanzadeh, B. A. ve arkadaşlarının ortodontik braketleri self adeziv dual cure sertleşen rezin simanlara göre daha az renk stabelitesi mikrosızınlının ise benzer olduğunu belirtmişlerdir. Liebermann, self adeziv simanlarda daha fazla olduğunu, gingival marjindeki jinlerdeki mikrosızınlının konvansiyonel rezin simanlara göre düşük monomer miktarları ile solunum yoluyla pul-paya ulaşan, bu durum pulpa için toksik etki oluşturabilmektedir. 46

Self Adeziv Rezin Simanın Marjinal Uyum ve Renklenmesi Üzerine Çalışmalar

Tablo 2. Self adeziv rezin simanlarının biyouyumluluğu üzerine yapılan bazı çalışmalar

<table>
<thead>
<tr>
<th>Araştırmacılar - Yıl</th>
<th>Kullanılan simanlar</th>
<th>Sonuç</th>
</tr>
</thead>
<tbody>
<tr>
<td>D’Alpino ve ark-2017</td>
<td>Maxcem Elite (Kerr Italia Srl, Scafati, Italy), Bifix SE (Voco GmbH, Cuxhaven, Germany), G-Cem LinkAce (GC, Leuven, Belgium), Clearfil SA Luting(Kuraray Dental Co.Ltd., Osaka, Japan), ve RelyX U200 (3M ESPE, Neuss, Germany)</td>
<td>Hücre sitotoksisitesi büyük hücre kültüründe odontoblast hücreleri (MDPC-23) kullanarak incelenmiştir. MaxCem Elite’e maruz kalan hücrelerin ölümünde bir artış saptanmıştır. Self adeziv rezin simanların hücrelerde sitotoksisite etkileri %26, 3T3 fibroblast hücre kültüründe 24 saat boyunca en düşük hücre canlanması için %41 olarak belirtilmiştir. Huśnöz, O. ve ark-2017</td>
</tr>
<tr>
<td>Ayşegül ve ark-2018</td>
<td>G-Cem (GC, Leuven, Belgium), SpeedCem (Ivoclar Vivadent, Schaan, Liechtenstein), RelyX U200 (3M ESPE, Neuss, Germany)</td>
<td>Self adeziv simanlarla artıkan polimer salınımı ve sitotoksisite etkileri görülmektedir. Self adeziv simanlarının etkileri %26, 3T3 fibroblast hücre kültüründe 24 saat boyunca en düşük hücre canlanması için %41 olarak belirtilmiştir.</td>
</tr>
<tr>
<td>Alvarez, M. M. P. ve ark-2019</td>
<td>Maxcem Elite (Kerr Italia Srl, Scafati, Italy), RelyX U200 (3M ESPE, Neuss, Germany)</td>
<td>Self adeziv simanların hücrelerdeki sitotoksisite etkileri %26, 3T3 fibroblast hücre kültüründe 24 saat boyunca en düşük hücre canlanması için %41 olarak belirtilmiştir. Şişmanoğlu ve ark-2019</td>
</tr>
<tr>
<td>Alkurt, M. ve ark. – 2019</td>
<td>Cam ionyonom siman (Meron) Çinko polikarboksilat siman (adhesor) Ojenollü geçici siman (Rely X temp E) Ojenollu siman (cavex) Self adeziv rezin siman (panavia)</td>
<td>Hücre sitotoksisitesi büyük hücre kültüründe odontoblast hücreleri (MDPC-23) kullanarak incelenmiştir. MaxCem Elite’e maruz kalan hücrelerin ölümünde bir artış saptanmıştır. Self adeziv rezin simanlarla artıkan polimer salınımı ve sitotoksisite etkileri %26, 3T3 fibroblast hücre kültüründe 24 saat boyunca en düşük hücre canlanması için %41 olarak belirtilmiştir.</td>
</tr>
<tr>
<td>Şişmanoğlu, S. ve ark -2020</td>
<td>BeautilCem Cement (BC; Shofu Inc, Kyoto, Japan), Panavia SA Cement Plus, RelyX U200 (3M ESPE, Neuss, Germany), Theracem (Bisco Inc, Schaumburg, IL, USA)</td>
<td>Hücre sitotoksisitesi büyük hücre kültüründe odontoblast hücreleri (MDPC-23) kullanarak incelenmiştir. Evlerce 3T3 hücre kültüründe en düşük hücre canlanması için %41 olarak belirtilmiştir. Ekstrakt metodunda 24 saat boyunca en düşük hücre canlanması için %41 olarak belirtilmiştir.</td>
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</table>
çinko oksit öjenollü geçici siman ve öjenolsuz geçici siman sınırlı anti mikrobiyal etki gösterdiklerini bildirmişlerdir.

**Self Adeziv Rezin Simanları İlgili Klinik Çalışmalar**


**Hakem Değerlendirmesi:** Dış bağımsız.


**Çıkar Çatışması:** Yazarlar çıkar çatışması bildirmemişlerdir.

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**Peer-review:** Externally peer-reviewed.


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**KAYNAKLAR**

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Magnetic Resonance Imaging and Cone Beam Computed Tomography Evaluated Stafne Bone Cavity: Report of Two Cases

Stafne Kemik Kavitesinin MRG ve KIBT ile Değerlendirilmesi: İki Olgu Sunumu

ABSTRACT
Stafne bone cavity is a rare, asymptomatic, ovoid, or round-shaped radiolucent mandibular defect detected in the posterior region of the mandible and below the inferior alveolar canal. Although Stafne bone cavity can be seen at any age, it is mostly fifth or sixth decade and more common in men. This report presents two cases of Stafne bone cavity and describes their radiologic characteristics. In both cases, cone beam computed tomography and magnetic resonance imaging were used to evaluate the borders and classification of the lesions. Magnetic resonance imaging revealed that both cases had submandibular gland content. Both patients were informed about the nature of the lesions. Clinical and radiographic follow-up of these lesions without clinical symptoms showed no radiographic changes.

Keywords: Mandible, submandibular gland, magnetic resonance imaging, cone beam computed tomography

ÖZ
Stafne kemik kavitesi, inferior alveolar kanalin altında ve mandibula posterior bölgede nadir olarak görülen, asemptomatik, oval veya yuvarlak şekilli olabilen radyolusent bir mandibula defektidir. Stafne kemik kavitesi her yaşta görülebilebilmesine rağmen çoğunlukla beşinci veya altıncı dekata ve erkeklerde daha sık görülür. Bu makalede iki Stafne kemik kavitesi olsuzu ve radyolojik özelliklerini sunulmuştur. Lezyonların sınırları ve sınıflaması konik ışınlı bilgisayarlı tomografi (KIBT) ve manyetik rezonans görüntüleme (MRG) ile belirlenmiş ve MRG ile her iki vakada da submandibular bez ait yapılar olduğu gösterilmiştir. Hastalar lezyonların özellikleri hakkında bilgilendirilmiş ve klinik semptomları olmayan bu lezyonların klinik ve radyolojik takiplerinde herhangi bir değişiklik gözlenmemiştir.

Anahtar Kelimeler: Mandibula, submandibular bez, manyetik rezonans görüntüleme, konik ışınlı bilgisayarlı tomografi

INTRODUCTION
Stafne bone cavity (SBC) is an asymptomatic mandibular defect and its etiology is still unknown. In 1942, based on the radiographic findings, Stafne described 35 asymptomatic round or oval-shaped radiolucent cases near the angle and the lingual side of the mandible. Although Stafne bone cavity can be seen at any age, it is mostly fifth or sixth decade and more common in men. This report presents two cases of Stafne bone cavity and describes their radiologic characteristics. In both cases, cone beam computed tomography and magnetic resonance imaging were used to evaluate the borders and classification of the lesions. Magnetic resonance imaging revealed that both cases had submandibular gland content. Both patients were informed about the nature of the lesions. Clinical and radiographic follow-up of these lesions without clinical symptoms showed no radiographic changes.

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Stafne bone cavities are commonly described as unilateral, ovoid or round, well-circumscribed radiolucent lesions ranging in diameter from 1 to 3 cm located proximally to the mandibular angle and below the inferior alveolar nerve.2 Lingual posterior (LP) variations of these defects are most commonly observed in the fossa of the submandibular gland region between the angle of the mandible and the first molar. Rare lingual anterior (LA) defects are associated with lingual salivary glands which are located between incisor and premolar teeth.3 Several researchers reported that Stafne bone cavities include normal salivary gland tissue and they do not have an epithelial lining. However, many reports showed that they may also contain fat, blood vessels, lymphatic tissue, connective tissue, muscle, nerve bundles, or air.6,8,9 The location, radiological findings, and the content of the lesions are important for differential diagnosis. Stafne bone cavity-like lesions in the posterior mandibular region above the inferior alveolar nerve are thought to be odontogenic, whereas lesions below the inferior alveolar nerve are non-odontogenic.2 Although rare, neoplasms may also be developed in that region, particularly in cases with salivary gland contents.3

Few studies made an attempt to classify the Stafne lesions. In an earlier computed tomography (CT) report, Ariji et al made a detailed classification of 16 SBC cases in terms of their outlines and their associations with the buccal cortical plate. They also made a soft tissue content classification based on the findings of CT or CT-sialography.9 Several researchers examined the cases using aforementioned classification. In 2016, Chaudhry suggested a modification to the classification of Ariji et al in an editorial note while referring to the report of More et al.4,10

This report presents two cases of Stafne bone cavity evaluated by cone beam computed tomography (CBCT) and magnetic resonance imaging (MRI) and describes their radiologic characteristics on the basis of the previous studies.

**CASE PRESENTATION**

As stated by Ariji et al. and suggested by Chaudry et al., Stafne lesions were assessed as follows: When the lowest part of the cavity concavity did not extend to the buccal cortical plate—type I; when the lowest part of the concavity extended to the buccal cortical plate but without showing any distortion or expansion of the plate—type II; and when it was characterized by a buccal cortical plate expansion—type III.3 type IIa: cavity depth reached the buccal cortical plate and caused its erosion; type IIb: it reached the buccal cortical plate and caused its perforation; type IV: it reached the buccal cortical plate and caused its expansion and perforation.3 The following classification was used for the soft tissue contents: type F: the concavity was contained just fat density; type S: showing the soft tissue structure density indicating any connective tissue, vessel, lymph node, or others; type G: submandibular gland was present near to or entrapped in the concavity.3 Baseline characteristics and classification of the present 2 cases of Stafne bone cavity are summarized in Table 1. Patient consent forms for publication were taken.

**Case 1**

A 60-year-old male patient was referred to the Faculty of Dentistry for dental and oral examination. The patient’s medical history and clinical examination were noncontributory and there was no previous history of trauma to the head and neck region. On viewing the routine panoramic image, a unilocular, ovoid radiolucent lesion was noted in the right posterior mandibula beneath the inferior alveolar canal (Figure 1A).

Subsequently, CBCT imaging revealed a hypodense, non-expansive 1.21 × 0.79 × 0.58 cm sized lesion (Figure 1B-E). It had well-defined cortical borders with an absence of the lingual cortex of the right mandible (Figure 1A), and the lesion was located beneath the inferior alveolar canal (Figure 1C and D).

**Table 1. Baseline Characteristics and Classification of Stafne Bone Cavity Cases**

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Side</th>
<th>Location Variant</th>
<th>Lesion Size (cm)</th>
<th>Type of Outline</th>
<th>Content and Type</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>♂</td>
<td>R LP</td>
<td>1.21 × 0.79 × 0.58</td>
<td>II</td>
<td>Submand. g., G</td>
<td>Follow-up</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>♀</td>
<td>R LP</td>
<td>2.27 × 1.44 × 0.95</td>
<td>III</td>
<td>Submand. g., G</td>
<td>Follow-up</td>
</tr>
</tbody>
</table>

†, male; ♀, female; R, right; LP, lingual posterior; Submand. g., submandibular gland.

**Figure 1.** Case 1 is shown with arrows in conventional panoramic and CBCT images: (A) cropped panoramic image, (B) axial section, (C) oblique-sagittal section, (D) coronal section, (E) 3D CBCT reconstruction. CBCT, cone beam computed tomography.
Magnetic resonance imaging was performed with a 1.5-T (Siemens Magnetom Espree, Erlangen, Germany). T1- and T2-weighted images (thickness of the sections: 3.0 mm with a 0.5 mm gap) were evaluated and T1WI showed that the mandibular defect contained isotense soft tissue in continuity with the submandibular salivary gland (Figure 2A). Axial and coronal fat-suppressed T2WI again showed that the bone defect contained the extension of submandibular gland tissue and it was not suppressed (Figure 2B and C).

Based on these findings, MRI verified the diagnosis of Stafne bone cavity. The patient has been on regular follow-up for over 1 year without any change of the lesion.

**Case 2**

A 75-year-old female patient was referred by her dentist for a further examination regarding the radiolucent cystic lesion detected close to the angle of the mandible. The patient had no complaints referable to the mandible and both her medical and dental history was not contributory. No trauma or any other findings were recorded. The panoramic image showed the ovoid unilocular cavity and CBCT was performed to evaluate the lesion in detail (Figure 3A).

The CBCT showed a hypodense lesion 2.27 × 1.44 × 0.95 cm in diameter (Figure 3B-E). Axial sections showed its well-defined cortical borders, thinned buccal cortex, and also the absence of the lingual cortex (Figure 3B). Oblique sagittal and coronal sections showed the location of the lesion displacing the inferior alveolar nerve to the superior direction (Figure 3C and D).

To evaluate the content of the lesion, a further examination was made by MRI (Siemens Magnetom Espree, Erlangen, Germany) with a 1.5-T. T1- and T2-weighted images (thickness of the sections, 3.0 mm with a 0.5 mm gap) showed that the mandibular defect was continuing with the adjoining submandibular gland having a similar signal intensity to the submandibular gland on both the sequences (Figure 4 A1-2 and B1-2). Axial and coronal post-contrast T1 fat-suppressed sections revealed that the submandibular gland showed diffuse contrast and was not suppressed (Figure 4 C1-2).

Since the defect was again identified as Stafne bone cavity, no further therapy was instituted. Fifteen-month follow-up of the patient showed no radiographic changes.
DISCUSSION

Several terms have been used to identify the specific asymptomatic radiolucencies around the angle of the mandible: Stafne bone cavity, Stafne bone cyst, static bone cyst/cavity, latent bone cyst, developmental bone defect of the mandible, lingual cortical mandibular bone defect, lingual mandibular bone depression, aberrant salivary gland defect, mandibular embryonic defect, etc. Earlier reports of Stafne bone cavities have revealed their findings on conventional intraoral or panoramic radiographs; however, they were not definitive if the lesion was in a nonspecific location and diffuse or lobulated. The differential diagnosis for radiolucencies having proximity to the angle of the mandible includes simple bone cyst, traumatic bone cyst, dentigerous cyst, residual cyst, keratocyst, ameloblastoma, focal osteoporotic bone marrow defect, vascular malformation, the brown tumor of hyperparathyroidism, giant cell tumor, and tumor metastasis. To eliminate the above-mentioned conditions, further investigations with advanced imaging methods are needed to confirm the initial radiological diagnosis. Medical CT and MRI are the most preferred techniques because three different dimensional sections are essential for the extension and size of the lesion and also for its definitive diagnosis. When compared to medical CT, CBCT requires a low radiation dose which also provides 3-D data on the shape and size of the lesion. Yet, it is insufficient to give any information about the contents. Previous reports showed that Stafne bone cavity cases may include soft tissues such as lymph nodes, fat, muscle, and blood vessels and some were lacking any content, other than the salivary glands. Therefore, CBCT and MRI examinations were used for the accurate evaluation investigation of the cavities in the present study.

Both cavities were characteristically situated above the angle of the mandible, beneath the inferior alveolar canal without showing any clinical symptoms (i.e., pain, tenderness, or swelling on palpation), and that was in line with previously documented cases.

As in our cases and as stated in the previous reports, the incidence of Stafne bone cavity cases increases with age, particularly in the fifth and sixth decades. Stafne bone cavities are radiologically observed as oval or round radiolucent cyst-like lesions in the lingual side of the mandible. Likewise present Stafne bone cavity cases had oval well-defined cortical borders, homogeneous radiolucent content, and were located on the right side of the mandible. The incidence of being in LP and LA locations are reported as 0.10%-0.48% and less than 0.009%, respectively. While the radiological diagnosis of LP cases is simple, it was stated that LA-located cases can easily be confused with odontogenic cysts. In the present report, both cases were LP variants. As stated in the report of Ariji et al., the most frequent Stafne bone cavity was type II and the majority of the cases contained the submandibular gland. Similarly, our first case was type II and both cases contained the submandibular gland (type G). These findings also match those observed in earlier studies.

It is well-known that Stafne bone cavities are asymptomatic and static, hence the surgical treatment of the lesion is usually not indicated. However, it is of great importance to rule out the presence of any neoplastic conditions using various advanced imaging modalities. Prior reports have noted the importance of radiological follow-up to monitor for any changes.

Both patients were informed about the nature of the lesions, and since both Stafne bone cavities were quiet and stable, no treatment was required. Radiological continuous monitoring of the cases has been planned to avoid unnecessary surgical interventions that may be associated with complications and other many potential risks.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.


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Hakem Değerlendirmesi: Dış bağımsız.


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