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CONTENTS

Evaluation of the Prevalence of congenitally permanent tooth agenesis among pediatric patients in the subregion of Antalya

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Article Info	ABSTRACT
Article History **Received:** 21.05.2024 **Accepted:** 05.09.2024 **Published:** 30.12.2024 **Keywords:** Congenitally tooth agenesis, Prevalence, Panoramic radiograph, Pediatric patients.	**Aim:** This research aimed to ascertain the prevalence of congenitally permanent teeth agenesis, excluding third molars, among children residing in the subregion of Antalya, Turkey. **Material and Methods:** A retrospective evaluation of panoramic radiographs from 3234 children (1567 females, 1667 males) aged 6 to 12 years was conducted. Participants with systemic illnesses, extracted teeth, ongoing orthodontic interventions, and congenital abnormalities were excluded. Chi-square test and One Sample Chi-square test were employed for comparing qualitative data. **Results:** The study cohort exhibited a mean age of 9.02 ± 1.99 years. The prevalence of congenitally permanent teeth agenesis was determined to be 1.9%, with a distribution of 2.3% among females and 1.6% among males, although no statistically significant disparity was observed between genders ($p>0.05$). Notably, a statistically significant difference in the occurrence of tooth agenesis was noted among the jaws ($p<0.05$), with a notably higher incidence observed in the mandibular region compared to the maxillary region ($p<0.05$). Mandibular second premolars represented the most frequently absent teeth, accounting for 77.9% of cases, a finding deemed statistically significant ($p<0.05$). Additionally, maxillary second premolars exhibited a notable prevalence of 15%, a proportion significantly higher than that observed for maxillary lateral incisors, mandibular lateral incisors, mandibular central incisors, and left mandibular first premolars ($p<0.05$). **Conclusion:** The prevalence of congenitally teeth agenesis varies across populations. Timely and accurate diagnosis of agenesis of permanent teeth is essential to facilitate the development of a comprehensive long-term treatment strategy and improve prognostic outcomes in affected individuals.

Antalya İlindeki Çocuk Hastalarda Görülen Konjenital Sürekli Diş Eksikliği Prevalansı'nın Değerlendirilmesi

Makale Bilgisi	ÖZET
Makale Geçmişi **Geliş Tarihi:** 21.05.2024 **Kabul Tarihi:** 05.09.2024 **Yayın Tarihi:** 30.12.2024 **Anahtar Kelimeler:** Konjenital diş eksikliği, Prevalans, Panoramik radyografi, Çocuk hastalar.	**Amaç:** Bu araştırmanın amacı, Antalya ilinde yaşayan çocuklarda, üçüncü azı dişleri hariç, konjenital sürekli diş eksikliğinin yaygınlığını belirlemektir. **Gereç ve Yöntemler:** 6-12 yaş arasındaki 3234 çocuğun (1567 kız, 1667 erkek) panoramik radyografileri retrospektif olarak değerlendirildi. Sistemik hastalığı olan, dişi çekilmiş, ortodontik tedavi gören ve konjenital anormallikleri olan katılımcılar çalışma dışı bırakıldı. Nitel verilerin karşılaştırılmasında ki-kare testi ve tek örneklem ki-kare testi kullanıldı. **Bulgular:** Çalışma grubunun ortalama yaşı $9,02 \pm 1,99$ yıl olarak belirlendi. Doğuştan kalıcı diş eksikliği prevalansı %1,9 olarak saptandı; bu oran kızlarda %2,3, erkeklerde ise %1,6 idi, ancak cinsiyetler arasında istatistiksel olarak anlamlı bir fark gözlenmedi ($p>0,05$). Çeneler arasında diş eksikliği görülme sıklığında istatistiksel olarak anlamlı bir fark belirlendi ($p<0,05$); mandibular bölgede, maksiller bölgeye göre daha yüksek bir insidans gözlendi ($p<0,05$). Mandibular ikinci küçük azı dişleri, vakaların %77,9'unu oluşturacak şekilde en sık eksik olan dişler olarak tespit edildi ve bu bulgu istatistiksel olarak anlamlıydı ($p<0,05$). Ayrıca, maksiller ikinci küçük azı dişleri %15'lik belirgin bir prevalans gösterdi ve bu oran, maksiller lateral kesici dişler, mandibular lateral kesici dişler, mandibular santral kesici dişler ve sol mandibular birinci küçük azı dişlerine göre istatistiksel olarak anlamlı derecede yüksekti ($p<0,05$). **Sonuç:** Konjenital diş eksikliği prevalansı, popülasyonlar arasında değişiklik göstermektedir. Sürekli diş eksikliğinin zamanında ve doğru teşhisi, kapsamlı, uzun vadeli tedavi stratejisinin geliştirilmesini sağlamak ve etkilenen bireylerde prognostik sonuçları iyileştirmek için esastır.

INTRODUCTION

Congenital tooth agenesis denotes an anomaly characterized by the absence of one or more teeth, attributed to various causative factors. Hypodontia, constituting the most prevalent dental anomaly, entails the developmental absence of fewer than six teeth, excluding third molars.[1] A systematic review revealed a global incidence of this anomaly affecting one in every 10 to 20 individuals.[2] Oligodontia, defined by the absence of six or more teeth (excluding third molars), contrasts with anodontia, which denotes the complete absence of all teeth.[3] Variations in tooth agenesis prevalence are contingent upon geographical, societal, and gender factors,[4] with a higher incidence noted in permanent dentition compared to primary dentition [5] eliciting both aesthetic and functional ramifications.[6]

Etiologically, congenital tooth agenesis arises from a multifactorial interplay involving genetic predisposition, environmental influences, and perturbations in dental lamina exposure to physical stimuli during tooth development, alongside anomalies in dental epithelium and mesenchymal cell proliferation.[4] The PAX9 (paired box gene 9), MSX1 (muscle segment homeobox 1), AXIN2 (axis inhibition protein 2), and EDA (ectodysplasin A) genes are critical for proper odontogenesis and are among the most frequently reported genes where mutations can disrupt normal tooth development, leading to congenital tooth agenesis.[5] While anterior region agenesis is purportedly of genetic origin, posterior region absences are often sporadic.[6,7] Such congenital defects stem from a complex interplay of general factors, encompassing genetic predispositions and syndromes, and local factors, including environmental triggers like chemo or radiotherapy, metabolic disorders, hormonal imbalances, trauma, osteomyelitis, accidental extraction of permanent teeth during primary tooth removal,[4,8,9] and endocrine disturbances.[10]

Congenitally tooth agenesis may precipitate malocclusions, periodontal complications, masticatory difficulties, alveolar bone growth deficiencies, speech impairments,[1] diastema, and deep bite,[11] and primary teeth retention, ankylosis, or infraocclusion.[12] Moreover, mandibular body length, height, and arch dimensions are often diminished in individuals with tooth agenesis.[13]

Prevalence rates of congenitally tooth agenesis range between 2.2% and 36.5%, reflecting variations attributable to age demographics, examination methodologies, regional disparities, racial diversity, and gender discrepancies.[14,15] It was also reported that the prevalence of tooth absence is higher among females compared to males.[16,17] Radiographic assessments, including periapical and panoramic radiographs, facilitate identifying the localization and number of absent teeth, while cone-beam computed tomography offers enhanced diagnostic precision.[12]

Treatment planning for congenitally permanent teeth agenesis necessitates a holistic approach, integrating considerations of age, growth and development dynamics, eruption patterns, existing dental configurations, arch space availability, facial profiles, and malocclusion status. Therapeutic modalities encompass restoration or root canal treatment of primary teeth, implantation, autotransplantation, primary teeth extraction, and fixed or removable prosthetic solutions, underscoring the significance of a multidisciplinary approach involving pediatric dentists, orthodontists, oral and maxillofacial surgeons, and prosthodontists.[6]

Scientific evidence suggests an increased prevalence of tooth agenesis in contemporary times compared to historical records.[18]

Investigations conducted within the Turkish population have reported tooth agenesis prevalence rates ranging from 1.77% to 7.54%.[19,20] Despite the abundance of data on the distribution and prevalence of congenital tooth absence, information regarding Turkish children is quite limited. The scarcity of data on this topic has motivated us to undertake this study. This study endeavors to ascertain the prevalence and characteristics of congenitally tooth agenesis among a sizable cohort of systemically healthy, non-syndromic children residing in the subregion of Antalya, Turkey.

MATERIAL and METHODS

Study design and sample

This observational, retrospective epidemiological study was conducted with the approval of the Clinical Research Ethics Committee of University of Health Sciences Antalya Training and Research Hospital (approval date: 17.02.2022; approval number: 4/8). Digital panoramic radiographs taken during dental examinations of patients presenting to Antalya Bilim University Faculty of Dentistry for various dento-maxillofacial issues between 2018 and 2022 were examined.

Inclusion criteria

i. Patients age range between 6 to 12 years old.

ii. Patients without any systemic disease or syndrome.

iii. Patients with high-quality panoramic radiographs.

Exclusion criteria

i. Patients with systemic diseases, genetic syndromes, ongoing orthodontic interventions, cleft lip and palate, or other congenital anomalies.

ii. Patients with previous dental visits or tooth loss due to any reason.

iii. Patients with panoramic radiographs of inadequate quality for optimal evaluation.

A total of 5000 digital panoramic radiographs obtained from January 2018 to January 2022 were selected. Among these, 3234 radiographs met the inclusion criteria, comprising 1567 females and 1667 males.

Data acquisition

All panoramic radiographs were captured using a single device (Dentsply Sirona, Orthopos SL, Germany). Congenital tooth absence, excluding third molars, was diagnosed by two calibrated experienced observers (BBA, RGKE) following an identical protocol. Intraobserver and interobserver method errors were assessed by reexamining 100 radiographs by both observers after a 2-week interval and kappa statistics were found to be higher than 0.90, indicating that all evaluations' reliability was acceptable. Any disagreements were resolved through consensus. A tooth with no crown mineralization on panoramic radiographs was classified as congenital agenesis. Demographic data, including age, gender, and details of missing teeth, were recorded in an Excel file.

Statistical analysis

IBM SPSS Statistics 22 software was employed for statistical analyses. Descriptive statistics (mean, standard deviation, frequency) and the Chi-square test and One Sample Chi-square test, were used to compare qualitative data. Significance was considered at $p<0.05$ level.

RESULTS

A total of 3234 children aged between 6 and 12 years participated in the study, with a mean age of 9.02 ± 1.99 years. The demographic distribution of the study population is summarized in Table 1.

Table 1: Demographic distribution

		n	%
Age	6	464	14.3
	7	425	13.1
	8	476	14.7
	9	475	14.7
	10	449	13.9
	11	492	15.2
	12	453	14.0
Gender	Boy	1667	51.5
	Girl	1567	48.5
	Total	3234	100

Among these children, 63 (1.9%) had

congenitally tooth agenesis, with bilateral agenesia observed in 36 cases (57.14%). Predominantly, bilateral absent teeth affected the second premolars, with only one case involving bilateral absent teeth of lateral incisors. The number of absent teeth ranged from 1 to 4, with an average of 1.8±0.9 teeth per affected child. Overall, 113 absent teeth were identified, with 41.3% of children having one absent tooth, 46% having two absent teeth, 4.8% having three absent teeth, and 7.9% having four absent teeth, as depicted in Table 2.

Table 2: Distribution of the absent teeth according to type, gender, side, and age

		n	%	p
Absent tooth	Yes	63	1.9	
	No	3171	98.1	
Number of the absent teeth (n=63)	1	26	41.3	
	2	29	46.0	
	3	3	4.8	
	4	5	7.9	
Jaw (n=113)	Right maxilla	12	10.6	0.000*
	Left maxilla	10	8.8	
	Right mandible	42	37.2	
	Left mandible	49	43.4	
Tooth type (n=113)	Maxiller second premolar	17	15.0	0.000*
	Mandibular second premolar	88	77.9	
	Maxiller lateral	5	4.4	
	Mandibular lateral	1	0.9	
	Mandibular incisors	1	0.9	
	Mandibular first premolar	1	0.9	
Age (n=113)	6	36	31.9	0.000*
	7	12	10.6	
	8	7	6.2	
	9	10	8.8	
	10	12	10.6	
	11	14	12.4	
	12	22	19.5	
Gender (n=113)	Male	58	51.3	0.778
	Female	55	48.7	

One Sample Chi-square test

$p<0.05$

Table 3: Evaluation of tooth agenesis rates categorized by age and gender

		Absent teeth		
		Exist (n=63)	Non-exist (n=3171)	
		n (%)	n (%)	p
Age	6	20 (4.3%)	444 (95.7%)	0.003*
	7	6 (1.4%)	419 (98.6%)	
	8	5 (1.1%)	471 (98.9%)	
	9	6 (1.3%)	469 (98.7%)	
	10	7 (1.6%)	442 (98.4%)	
	11	7 (1.4%)	485 (98.6%)	
	12	12 (2.6%)	441 (97.4%)	
Gender	Male	27 (1.6%)	1640 (98.4%)	0.163
	Female	36 (2.3%)	1531 (97.7%)	

Chi-square test

*p<0.05

The distribution of absent teeth by jaw is illustrated in Figure 1. Statistical analysis revealed no significant difference in the prevalence of absent teeth among different age groups (p=0.003; p<0.05, Table 3). However, the prevalence of absent teeth in the 6-year-old group (4.3%) was significantly higher than in other age groups. No significant variation in absent teeth prevalence was observed among the remaining age groups. Additionally, the prevalence of absent teeth did not significantly differ between genders, with rates of 1.6% in boys and 2.3% in girls (p>0.05, Table 3).

Figure 1: The distribution of absent teeth by jaw
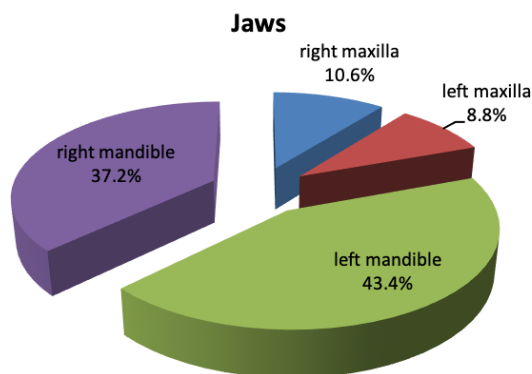
The prevalence of absent teeth was significantly higher in the right and left mandibular jaws compared to the right and left maxillary jaws (p<0.05). Mandibular second premolars were the most commonly absent

teeth, with a statistically significant difference observed (p<0.05). Furthermore, the agenesis rate of maxillary second molars, the second most commonly absent teeth, was significantly higher than other teeth types (p<0.05). The distribution of absent teeth according to tooth type is presented in Figure 2. No instances of oligodontia were identified in the panoramic radiographs analyzed.

Figure 2: The distribution of absent teeth according to tooth type
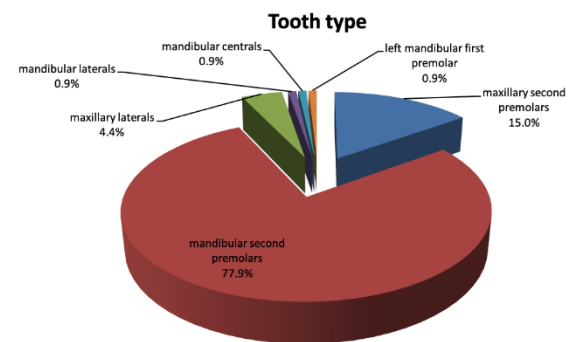
DISCUSSION

This study conducted an extensive review of patient radiographs at a hospital in Antalya, known for its substantial pediatric patient volume. While the sample size constituted a modest fraction of the Turkish population, it encompassed a significant number of pediatric cases (totaling 3234) and ascertained the prevalence of tooth agenesis

exclusively through the analysis of radiographic images and patient medical histories. To the best of our knowledge, this study represents the first investigation of congenital tooth agenesis among pediatric patients conducted in Antalya Province.

The etiology of congenitally teeth agenesis remains a topic of debate, with various factors potentially contributing to this anomaly. Infections, traumas, early exposure to chemotherapy or radiotherapy, cleft lip-palate, ectodermal dysplasia, Down syndrome, low birth weight, advanced maternal age, multiple births, and infections such as rubella, osteomyelitis, and candidiasis are among the factors speculated to play a role in tooth agenesis.[5] The multifactorial nature of this anomaly likely explains the variation in its prevalence reported in the literature.[10]

Altuğ-Ataç et al.[21] reported hypodontia as the most prevalent dental anomaly in Turkish orthodontic patients. Similarly, studies in Turkey have reported varying prevalence rates of hypodontia, ranging from 2.63% to 7.95%, and oligodontia, ranging from 0.07% to 0.71%.[22] In the present study, the prevalence of hypodontia was 1.9%, indicating discrepancies among studies assessing congenital tooth deficiency. Methodological differences, such as the inclusion or exclusion of third molars, sample size, selection criteria, and age range, may contribute to these variations.

Considering that the mean age of third molar calcification is reported to be 9.5 years,[6] we excluded third molars from our study to prevent overestimation. Notably, the prevalence of missing teeth was significantly higher in the 6-year-old group compared to other age groups (p<0.05). This finding aligns with the onset of permanent tooth germ calcification around 3 years of age, with mineralization completed by age 6.[6,17,23] However, some cases have reported delayed mandibular second premolar

development, suggesting that inclusion of children aged 7 years and older may be more appropriate for detecting missing teeth,[24] which could be a limitation of our study.

The influence of gender on congenital tooth agenesia remains uncertain. While some studies suggest a higher prevalence in females, attributed to smaller jaw structures, others report no significant gender-based differences.[6,25,26] In their extensive investigation, Aktan et al. explored dental agenesis across six distinct regions of Turkey, noting a greater prevalence of congenitally teeth agenesis among females compared to males in five of these regions.[27] In the present study, although the incidence of teeth agenesia was higher among girls (2.3%) compared to boys (1.6%), no statistically significant difference was observed between genders (p>0.05). This outcome aligns with numerous prior publications on the subject.[9,16,28,29]

In accordance with prior investigations, the majority of patients exhibited one (41.3%) or two (46%) absent teeth, with a maximum of four (7.9%) absent teeth observed, and no instances of oligodontia were identified.[9,10,30] Our study findings indicated a higher prevalence of bilateral agenesis compared to unilateral agenesis across all tooth types. Polder et al.[10] reported that upper lateral teeth were the most commonly bilaterally absent teeth, whereas unilateral tooth absence predominantly affected lower second premolars. Similarly, some studies documented upper lateral incisors as the most commonly bilaterally absent teeth.[21,31] However, in alignment with the findings of Gkantidis et al.[29] our study identified second premolar teeth as the most frequent bilateral absent teeth (57.14%). Upon examination of the inter-jaw relationship, no statistically significant disparity was noted between the right and left arches in the present investigation (p>0.05). Conversely, a

statistically significant discrepancy was observed in the incidence of absent teeth between the mandibula and maxilla (p<0.05), consistent with findings from previous studies.[28,32]

In accordance with a general trend, when few teeth are absent, they tend to be those situated more distally within each dental group.[6,9,33] The findings of this study align with this pattern. A statistically significant discrepancy in the prevalence of absent teeth among different tooth types was observed (p<0.001; p<0.05), with mandibular second premolars exhibiting the highest prevalence compared to other teeth (p<0.05). Consistent with numerous investigations into congenital tooth agenesis, lower second premolars emerged as the most commonly absent teeth, consistent with our findings.[11,16,21,34] However, our study revealed maxillary second premolars as the second most frequently absent teeth, contrasting with findings from diverse populations such as Japanese, Brazilian, Iranian, Venezuelan, and Portuguese studies, where maxillary lateral incisors were reported as the second most commonly absent teeth.[9,28,35,36] Conversely, Rolling S. et al.[30] reported a predominance of mandibular second premolars, maxillary second premolars, and maxillary lateral incisors as the most commonly absent teeth in Danish schoolchildren, a pattern consistent with our study. These findings suggest that ethnicity may influence both the prevalence and type of congenital tooth agenesis, consistent with existing literature.[21,37]

Advancements in imaging and diagnostic techniques have led to an elevated detection rate of absent teeth in recent years, consequently resulting in a more frequent encounter of these anomalies by dentists.[5] Sogukpinar et al.[12] highlighted insufficiencies in the training of Turkish dentists concerning congenital permanent tooth agenesis, stressing the

necessity for enhanced theoretical and practical education in this domain.

In cases of permanent tooth agenesis, a comprehensive approach to management during the primary dentition phase is essential to mitigate the potential long-term effects on oral health. Early diagnosis and monitoring through regular dental check-ups and radiographs allow for the timely identification of agenesis and enable the development of tailored interventions that address the specific needs of each patient. The maintenance of space for future teeth, whether through the use of space maintainers or serial extractions, is critical in preserving dental arch integrity and preventing malocclusion. Preservation of primary teeth through conservative care, including preventive restorations, plays a vital role in maintaining function and aesthetics in the absence of permanent successors. Moreover, early orthodontic planning, incorporating both evaluation and the use of appliances to guide tooth eruption, is crucial in optimizing alignment and occlusion outcomes. Prosthetic planning, initiated during early stages, ensures the preservation of bone and soft tissue, which are indispensable for successful future restorative treatments. Additionally, educating patients and parents on proper oral hygiene practices and dietary habits, combined with addressing psychosocial concerns through aesthetic interventions and counseling, is fundamental in supporting the child's overall well-being and self-esteem. Implementing these preventive strategies not only facilitates the management of permanent tooth agenesis but also enhances the likelihood of achieving favorable functional and aesthetic results as the child matures.[5]

CONCLUSION

The prevalence of congenitally permanent teeth agenesis was determined to be 1.9% with a notably higher incidence observed

in the mandibular region compared to the maxillary region. Mandibular second premolars represented the most frequently absent teeth followed by second premolars. This study underscores the significance of congenitally tooth agenesis in pediatric dentistry due to its common occurrence, which can lead to aesthetic and functional challenges, necessitating costly and intricate interventions. Hence, prompt diagnosis of tooth agenesis is imperative to mitigate potential complications, thereby potentially reducing treatment expenses and alleviating psychosocial impacts.

Ethical Approval

The ethics approval for this study was received from the Non-Pharmaceutical and Non-Medical Device Ethics Committee of the Clinical Research Ethics Committee of University of Health Sciences Antalya Training and Research Hospital (17.02.2022-4/8).

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Conflict of Interest

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

Author Contributions

Design: BBA, Data collection and processing: BBA, RGKE, Analysis and interpretation: MB, Literature review: BBA, RGKE, MB, Writing: BBA, RGKE, MB.

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Relevance of Internet data on Dentistry in Global Countries using the Google Trends Approach

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Article Info	ABSTRACT
	Aim: The purpose of current study was to compare Google Trends (GT) values on dental terms (dental caries, toothache, dentist, teeth whitening, and toothbrush) with countries' gross domestic product (GDP) and population. **Materials and Methods:** Dental terms of the GT values "dental caries, toothache, dentist, teeth whitening, and toothbrush" were obtained through the GT application, including "All categories and search sources." The findings were obtained for 49 countries from around the world with data. The GDP and population values of the countries analyzed were used. Spearman correlation was used to investigate the correlation between dentistry-related data and the GDP and population values of the countries ($p<0.05$). **Results:** The positive moderate correlations between GDP and toothbrush values were statistically significant ($r=0.582$; $p<0.001$). The positive moderate correlation between GDP and dentist values was statistically significant ($r=0.615$; $p<0.001$). The negative moderate correlation between GDP and toothache values was statistically significant ($r=-0.476$; $p=0.001$). The negative correlation between dentist and population values was statistically significant ($r=-0.398$; $p=0.005$). The positive moderate correlation between dentist and toothbrush values was statistically significant ($r=0,632$; $p<0,001$). The negative moderate correlation between dentist and dental caries values was statistically significant ($r=-0,403$; $p<0,001$). **Conclusion:** Individuals who care about oral health search more for terms such as toothbrush and teeth whitening and less for terms such as dental caries and toothache. Moreover, individuals in countries with a high GDP are significantly less likely to search online for terms such as toothache.

Google Trends Yaklaşımı Kullanılarak Ülkelerdeki Diş Hekimliğine İlişkin İnternet Verilerinin Değerlendirilmesi

Makale Bilgisi	ÖZET
	Amaç: Bu çalışmada diş hekimliği (diş çürüğü, diş ağrısı, diş hekimi, diş beyazlatma ve diş fırçası) ile ilgili Google Trends (GT) verilerininin, ülkelerin gayri safi yurtiçi hasılası (GSYH) ve nüfusu ile ilişkisini değerlendirilmesi amaçlandı. **Gereç ve Yöntemler:** "Diş çürüğü, diş ağrısı, diş hekimi, diş beyazlatma ve diş fırçası" terimleri için GT değerleri, "tüm kategoriler ve arama kaynakları" GT uygulaması aracılığıyla elde edildi. Dünya çapında yeterli veriye sahip 49 ülke için arama sonuçları kaydedildi. Analiz edilen ülkelerin GSYH ve nüfus sayıları kullanıldı. Diş hekimliğine ait GT verileri ile ülkelerin GSYH ve nüfusa ait değerler arasındaki korelasyonu araştırmak için Spearman korelasyonu kullanıldı ($p<0,05$). **Bulgular:** GSYH ve diş fırçası değerleri arasında pozitif orta korelasyon istatistiksel olarak anlamlıdır ($r=0,582$; $p<0,001$). GSYH ile diş hekimi değerleri arasında pozitif orta korelasyon istatistiksel olarak anlamlıydı ($r=0,615$; $p<0,001$). GSYH ile diş ağrısı değerleri arasında negatif orta korelasyon istatistiksel olarak anlamlıdır ($r=-0,476$; $p=0,001$). Diş hekimi ile nüfus değerleri arasında negatif korelasyon istatistiksel olarak anlamlıdır ($r=-0,398$; $p=0,005$). Diş hekimi ile diş fırçası değerleri arasında pozitif orta korelasyon istatistiksel olarak anlamlıdır ($r=0,632$; $p<0,001$). Diş hekimi ile diş çürüğü değerleri arasında negatif orta korelasyon istatistiksel olarak anlamlıdır ($r=-0,403$; $p=0,004$). **Sonuç:** Ağız sağlığını önemseyen bireyler diş fırçası ve diş beyazlatma gibi terimleri daha çok araştırmaktadır, diş çürüğü ve diş ağrısı terimleriniyse daha az araştırmaktadır. Ek olarak, GSYH'si yüksek ülkelerdeki bireyler diş ağrısı terimini internette aramayı anlamlı düzeyde daha az yapmaktadır.

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INTRODUCTION

Oral and dental diseases, which are among the most common health problems worldwide, affect the general health of individuals and create a serious economic burden on individuals.[1] Oral diseases can cause serious health problems. Thus, good oral hygiene plays an important role in preventing these diseases.[2] Individuals' general health and quality of life are negatively affected by poor oral hygiene.[3] Dental caries is a significant public health burden on individuals worldwide. Dental caries should be taken seriously into consideration, as it negatively affects different age groups and individuals' quality of life.[4] It has been reported that individuals with low socioeconomic status and high caries experience visiting clinics more frequently due to toothache.[5] Toothache is a discomfort caused by a variety of etiologic factors, and the most common cause of this pain is dental caries.[6] Dental caries can be prevented with early diagnosis by an experienced dentist and proper oral hygiene.[4]

Despite improvements in the oral health of individuals worldwide, major oral health challenges persist in countries with different income levels.[7] Research has shown that the delivery of health services to individuals and providing a better quality of life to the public positively affects the economic welfare of individuals.[1] Health systems should have strong components for improving and maintaining health across age groups and facilitating the early detection of diseases and appropriate treatment.[8] A health system should provide staff, funding, information, materials, transportation, communication networks, and financially equitable services. In high-income countries, advanced systems for dental health provide treatment and preventive services to individuals.[9] Moreover, healthcare has become one of the most important fields of study that now has amassed large databases[10], while the number of publications in this field is constantly increasing.[11]

The internet has rapidly become a primary source of health information. Individuals around the world search for health information every day. In particular, individuals can access a large amount of information on the internet for any keyword they want to search.[12] A study has shown that the most frequently searched topics on internet search engines are related to healthcare terminologies.[13] The most popular tool for using web-based data on internet searches is Google Trends (GT).[10] GT is a service that provides users with statistical information such as the geography, languages, and frequency of searches for a word or phrase in the Google search engine. Thus, GT allows users to evaluate how many times a word is searched on Google and its popularity. GT data, which are publicly available, can be collected and stated in real time.[14] Moreover, GT is a reliable tool for predicting changes in human behavior. If search terms are carefully chosen, they can be accurately measured using Google data.[10] GT is valid, accurate, and useful for forecasting and offers new opportunities for big data. Therefore, there is great potential in using web-based queries to study topics that are difficult or even impossible to investigate without the use of big data.[10]

Given the diversity of topics for which GT data has been used to examine changes in interests up to this point and the usefulness of this tool in assessing human behavior, it is clear that it is indeed valuable in discovering and predicting behavioral trends of individuals.[10] It can also be a useful tool for analyzing the popularity of internet search queries. Therefore, the aim of our study was to evaluate the relationship between dentistry-related GT data (dental caries, toothache, dentist, teeth whitening, and toothbrush) and countries' gross domestic product (GDP) and population. The null hypothesis of our study was that there will be

no significant relationship between the GT data on dentistry and the GDP and population of countries.

MATERIALS AND METHODS

As we used only publicly available information in the study, we did not deem it necessary to obtain approval from an ethics committee. The GT online search tool analyzes search terms based on their total search volume, providing data on the relative popularity of a search term in a given region and time. However, it also allows for the measurement of the relative popularity of search terms within a given category, place, and time range by providing information on their popularity at a given time. Relative search volume (RSV) is a measure of relative popularity, represented on a scale of 0–100 (with 100 indicating the highest relative popularity).[15] GT values (GTv) were taken as the basis for RSV values in the study.

Access to the GT application for the current study was on March 15, 2024. Values related to dental caries, toothache, dentist, teeth whitening, and toothbrush were collected worldwide (2023). Search results for all keywords were recorded in 49 countries with sufficient data. Data were linked to the population, and the countries' latest GDP and population numbers were retrieved from the internet website.[16,17] On the Internet, GDP and population values are updated over time. In GT, topics are a group of terms that share the same concept in any language. Topics can be found under your search term. For example, if you search for London and select the related topic, you may see sub-topics such as "The capital of the United Kingdom" and "Londres," which means "London" in Spanish, in your search results.[18]

Statistical Analysis

The data were analyzed using IBM SPSS Statistics 25 (IBM Corp., Armonk, NY, USA). Spearman's correlation was used to evaluate the relationship between the obtained data. Additionally, correlation matrix plot graphs were prepared using the Minitab 19 statistical program, depicting the examined terms, GT values, population, and GDP by province (Figure 1). The significance value in this study was accepted as $p<0.05$.
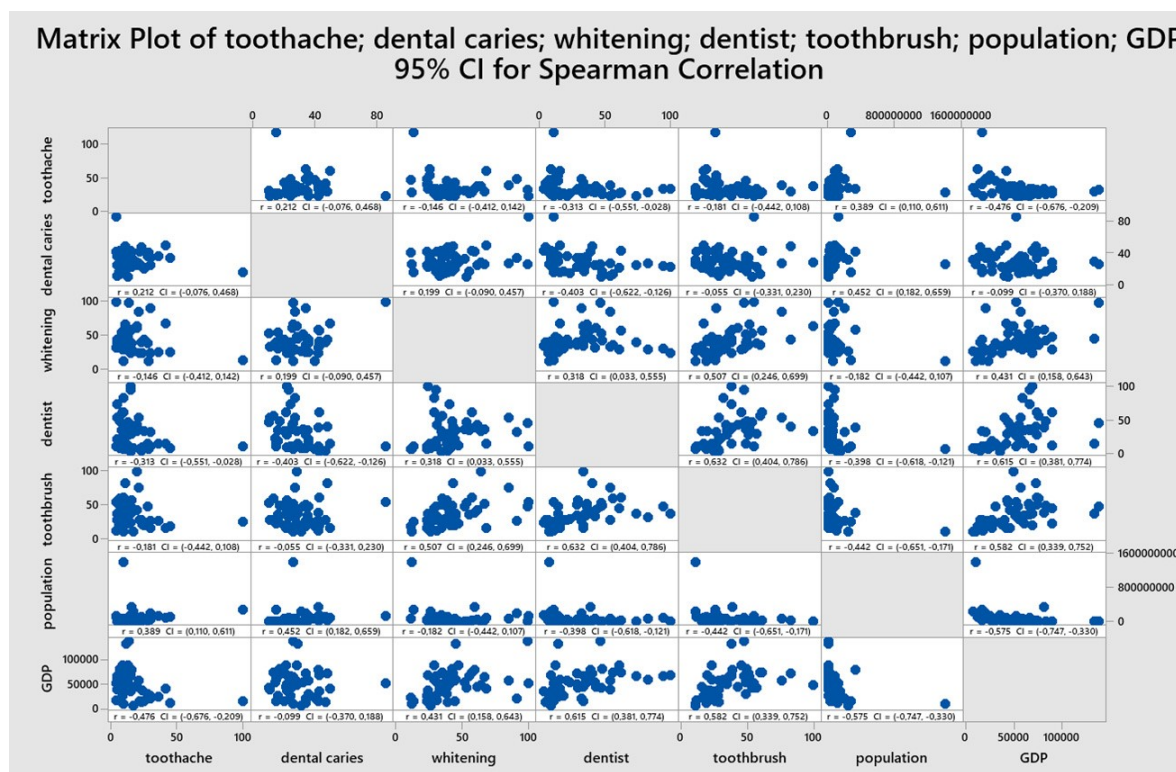
Figure 1: *Matrix plot of values for Gross Domestic Product (GDP), population and dental terms*

RESULTS

GT values (GTv), population values, and GDP values of the terms analyzed by country are shown in Table 1. When searching for "toothache," the highest value was found in Indonesia (100) and the lowest in Japan (4) and Egypt (4). When searching for "toothbrush," the highest value was found in Czechia (100) and the lowest in India (11) and Pakistan (11). For the search "dentist," the highest value was found in Austria (100) and the lowest in Russia (3). For the search for "dental caries," the highest value was found in Japan (86) and the lowest in Hungary (10). When "teeth whitening" was searched, the highest value was found in Japan (100) and the lowest in Thailand (11). The correlations of the analyzed parameters is shown in Table 2. The negative medium correlation between the GDP and population GTv was statistically significant ($r = -0.575$; $p < 0.001$). The positive moderate correlation between GDP and teeth whitening GTv was statistically significant ($r = 0.431$; $p = 0.002$). The positive moderate correlation between GDP and toothbrush GTv was statistically significant ($r = 0.582$; $p < 0.001$). The positive moderate correlation between GDP and dentist GTv was statistically significant ($r = 0.615$; $p < 0.001$). The negative moderate correlation between GDP and toothache GTv was statistically significant ($r = -0.476$; $p = 0.001$). The negative moderate correlation between toothbrush and population GTv was statistically significant ($r = -0.442$; $p = 0.001$). The negative moderate correlation between dentist values and population GTv was statistically significant ($r = -0.398$; $p = 0.005$). The positive moderate correlation between dental caries values and population GTv was statistically significant ($r = 0.452$; $p = 0.001$). The positive moderate correlation between toothache and population GTv was statistically significant ($r = 0.389$; $p = 0.006$). The positive moderate correlation between toothbrush and teeth whitening values was statistically significant ($r = 0.507$; $p < 0.001$). The negative moderate correlation between dentist and teeth whitening GTv was statistically significant ($r = 0.318$; $p = 0.026$). The positive moderate correlation between dentist values and toothbrush GTv was statistically significant ($r = 0.632$; $p < 0.001$). The negative moderate correlation between dentist GTv and dental caries values was statistically significant ($r = -0.403$; $p = 0.004$). The negative moderate correlation between dentist and toothache GTv was statistically significant ($r = -0.313$; $p = 0.028$).

Table 1: Google Trends values of the countries included in the study, population, Gross Domestic Product (GDP) values, and dental terms

Country	Toothache	Dental caries	Teeth whitening	Dentist	Toothbrush	Population	GDP
Indonesia	100	15	13	10	26	279118866,00	15834,00
Philippines	45	34	25	8	19	110683773,00	11326,00
Türkiye	42	50	68	15	17	85372377,00	41888,00
Mexico	36	36	25	14	27	129406736,00	24976,00
Argentina	30	24	23	10	17	46044703,00	26506,00
Brazil	30	34	91	32	27	203062512,00	20079,00
Thailand	29	40	11	7	19	65988650,00	22491,00
Chile	28	36	38	14	49	19960889,00	29935,00
South Africa	25	20	44	33	20	60604992,00	16211,00
Malaysia	24	22	24	9	22	33500000,00	37083,00
Vietnam	23	47	39	4	29	100000000,00	14285,00
Peru	22	42	23	6	28	33396698,00	15894,00
United Kingdom	21	27	85	54	76	67026292,00	56836,00
Czechia	20	28	64	33	100	10827529,00	49030,00
Poland	20	25	61	43	43	37726000,00	45538,00
Pakistan	17	31	26	8	11	241499431,00	6773,00
USA	16	42	59	39	39	336080688,00	80412,00
Slovakia	16	22	38	29	57	5428792,00	42228,00
Russia	15	43	34	3	25	146424729,00	35310,00
Germany	15	23	30	95	48	84607016,00	66038,00
Austria	15	22	24	100	38	9159993,00	69069,00
Ireland	14	26	99	46	48	5123536,00	137638,00
Spain	14	22	40	28	35	48345223,00	50472,00
Hong Kong	14	34	35	28	51	7333200,00	72861,00
United Arab Emirates	13	28	47	12	23	9282410,00	88962,00
Hungary	13	10	53	47	54	9678000,00	43601,00
New Zealand	13	32	52	36	49	5199100,00	53809,00
Singapore	12	29	45	14	38	5453600,00	133108,00
Canada	12	35	45	35	35	40027242,00	59813,00
Australia	11	26	67	36	52	26707556,00	64675,00
Taiwan	11	48	43	40	83	23420442,00	72485,00
France	10	27	29	83	32	68226000,00	58765,00
Italy	10	25	31	42	34	58919345,00	54259,00
India	10	26	12	7	11	1412604531,00	9183,00
Netherland	10	43	57	62	61	17947684,00	73317,00
Portugal	9	21	34	33	16	10467366,00	45227,00
Israel	9	14	37	23	30	9740480,00	54771,00
Serbia	9	16	30	18	28	6647003,00	26074,00
Switzerland	9	21	29	61	46	8865270,00	89537,00
Sweden	8	16	55	34	37	10545310,00	66209,00
Denmark	7	13	35	56	60	5961249,00	74958,00
Norway	7	17	42	48	50	5514042,00	82236,00
Saudi Arabia	7	43	41	8	20	32175224,00	68453,00
Finland	6	15	39	15	23	5581767,00	59869,00
Belgium	5	24	40	74	38	11808859,00	65813,00
South Korea	5	36	44	21	29	51439038,00	56709,00
Greece	5	11	33	54	29	10482487,00	39864,00
Japan	4	86	100	10	55	124500000,00	52120,00
Egypt	4	42	31	10	12	105373154,00	17123,00

Table 2: Correlation values of Google Trends values for Gross Domestic Product (GDP), population and dental terms

	GDP	Population	Tooth Whitening	Toothbrush	Dentist	Dental caries	Toothache
GDP	-	-	-	-	-	-	-
Population	r=-0.575** p<0.001	-	-	-	-	-	-
Whitening	r=0.431** p=0.002	r=-0.182 p=0.212	-	-	-	-	-
Toothbrush	r=0.582** p<0.001	r=-0.442** p=0.001	r=0.507** p<0.001	-	-	-	-
Dentist	r=0.615** p<0.001	r=-0.398** p=0.005	r=0.318* p=0.026	r=0.632** p<0.001	-	-	-
Dental caries	r=-0.099 p=0.5	r=0.452** p=0.001	r=0.199 p=0.171	r=-0.055 p=0.706	r=-0.403** p=0.004	-	-
Toothache	r=-0.476** p=0.001	r=0.389** p=0.006	r=-0.146 p=0.316	r=-0.181 p=0.213	r=-0.313* p=0.028	r=0.212 p=0.143	-

**Correlation is significant at 0.01 level. *Correlation is significant at 0.05 level.

DISCUSSION

In this study, correlations were found between the analyzed dental terms-related GT data of the studies countries for the year 2023 and the GDP data at the relevant times and population of the countries. Therefore, the hypothesis tested in the study was rejected.

Low-income countries have significantly fewer dentists than both middle- and high-income countries.[1] When our findings were analyzed, a positive correlation was found between the GDP and dentist values. An increased search for a dentist GT values decreased toothache GT values searches. In a study, it was reported that individuals with low education levels or low incomes had a higher caries risk in terms of caries experience.[19] Individuals' education level, income, and place of residence indicate their socioeconomic level. These factors are recognized as the strongest determinants of caries formation.[20] In high-income countries, preventive measures are more common and prevent the beginning or progression of caries.[1] However, access to high-quality oral care is more difficult to obtain in low-income countries than in high-income countries, and this has contributed to the global neglect of oral health.

Dental caries is one of the most common major complaints of patients, affecting people from a wide range of age groups and ethnic origins.[21] Although caries is asymptomatic in its initial stages, it is associated with a reduced quality of life for affected individuals.[22] We found that related online queries possibly indicate that web users' relevant search queries are often single or multiple cavitation and dental caries. The fact that tooth decay is a technical term may have created a high variation in search graphs due to the fact that the patient may have been questioned about the diagnosis in the dental office.[23] Treatment of oral diseases is extremely costly in many industrialised countries and difficult in most low- and middle-income countries.[24] This reason the income level of countries geographical situation is further complicated by the pace of economic development and rapid changes in habits and nutrition in many countries.[25] The GDP is a strong predictor in assessing the effects of the social environment and individual factors on dental pain and dental caries.[26] Toothache is still common among children and adolescents and is strongly associated with dental caries, especially in groups of low socioeconomic status.[27] Similarly, toothache and dental caries are most frequently associated with reduced oral health-related quality of life in adults.[25] Caries

has a negative impact on health, as children with poor oral health have higher school absences and perform worse than children with better oral health.[25] In addition, the decline in health systems in many areas of the world may hinder access to oral health services, potentially increasing the risk of dental caries and consequently the occurrence of dental pain.[28]

The importance of oral care products has increased over time due to increased awareness among consumers and better dissemination of information in developing countries. The reason for the increased use of these products is due to the fact that oral diseases can be prevented or treated with the use of oral care products.[29] When our findings were evaluated, it was found that there was a positive relationship between the data of teeth whitening, toothbrush, and dentist terms in countries with high GDP. However, there was a negative relationship between GDP and the toothache search terms. Patthi et al. reported that the search term "dental caries" was highly queried by individuals.[23] Individuals in countries with low GDP may be thought to question internet search preference more when there is a specific disease finding. In addition, a positive relationship was found between tooth whitening and toothbrush data as well between toothbrush and dentist data. This suggests that individuals in countries with high GDP can access oral care products more easily. The findings of our study align with those of another study that reported that individuals with low socio-economic status had low oral hygiene.[30] In our study, the positive correlation between GDP and oral care product search values indicates that dental caries and toothaches may affect internet search values. We also found a negative correlation between toothbrush and toothache and between dentist and toothache. In a previous study, it was found that individuals searching for the term toothache queried terms aimed at preventing toothache.[12] In support of other published research findings,

our study found that individuals who cared about oral health searched more for the terms dentist and toothbrush and less for dental caries and toothache.

Currently, the number of internet users is increasing day by day, and individuals are searching for information on internet search engines.[14] In this study, GT was used to evaluate individuals' search terms. In particular, we showed that GT can be a useful tool for analyzing the popularity of internet searches, with the advantages of easy accessibility and easy reporting of GT data. We determined that by analyzing internet search frequencies and GDP data, it is possible to make an overall assessment of the oral health of individuals in a region. In addition, we found that GT data are a reliable source for obtaining meaningful results, which shows GT can be used as an effective tool for future research.

This study has some limitations. The constant updating of internet data makes it possible to make assessments that are only instantaneous or cover a certain period of time. In addition, the inability to collect data at the specified level in all regions is a limitation of this study. This is because data for the relevant terms were collected from the same countries for these values. In recent years, it has been observed that spending more time on the internet and social media has led individuals to use internet searches to reduce dental health problems. This reflects changing trends in individuals' access to information and greater awareness of oral health. Furthermore, understanding how regional and economic factors influence individuals' demands for dental care can provide important information for more effective resource allocation and service planning. The results obtained through GT cannot replace epidemiological data but can provide a broad perspective for analysis in the area of interest based on internet search results.

CONCLUSION

The GT application can provide valuable insights into emerging diseases and their search analysis across populations. We found that individuals who care about oral health search more for issues such as toothbrush and teeth whitening and less for issues such as tooth decay and toothache. However, individuals in countries with a high GDP search less online for issues such as toothache and dental caries but more for oral healthcare products (toothbrush, teeth whitening). Our findings indicate that awareness-raising activities on dental health will help individuals achieve better oral and dental health.

Ethical Approval

Since sources obtained from humans or animals were not used in this study, ethics committee approval was not obtained.

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Conflict of Interest

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

Author Contributions

Design: SF, MF, Data collection and processing: SF, MF, Analysis and interpretation: SF, MF, Literature review: SF, MF, Writing: SF, MF.

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Assessment of Anatomic Variations in the Mandible by CBCT

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Article Info	ABSTRACT
	Objective: This study aimed to determine the prevalence of mandibular neurovascular anatomical variations in a group Turkish population with cone beam computed tomography. **Methods:** Sagittal, axial, coronal, serial cross-sectional and three-dimensional reformatted 410 CBCT images were investigated in accordance with age and gender. Median lingual foramen, lateral lingual foramen, mandibular incisive canal, anterior loop, accessory mental foramen, retromolar foramen, bifid mandibular canal, absence of mental foramen were evaluated in multiplanar sections. Obtained data were analysed with the IBM SPSS Statistics 25 package program. **Results:** Images of cases with a mean age of 44.25 ± 17.47 years, consisting of 233 (56.8%) men and 177 (43.2%) women, total 410 CBCT were included in the study. The most detected anatomical variation was the median lingual foramen (44.7%), followed by the mandibular incisive canal (33.9%). No statistically significant relationship was found between parameters and gender (p>0.05). **Conclusions:** Although the anterior interforaminal region is known as a safe region for surgery, the results of this study show that the presence of lingual foramina and mandibular incisive canal is not at a level that can be ignored.

Mandibuladaki Anatomik Varyasyonların KIBT ile Değerlendirilmesi

Makale Bilgisi	ÖZET
	Amaç: Bu çalışmada, bir grup Türk popülasyonunda mandibular nörovasküler anatomik varyasyonların prevalansının konik ışınlı bilgisayarlı tomografi ile tespit edilmesi amaçlandı. **Yöntem:** Aksiyal, sagital, koronal, seri kesitsel ve üç boyutlu reformat 410 KIBT görüntüsü yaşa ve cinsiyete göre değerlendirilmiştir. Median lingual foramen, lateral lingual foramen, mandibular kesici kanal, anterior loop, aksesuar mental foramen, retromolar foramen, bifid mandibular kanal ve mental foramen yokluğu çok düzlemli kesitlerde değerlendirildi. Elde edilen veriler IBM SPSS Statistics 25 paket programı ile analiz edilmiştir. **Bulgular:** Çalışmaya 233 (%56,8) erkek, 177 (%43,2) kadından oluşan ortalama yaşı 44,25 ± 17,47 olan toplam 410 KIBT görüntüleri dâhil edilmiştir. Tüm olgularda en çok izlenen anatomik varyasyon median lingual foramen (%44,7), ikinci olarak mandibular insiziv kanal (%33,9) olarak tespit edilmiştir. İncelenen parametreler ile cinsiyet arasında istatistiksel olarak anlamlı bir ilişki bulunamamıştır (p>0,05). **Sonuç:** İnterforaminal bölge cerrahi için güvenli bir bölge olarak bilinmesine rağmen bu çalışmanın sonuçları lingual foramenlerin ve mandibular insiziv kanalın varlığının göz ardı edilebilecek düzeyde olmadığını göstermektedir.

INTRODUCTION

Recognizing the anatomic special features of the oral region is a requisite factor for the correct application of both protective and medicinal procedures in that region. Frequently observed anatomic variations play a major role in the planning of surgery and are with ease overlooked. The increasing claim for surgical procedures like implant placement and orthognathic surgeries has resulted in anatomic property and their normal variations in the human jawbone has rekindled interest. Considering the possible risk of bleeding and neural damage neovascularization of the jawbone is of special attention in this perspective.[1, 2]

The importance of variations in dental clinical practice is that this structure is used as a reference point in the application of local anesthesia, placement of dental implants, and application of endodontic, prosthetic and another dental applications in that area.[3, 4-6] It is significant to identify the presence, course, location, morphology and function of the neurovascular variations in order not to cause neurovascular complications in the floor of the mouth. Cone beam computed tomography (CBCT) is of major clinical importance in the detecting of anatomical diversity. The most significant utilize of CBCT in the oral region is the three-dimensional reconstruction of the anatomic properties of the area. This provides determination of all anatomic diversity and pathological circumstances like changes in soft and bone tissue.[2]

There are several studies in the literature examining neurovascular structures in the Turkish population.[7-11] There is no study in the literature that examines all mandibular neurovascular structures together in the Turkish population. In this study, it was aimed to evaluate the frequency of all mandibular neurovascular anatomical variations in the mandible in the Turkish subpopulation with CBCT.

MATERIALS AND METHODS

Ethical approval was obtained by the clinical research ethics committee of Harran University with the decision numbered 22.22.18. As the associated study is a retrospective study with institutional approval the consent form is not required by committee. Images were obtained using the Castellini X-Radius Trio Plus (imola, ITALY) (90 kVp, 16 mAs). IRYS 15.1 software package program was used in the multiplanar reconstruction of the images. CBCT images were selected from archive of Dentomaxillofacial Radiology Department according to the screening criteria of the study and retrospectively evaluated.

Inclusion criteria;

- 13x10 cm, 13x16 cm field of view (FOV), voxel size of 0.3 mm and a slice thickness of 1 mm CBCT images in which the mandible is observed in the imaging region,

- Individuals aged 17-90,

- Images in which there are no radiopaque objects such as implants or mini plates in the mandible that would affect the image quality,

- Distortion, magnification, foreign body, etc. in the examination region absence of images.

Exclusion criteria;

- Presence of metabolic disease involving the bone (osteopetrosis, Paget, etc.),

- Facial growth disorder

- Presence of cyst and tumor in the mandible,

- Patients with fractures in the mandible because of trauma were not included in the study.

410 CBCT images were examined in multiplanar projections for age and gender. 20% of patients were re-examined to analysis intra-observer agreement. The images were evaluated by a dentomaxillofacial radiologist (M.E.D) with 5 years of experience on a 15-inch screen resolution 1920 x 1080 Lenovo monitor. Neurovascular variations in the mandible were divided into three region and examined.

1. Anterior inter-foraminal region

Median lingual foramen and lateral lingual foramen

The lingual foramen was divided into two according to its location as median and lateral lingual foramen. Since the lingual foramen is best seen in the axial section, it was examined in the axial section and those in the midline were accepted as median lingual foramen.[12] Those seen more laterally than the midline were accepted as lateral lingual foramen (Figure 1A, 1B, 1C, 1D).

Figure 1. Median lingual foramen shown in CBCT axial section by arrow in A, sagittal view in B, lateral lingual foramen shown in CBCT axial section by arrow in C, sagittal view in D.
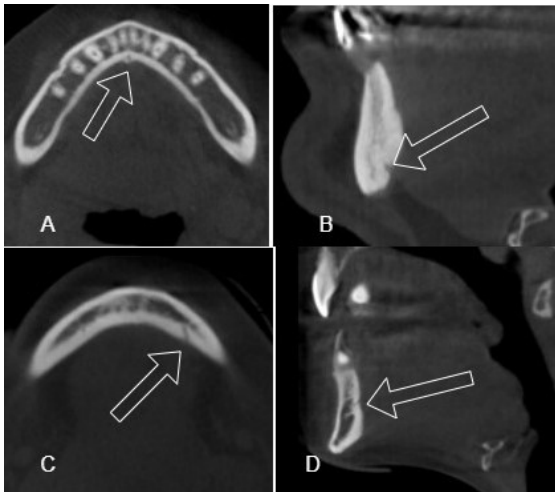
Mandibular incisive canal

When the inferior alveolar canal continues from the mental foramen (MF) to the anterior, it is considered as the mandibular incisive canal (MIC). MICs are defined as an accessory canal with a cortical structure that extends anteriorly from the mental foramen and provides nerve and blood supply to the incisors.[13] (Figure 2).

Anterior loop

A variation, referred to as the anterior loop (AL), is described as an average of 0.5–5 mm, nearly 1 mm in length, when the mental nerve passes under the MF and proceeds to the midline, then forms an upward arc and returns to the MF [14, 15](Figure 2). AL was examined in the foraminal region and evaluated on sagittal and panoramic reformat images.

2. Foraminal egion

Accessory mental foramen

Anatomical diversity of MF can appear in a particular number of conditions, in the form of variations in the form, dimension, location, and count of apertures. In some events, there is one or several extra apertures called the accessory mental foramen (AMF).[2] (Figure 2B).

Figure 2. Mental foramen shown in CBCT sagittal section with thin arrow in A, mandibular incisive canal continuing anteriorly from mental foremen shown with thick arrow. The short arrow shows the mental foramen and the long arrow shows the accessory mental foramen in the axial CBCT image in B. It is clearly visible in the 3D model.
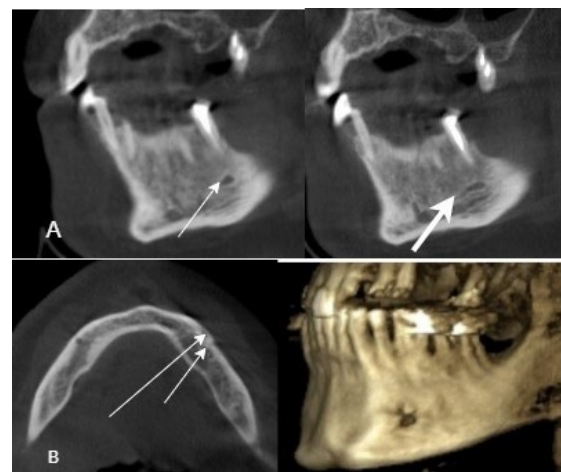
3. Posterior mandibular region

Bifid mandibular canal

Bifid mandibular canal (BMC) is defined as the presence of two separate inferior alveolar

canals in the mandibular body.[16] (Figure 3).

Figure 3. Arrowheads in A indicate the anterior loop, thick and thin arrows in B indicate the bifid mandibular canal in CBCT panoramic reformatted images.
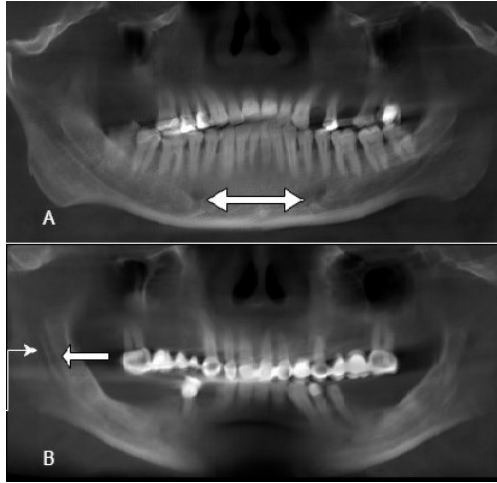
Retromolar foramen

Contains one or more foramen called retromolar foramen in the retromolar fossa between the anterior border of the ramus of the mandible and the temporal crest. Retromolar foramen (RMF) are accessory branches in the retromolar region, which are generally continuous with the inferior alveolar canal. [17] (Figure 4).

Figure 4. The thick arrow in the sagittal CBCT image and the thin arrow in the axial image indicate the retromolar foramen.
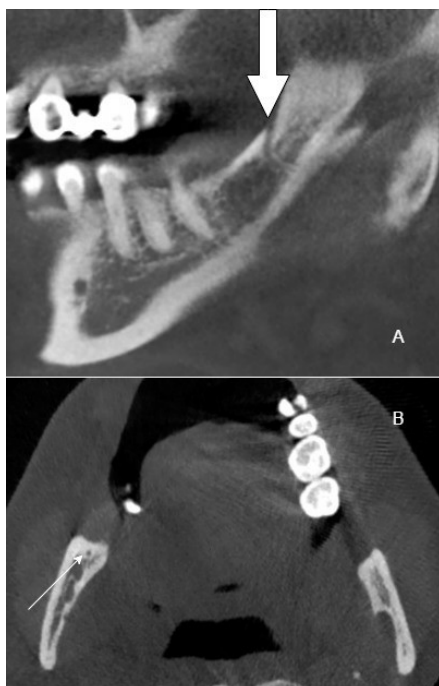
All parameters were examined in multiplanar sections in case they were overlooked.

G power 3.1 was used for power analysis. When $\alpha = 0.05$ and $1-\beta = 0.95$ were accepted, the sample size was found to be 220. IBM SPSS Statistics 25 (Armonk, NY, USA) package program was used in the statistical analysis of the obtained data. Descriptive statistics were used to calculate values such as numbers and percentages. Kolmogorov Smirnov test were used to control the normal distribution of the data. Kappa test was used for intra-observer agreement. The relation between categorical factors was analysed with the Pearson chi-square test. The Mann Whitney U test was used to analyse the relationship between the data by the mean age. Importance grade was admitted as $p < 0.05$.

RESULTS

According to the data obtained from this study, images of 233 (56.8%) men and 177 (43.2%) women with a mean age of 44.25 ± 17.47 were evaluated. In this study, the minimum age was 17 and the maximum age was 90. Age was categorized in 6 groups: 17-25, 26-35, 36-45, 46-55, 56-65, 65>. Intraobserver agreement was found to be good (0.93). The most common anatomical variation in all cases was the median lingual foramen with 44.7%. And secondly, the presence of mandibular incisive canal was found with a rate of 33.9%. The existence of the median lingual foramen was found to be 25.6% in men and 19.1% in women. The least common was the absence of the mental foramen with 0.2%. The distribution of the data by gender is shown in Table 1. When the parameters according to gender were examined, no statistically important distinction was found (p > 0.05). When the data were compared in accordance with age groups; a statistically significant difference was detected only in the lateral lingual foramen and mandibular incisive canal (p <0.05). The presence of lateral lingual foramen was

observed to be significantly higher in the 36-45 age group than in the 56-65 age group. The presence of mandibular incisive canal in the 46-55 age group was found higher and more significant than its presence in the 17-25 age group. The distribution of parameters according to age groups is given in Table 2.

Table 1: Distribution of mandibular anatomical variations

Anatomic Variation	Gender	Status	Percent	P value
Median lingual foramen	Male	Absence	128 (31.2%)	0.841
		Presence	105 (25.6%)	
	Female	Absence	99 (24.1%)	
		Presence	78 (19.1%)	
	Total	Absence	227 (55.3%)	
		Presence	183 (44.7%)	
Lateral lingual foramen	Male	Absence	211 (51.5%)	0.234
		Presence	22 (5.3%)	
	Female	Absence	166 (40.5%)	
		Presence	11 (2.7%)	
	Total	Absence	377 (92%)	
		Presence	33 (8.0%)	
Mandibular incisive canal	Male	Absence	159 (38.8%)	0.293
		Presence	74 (18.0%)	
	Female	Absence	112 (27.3%)	
		Presence	65 (15.9%)	
	Total	Absence	271 (66.1%)	
		Presence	139 (33.9%)	
Anterior loop	Male	Absence	193 (47.0%)	0.337
		Presence	40 (9.8%)	
	Female	Absence	140 (34.2%)	
		Presence	37 (9.0%)	
	Total	Absence	333 (81.2%)	
		Presence	77 (18.8%)	
Accessory mental foramen	Male	Absence	221 (53.9%)	0.134
		Presence	12 (2.9%)	
	Female	Absence	173 (42.2%)	
		Presence	4 (1.0%)	
	Total	Absence	394 (96.1%)	
		Presence	16 (3.9%)	
Retromolar foramen	Male	Absence	229 (55.8%)	0.165
		Presence	4 (1.0%)	
	Female	Absence	170 (41.5%)	
		Presence	7 (1.7%)	
	Total	Absence	399 (97.3%)	
		Presence	11 (2.7%)	
Bifid mandibular canal	Male	Absence	223 (54.4%)	0.262
		Presence	10 (2.4%)	
	Female	Absence	173 (42.2%)	
		Presence	4 (1.0%)	
	Total	Absence	396 (96.6%)	
		Presence	14 (3.4%)	
Absence of mental foramen	Male	Absence	232 (56.6%)	0.383
		Presence	1(0.2%)	
	Female	Absence	177 (43.2%)	
		Presence	0 (0.0%)	
	Total	Absence	409 (99.8%)	
		Presence	1 (0.2%)	

Table 2. Distribution of mandibular anatomical neurovascular variations

		Age groups						
		Ages 17-25	Ages 26-35	Ages 36-45	Ages 46-55	Ages 56-65	Ages 65>	P
Median lingual foramen	presence	30 (7.3%)	16 (3.9%)	33 (8%)	48 (11.7%)	32 (7.8%)	24 (5.9%)	0.067
	absence	55 (13.4%)	25 (6.1%)	38 (9.3%)	39 (9.5%)	50 (12.2%)	20 (4.9%)	
Lateral lingual foramen	presence	10 (2.4%)	4 (1%)	11 (2.7%)	3 (0.7%)	2 (0.5%)	3 (0.7%)	0.022*
	absence	75 (18.3%)	37 (9%)	60 (14.6%)	84 (20.5%)	80 (19.5%)	41 (10%)	
Mandibular incisive canal	presence	17 (4.1%)	16 (3.9%)	25 (6.1%)	42 (10.2%)	30 (7.3%)	9 (2.2%)	0.001*
	absence	68 (16.6%)	25 (6.1%)	46 (11.2%)	45 (11%)	52 (12.7%)	35 (8.5%)	
Anterior loop	presence	16 (3.9%)	11 (2.7%)	14 (3.4%)	18 (4.4%)	14 (3.4%)	4 (1%)	0.434
	absence	69 (16.8%)	30 (7.3%)	57 (13.9%)	69 (16.8%)	68 (16.6%)	40 (9.8%)	
Accessory mental foramen	presence	5 (1.2%)	0 (0%)	1 (0.2%)	3 (0.7%)	6 (1.5%)	1 (0.2%)	0.249
	absence	80 (19.5%)	41 (10%)	70 (17.1%)	84 (20.5%)	76 (18.5%)	43 (10.5%)	
Retromolar foramen	presence	2 (0.5%)	1 (0.2%)	0 (0%)	3 (0.7%)	5 (1.2%)	0 (0%)	0.215
	absence	83 (20.2%)	40 (9.8%)	71 (17.3%)	84 (20.5%)	77 (18.8%)	44 (10.7%)	
Bifid mandibular canal	presence	1 (0.2%)	2 (0.5%)	4 (1%)	3 (0.7%)	3 (0.7%)	1 (0.2%)	0.730
	absence	84 (20.5%)	39 (9.5%)	67 (16.3%)	84 (20.5%)	79 (19.3%)	43 (10.5%)	

*: p< 0.05

DISCUSSION

The mandibular anterior region is noted a safe zone for various invasive and non-invasive operations. This region is among the generally preferred donor sites for implant surgery and genioplasty. However, a detailed examination of the anatomic neurovascular variations is required to consider this region as a safe region. Damage to the vascular nerve packages carried by the lingual canals during surgical procedures may reason complications such as hemorrhage, hematoma and paraesthesia in the relevant region. The sublingual artery branches, which form extensive anastomoses at the floor of the mouth, were not examined in detail during surgical operations, resulting in a few complications from the operation.[18] It has been reported that a severe hematoma that occurs after an hour causes obstruction of the upper respiratory tract. The anatomy of the neurovascular variations should be analysed in detail to prevent bleeding, which is a complication that may occur after dental implantation.[19]

For more accurate detection and diagnosis of anatomical variations, technological advances and the development of diagnostic imaging methods have contributed significantly. Studies have reported that CBCT also reveals canals branching from the buccal and lingual surfaces, which cannot be detected in 2-dimensional images compared to panoramic radiographs.[16] When the techniques used in these studies are evaluated, it is accepted that anatomical macroscopic examinations and CT/CBCT studies reflect the measurements more accurately than conventional imaging techniques such as panoramic and periapical.[20]

In the literature, lingual foramina are classified differently according to their location. Studies have been conducted to divide the mandibular lingual canals into two basic groups

as median lingual canals (MLC) and lateral lingual canals (LLC).[8,12] According to the classification we used in this study, all lingual canals in the midline were classified as MLC, and all other lingual canals that were not in the midline were classified as LLC. There are also studies that classify MLCs as lingual canals located in and around the midline, and LLCs as lingual canals located in the premolar and molar region.[21, 22]

Taschieri et al.[23] in their study by examining CBCT images of 300 Caucasian Italian patients, they reported that the lingual foramen was mostly detected in the midline region (65.7%), followed by the lateral lingual foramen (37.3%). Rai et al.[24] In a study conducted in 250 Indian population, the frequency of MLC was reported to be 81.7%. Wang et al.[25] found that the rate of MLC was 97% in their study in which they examined 101 cases. In our study, 410 cases were examined and the prevalence of MLC was 44.7%, and the prevalence of LLC was 8.0%. We think that the reason for these differences between the results is the ethnicity differences.

Borghesi et al.[13] in a study conducted with 110 Caucasian (Italian) patients, the MIC rate was found 82.3%. In a study in the North-Brazilian population, the MIC was found to over 76%.[26] In this CBCT-based study conducted in the Turkish population, this rate was found to be 66.1%.

Any damage that may occur in the MIC, which is located in the interforaminal region and makes innervation to the anterior teeth and surrounding tissues, may cause permanent or temporary paraesthesia, severe hemorrhage in the floor of the mouth, and implant failure by preventing osteointegration.[13]

In CBCT-based studies, the prevalence of AL was reported as high as 56% [27] and 93.57%.[28] Sahman et al.[29] examined 494 CBCT images in the Turkish population, and AL was observed in 141 cases (28.5%). AL was observed in 77 (18.8%) of 410 CBCT images evaluated in current study. In this study, the prevalence of AL no statistically significant difference was observed according to gender. In studies conducted, the prevalence of AL was generally found to be higher in men than in women, but no significant difference was reported in the statistical evaluation in any of them.[30]

As a result of the studies in the literature, the number of data used in the studies and the different methods used in the studies can be shown as the reason for the prevalence of AL to be followed in such a wide range.

In the literature on AMF, there are studies that make anatomical examinations on different ethnic groups.[7,31] Noruzi et al.[31] found the prevalence of AMF to be 5.6% in an Iranian Population. In a study conducted on dry mandibles, AMF was detected at a rate of 8.51%.[32] In their CBCT-based study in the Turkish population, Kalender et al.[7] found the prevalence of AMF to be 6.5%, and Sisman et al.[33] found it to be 2%. In this CBCT study, the prevalence of AMF was determined as 3.9%. The results of this study are similar to other studies in the literature.

In previous studies using CBCT, the incidence of RMF was found to be between 8.5% and 75.4%.[6,33] de Gringo et al.[34] found in their study in the CBCT, the rate of RMF was 24.5%, while Han and Hwang [35] reported this rate as 8.5% in their study in the Korean population. In this study, in which we evaluated the Turkish population, the frequency of RMF was found to be 2.7%, lower than other studies. We think that the variation in the frequency of RMF between studies is due to the investigation of different populations and the use of diverse imaging methods. Consistent with many studies in the literature, it was found that there was no statistically significant difference between RMF and gender in this study.[35-37]

In previous studies, the prevalence of BMC has been found in various populations at proportions ranging from 10.2% to 65%.[28,33] Studies examining the Turkish population have reported the frequency of BMC in the range of 26.7%-46.5%.[33] In this study evaluating the Turkish population with CBCT, the prevalence of BMC was found to be 3.4%. The reason why the results of current study differ from similar studies in the literature may be due to the different classifications used. Because accessory branches separated from the mandibular canal with sharp and distinct boundaries were considered as bifid mandibular canal.

Rai et al.[24] classified the lingual foramen and examined them according to age groups and found a significant difference. Demiralp et al.[38] dry skull study < 35 years group showed lingual foramen significant higher measurements than the other age groups.

In a study with 100 cbcts, no significant difference in mandibular incisive canal was detected according to age group.[39]

Ayesha et al.[19] In a study divided into 4 age groups, were not detect a significant difference between the mandibular incisive canal and age groups. Consistent with this study, Barbosa et al. found a significant difference between age groups and reported that it was most observed between the ages of 51-60.[40]

The limitations of our study are that since it is a retrospective study, the systemic and genetic disease status of the patients and the medications they use are not known and cannot be evaluated whether there are sensory differences due to neurovascular variations.

CONCLUSION

Although the anterior interforaminal region is known as a safe region for surgery, the results of this study show that the presence of lingual foramina and mandibular incisive canal

is not at a level that can be ignored. Therefore, detailed analysis of the region with CBCT before planned surgical procedures in the mandible can significantly prevent possible complications.

Ethical Approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Harran University (Date: 14.11.2022 /No: 2022/22/18).

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Conflict of Interest

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

Author Contributions

Design: MED, SK. Data collection or data entry: MED. Analysis and interpretation: SK Literature search: MED. Writing: MED, SK.

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Investigation of Readability and Quality Levels of Online Patient Information Texts Related to Jaw Cysts

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Article Info	ABSTRACT
Article History 	**Aim:** The internet is frequently utilized as a resource for accessing health-related information, contributing significantly to health literacy. With the proliferation of internet usage, it has become evident that the majority of hospitals maintain websites, which serve as platforms for disseminating information to individuals regarding healthcare professionals, medical conditions, and treatment options. This study aims to assess the readability and quality of patient information texts about jaw cysts available on the internet. **Materials and Methods:** In May 2023, patient information texts relating to "jaw cysts" from 62 out of the initial 120 websites retrieved through the Google search engine (Google LLC, Mountain View, California, USA) were assessed for readability and quality. Readability levels of the texts were determined using the "ARI(ARI)", while the quality assessment was conducted utilizing the DISCERN scale. Statistical analysis was performed using SPSS 23 (SPSS Inc., Chicago, IL, USA). **Results:** According to the ARI, 50% (31 websites) of the patient information texts available on the internet were assessed at the 11-12 grade level, with 85.5% (53 websites) categorized as of medium difficulty. Additionally, based on the DISCERN scale assessment, 46.7% (29 websites) of the texts were rated as poor in quality. **Conclusion:** In the creation of patient information texts concerning jaw cysts on the internet, it is imperative to take into account our society's health literacy levels. There is a pressing need for the development of higher quality and more readable texts to effectively disseminate information to the public.

Çene Kistleri ile İlgili Çevrim İçi Hasta Bilgilendirme Metinlerinin Okunabilirlik ve Kalite Düzeylerinin Araştırılması

Makale Bilgisi	ÖZET
Makale Geçmişi 	**Amaç:** İnternet, sağlık okuryazarlığında bilgiye ulaşmak için sıklıkla başvurulan kaynaklardan biridir. İnternet kullanımının artmasıyla birlikte çoğu hastanenin web sitesine sahip olduğu ve bu web sitelerinin bireylere doktorlar, hastalıklar ve tedavi seçenekleri hakkında bilgi verdiği görülmektedir. Bu çalışmadaki amaç, internet ortamında yer alan çene kistleri ile ilgili hasta bilgilendirme metinlerinin okunabilirliğini ve kalite düzeylerini araştırmaktır. **Materyal ve Metod:** "Çene kistleri" terimi kullanılarak, Google (Google LLC, Mountain View, California, USA) arama motoru üzerinden çıkan ilk 120 web sitesinden 62'sideki hasta bilgilendirme metinleri okunabilirlik ve kalite açısından Mayıs 2023'te değerlendirildi. Metinlerin okunabilirlik düzeylerini hesaplamak amacıyla "Ateşman Okunabilirlik İndeksi" kullanılırken, kalite değerlendirmesinde ise DISCERN ölçeğinden yararlanıldı. İstatistiksel değerlendirme için SPSS 23 (SPSS Inc., Chicago, IL, ABD) programı kullanıldı. **Bulgular:** Ateşman Okunabilirlik indeksine göre internet ortamında bulunan hasta bilgilendirme metinlerinin %50'sinin (31 web sitesi) 11-12 sınıf düzeyinde ve %85,5'in (53 web sitesi) orta zorlukta olduğu ve DISCERN ölçeğine göre metinlerin %46,7'sinin (29 web sitesi) zayıf ölçekte olduğu görüldü. **Sonuç:** Çene kistleri ile ilgili internet ortamında yer alan hasta bilgilendirme metinleri hazırlanırken toplumumuzun sağlık okuryazarlığı dikkate alınıp daha kaliteli ve okunabilir metinler oluşturulmalıdır.

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INTRODUCTION

Health literacy encompasses an individual's capacity to access, comprehend, and apply patient education materials and information in making informed health-related decisions.[1] Individuals grappling with health issues often resort to the Internet to seek information concerning disease diagnosis, treatment modalities, and associated outcomes.[2,3]

In recent years, the internet has emerged as a crucial source of health-related information. Patients utilize online resources to access medical information, alleviate concerns and anxieties, and optimize time efficiency through internet-based patient education materials.[4] Consequently, the readability levels of websites containing health-related content hold significant importance.[5] Readability, a concept assessing the comprehensibility of text based on its writing style, plays a pivotal role in evaluating text readability levels.[6] Readability in a given language can be quantified using formulas specifically designed for that language. In the Turkish context, two readability formulas have been developed by Ateşman and Bezirci-Yılmaz, respectively.[7,8]

In addition to text readability, the accuracy and informativeness of content hold paramount importance. The capacity of individuals to make informed and reliable decisions regarding health matters is directly correlated with the accuracy of the information they access.[9] Given that the quality of text on websites is not consistently regulated, there exists a risk of encountering inaccuracies. Consequently, information obtained online may lead to misinformation and potentially detrimental effects on health-related decision-making.[10,11] To address this issue, systematic and scientifically grounded scales such as DISCERN and JAMA have been developed to evaluate the quality of texts.[12,13]

Jaw cysts represent one of the most prevalent lesions affecting the maxillofacial region, impacting the jaws, and are categorized into two main groups: odontogenic and non-odontogenic cysts, depending on the epithelium from which they originate. These cysts typically contain semi-liquid or liquid contents, partially or completely enclosed by the epithelial lining.[14,15] Clinically, they often manifest as painless growths, progressing slowly without apparent symptoms, potentially leading to asymmetry and facial deformities. Pain may arise in cases of cyst infection.[16] Radiographically, jaw cysts typically exhibit a radiolucent appearance with smooth and well-defined margins, typically presenting as round lesions in the maxilla and oval lesions in the mandible, often accompanied by a radiopaque border surrounding the radiolucent area.[17] Treatment modalities for these cysts include enucleation, decompression or marsupialization, combined methods, and curettage following enucleation.[14,18]

In the literature search conducted, no prior study examining the readability and quality levels of patient information texts available on the internet concerning jaw cysts was identified. Hence, this study represents the first attempt to investigate this aspect.

MATERIALS AND METHODS

In this study, conducted in May 2023, we evaluated texts from the first 120 websites obtained through the Google (Google LLC, Mountain View, California, USA) search engine using the Turkish keyword "jaw cysts" to assess their readability and quality levels. The selection of the top 120 websites was consistent with previous research methodologies (19,20). Exclusion criteria encompassed commercial websites primarily featuring videos and images, forum and chat platforms, websites providing less than 15 sentences of information,

subscription-based websites, platforms prohibiting data copying, and academic articles. Consequently, 58 websites were excluded, leaving 62 websites for evaluation. A readability analysis of the texts was performed using the ARI, while content quality assessment was conducted utilizing the DISCERN scale.

ARI

The ARI, developed by Ateşman in 1997, is based on the Flesch Ease of Reading formula.[7] The formula used to calculate the readability score is as follows:

Readability score=198.825-40.175xword length (total syllables / total words)-2.610xsentence length (total words / total sentences).

According to this formula, the readability of the text is categorized as follows:

"Very easy" if the score falls within the range of 90-100,

"Easy" if the score falls within the range of 70-89,

"Moderate difficulty" if the score falls within the range of 50-69,

"Difficult" if the score falls within the range of 30-49,

"Very difficult" if the score falls within the range of 1-29.[7]

DISCERN Scale

The DISCERN scale represents the first standardized measurement tool designed to evaluate the quality of written information texts about any health issue available on the internet. This scale comprises three sections, each consisting of 16 questions rated on a scale of 1-5. The first section comprises eight questions focusing on the reliability and sourcing of information contained within the texts, the second section comprises seven questions centering on treatment options, and the third section includes a single question assessing the

overall quality of the text.[13]

Consequently, the DISCERN score ranges from 16 to 80. Based on the score outcomes, ratings are categorized as follows: 63-80 as "excellent", 51-62 as "good", 39-50 as "medium", 28-38 as "poor", and 16-27 as "very poor".[13]

During the quality assessment process, an independent evaluation was conducted by a professor specializing in oral and maxillofacial surgery along with a research assistant in the same field. Each evaluator scored the responses to the questions independently. The scores provided by both evaluators were then anonymously submitted to the statistical unit.

STATISTICAL ANALYSIS

Statistical analysis was performed using the SPSS 23 software package (SPSS Inc., Chicago, IL, USA). Descriptive statistics including minimum, maximum, mean, and standard deviation values were computed for the data obtained from the readability analysis. The Kolmogorov-Smirnov test was utilized to assess the normality distribution of the data.

In the evaluation of texts quality, the scores assigned by the researchers were averaged, and subsequent statistical analysis involved calculating the Pearson correlation coefficient.

RESULTS

The study comprised 62 websites, of which 39 (63%) were private dental clinics, 18 (29%) were private oral and dental polyclinics, and 5 (8%) were private medical hospitals. Table 1 presents the minimum, maximum, mean, and standard deviation statistical values of online patient information texts regarding jaw cysts. The distribution of readability difficulty levels of the texts is illustrated in Figure 1. Furthermore, the alignment of the texts with various readability levels was distributed as follows: 8th grade (4, 6.5%), 9-10th grade (23, 37.1%), 11-12th grade (31,

50%), 13-14th grade (3, 4.8%), and undergraduate graduate (1, 1.6%).

Table 1: Statistical values of the data

	N	Minimum	Maximum	Mean	Std. Deviation
Number of words	62	166.00	1356.00	456.483	284.849
Number of characters	62	312.00	10708.00	3483.903	2224.447
Difficult Number of words	62	166.00	1347.00	453.854	282.951
Number of Unique Words	62	22.00	734.00	284.274	144.492
Number of Short Words	62	23.00	244.00	75.306	54.565
Characters without spaces	62	1042.00	9317.00	3071.354	1896.608
Number of sentences	62	17.00	134.00	43.225	30.450
Number of paragraphs	62	5.00	68.00	19.161	13.882
The average word in length	62	2.52	3.05	2.747	0.110
The average sentence length	62	7.80	19.30	11.161	2.154
Ateşman Readability Index	62	36	73.8	59.298	50.953
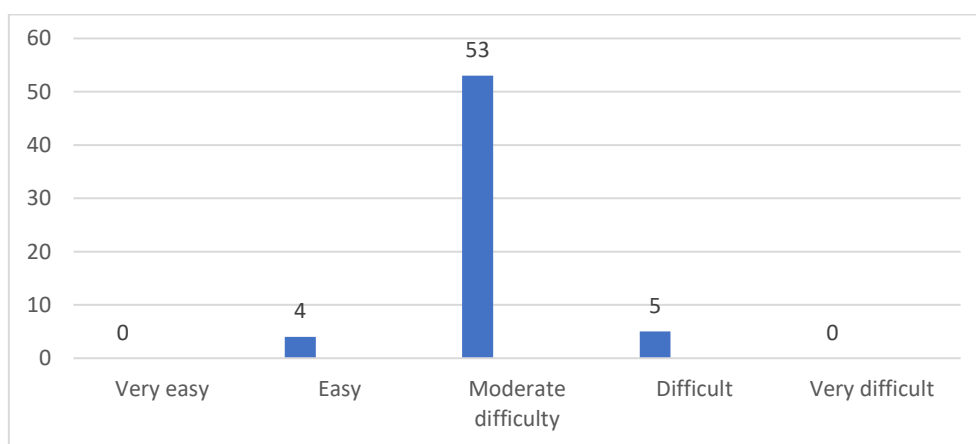
Figure 1: According to the readability scoring of the data, it was observed that patient information texts predominantly fell within the category of medium difficulty, accounting for 85.5% of the texts.

The Kolmogorov-Smirnov test was employed to assess the normality distribution of various parameters including the number of words, number of characters, number of difficult words, number of unique words, number of short words, number of characters without spaces, number of sentences, number of paragraphs, average sentence length, and ARI.

The data distribution for the ARI exhibited conformity to the normal distribution, as indicated by a p-value of 0.200, which is greater than the significance level of 0.050. However, the data distribution of the other parameters did not demonstrate normality, as evidenced by the normality test results presented in Table 2.

Table 3 shows the average scores given by two different authors for the quality assessment questions regarding the texts across the websites analyzed in the study. The DISCERN score obtained from the average scores given by the authors is determined to be 36.09. According to the distribution of DISCERN scores, 29 websites (46.7%) were categorized as poor, 22 (35.4%) as medium, 6 (9.6%) as very poor, and 5 (8.3%) as good, with

none of the websites being evaluated as excellent.

Table 2: Normality test results of the data

	Statistics	p-value
Number of Words	0.237	0.000
Number of Characters	0.230	0.000
Number of Difficult Words	0.239	0.000
Unique Word Count	0.203	0.000
Number of Short Words	0.245	0.000
Characters without spaces	0.228	0.000
Number of Sentences	0.220	0.000
Number of Paragraphs	0.182	0.000
Average Sentence Length	0.125	0.017
Ateşman Readability Index	0.072	0.200

Table 3: Based on the analysis conducted between the ratings of the two authors, since the p-value = 0.693 > 0.050, no significant difference was found. Furthermore, in the consistency analysis between the two authors, the consistency coefficient is 0.976 (p-value = 0.000 < 0.050), indicating a significant and quite high level of agreement.

	Author 1	Author 2	Mean	Statistics
1-) Are the objectives clearly stated?	3.51	3.25	3.38	
2-) Does it achieve its objectives?	3.27	3.1	3.19	
3-) Is the text relevant?	2.89	2.97	2.93	
4-) Does it indicate which sources are referenced?	1.05	1.05	1.05	
5-) Is it specified when the information in the text was written?	1.49	1.47	1.48	
6-) Is the information balanced and unbiased?	2.44	2.13	2.29	Test value = 0.398
7-) Does it share details of additional support and sources of information?	1.2	1.12	1.16	
8-) Does it address situations of uncertainty?	2.05	2.29	2.17	
9-) Is it explained how each of the treatment methods will be carried out?	2.34	2.13	2.24	p-value = 0.693
10-) Are the benefits of each treatment described?	2.42	2.16	2.29	
11-) Are the potential risks of each treatment mentioned?	1.76	1.63	1.7	
12-) Is information given about what will happen if no treatment is provided?	2.6	2.52	2.56	
13-) Is the impact of treatment methods on quality of life explained?	2.21	2.07	2.14	
14-) Does the information indicate that there can be more than one treatment choice?	2.81	2.92	2.87	
15-) Does the shared information offer assistance for decision-making?	2.37	2.21	2.29	
16-) Assessment of the overall quality of the text.	2.41	2.29	2.35	
The DISCERN score	36.88	35.31	36.09	

DISCUSSION

Health literacy is an evolving concept that intersects health and literacy, aiming to empower individuals with the skills and knowledge necessary to navigate health-related information effectively. Our literacy levels not only directly impact our capacity to comprehend and act upon health information but also influence our ability to assert greater control over our health outcomes.[19,20] Therefore, initiatives aimed at enhancing general literacy are poised to positively impact health literacy as well.

The proliferation of internet usage, commonly employed as the primary avenue for accessing health-related information, has resulted in the widespread adoption of websites by the majority of hospitals. These websites function as platforms for disseminating information to individuals concerning

healthcare providers, medical conditions, and treatment options. Furthermore, numerous other websites dedicated to providing health information exist, adding to the complexity of accessing accurate information for patients.[4,21] Notably, all websites examined in the study were found to belong to private institutions, typically with some degree of promotional content regarding treatment methods. Similar studies in the field of dentistry have also observed a predominance of websites affiliated with private institutions [22-24] This underscores a notable deficiency, as institutions such as university hospitals and state hospitals often lack patient information texts on their websites. It is imperative to address this gap by incorporating informative texts about conditions like jaw cysts on the websites of non-commercial entities, enabling patients to access valuable information.

Health professional organizations in the United States recommend preparing patient education materials at an appropriate reading level, ideally targeting 6th grade or below.[25,26] However, according to the 2022 Human Development Report by the United Nations Development Program, the average education period in Turkey is 8.7 years.[27] In this study, it was observed that based on the ARI, 50% (31 websites) of patient information texts were at the 11-12 grade level, with 85.5% (53 websites) falling into the medium difficulty category. Similar findings have been reported in other studies on readability.[22,23,28] These readability levels surpass the health literacy levels of individuals in our country. Therefore, efforts to enhance health literacy in Turkey need to be intensified.

Health-related patient information texts on the internet must align with the literacy level of individuals to ensure comprehensibility.[29] Lengthy words and sentences can hinder the creation of meaning, thereby decreasing text comprehensibility.[30] According to Ateşman, the average word length in Turkish is 2.6 syllables,

and the average sentence length is 9-10 words.[7] However, the average word length (2.747) and average sentence length (11.161) of the texts analyzed in this study exceed these averages. By reducing these parameters, texts that are easier to read and understand can be created.

Another critical criterion for evaluating online health information is the quality assessment of the presented text. DISCERN is a widely used scale for assessing content quality, particularly in the context of treatment decision-making.[13] This scale assigns grades to websites based on various quality criteria, offering a quantitative assessment of publications related to health services.[31,32] In this study, it was observed that 46.7% (29 websites) of the patient information texts analyzed using DISCERN fell into the poor category. Specifically, these texts generally lacked specified reference sources (mean score: 1.05), failed to provide additional support and information sources (mean score: 1.12), and did not include publication dates (mean score: 1.48). Patients reading these poorly rated texts, which lack specified references and publication dates, may experience confusion and develop distrust toward healthcare providers.

With this study, it is anticipated that various interventions can be implemented to improve the readability and quality of patient information texts available on the Internet, ultimately benefiting both physicians and patients. However, the study does have several limitations. These include the fact that the data search was conducted within a specific timeframe, a single search engine was utilized, only the term "jaw cysts" was used as a keyword, and websites from a single country's data network were considered.

CONCLUSION

Patient information texts concerning jaw cysts on the internet should be meticulously crafted, drawing upon current and accurate sources of information. Additionally, the readability level of these texts should be tailored

to match the literacy level prevalent in our society. By adhering to these principles, it becomes possible to create high-quality texts that effectively fulfill their intended purpose. Ultimately, this approach can help reduce confusion among patients, thereby fostering trust and strengthening patient-physician relationships.

Ethical Approval

Since sources obtained from humans or animals were not used in this study, ethics committee approval was not obtained.

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Conflict of Interest

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

Author Contributions

Design: UD, HK, Data collection and processing: UD, YA, Analysis and interpretation: UD, HK, YA, Literature review: UD, HK, Writing: UD,YA.

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Evaluation of the Pubertal Growth Spurt Times on Different Malocclusions: A Cross Sectional Study

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Article Info	ABSTRACT
	Aim: This study aims to compare and examine the relationship between pubertal growth spurt time and malocclusion types. **Methods:** Hand-wrist and lateral cephalometric radiographs of 1500 patients were examined. Among these records, 279 patients in the peak period of the pubertal growth spurt were included in the study. Skeletal malocclusion of the patients was determined with cephalometric analysis via ANB (°) angle. If the ANB angle was between 0° and 4°, it was recorded as skeletal Class I; if it was greater than 4°, it was recorded as Class II; and if it was less than 0°, it was recorded as Class III. Data were analyzed with one-way analysis of variance and Tukey post hoc tests. Kappa test was also performed to check intraobserver reliability. **Results:** Intraobserver reliability was found to be excellent. The mean age at the pubertal growth spurt was 12.08 ± 0.8 years in girls and 13.71 ± 1 years in boys. When the age of the pubertal growth spurt was examined according to malocclusion, a statistically significant difference was found between the mean ages of Class I, Class II and Class III. When pubertal growth spurt ages were compared between sexes, a statistically significant difference was found between girls and boys in all malocclusion types. **Conclusion:** Girls in all malocclusion groups started the pubertal growth spurt earlier than boys. Additionally, it was observed that girls with Class III malocclusion reached pubertal growth spurt earlier than other groups.

Maloklüzyon Tiplerine Göre Pubertal Büyüme Atılım Zamanlarının İncelenmesi: Kesitsel Bir Çalışma

Makale Bilgisi	ÖZET
	Amaç: Bu çalışmanın amacı pubertal büyüme atılımı zamanının maloklüzyon tipleri ile arasındaki ilişkinin karşılaştırılarak incelenmesidir. **Gereç ve Yöntemler:** 1500 hastanın el bilek ve lateral sefalometrik radyografileri incelendi. Bu kayıtlar arasından pubertal büyüme atılımının zirve döneminde bulunan 279 hasta çalışmaya dahil edildi. Sefalometrik analiz ile elde edilen ANB değerine göre iskeletsel maloklüzyon sınıflaması yapıldı. ANB (°) açısı, 0°- 4° arası ise iskeletsel Sınıf I, 4°'den büyük ise Sınıf II ve 0°'den küçük ise Sınıf III olarak kaydedildi. Elde edilen veriler tek yönlü varyans analizi ve Tukey post hoc testleri ile analiz edildi. Gözlemci içi güvenilirliğin kontrolü için de kappa testi yapıldı. **Bulgular:** Gözlemci içi güvenilirliğin mükemmel olduğu bulundu. Pubertal büyüme atılımının zirve zamanındaki ortalama yaş kızlarda $12,08 \pm 0,8$ yıl, erkeklerde $13,71 \pm 1$ yıl olarak ölçüldü. Maloklüzyona göre pubertal büyüme atılımı zamanı incelendiğinde yaş ortalaması Sınıf I, Sınıf II ve Sınıf III gruplar arasında istatistiksel olarak anlamlı fark bulundu. Cinsiyetler arasında pubertal büyüme atılım zamanları karşılaştırıldığında ise bütün maloklüzyon tiplerinde kızlar ve erkekler arasında istatistiksel olarak anlamlı fark bulundu. **Sonuç:** Tüm maloklüzyon gruplarındaki kızlarda, erkeklerden daha önce pubertal büyüme atılımının başladığı bulundu. Ayrıca Sınıf III maloklüzyona sahip kızların diğer gruplardaki kızlara ve erkeklere göre daha erken dönemde pubertal büyüme atılımına ulaştığı görüldü.

INTRODUCTION

In orthodontics, addressing various forms of malocclusion is a common and crucial aspect of treatment. One specific challenge is Class II malocclusion, which involves a discrepancy where the mandible is positioned further back than the maxilla. The treatment of Class II malocclusion characterized by mandibular retrognathia with functional appliances is an essential issue in current orthodontics. The use of growth modification to treat such skeletal anomalies encountered during routine orthodontic examination is a prevalent method today. This method aims to correct the existing malocclusion by directing the physiological bone growth during the patient's skeletal development. Likewise, with appliances, such as face masks used in treating Class III malocclusion, the growth of the maxilla can be increased, and the malocclusion can be treated by modifying the growth direction of the mandible.[1]

In this context, determining the age range of growth modification to be applied to the mandible is of clinical importance regarding treatment planning. To achieve the ideal bony response during the growth modification, the patient must be in optimal skeletal maturation.[2] Doctors need to understand how a child's growth works to predict if Class III malocclusion might relapse after treatment during early puberty. However, skeletal development varies among individuals, and the time of onset of pubertal growth spurt (PGS) is affected by factors, such as sex, society, and environment.[3]

Researchers have evaluated many different parameters to determine the growth potential of adolescents. Many methods, such as weight[4], height[5], sex characteristics[6], dental and skeletal development[7], have been used. Hand-wrist radiographs are also a reliable method frequently used for this purpose.[8-10] In this method, the patient's growth spurt is determined by comparing various indicators in the ossification stages of the carpal and phalanx bones.[11]

Researchers have noticed that there may be differences between the pubertal growth spurt times of individuals with different malocclusions.[12] However, to our knowledge, there is no comprehensive study on this subject in the literature.

This study evaluates the relationship between the PGS time obtained from hand-wrist and lateral cephalometric radiographs taken for diagnostic purposes from patients who applied to the orthodontic clinic and the individual's malocclusion type.

MATERIAL AND METHODS

Ethical approval was received for this study from the Bolu Abant izzet Baysal University Clinical Research Ethics Committee. The material of this retrospective study consisted of hand-wrist and lateral cephalometric radiographs taken routinely at the beginning of treatment from patients who accepted treatment between 2013 and 2022 at Bolu Abant izzet Baysal university, Department of Orthodontics. In our study, the records of 1500 patients were examined. Among these records, patients in the peak period of the PGS were included in the present study. Patients with systemic disease, trauma or injury to the face and wrist area, and congenital or acquired malformations in the hand-wrist area were not included in this study. We conducted this study in accordance with the Principles of the World Medical Association's Declaration of Helsinki.

The skeletal maturation stage of each hand-wrist radiograph was determined using the method described by Björk and Helm,[3] and those at the Mp3 Capping stage were considered peak. With this method, 279 patients (126 girls, 153 boys) were identified at the PGS's peak. The digital cephalometric analysis program

Nemoceph (Nemotec, Madrid, Spain) was used. Malocclusion classification was made according to the ANB value obtained by cephalometric analysis. If the ANB (˚) angle was between 0˚ and 4˚, it was recorded as skeletal Class I; if it was greater than 4˚, it was recorded as skeletal Class II; and if it was less than 0˚, it was recorded as skeletal Class III. In this process, the demographic characteristics of the patients were noted from the archive records and the relationship between age, sex, PGS time and the type of malocclusion was investigated.

Statistical Analysis

SPSS V. 26.0 (Statistical Package for the Social Sciences, IBM, NY, USA) statistical package program was used to analyze the data in this study. The data showed normal distribution with the Shapiro-Wilk test. One-way analysis of variance was applied to compare skeletal classes according to sex. Tukey post-hoc test was used to determine differences. An independent samples t-test was used to compare the sexes. The significance level was defined as 0.01 and 0.05. Descriptive statistics were obtained for mean ages by malocclusion type and sex. The hand-wrist maturation (HWM) classification of 30 randomly selected patients was repeated one month later by the same researcher to check

intraobserver reliability. Measurement error was evaluated using the Kappa test, and the results were interpreted using the Landis and Koch method.[13]

RESULTS

As a result of the analysis applied to evaluate the consistency between observations, the Kappa value for HWM S5 was statistically significantly higher (Kappa coefficient: 0.880 and p<0.001). According to the Landis and Koch [13] scale, weighted kappa coefficients show almost perfect agreement.

In girls, the mean age at the PGS was 12.08 ± 0.8 years (n = 126). The average age of PGS according to malocclusion was 12.27 ± 1.15 years in Class I malocclusion, 11.81 ± 0.99 years in Class II malocclusion, and 11.65 ± 0.90 years in Class III malocclusion, and this was statistically significant (p<0.05; Table-1). In post-hoc tests performed to evaluate the difference between groups, the average age of individuals with Class I malocclusion was significantly higher than that of individuals with Class II and III malocclusion. No difference was observed between Class II and Class III groups. Class III malocclusion was observed as the group that entered the earliest pubertal breakthrough.

Table 1. *Average age by sex and malocclusion type*

	Sex	N	Mean	Standard deviation	Minimum	Maximum	p*
Female	Class I	62	12.27	1.15	9.67	15.00	
	Class II	45	11.81	.99	9.92	14.50	
	Class III	19	11.65	.90	10.25	13.67	.026*
	Total	126	12.01	1.08	9.67	15.00	
Male	Class I	75	13.68	1.01	11.50	16.33	
	Class II	59	13.76	.97	11.17	16.33	
	Class III	19	13.67	1.12	11.67	15.42	.0897
	Total	153	13.71	1.00	11.17	16.33	

p<0.05*

Age values at the PGS were 13.71 ± 1 year in boys (n = 153). The average age according to malocclusion was 13.68 ± 1.01 years in Class I malocclusion, 13.76 ± 0.97 years in Class II malocclusion, and 13.67 ± 1.12 years in Class III malocclusion, but this was not statistically significant (p>0.05; Table-1). Post hoc tests were not performed because of the statistical insignificance.

When PGS times were compared between sexes, a statistically significant difference was found between girls and boys in all malocclusion types (p<0.01; Figure 1; Table 2). It was observed that the PGS time of the girls was earlier.

Table 2. Comparison of male and female groups according to malocclusion class

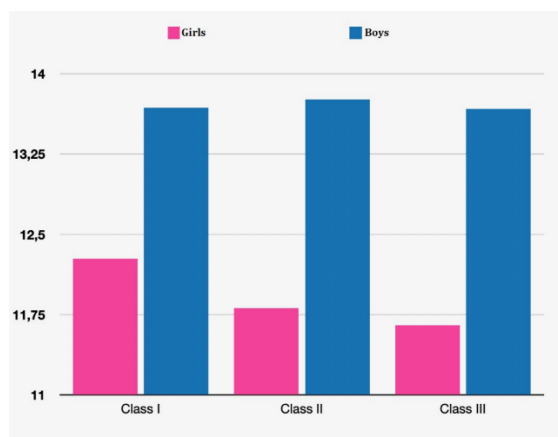|	
Class I	.000*
Class II	.000*
Class III	.000*

*p<0.01

Figure 1. Mean age of pubertal growth spurt of girls and boys in different malocclusions.

DISCUSSION

Knowing the PGS onset and completion times in patients receiving growth modification treatment is crucial in predicting the treatment results.[14] Few studies in the literature examine the PGS duration in different types of malocclusion.[12,15,16] However, to our knowledge, no study has been found comparing the onset time of PGS according to sex for all three types of malocclusion. This study aimed to shed light on this issue.

In their study comparing the PGS time of individuals with Class I and Class II malocclusion, Salazar-Lazo et al.[16] reported that the onset of the growth spurt was similar between both malocclusion types. However, since they did not evaluate the differences between the sexes in their study, their results do not coincide with ours. Our clinical experience is that girls begin the PGS earlier. The results obtained in our study showed that girls entered the PGS earlier than boys in all malocclusion types, and a significant difference was found.

Reyes et al.[15] reported that the PGS lasted longer in individuals with Class III malocclusion and the mandibular length increased more than Class I and Class II individuals. Our study observed that the boys with Class III malocclusion had a growth spurt time similar to other malocclusion types. A significantly earlier pubertal spurt time was detected in girls with Class III malocclusion compared to girls with Class I and Class II malocclusion. This should be kept in mind during the treatment and retention phases if Class III malocclusion treatment will be performed with growth modification.

Kuc-Michalska and Baccetti[12] compared the growth spurt periods of individuals with Class I and Class III malocclusion and reported that the onset of pubertal spurt was similar in both malocclusion types. Additionally, consistent with Reyes et al.,[15] they noted that the PGS lasted an average of 5 months longer in individuals with Class III malocclusion. Since this study also evaluated according to sex, our results differed from those mentioned studies. Although there is no difference in the time of PGS according to malocclusion types in boys, it has been found that in girls, the PGS of individuals with Class III and Class II malocclusion, respectively, starts earlier than individuals with Class I malocclusion.

Hand-wrist radiographs were used to determine the PGS period of the individuals included in our study. As an alternative, the cervical vertebra maturation method developed by Baccetti et al.[2] can also be used. However, some researchers reported that this method is less reliable than hand-wrist radiographs and has moderate repeatability.[17-20] Hand-wrist radiographs were used to determine pubertal growth, even though they required additional radiography examination.

Limitations of this study may include the need for more homogeneity between patients in the determined sample group and patients in different malocclusion groups. According to a meta-analysis published in 2023, 56% of the malocclusions seen in the Turkish population are Class I, 31% are Class II, and 11% are Class III malocclusions.[21] Our study's distribution of individuals according to malocclusion types is also close to the mentioned meta-analysis. Increasing the sample number of the Class III malocclusion group will improve the reliability of this research.

CONCLUSION

According to the results of this study, it was observed that the PGS started earlier in girls than in boys. Regardless of the appliance used, the patient's growth spurt must be active to achieve an orthopaedic effect through growth modification in treating female patients with Class II malocclusion. Therefore, attention should be paid to the timing of treatment in this patient group. It has been observed that the growth spurt in girls with Class III malocclusion begins earlier than in other groups. It should be considered in clinical practice that the growth of the mandible will accelerate with the growth spurt and that relapse may occur in previously completed Class III malocclusion treatment.

Ethical Approval

The ethical approval for this study was obtained from Bolu Abant Izzet Baysal University Clinical Research Ethics Committee.

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The Effect of Traditional Regional Beverages on the Color Stability of PMMA Denture Base Materials

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Article Info	ABSTRACT
	Aim: The color stability of PMMA-based denture base materials can be affected by personal habits, such as hygiene and beverage consumption. Color stability of denture bases is a crucial esthetic criterion for long-term success. In our study, the effect of three different local drinks consumed in the Thrace region on the color of base materials was measured. **Material and Methods:** In this study, samples produced from three different PMMA-based pink acrylics (Meliodent Rapid Repair, Imicryl IQ15, Duracryl Heat Cure) with the traditional muffle method were immersed in four different solutions (Distilled water (ontrol Group), Chasteberry juice, Plum Juice, Black Mulberry Juice) (n=10) was kept for 21 days. Color measurements were made with a spectrophotometer on days 0-7 and 21, and color change values (ΔE00) were calculated. One-way ANOVA and Tukey HSD multiple comparison test were used for statistical analysis of color changes (p=0.05). **Results:** The findings showed that on the seventh day, the coloration caused by plum juice in samples was significantly higher than that of distilled water (p=0.002). There was no difference in color change in other drinks, materials and times (p>0.05). It was observed that on the seventh and twenty-first days, the color change values in all beverages remained below the visual perceptible limit (ΔE00<1.72). **Conclusion:** PMMA-based base materials show color change as a result of interaction with beverages, and this change varies depending on the waiting time, acrylic brand and type. As a result, color changes between base materials and beverages were not clinically significant.

Geleneksel Yöresel İçeceklerin PMMA Protez Kaidelerinin Renk Stabilitesi Üzerindeki Etkisi

Makale Bilgisi	ÖZET
	Amaç: PMMA esaslı protez kaide materyallerinin renk stabilitesi hijyen alışkanlıkları ve içecek tüketimi gibi kişisel alışkanlıklar tarafından etkilenebilir. Protez kaidelerinin renk değişiminin etkilenmemesi uzun dönem başarı için önemli bir estetik kriterdir. Çalışmamızda Trakya bölgesinde tüketilen üç farklı yöresel içeceğin kaide materyallerinin rengi üzerindeki etkisi ölçülmüştür. **Gereç ve Yöntemler:** PMMA esaslı 3 farklı pembe kaide akriliğinden (Meliodent Rapid Repair, Imicryl IQ15, Duracryl Heat Cure) geleneksel mufla yöntemi ile üretilen örnekler 4 farklı solüsyonda (Distile su (Kontrol Grubu), Hayıt suyu , Erik Suyu, Karadut Suyu) (n=10) 21 gün bekletilmiştir. 0-7 ve 21. günlerde spektrofotometre ile renk ölçümü yapılmış ve renk değişim değerleri (ΔE00) hesaplanmıştır. Renk değişimlerinin istatistiksel analizleri için tek yönlü varyans analizi (one-way ANOVA) ve Tukey HSD çoklu karşılaştırma testi kullanılmıştır. (p=0,05). **Bulgular:** Imicryl ile hazırlanan örnekler yedinci günde erik suyunun sebep olduğu renklenme distile suya göre anlamlı derecede yüksektir (p=0,002). Diğer içecekler, materyaller ve sürelerde renk değişimi açısından fark görülmemiştir (p>0,05). Yedinci ve yirmi birinci günlerde tüm içeceklerde renk değişimi değerlerinin gözle algılanabilecek sınırın (ΔE00<1.72) altında kaldığı görülmüştür. **Sonuç:** Çalışmamızda PMMA esaslı kaide materyallerinin içeceklerle etkileşim sonucunda renk değişimi gösterdiği ve bu değişimin bekleme süresi, akrilik markası ve tipine bağlı olarak değiştiği bulunmuştur. Sonuç olarak, kaide materyalleriyle içecekler arasındaki renk değişimleri klinik olarak anlamlı değildir.

INTRODUCTION

In our country, especially in elderly patients with partial or complete tooth loss, removable dentures are the most commonly used form of prosthetic rehabilitation.[1] Due to its excellent physical and mechanical properties, Polymethyl methacrylate (PMMA) is the most commonly used denture base material in removable dentures. However, its disadvantages include brittleness and liquid absorption over prolonged use, which may lead to a negative impact on its mechanical properties.[2] Liquid absorption primarily arises from the polar properties of resin molecules, making PMMA denture base materials susceptible to staining through denture cleaners and exposure to liquids and food intake.[3]

Color stability is crucial for the long-term aesthetic success of dentures and is a significant factor in material selection. Non-color change of denture bases is considered crucial for success. Both dentists and patients desire dentures that maintain surface gloss and exhibit minimal staining..[3,4] Studies have shown that personal habits, such as hygiene practices and beverage consumption, can significantly affect the color stability of acrylic resin-based dental prostheses.[5] Beverages, such as black tea, coffee, cola drinks, and fruit juices, have been shown to discolor denture surfaces. These beverages may also impact the surface finish of the dentures..[6,7] Therefore, our study aimed to investigate the effect of commonly consumed fruit juice varieties in the region where our faculty is located on denture bases. This investigation was prompted by the lack of existing literature on the color effects of these local beverages on denture bases. From a clinical perspective, measuring and comparing color differences in dental materials is important for statistical significance and associating them with perceptibility and acceptability thresholds. Results obtained through visual assessments are subjective and

may vary, making them less reliable. Using color measurement devices eliminates human errors and provides objective and reproducible data. These devices yield reliable and precise results.[8]

Colorimeters measure colors and express them with three coordinate values (L*, a*, b*) in the CIELAB color space. The L* coordinate represents the brightness, the a* value represents red-green chroma, and the b* value represents yellow-blue chroma. The color difference (ΔE) between two objects can be determined by comparing the respective coordinate values.[9] In our study, the current CIEDE2000 formula was used to calculate color differences ($\Delta E00$). The CIEDE2000 formula is recommended for measuring color differences because it is more accurate than the CIELAB formula and better reflects human color perception. Additionally, the CIEDE2000 formula effectively aligns color differences with perceptibility and acceptability thresholds.[10–12]

This study aims to measure the color changes of three different PMMA-based denture base materials within three different traditional regional beverages commonly consumed in the Trakya region. Our hypothesis was that there would be no difference in color changes of base materials across different beverages.

MATERIALS AND METHODS

In this study, three different pink denture base acrylics based on PMMA were used. A summary of the materials is detailed in Table 1. A total of 120 circular samples, each 2 mm thick and 20 mm in diameter, were prepared for each denture base material, with 40 samples for each material. Sample size and measurements were based on similar studies in the literature [4,13,14] To obtain a standard surface, the samples were polished on one side for 45 seconds with a green

jumbo rubber, 15 seconds with pumice, and finished a felt and hair brush. Before color

Table 1: Materials used in the study

Name	Type of Polymerisation	Liquid/Powder Ratio (ml/g)	Polymerisation Process	Manufacturer
Meliodent Rapid Repair	Chemical Cure	0.7	2 minutes at room temperature 23 °C	Heraeus Kulzer, Hanau, Germany
Imicryl IQ15	Heat Cure	0.4	20 minutes in 100°C boiling water	Imicryl, Konya, Türkiye
Duracryl Heat Cure	Heat Cure	0.42	25 minutes in 100°C boiling water	Erk Dental, İzmir, Türkiye

A spectrophotometer (Chroma Meter CR 400, Konica Minolta, Tokyo, Japan) with the CIELAB system was used for color measurements. The device was calibrated before each measurement. Acrylic samples were measured from their centers on a grey background. Measurements were repeated three times for each sample, and the average values of L, a, and b were recorded. To evaluate color changes in different beverages, the 40 samples in each acrylic type were divided into four subgroups of 10 samples for different beverages.

The beverages used were:

1. Distilled water (Control Group)
2. Chasteberry Juice (Mindivan, Beyazlar Group, Kocaeli/Turkey)
3. Plum Juice (Ancora, Forte Gıda, Ankara/Turkey)
4. Black Mulberry Juice (Ancora, Forte Gıda, Ankara/Turkey)

Beverages were used undiluted. Samples were placed in jars containing beverages and kept at room temperature, with beverages being renewed every 48 hours. Color measurements were retaken on the seventh and twenty-first days. The samples were dried, and L, a, and b values were measured and recorded using the same method.

To determine the differences in color measurements on acrylic denture base materials on the 0th, 7th, and 21st days, ΔE00 values were

measurements, the samples were soaked in distilled water at room temperature for 48 hours.

calculated using the CIEDE2000 formula provided below.

$$\Delta E_{00}^* = \sqrt{\left(\frac{\Delta L'}{k_L S_L}\right)^2 + \left(\frac{\Delta C'}{k_C S_C}\right)^2 + \left(\frac{\Delta H'}{k_H S_H}\right)^2 + R_T \frac{\Delta C'}{k_C S_C} \frac{\Delta H'}{k_H S_H}}$$

Statistical Analysis: Data analysis was conducted using statistical software (SPSS 26.0 for Windows; IBM Corp, SPSS Inc, Chicago, IL, USA). Color differences were evaluated using one-way ANOVA and Kruskal-Wallis tests, while differences between beverages were analyzed with multiple pairwise comparison tests, applying Bonferroni correction. The statistical significance level was set at $p=0.05$.

RESULTS

Table 2 presents the group means and standard deviations of color change values exhibited by different materials in various beverages after a specific duration. A significant difference in color changes was found for samples prepared with Imicryl on the seventh day. The color change in samples soaked in plum juice was significantly higher than those soaked in distilled water ($p=0.002$). However, no significant difference was observed among other beverages. There was no significant difference between beverages in terms of color changes observed on the twenty-first day.

For samples prepared with Meliodent and Duracryl, no significant differences were observed among beverages in terms of color changes measured on both the seventh and twenty-first days. Table 3 presents the test

results and significance values of base resins

Table 2: Color change and standard deviation values

with time and beverage variables.

Material	Beverage (Group)	Day 7 ΔE_{00} (SD)	Day 21 ΔE_{00} (SD)
Imicryl	Distilled water (A)	0.27 (0.31)	0.98 (0.47)
	Black Mulberry juice (B)	0.35 (0.16)	0.69 (0.27)
	Plum juice (C)	0.91 (0.63)	1.13 (0.74)
	Chasteberry juice (D)	0.34 (0.26)	0.51 (0.18)
Meliodent	Distilled water (E)	0.59 (0.55)	0.79 (0.62)
	Black Mulberry juice (F)	0.59 (0.66)	0.59 (0.69)
	Plum juice (G)	0.81 (0.59)	0.94 (0.83)
	Chasteberry juice (H)	0.80 (0.64)	0.90 (0.73)
Duracryl	Distilled water (K)	0.52 (0.44)	0.73 (0.49)
	Black Mulberry juice (L)	0.73 (0.46)	0.87 (0.43)
	Plum juice (M)	0.56 (0.40)	0.69 (0.43)
	Chasteberry juice (N)	0.36 (0.36)	0.54 (0.31)

Table 3: Statistical analysis results of color change of denture base materials

Independent-samples Kruskal-Wallis Test		Meliodent		Duracryl		Imicryl	
		Day 7	Day 21	Day 7	Day 21	Day 7	Day 21
	Sig	0.354	0.470	0.140	0.272	0.003	0.045
Pairwise Comparisons	A-B	-	-	-	-	0.836	1.000
	A-C	-	-	-	-	0.002*	1.000
	A-D	-	-	-	-	1.000	0.082

In comparison among materials, no significant differences were found in color changes among the three acrylics and all beverages on the seventh and twenty-first days. The $\Delta E00$ color change values for all beverages on the seventh and twenty-first days were measured below the threshold perceptibility of 1.72.[15]

DISCUSSION

This study evaluated the color changes of various denture base materials due to exposure to local beverages. Significant discoloration was observed due to plum juice in samples prepared with Imicryl IQ15 denture base material on the seventh day. No significant differences were observed among other denture materials, beverages, or time intervals. Therefore, the null hypothesis was partially accepted.

External staining on restoration surfaces is influenced by physical and chemical forces like van der Waals forces, chemical bonds, and hydrophobic interactions facilitating the adhesion of color pigment particles.[16], Liquid absorption in PMMA materials is associated with the polar properties of molecules.[3,17]

Additionally, the size of molecules exposed to acrylic resins plays a significant role in color change, primarily due to pigment absorption.[18] The addition of nanoparticles to the denture base has been shown to act as an inorganic filler, reducing porosity and thus resulting in less staining.[19]

The measurement and comparison of color and color changes yield subjective and complex results due to various factors like light conditions, material optical properties, and human perception. To minimize potential errors, color measurement devices like spectrophotometers have been developed and used in various studies as they are highly regarded for detecting color and color differences.

In our study, distilled water, used as the control group, also caused discoloration in acrylic resins. Although this change was not statistically significant and remained below the perception threshold, it was comparable to changes observed in other beverages (Graph 1). Similar results were found by Aysan et al. when examining color changes in different beverages for denture base materials. Potential reasons for color change in distilled water include water

absorption by the polymer structure, the effect of the soaking environment, and the discoloration properties of distilled water.[4] While several studies have noted color changes in PMMA base materials due to distilled water, the exact reason remains open for further investigation.[8,20–23]

Graph 1: Graph of color change values for three materials and four beverages
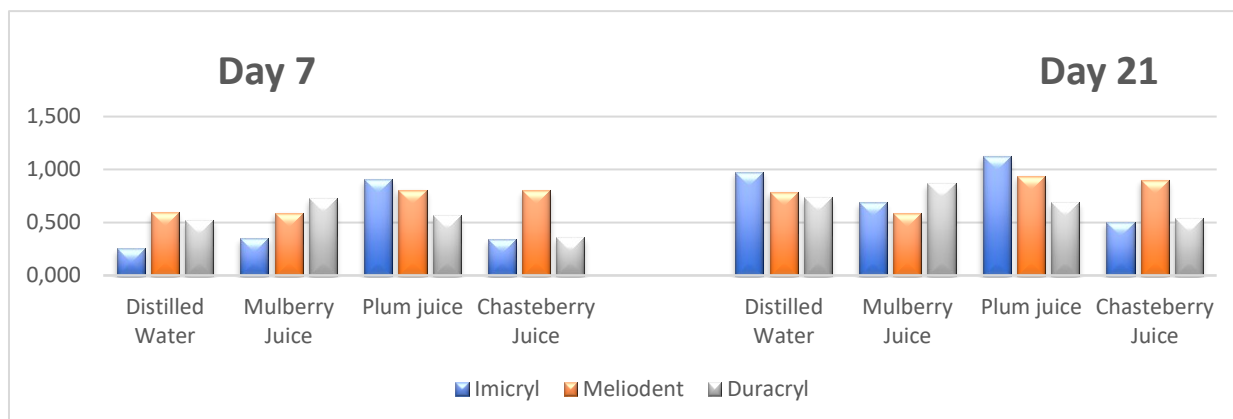
Ren et al. evaluated perceptibility and acceptability threshold values for color changes in denture acrylics. According to the CIEDE2000 formula, the perceptibility threshold for ΔE00 at a 50:50 confidence interval was 1.72, while the acceptability threshold was 4.08.[15] In our study, all color change values measured in PMMA base materials remained below the perceptibility threshold. This suggests that these beverages will not cause a noticeable color change in the base materials. Additionally, color changes in pink acrylic resins are reported to be less perceptible compared to tooth-colored restorative materials.[15]

A limitation of our study is that the acrylics used are conventional, although some might been chemically or heat-cured. Today, additive and subtractive manufacturing techniques for denture materials are also used. Gruber et al. reported significantly higher color changes for 3D-printed denture base materials than conventional and subtractively manufactured ones.[23] Further studies may include these new production techniques for examination.

CONCLUSION

1. PMMA denture base materials exhibited some color change due to interaction with beverages.
2. The extent of this change increased with prolonged exposure and varied according to the acrylic brand and type used.
3. Overall, the color changes observed between denture base materials and beverages were not clinically significant.

Ethical Approval

Since sources obtained from humans or animals were not used in this study, ethics committee approval was not obtained.

Financial Support

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Conflict of Interest

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

Author Contributions

Design: HMA, ÖHÇ, İE, GU, Data collection and processing: ÖHÇ, İE, GU, Analysis and interpretation: HMA, Literature review: ÖHÇ, İE, GU, Writing: HMA.

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Evaluation of the Prevalence of Lesions Resembling Cemento-Osseous Dysplasia on Panoramic Radiographs: A Retrospective Study

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Article Info	ABSTRACT
Article History **Received:** 08.07.2024 **Accepted:** 02.12.2024 **Published:** 30.12.2024 **Keywords:** Cemento-osseous Dysplasia, Panoramic Radiography, Osseous Dysplasia Prevalence	**Aim:** Cemento-osseous dysplasia (COD) is a benign fibro-osseous lesion where normal bone tissue is replaced by fibrous connective tissue. This study aims to evaluate the prevalence of COD, and its periapical, focal, and florid types based on age and gender using panoramic radiographs. **Material and Methods:** This retrospective study was conducted at the Department of Oral, Dental, and Maxillofacial Radiology, Necmettin Erbakan University Faculty of Dentistry. Panoramic radiographs of 500 patients who visited between January 2023 and January 2024 were included in the study. These radiographs were screened for the presence of subtypes of cemento-osseous dysplasia. The findings were classified according to age, gender, and types of COD. **Results:** Cemento-osseous dysplasia was detected in 25 out of 500 patients (5%). Among the radiographs, 19 cases were identified as focal COD (76%), and 6 cases as periapical COD (24%). No cases of florid COD were found. There was no significant difference in the prevalence of COD based on gender and age (p<0.05). **Conclusion:** The study highlights the utility of panoramic radiographs in detecting COD. The findings illuminate the distribution of different types of COD according to age and gender. The data obtained may provide a better understanding of the recognition and management of COD for dental practitioners and other healthcare professionals.

Panoramik Radyografilerde Semento-Osseöz Displaziye Benzeyen Lezyonların Prevalansının Değerlendirilmesi: Retrospektif Bir Çalışma

Makale Bilgisi	ÖZET
Makale Geçmişi **Geliş Tarihi:** 08.07.2024 **Kabul Tarihi:** 02.12.2024 **Yayın Tarihi:** 30.12.2024 **Anahtar Kelimeler:** Semento-osseöz Displazi, Panoramik Radyografi, Osseöz Displazi Prevalansı	**Amaç:** Semento-osseöz displazi (SOD), normal kemik dokusunun fibröz bağ dokusu ile yer değiştirdiği iyi huylu bir fibro-osseöz lezyondur. Bu çalışma, panoramik radyografilerde SOD'un prevalansını ve periapikal, fokal ve florid SOD tiplerini yaş ve cinsiyete göre değerlendirmeyi amaçlamaktadır. **Gereç ve Yöntemler:** Bu retrospektif çalışma, Necmettin Erbakan Üniversitesi Diş Hekimliği Fakültesi Ağız, Diş ve Çene Radyolojisi Bölümü'nde gerçekleştirilmiştir. Ocak 2023-Ocak 2024 tarihleri arasında başvuran 500 hastanın panoramik radyografileri çalışmaya dahil edilmiştir. Bu grafilerde semento-osseöz displazinin alt türlerinin varlığı taranmıştır. Elde edilen bulgular yaş, cinsiyet ve SOD çeşitlerine göre sınıflandırılmıştır. **Bulgular:** Semento-osseöz displazi 500 hastanın 25'inde (%5) tespit edilmiştir. Radyografilerde 19 fokal SOD (%76), 6 periapikal SOD (%24) bulunmuştur. Florid SOD'a ise rastlanmamıştır. Semento-osseöz displazinin görülmesinde cinsiyet ve yaş ile ilişkili anlamlı bir fark kaydedilmemiştir (p<0,05). **Sonuç:** Çalışma, SOD'un tespiti için panoramik radyografilerin kullanılabilirliğini vurgulamaktadır. Elde edilen bulgular, SOD'un farklı tiplerinin yaş ve cinsiyete göre dağılımını aydınlatmaktadır. Elde edilen veriler, diş hekimlerine ve diğer sağlık profesyonelleri için SOD'un tanınması ve yönetimi konusunda daha iyi bir anlayış sağlayabilir.

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INTRODUCTION

Cemento-osseous dysplasia (COD) is a benign fibro-osseous bone lesion characterized by the replacement of normal bone with fibrous connective tissue, followed by calcification of the fibrous tissue resulting in the formation of osseous and cementum-like tissue. Abnormal bone or cementum takes the place of normal bone formation.[1] COD is most commonly seen in fibro-osseous lesions and is predominantly observed in middle-aged African-origin women. Among African-origin women, the prevalence is reported to be 5.5%.[2]

COD occurs in the periapical regions of vital teeth or in areas where teeth have been extracted.[3] However, contact between the lesions and oral flora can lead to infection, and sclerotic lesions may be more susceptible to infection (Figure 4).[4]

Based on their location in the jaws, COD lesions are categorized into three types: periapical COD, focal COD, and florid COD. Periapical COD is observed in the apical region of anterior mandibular teeth, while focal COD is associated with a single tooth. Florid COD, on the other hand, is seen in multiple quadrants of the jaws (Figure 1,2,3).[5-7]

Figure 1: Periapical cemento-osseous dysplasia in the anterior mandible

Although COD lesions can be diagnosed without the need for biopsy based on clinical and radiological evaluation, their radiographic features play a crucial role in diagnosis.[7-9] COD lesions can appear radiolucent, radiopaque, or mixed on radiographs, with increased density and calcification indicating lesion maturation. In the initial stage, COD appears radiolucent, followed by a mixed appearance in the second stage, and finally radiopaque in the third stage (Figure 3).[6-9] Some lesions may show no interruption of the periodontal ligament on radiographs between the tooth and the lesion.[2,10]

Figure 2: Focal cemento-osseous dysplasia seen in the posterior right mandible
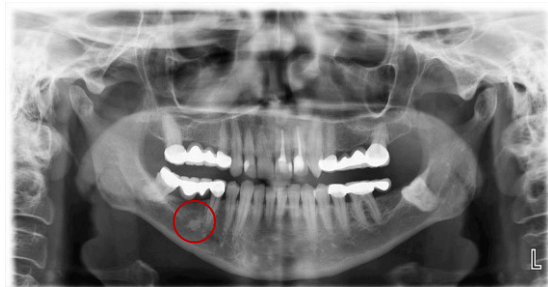

Figure 3: Fluoride cemento-osseous dysplasia of the mandible in an asymptomatic 48-year-old African-American woman.[14]
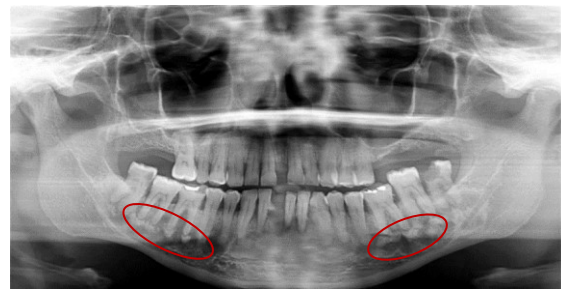

Figure 4: Fluorid cemento-osseous dysplasia involving four quadrants in a symptomatic 54-year-old African-American woman.[14]
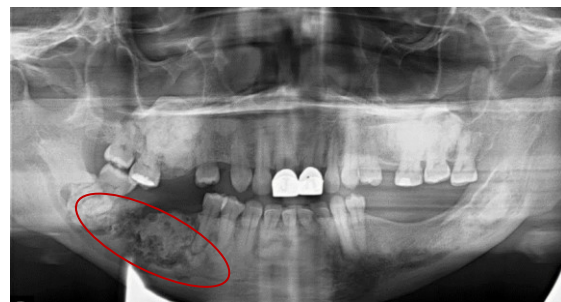
Caries, infection, trauma, periodontal disease and systemic diseases have been reported to trigger focal cemento-osseous

dysplasia. However, the focal pathogenesis and etiology of cemento-osseous dysplasia are not known exactly.[11] It is thought that these lesions are formed as a result of a dysplastic or reactive process in periapical tissues. It is less common in the maxilla than in the mandible.[12]

Understanding the incidence of COD and its distribution across age and gender is crucial for improving clinical decision-making and patient outcomes. COD lesions, despite being benign, often mimic other pathologies such as periapical lesions or inflammatory conditions on radiographs, which can lead to misdiagnosis and unnecessary invasive procedures, including endodontic or surgical interventions. By analyzing the demographic patterns and prevalence of COD, this study aims to provide valuable insights that will aid clinicians in recognizing and differentiating COD more effectively. This, in turn, can help prevent overtreatment, optimize patient management, and contribute to better overall oral healthcare practices.

MATERIAL AND METHODS

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Necmettin Erbakan University (approval number:2024/426). As this was a retrospective study, patient consent was waived, and all data were anonymized to protect patient confidentiality.

Study Design and Sample Selection

A retrospective cross-sectional study was conducted using panoramic radiographs and demographic data of patients who presented to the X clinic between January 2023 and January 2024 for routine dental care or specific complaints. Radiographs were systematically reviewed to identify cases of COD and assess their distribution in the study population.

Inclusion criteria:

Patients with panoramic radiographs displaying diagnostic features of COD.

Complete demographic data, including age and gender.

Radiographs with sufficient image quality for evaluation.

Exclusion criteria:

Radiographs with poor image quality or significant artifacts.

Cases lacking demographic information or presenting with other fibro-osseous lesions.

Radiographs of conditions mimicking COD (e.g., periapical cysts, chronic osteomyelitis).

From the initial pool of 552 panoramic radiographs, 500 met the inclusion criteria and were included in the study.

Radiographic Evaluation

Panoramic radiographs were acquired using a standardized imaging protocol with the Planmeca ProMax® panoramic unit (Planmeca, Helsinki, Finland), operated at 60-70 kVp, 5-7 mA, and a 6-8 second exposure time, as recommended by the manufacturer. Proper positioning of patients was ensured to achieve diagnostic-quality images.

Two maxillofacial radiologists with extensive experience reviewed the radiographs independently on high-resolution, calibrated LCD monitors under standardized lighting conditions. Diagnoses were confirmed by identifying characteristic radiographic features of COD, such as radiolucent, mixed, or radiopaque patterns, depending on the lesion's maturation stage. Cases of interobserver disagreement were

resolved through consensus.

Data Collection and Analysis

For each patient, demographic data (age and gender) were retrieved from clinical records and paired with radiographic findings. The incidence of COD was calculated as a proportion of the total study population. The age distribution of cases was categorized into decade intervals (e.g., 20-29, 30-39), and the gender ratio was analyzed to identify potential differences.

Statistical Analysis

Descriptive statistics, including mean and standard deviation for continuous variables (e.g., age) and frequencies and percentages for categorical variables (e.g., gender), were computed. Chi-square tests were employed to analyze differences in COD prevalence between genders, and independent t-tests or Mann-Whitney U tests were used to assess age-related variations, based on normality testing. A p-value < 0.05 was considered statistically significant.

RESULTS

COD-like lesions were detected in 25 (5%) of 500 patients. Of the 25 patients with COD, 20 (80%) were female and 5 (20%) were male. The mean age of males was 25.4 years with a standard deviation of 6.88, while the mean age of females was 37.45 years with a standard deviation of 12.13.

Radiographs revealed 19 focal COD (76%) and 6 periapical COD (24%). Of the 19 patients with focal COD, 16 (84.21%) were female and 3 (15.79%) were male. Of the 6 patients with periapical COD, 4 (66.67%) were female and 2 (33.33%) were male. Fluoride COD was not detected.

DISCUSSION

COD are non-neoplastic fibro-osseous lesions in which normal bone is replaced by a fibrous tissue matrix and are most commonly seen in Africans, followed by Asians.[5,9,13-16] Although COD lesions are more common in females, the majority of cases are observed in the fourth and fifth decade.[6,16-18] In our study, the ratio of females to males in COD lesions was 4:1, with a mean age of 35.04 years in a total of 25 patients.

Periapical COD is a relatively common type of COD affecting single or multiple teeth, predominantly involving the anterior mandible.[19] Periapical COD is more common in black women over 40 years of age. The lesions may be single or multiple. It is asymptomatic and does not involve changes in periodontal tissue. The common lesion site is the anterior region of the mandible close to the apices of the mandibular anterior teeth and canines, and the relevant teeth retain their vitality.[10, 20] The patient usually has no history of pain or tenderness. The lesions may become quite large and cause a marked enlargement of the alveolar process and may continue to grow slowly.[21] In our study, periapical COD lesions were detected in the anterior mandible in accordance with the literature. The mean age of 4 female patients with periapical COD was 32 years and the mean age of 2 male patients was 24.5 years.

Focal CODs are usually seen in the posterior mandibular region, more frequently in females and in the mid-thirties.[3,5,22,23] Histopathologically, focal CODs are heterogeneous lesions consisting of benign fibrous stroma and cement-like material including irregular trabeculation of mature or immature bone.[3,24] Focal COD does not require interventional treatment unless it reaches very large dimensions. Surgical excision and curettage is the recommended treatment method if they cause functional and aesthetic losses.[25] In this study, the female to male ratio in focal COD lesions was found to be 5.3:1 and the mean age of females was 38.8 years. The mean age of male was found to be 26 years.

Fluorid COD is a rare benign fibro-osseous lesion in the jaws.[26] It is most common in middle-aged black women who are usually Caucasian or Asian.[27] The lesions are located bilaterally and symmetrically. Although its etiology is unknown, it is thought that it may be caused by reactive or dysplastic change of the periodontal ligament.[28]

COD lesions should not be intervened if they are asymptomatic and there is no secondary infection. Patients should be followed up with routine radiographs. Biopsy should be avoided in asymptomatic sclerotic COD with poor blood supply as it may cause secondary infection. Cases with secondary infection are cured with antibiotics.[6]

CONCLUSIONS

This study identified a 5% prevalence of COD-like lesions, with no significant differences observed based on age or gender. Focal COD was the most common subtype (76%), while no cases of florid COD were detected. The findings emphasize the importance of panoramic radiography as a vital diagnostic tool for detecting and assessing COD-like lesions, aiding in accurate diagnosis and avoiding unnecessary treatments. Future research should focus on refining diagnostic criteria and understanding the clinical implications of COD.

Ethical Approval

The necessary ethical approval for this study has been obtained from the Necmettin Erbakan University Non-Drug and Medical Device Ethics Committee (2024/426).

Financial Support

The authors have no relevant financial or non-financial interests to disclose.

Conflict of Interest

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

Author Contributions

Design: SB, IBY, Data collection or data entry: SB, IBY, AA, TZ Analysis and interpretation: SB, IBY, AA, TZ Literature review: SB, IBY, AA, TZ Writing: SB, IBY

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Evaluation of the Effect of Different Finishing and Polishing Procedures on the Color Change and Translucency Properties of Monolithic CAD/CAM Ceramic

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Article Info	ABSTRACT
	Aim: The purpose of this study was to compare the effects of different finishing and polishing procedures for monolithic CAD/CAM ceramics on their optical properties after ultraviolet (UV) aging. **Material and Methods:** A zirconia-reinforced lithium silicate ceramic (Vita Suprinity) with a thickness of 1.5 mm was selected for this study. A total of 42 samples were prepared and divided randomly into six groups on the basis of the finishing–polishing technique used: disc, polishing paste and glazing or combinations (n=7). Color change measurements of the samples were performed on a gray background before and after UV aging. The translucency values on white and black backgrounds were calculated after UV aging according to the CIEDE2000 formula. The Kruskal–Wallis H test and post hoc Dunn test were used for the statistical analysis (P<0.05). **Results:** The effects of finishing–polishing procedures were statistically significant in terms of color change and translucency (P<0.001). The highest color change was found in the crystallized samples. The samples polished with polishing paste after crystallization and glazing exhibited the lowest color change. The lowest translucency was presented in the samples that just crystallized. The highest translucency was presented in ceramics crystallized with glaze, which was significantly different from that in those crystallized, crystallized+polished with discs, and crystallized+polished with polishing paste ceramics (P<0.001). **Conclusion:** Finishing ceramic restorations is an important step for long-term clinical use. Glazing or mechanical polishing of zirconia-reinforced lithium silicate ceramics produces similar results in terms of optical properties. Crystallization with glazing together can be used for quick and reliable finishing.

Monolitik CAD/CAM Seramiğin Renk Değişimi ve Yarı Saydamlık Özellikleri Üzerinde Farklı Bitirme ve Polisaj Prosedürlerinin Etkisinin Değerlendirilmesi

Makale Bilgisi	ÖZET
	Amaç: Bu çalışmanın amacı, farklı bitim ve polisaj prosedürlerinin monolitik CAD/CAM seramiğin optik özellikleri üzerindeki etkisini UV yaşlandırma sonrası karşılaştırmaktır. **Gereç ve Yöntemler:** Bu çalışma için 1,5 mm kalınlığında zirkonya ile güçlendirilmiş lityum silikat seramik (Vita Suprinity) seçildi. Toplam 42 adet örnek hazırlanarak disk, polisaj pastası, glaze veya kombinasyonları ile bitirme ve cilalama tekniklerine göre rastgele altı gruba ayrıldı (n=7). Örneklerin renk değişimi ölçümleri, UV yaşlandırma öncesi ve sonrası gri bir arka plan üzerinde gerçekleştirildi. Beyaz ve siyah zemin üzerindeki translüsensi değerleri ise UV yaşlandırma sonrası CIEDE2000 formülüne göre hesaplandı. İstatistiksel analizlerde Kruskal–Wallis H ve post hoc Dunn testleri kullanıldı (P<0,05). **Bulgular:** Renk değişimi ve translüsensi açısından bitirme ve polisaj prosedürlerinin etkisi istatistiksel olarak anlamlı bulundu (P<0,001). En yüksek renk değişimi yalnızca kristalize örneklerde görüldü. En düşük renk değişimini kristalizasyon ve glaze sonrası polisaj pastası ile polisajlanan örnekler sergiledi. En düşük translüsensi parametrelerini yalnızca kristalize örnekler sundu. En yüksek translüsensi parametreleri glaze ile birlikte kristalize edilen seramiklerde ortaya çıktı ve kristalizasyon, kristalizasyon+disk ile cilalama ve kristalizasyon+parlatma pastası ile cilalama ile karşılaştırıldığında istatistiksel olarak farklılık gösterdi (P<0,001). **Sonuç:** Seramik restorasyonların bitirilmesi uzun süreli klinik kullanım için önemli bir adımdır. Zirkonya ile güçlendirilmiş lityum silikat seramiğin glazelenmesi veya mekanik olarak parlatılması, optik özellikler açısından benzer sonuçlar verir. Glaze ile birlikte kristalizasyon, hızlı ve güvenilir bir son işlem olarak kullanılabilir.

INTRODUCTION

Improvements in monolithic ceramic materials and computer-aided design and computer-aided manufacturing (CAD/CAM) technologies supply to manufacture aesthetic restorations without chipping veneer ceramics in chairside time.[1] One of the high-strength glass ceramics that can be produced monolithic is zirconia-reinforced lithium silicate, which is marketed as monochromatic blanks at two translucency levels.[2] The development of zirconia-reinforced lithium silicate glass ceramics in prefabricated and preprocessed forms has made them suitable for the production of restorations with reduced internal defects through subtractive manufacturing.[3] Zirconia-reinforced lithium silicate ceramics are in an intermediate sintered i.e. pre-crystallized structure for easy milling, and require crystallization firing, in which lithium silicate crystals grow and gain the final color and strength of the ceramic.[3,4] The manufacturer recommends that restorations produced from these blocks be crystallized in a vacuum furnace that allows slow cooling.[2] These ceramics are reported to have better mechanical properties, however higher opalescence and lower translucency when compared to the lithium silicate ceramics probably connected to the material content.[5]

Color and translucency play active roles in matching ceramic restorations with natural appearance and provide aesthetic results.[6] Optical properties depend on several intrinsic characteristics of the material, such as its composition, grain size, porosity and sintering process [7-9], and extrinsic factors, such as surface texture and glaze.[10] Monolithic ceramic restorations, which are fabricated with CAD/CAM, require polishing or glazing to provide smooth and glossy finish after crystallization. Manufacturers recommend both mechanical polishing and/or glazing with glazing spray and pastes for finishing zirconia-reinforced lithium silicate ceramics. Tungsten carbid finishing burs and silicon carbide or rubber polishing discs, with different colors and grain sizes, are used for finishing and glazing protocols.[11,12]

The color and translucency parameters are evaluated with the color coordinates represented in the CIELAB color space. Currently, the CIEDE2000 color difference formula is recommended for standard color change assessment and is also based on CIELAB color coordinates.[13,14] Translucency parameter can be calculated by the difference over white and black backgrounds. While the result is zero in opaque materials, the translucency of the material increases when the result is more than zero.[15]

Previous studies have compared the effects of polishing and finishing methods in CAD/CAM restorations. Kılınç and Turgut [16] reported that mechanical polishing procedures ensured similar optical properties when compared to conventional glazing methods for aesthetic CAD/CAM restorations. Tholt et al. [17] reported that polishing methods had varying effects on three different ceramics that they studied. When the related literature is reviewed, it is not clear which finishing protocol provides the optimum optical appearance for zirconia-reinforced lithium silicate ceramics.

The aim of this in vitro study was to define the color change (ΔE_{00}) and translucency parameter (TP_{00}) of zirconia-reinforced lithium silicate ceramics after different finishing and polishing procedures after ultraviolet (UV) aging. The null hypothesis was that the color change (ΔE_{00}) and translucency parameter (TP_{00}) of the samples are not dependent on different finishing and polishing procedures.

MATERIAL AND METHODS

Power analysis was performed via the G*Power V3.1.9.7 program to determine the

number of samples to be included in the study. Considering the results of the opalescence parameters in the reference study [18], a minimum of 18 samples in total should have been included in the study, with 3 samples in each group, as a result of one-way ANOVA power analysis with 95% confidence ($1-\alpha$), 95% test power ($1-\beta$), and an effect size of f=1.702. The study was completed with 42 samples, and the power of the study was 100% as a result of one-way ANOVA post hoc power analysis with 95% confidence ($1-\alpha$), f=1.702 effect size.

The zirconia-reinforced lithium silicate CAD/CAM ceramic chosen for this study was Vita Suprinity shade A1 (Vita Zahnfabrik, Bad Sackingen, Germany). Rectangular samples ($1.5\times12\times14$ mm) were prepared by slicing ceramic blocks of $12\times14\times18$ mm into 1.5 mm thickness with a diamond disc (Microcut, Metkon, Turkey). All dimensions were confirmed to be within 0.1 mm with digital calipers (IP67, Yamer, İzmir, Turkey). In total, 42 ceramic samples were prepared and divided randomly into six groups on the basis of the

finishing and polishing procedures (n=7). The materials and manufacturers used for the finishing and polishing methods are presented in Table 1, and the finishing and polishing procedures are defined in Table 2. All crystallization and glazing applications were carried out in a porcelain furnace (Programat P710, Ivoclar Vivadent AG, Schaan Liechtenstein) with the parameters defined by the manufacturer. Additionally, after all procedures, the specimen thicknesses were checked with a digital caliper.

Table 1: Materials used in the study

Materials	Manufacturer
The zirconia-reinforced lithium silicate CAD/CAM ceramic (Vita Suprinity)	Vita Zahnfabrik, Bad Sackingen, Germany
Polishing discs	Vita Suprinity Polishing Set Clinical, Vita Zahnfabrik, Bad Sackingen, Germany
Polishing paste	Renfert Polish, Renfert, Hilzingen, Germany
Glaze material	HeraCeram Glaze Universal, Kulzer, Germany

Table 2: Study design for the finishing and polishing procedures

Groups	Finishing and polishing procedures
(1) Crystallized+polished with discs	Step 1: Crystallized in the porcelain furnace at 830°C/8 min Step 2: Polished with prepolishing pink instruments at 10.000 rpm/60 sec per instruments Step 3: Polished with high-gloss polishing gray instruments at 5.000 rpm/60 sec per instruments
(2) Crystallized+polished with polishing paste	Step 1: Crystallized in the porcelain furnace at 830°C/8 min Step 2: Polished with prepolishing pink instruments at 10.000 rpm/60 sec per instruments Step 3: Polished with high-gloss polishing instruments at 5.000 rpm/60 sec per instruments Step 4: Applied the polishing paste with brush at 60 sec
(3) Crystallized+glazed	Step 1: Crystallized in the porcelain furnace at 830°C/8 min Step 2: Glazed in the porcelain furnace at 800°C/1 min
(4) Crystallized+glazed+polished with polishing paste	Step 1: Crystallized in the porcelain furnace at 830°C/8 min Step 2: Glazed in the porcelain furnace at 800°C/1 min Step 3: Applied the polishing paste with brush at 60 sec
(5) Crystallized with glaze	Step 1: Applied the glaze material Step 2: Crystallized with the glaze material at 830°C/8 min
(6) Control/Crystallized	Step 1: Crystallized in the porcelain furnace at 830°C/8 min

After finishing the polishing procedures, a colorimeter (ShadeEye NCC, Shofu, Kyoto, Japan) was used for color difference measurements of the ceramic samples.

Measurements were performed on a gray background under D65 standard illumination before and after UV aging procedures to calculate the color change of the samples. The colorimeter was calibrated, and the samples

were cleaned and dried before measurement. During the measurements, first, the colorimeter was placed on the center of the ceramic samples, and L*a*b* values were recorded for each sample. The measurements were then repeated two more times, and the final values were calculated by averaging the three measurements.

The CIEDE2000 formula was used to calculate the color change values of each sample. In the defined formula, variations in lightness, chroma and hue data are expressed as ΔL', ΔC', and ΔH'. SL, SC and SH are weighting functions of chrome and hue. RT is the cycle function that shows the amount of interaction between chroma and hue differences in the blue area in the CIE L*a*b color system. KL, KC and KH are parametric factors calculated for lightness, chroma and hue and are taken as 1.[19]

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

The translucency parameters (TP_{00}) were measured by determining the L*a*b* values against a black and white background after finishing–polishing procedures and UV aging. The CIEDE2000 formula was used to calculate the translucency parameter of each sample. In this formula, the lightness (L), color (C) and hue (H) of the ceramic samples on white and black backgrounds are indicated with the subscripts 'B' and 'W'.[20] All color measurements were performed three times for each ceramic sample, and the final values were calculated by averaging the three measurements.

$$TP_{00} = \left[\left(\frac{\Delta L_{(B-W)}'}{K_L S_L}\right)^2 + \left(\frac{\Delta C_{(B-W)}'}{K_C S_C}\right)^2 + \left(\frac{\Delta H_{(B-W)}'}{K_H S_H}\right)^2 + R_T \left(\frac{\Delta C_{(B-W)}'}{K_C S_C}\right) + \left(\frac{\Delta H_{(B-W)}'}{K_H S_H}\right)\right]^{1/2}$$

UV aging was performed for 27 hours in a test machine (Atlas UV test machine, Illinois, USA) using UVB-313 fluorescent lamps. The light source was applied continuously to the measurement surface of each sample. The temperature of the panels to which the samples were attached was 38°C in the dark and 70°C in the light during water spraying. The humidity rate was 50% in the light and 95% in the dark. The dry lamp temperature was 38°C in the dark and 42°C during the light period. The test procedure was performed as follows: 40 minutes of light only, 20 minutes of light by spraying water from the front, 60 minutes of light only, and 60 minutes of dark by spraying water from the back.[21] It has been reported that 300 hours of UV aging with reference parameters corresponds to approximately 1 year of clinical use.[16] In this study, the total energy delivered and dark–light cycle times were calculated via a UV aging tester, and the UV aging procedures were applied to reflect approximately 1 month of clinical use.

The data were analyzed via SPSS V23.0 software. The Shapiro–Wilk test was used to determine whether the data were normally distributed. Nonparametric data were statistically analyzed with the Kruskal–Wallis H test, and pairwise comparisons were performed with the post hoc Dunn test ($P<0.05$).

RESULTS

The mean, standard deviation, median, minimum and maximum values of color change and the translucency parameter for each group according to the finishing and polishing steps are presented in Table 3.

Table 3: Color change and translucency parameters for each group according to the finishing and polishing procedures (mean, standard deviation, median, minimum and maximum values)

Test groups	Color change (ΔE_{00})		Translucency parameter (TP_{00})	
	Mean ± SD	Median (Min–Max)	Mean ± SD	Ortanca (Min–Max)
1	0.87 ± 0.36	0.86 (0.47 – 1.5) [ab]	17.02 ± 0.63	17.02 (16.35 – 18.21) [ac]
2	0.85 ± 0.69	0.71 (0.11 – 1.94) [b]	16.7 ± 0.42	16.59 (16.21 – 17.21) [ac]
3	1.01 ± 0.42	0.8 (0.51 – 1.5) [ab]	19.05 ± 0.28	19.12 (18.55 – 19.35) [bc]
4	0.59 ± 0.39	0.53 (0.29 – 1.43) [b]	18.33 ± 0.2	18.23 (18.12 – 18.65) [bc]
5	0.58 ± 0.29	0.63 (0.2 – 1.03) [b]	20.02 ± 0.29	20.12 (19.38 – 20.21) [b]

6	2.66 ± 0.48	2.44 (2.19 – 3.5) [a]	13.68 ± 0.38	13.68 (13.21 – 14.12) [a]
p*	**0.001**		**<0.001**	

Different lowercase letters in the same column indicate statistically significant differences between groups (*P*<0.001).

The different finishing and polishing procedures were statistically significant in terms of color change and translucency (*P*<0.001). The only crystallized samples (group 6) exhibited the highest color change (*P*<0.001). The samples that were only crystallized presented more color changes than those that were crystallized+polished with polishing paste (group 2), crystallized+glazed+polished with polishing paste (group 4), and crystallized with glaze together (group 5) (*P*<0.001). There was no difference between groups 1 and 3, which were just polished with discs or just glazed after crystallization (*P*>0.001). The lowest translucency values were presented in the samples that just crystallized (group 6). The highest translucency values were presented in the ceramics crystallized with glaze together (group 5), which were significantly different from those in the crystallized (group 6), crystallized+polished with discs (group 1), and crystallized+polished with polishing paste (group 2) ceramics (*P*<0.001).

DISCUSSION

According to the results of this in vitro study, different finishing and polishing procedures affected the color change and translucency parameter of the ceramic samples. Thus, the null hypothesis was rejected.

Polishing or glazing methods are essential for ensuring the smoothness of CAD/CAM ceramic restoration surfaces. The results of this in vitro study demonstrated that polishing and/or glazing after crystallization create better surfaces that resist color changes against UV aging cycles for zirconia-reinforced lithium silicate ceramics. Parallel results were emphasized by Manziuc et al. [6] and Kim et al.[18], who reported that color and translucency changed after glazing for monolithic zirconia restorations.

For zirconia-reinforced lithium silicate ceramic restorations, the manufacturer recommends polishing with polishing sets instead of glazing. While there was no significant difference in terms of color change between the polished and glazed groups, the translucency parameters differed. The highest translucency values were presented in ceramics crystallized with glaze together. Translucency is an important property in matching natural tooth appearance and has been reported as a critical esthetic parameter for dental materials.[22,23] Producing more translucent restorations results in more aesthetic results because of the translucent appearance of natural teeth. Based on these results, glazing can be the preferred finishing method for zirconia-reinforced lithium silicate ceramic restorations when translucency is a key consideration.

Traditionally, thermal treatment processes for all ceramic restorations are separate stages that include crystallization and glaze firing. However, this additional firing for glazing has been emphasized to weaken the mechanical characteristics of the lithium disilicate glass ceramics.[24] Recently, CAD/CAM ceramics have made it possible to combine the glazing step with crystallization firing. There was no significant difference between the tested groups glazed with crystallization and those glazed after crystallization in terms of color change. Reducing the number of firing steps may be an alternative to a two-step procedure and can also save time for both the clinician and the patient.

Color measurements of dental materials can be performed by colorimeters, spectroradiometers or spectrofotometers according to the identified standard: ISO/TR

28642.[25] Colorimeters are widely used and reliable devices for color measurements of dental ceramics, as they are appropriate when providing standardization and numerical expression; therefore, in the present study, they are used for color evaluation.[26] In addition, all the samples were fixed to provide immobilization during color measurements and to minimize the edge-loss effect. The mean color difference (ΔE_{00}) and translucency parameter (TP_{00}) were calculated according to the new color difference formula (CIEDE2000), which has been recommended by the CIE based on the CIELAB color space.[27]

The correlation between the surface roughness and translucency of dental ceramics was investigated, and it was reported that smoother surfaces demonstrated higher reflectances and lower transmittances.[28] Incesu et al.[12] investigated the impact of various polishing kits on the roughness of dental ceramics and emphasized that glazing or polishing with OptraFine polishing kits (Ivoclar Vivadent AG, Schaan, Liechtenstein) showed similar results for monolithic zirconia. In this study, no difference was observed in terms of color change between glazing and polishing with discs. Considering the results of both studies, it is supported that surface roughness and optical properties may be related. In parallel with the findings of this study, Ozen et al.[29] reported that manual polishing and glazing had similar effects on the color change of zirconia-reinforced lithium silicate ceramics and defined manual polishing as an alternative to glaze firing. Additionally, many researchers have achieved smooth surfaces or acceptable color change values with manual polishing techniques.[16,30,31] Fasbinder and Neiva[30] obtained smoother surfaces compared to glazed ceramic surfaces when different polishing techniques were applied. Lawson and Burgess[31] polished different CAD/CAM restorative materials and observed clinically acceptable color changes when they were subjected to 1 year of artificial staining. Kılınç and Turgut[16] recommended manual polishing or glazing as a suitable finishing method for the color stability of CAD/CAM ceramic materials. However, in this study, the lowest color change was observed in the groups applied diamond polishing paste after glazing. The resistance of this group to color change may be explained by the chemical contents of the paste that make the surface smoother.

The highest color change and lowest translucency values were observed in the groups that were not glazed or polished after crystallization firing. According to these results, it can be concluded that additional procedures, such as glazing or polishing, are needed to obtain a more aesthetic appearance after crystallization of the blocks milled by CAD/CAM systems. Similar conclusions were drawn by Kurt et al.[1], Manzuic et al.[6], and Kim et al.[18]. It has been reported that optical properties of monolithic zirconia change after glazing, and finishing procedures affect the surface characteristics of monolithic zirconia ceramics.[1,6,18]

The improvement in the translucency of monolithic zirconia has made this material a more aesthetic option in clinical treatment plans. However, care should be taken when firing temperatures, and zirconia restorations should not be subjected to water before sintering, as the opacity of the materials can be affected, resulting in unaesthetic appearance of the final restoration.[32]

The limitations of this study include that only optical parameters were tested and that the surface properties were not evaluated, as it is known that surface texture is related to optical parameters. Additionally, the preparation of rectangular shaped samples, instead of manufacturing them as CAD/CAM restorations, may be considered a limitation. Future studies should investigate the strength and surface properties of these ceramics in clinically relevant designs to better reflect in vivo

conditions.

CONCLUSIONS

When the results obtained within the limits of the study are evaluated:

1) Glazing or mechanical polishing of zirconia-reinforced lithium silicate ceramics produces similar results in terms of optical properties.

2) Crystallization with glazing together can be a preferable finishing method for monolithic zirconia-reinforced lithium silicate ceramics as a color-resistant and time-saving option.

3) Finishing monolithic CAD/CAM restorations with glazing or polishing is necessary after crystallization, as it can influence the final optical appearance.

Ethical Approval

Since sources obtained from humans or animals were not used in this study, ethics committee approval was not obtained.

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Conflict of Interest

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

Author Contributions

Design: SÜA, Data collection and processing: SÜA, EAA, Analysis and interpretation: EAA, Literature review: SÜA, Writing: SÜA, EAA.

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Evaluation of the Content Quality of YouTube Videos Related to Endocrown

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Article Info	ABSTRACT
	Aim: The purpose of this study was to evaluate and validate the popularity, content, reliability, and educational contribution of endocrown-related YouTube videos. **Material and Methods:** Two researchers systematically searched about endocrown on YouTube on April 10, 2023, by using the term "endocrown". The top 250 of the search results were later added to the watchlist. Finally, 30 videos were included for analysis. Time since upload, duration, number of views, likes, number of subscriptions, number of views were recorded. The DISCERN instrument, the benchmarks established by the Journal of the American Medical Association (JAMA), and Global Quality Scores (GQS) were used to evaluate these 30 videos. Assumptions were checked and Kruskal Wallis tests were used to examine the differences between the averages of video features according to GQS and DISCERN scores. **Results:** According to the results of the analysis, a statistically significant difference was found between the averages of video features according to GQS groups and DISCERN scores (p<0.05). As a result of the analysis, a statistically significant difference was found between the video duration averages according to the JAMA scores (p<0.05). Kendal's Tau correlations were applied to examine the relationships between YouTube features and GQS, DISCERN, and JAMA scores. As a result of the analysis statistically significant relationships were found between time and GQS, DISCERN, and JAMA scores **Conclusions:** Despite the limited number of related videos, YouTube has shown similarity in the reliability and quality of videos on the topic of endocrown. As the duration of the videos increased, their reliability increased.

Endokron ile İlgili YouTube Videolarının İçerik Kalitelerinin Değerlendirilmesi

Makale Bilgisi	ÖZET
	Amaç: Bu çalışmanın amacı endokronla ilgili YouTube videolarının popülerliğini, içeriğini, güvenilirliğini ve eğitime katkısını değerlendirmek ve doğrulamaktır. **Gereç ve Yöntemler:** İki araştırmacı, 10 Nisan 2023'te YouTube'da "endocrown" terimini kullanarak sistematik olarak endokron hakkında arama yapmıştır. Arama sonuçlarının ilk 250'si daha sonra izleme listesine eklenmiştir. Son olarak analize 30 video dahil edilmiştir. Yüklemeden bu yana geçen süre, süre, izlenme sayısı, beğeniler, abonelik sayısı, izlenme sayısı kaydedilmiştir. Bu 30 videoyu değerlendirmek için DISCERN aracı, Journal of the American Medical Association (JAMA) ve Global Quality Scores (GQS) tarafından oluşturulan kriterler kullanılmıştır. Varsayımlar kontrol edilmiştir ve GQS ve DISCERN puanlarına göre video özelliklerinin ortalamaları arasındaki farkları incelemek için Kruskal Wallis testleri kullanılmıştır. **Bulgular:** Analiz sonuçlarına göre GQS gruplarına göre video özellikleri ortalamaları ile DISCERN skorlarına arasında istatistiksel olarak anlamlı fark bulunmuştur (p<0,05). Analiz sonucunda JAMA skorlarına göre video süre ortalamaları arasında istatistiksel olarak anlamlı bir fark bulunmuştur (p<0,05). Youtube özellikleri ile GQS, DISCERN ve JAMA puanları arasındaki ilişkileri incelemek için Kendal's Tau korelasyonları uygulanmıştır. Analiz sonucunda zaman ile GQS, DISCERN ve JAMA puanları arasında istatistiksel olarak anlamlı ilişkiler bulunmuştur. **Sonuç:** İlgili videoların sınırlı sayıda olmasına rağmen YouTube, endokron konusundaki videoların güvenilirliği ve kalitesi açısından benzerlik göstermiştir. Videoların süresi arttıkça güvenilirliği de artmıştır.

INTRODUCTION

The Internet is a frequently preferred communication tool for the dissemination of information in the field of health.[1,2] Based on 2015, 84% of adults use the internet, 60% of them try to obtain health-related information via the Internet, and these numbers are increasing day by day.[1,3] Because visual information is more remarkable than readable sources with a video upload speed of 300 hours per minute, YouTube has become a visual library that grows and evolves at a surprising rate. Every month, millions of people visit YouTube (Alphabet, Mountain View, CA), which is an internet-based video sharing site. Hundreds of videos are shared every day on this platform, and these videos also contain videos with health information.[4,5] The main purpose of YouTube is for entertainment rather than education. However, later on, it has become a research topic of academics because it is a source of medical information and attracts attention from patients. When queried by typing the keyword "YouTube" in the PubMed search engine, approximately 2921 results appear (Accessed on March 30, 2023).

With the conveniences brought by the communication age, patients; obtain information about health via the internet and/or YouTube, but do not share and discuss more than 80% of this information with their doctors.[1] On the other hand, 75% of individuals with chronic diseases learn about their diseases through these communication channels.[1] At this point, the validity and reliability of the information obtained come into question. Because the videos shared in areas such as YouTube are opened to access without examining the quality of information by operating an independent and blind refereeing system. This suggests that the information obtained from insufficient information sources, may cause various problems such as erroneous

diagnosis and treatment approaches.[5,6]

In parallel with the development of adhesive cements, endocrown restorations have been applied as an alternative to traditional treatment methods in recent years.[7] Endocrown restorations are produced in one piece. Unlike intracanal posts, they are supported by the pulp chamber and cavity walls and are cemented with adhesive cements.[8] Pissis named the endocrown technique the "monoblock porcelain technique" in 1995.[9] This method has started to be applied with the developments seen in the prosthetic treatment option, composites or acid-etched ceramics, dentin adhesives, and resin cements.[10,11] While endocrown restorations provide macromechanical retention as they are supported by the pulp chamber and cavity walls, micromechanical retention is also achieved by being cemented with an adhesive system.[12]

Because endocrown restorations are manufactured in one piece, adhesion only occurs between tooth and restoration. For this reason, it is stated that adhesive failure is minimized.[13] It is reported that the fracture strength of endocrown restorations is higher when compared to traditional methods.[14]

The aim of our study is to evaluate the quality, content, and adequacy of the YouTube video content related to endocrown and the reactions of the viewers to these videos. The research hypothesis was that YouTube videos on endocrown contain misleading or incomplete information.

MATERIAL AND METHODS

Youtube was searched on April 10, 2023, using the keyword "endocrown". The top 250 of the search results were later added to the watchlist. No ethical committee approval is required, since this study is performed on publicly available Internet data. The exclusion criteria included non-English videos and

irrelevant videos. Finally, 30 videos were included for analysis. English videos on 'endocrown' via YouTube have been added to the 'videos to watch later' digital folder on YouTube by the researchers who will analyze the videos. Only one of the videos showing duplication was evaluated. Within the scope of the research, the publication date of the videos, the number of views, the number of likes, the duration of the video, and the number of subscribers of the channel that published the video were recorded. The view rate was calculated as 'views/time (days)' [15] after the video was uploaded.

All videos were watched by 2 specialist dentists (ÖKK, ÖSK) and analyzed in terms of content; In case of inconsistency, a joint decision was made.

To evaluate the information quality of the videos; DISCERN measurement tool[16] for YouTube was used and the Journal of the American Medical Association (JAMA) benchmark score was evaluated.[15] Additionally, all videos were rated using a Global Quality Score (GQS) using a 5-point scale, where the reviewer could evaluate the quality of the video and its benefit to patients. A score between 1 and 5 can be obtained from this measurement tool, and an increase in the score indicates an increase in quality.[16] These scoring systems, it is stated that while JAMA evaluates the reliability in general, GQS evaluates the educational quality.[15]

Statistical analysis

The normality assumption of the statistical analysis was checked with the Shapiro Wilk test. Mann Whitney U test was used to compare the means of two groups that did not have a normal distribution. The Kruskal Wallis test was used to compare the means of three or more groups that did not have a normal distribution. The Post Hoc Bonferroni test was applied to reveal the group or groups that made

the difference. In testing the relationship between categorical variables, Fisher's Exact test was applied when the sample size assumption (expected value>5) was not met. Relationships between an ordinal categorical variable and continuous variables were checked with Kendall's Tau correlation. Analyzes were performed in the IBM SPSS 25 program.

RESULTS

At the end of the digital scan, it was determined that 30 videos on YouTube as of 10/04/2023 were in accordance with the research criteria. The ratios of GQS, DISCERN, JAMA, and follower numbers are shown in Table 1 according to the videos.

The average number of "likes" is 120.97; the average viewership rate was 13.33; the average number of comments was 5.47; the average number of followers was 16011.97; the average number of views was 8888.97 and the average duration was 15.86. In addition, the average of the interaction index was determined as 2.28 (Table 1).

Assumptions were checked and Kruskal Wallis tests were used to examine the differences between the averages of video features according to GQS. Bonferroni test was applied to determine the group or groups that made the difference. According to the results of the analysis, a statistically significant difference was found between the averages of video duration, number of likes, number of comments, number of views, viewing rate, and interaction index according to GQS groups (p<0.05). According to Bonferroni tests, statistically significant differences were determined between poor quality, generally poor quality, moderate quality, and good quality (p<0.05) (Table 2).

There was no statistically significant difference between the mean number of followers according to the GQS groups (p>0.05).

Table 1: Distribution of videos according to their features

			n	%
GQS		Poor quality	10	33.3
		Generally poor quailty	8	26.7
		Modereta quailty	5	16.7
		Good quality	7	23.3
Modified DISCERN		Score 1	10	33.3
		Score 2	10	33.3
		Score 3	4	13.3
		Score 4	6	20.0
JAMA score		Score 2	22	73.3
		Score 3	7	23.3
		Score 4	1	3.3
Number of followers		Nano follower (0-10K)	27	90.0
		Mikro follower (10K-100K)	2	6.7
		Mid follower (100K-500K)	1	3.3

	n	Minimum	Maximum	Average	Standard deviation	Median
Duration	30	0.31	98.05	15.86	23.89	5.31
Number of likes	30	0.00	835.00	120.97	196.70	53
Number of comments	30	0.00	25.00	5.47	6.88	3
Number of followers	30	1.00	375000.00	16011.97	68208.16	1120
Number of Views	30	13.00	142257.00	8888.97	25998.90	1776
Viewing Rate	30	0.02	185.71	13.33	34.13	3.24
Interaction index	30	0.00	6.17	2.28	1.75	1.91

Table 2: Comparison of averages of Youtube features according to Global Quality Scores

		n	Avg.	S.D.	Median	Rank Avg.	Test Statistics	p
Duration	Poor quality	10	3.27	2.23	2.75	8.85	16.703	0.001*
	Generally poor quality	8	5.61	3.16	4.85	14.13		
	Modereta quality	5	10.81	11.61	4.37	15.70		
	Good quality	7	49.16	30.48	41.59	26.43		
Number of likes	Poor quality	10	13.80	28.90	2.00	7.00	14.064	0.003*
	Generally poor quality	8	157.25	191.59	94.50	19.25		
	Modereta quality	5	170.60	209.40	91.00	20.10		
	Good quality	7	197.14	289.79	91.00	20.07		
Number of comments	Poor quality	10	0.90	1.52	0.00	8.20	12.335	0.006*
	Generally poor quality	8	5.25	5.75	4.00	16.50		
	Modereta quality	5	8.20	4.55	7.00	22.60		
	Good quality	7	10.29	10.23	6.00	19.71		
Number of followers	Poor quality	10	38154.80	118358.32	585.00	11.70	3.202	0.362
	Generally poor quality	8	2708.38	2320.00	1455.00	17.25		
	Modereta quality	5	1593.00	913.01	1000.00	15.60		
	Good quality	7	9882.71	14009.21	1140.00	18.86		
Number of views	Poor quality	10	866.10	1575.90	137.00	7.80	12.034	0.007*
	Generally poor quality	8	8432.38	10261.49	5086.50	20.00		
	Modereta quality	5	6445.20	5232.43	4868.00	21.00		
	Good quality	7	22617.57	52818.67	1881.00	17.43		
Viewing Rate	Poor quality	10	1.30	2.17	0.24	7.70	13.105	0.004*
	Generally poor quality	8	10.93	14.44	5.67	18.75		
	Modereta quality	5	13.77	5.01	16.14	23.20		
	Good quality	7	32.94	68.29	3.10	17.43		
Interaction index	Poor quality	10	1.12	1.25	0.67	9.30	9.337	0.025*
	Generally poor quality	8	2.21	1.37	1.63	15.63		
	Modereta quality	5	2.75	1.59	2.93	18.80		
	Good quality	7	3.70	1.94	2.92	21.86		

*p<0,05

Assumptions were checked and Kruskal Wallis tests were performed to examine the differences between the averages of video features according to DISCERN scores. Bonferroni test was applied to determine the group or groups that made the difference. According to the results of the analysis, a statistically significant difference was found between the averages of video duration, number of likes, number of comments, number of views, viewing rate, and interaction index according to DISCERN scores (p<0.05). According to Bonferroni tests, statistically significant differences were determined (p<0.05). There was no statistically significant difference between the mean number of followers according to DISCERN scores (p>0.05) (Table 3).

Table 3: Comparison of the averages of Youtube features according to DISCERN Scores

		n	Avg.	S.d.	Median	Rank Avg.	Test Statistics	p
Duration	Score 1	10	3.27	2.23	2.75	8.85	16.926	0.001*
	Score 2	10	6.00	3.62	4.85	14.30		
	Score 3	4	12.51	12.45	7.74	17.38		
	Score 4	6	55.50	27.87	50.47	27.33		
Number of likes	Score 1	10	13.80	28.90	2.00	7.00	14.316	0.003*
	Score 2	10	182.90	214.42	83.00	19.30		
	Score 3	4	129.25	72.49	103.50	21.88		
	Score 4	6	190.83	316.92	73.00	19.08		
Number of comments	Score 1	10	0.90	1.52	0.00	8.20	12.057	0.007*
	Score 2	10	6.30	6.11	5.00	17.75		
	Score 3	4	9.00	4.83	7.50	23.50		
	Score 4	6	9.33	10.86	4.50	18.58		
Number of followers	Score 1	10	38154.80	118358.32	585.00	11.70	3.998	0.262
	Score 2	10	2039.70	1889.51	1110.00	15.80		
	Score 3	4	7508.75	9050.97	4175.00	21.50		
	Score 4	6	8063.17	14411.77	1135.00	17.33		
Number of views	Score 1	10	866.10	1575.90	137.00	7.80	13.506	0.004*
	Score 2	10	7609.20	9511.88	4729.00	19.30		
	Score 3	4	7909.75	3844.58	6740.50	24.25		
	Score 4	6	25046.17	57430.22	1678.00	16.17		
Viewing Rate	Score 1	10	1.30	2.17	0.24	7.70	13.609	0.003*
	Score 2	10	12.87	12.78	10.60	20.20		
	Score 3	4	15.02	12.77	11.38	23.00		
	Score 4	6	33.02	74.81	2.57	15.67		
Interaction index	Score 1	10	1.12	1.25	0.67	9.30	9.574	0.023*
	Score 2	10	2.73	1.47	2.68	18.50		
	Score 3	4	1.76	0.87	1.62	13.75		
	Score 4	6	3.83	2.09	4.04	22.00		

*p<0,05

The assumptions were checked and the Mann-Whitney U test was used to examine the differences between the averages of the video features according to the JAMA scores. As a result of the analysis, a statistically significant difference was found between the video duration averages according to the JAMA scores (p<0.05).

According to JAMA scores, no statistically significant differences were found between the average of the number of likes, the number of comments, the number of followers, the number of views, the viewing rate, and the interaction index (p>0.05) (Table 4).

Table 4: Comparison of averages of Youtube features according to JAMA Scores

		n	Ort.	S.S.	Medyan	Sıra Ort.	Test İstatistiği	p
Duration	Score 2	22	8.38	13.00	4.43	13.20	37.50	0.016*
	Score 3 ve 4	8	36.42	34.61	28.86	21.81		
Number of likes	Score 2	22	100.86	162.83	49.00	14.30	61.50	0.219
	Score 3 ve 4	8	176.25	275.66	73.00	18.81		
Number of comments	Score 2	22	4.14	4.93	3.00	14.52	66.50	0.320
	Score 3 ve 4	8	9.13	10.11	5.00	18.19		
Number of follwers	Score 2	22	18606.73	79620.70	1055.50	14.23	60.00	0.202
	Score 3 ve 4	8	8876.38	13278.34	1470.00	19.00		
Number of views	Score 2	22	4441.27	7081.23	1776.00	14.77	72.00	0.475
	Score 3 ve 4	8	21120.13	49160.52	1678.00	17.50		
Viewing Rate	Score 2	22	7.04	10.16	3.95	14.59	68.00	0.368
	Score 3 ve 4	8	30.62	63.63	2.67	18.00		
Interaction index	Score 2	22	1.97	1.50	1.87	14.18	59.00	0.185
	Score 3 ve 4	8	3.16	2.17	2.90	19.13		

*p<0,05

Kendal's Tau correlations were applied to examine the relationships between YouTube features and GQS, DISCERN, and JAMA scores. As a result of the analysis, positive, moderate, and statistically significant relationships were found between time and GQS, DISCERN, and JAMA scores (0.584, 0.609, and 0.366, respectively). A positive, moderate, and statistically significant relationship was found between the number of likes, number of comments, number of views, viewing rate, interaction index and GQS and DISCERN scores (0.473 and 0.454, respectively), (0.498 and 0.466, respectively), (0.346 and 0.368, respectively), (0.388 ve 0.336, respectively), (0.444 ve 0.371, respectively).

Fisher's Exact tests were applied to investigate the relationships between GQS, DISCERN, and JAMA scores. As a result of the analysis, a statistically significant relationship was found between GQS and DISCERN scores (p<0.05). When the observations were examined for the reason of the relationship, it was seen that the scores obtained were compatible with each other. A statistically significant correlation was found between GQS and JAMA scores (p<0.05). When the observations are examined for the reason of the relationship; It has been determined that the GQS score of the videos with a JAMA score of

2 is mostly 1, 2 and 3, and the videos with a JAMA score of 2 and 3 have a GQS score of mostly 4.

Fisher's Exact test was used to investigate the relationship between DISCERN and JAMA scores. As a result of the analysis, a statistically significant relationship was found between JAMA and DISCERN scores (p<0.05). When the observations were examined for the reason for the relationship, it was determined that the DISCERN score of the videos with a JAMA score of 2 was mostly 1 and 2, and the DISCERN score of the videos with a JAMA score of 2 and 3 was mostly 4.

DISCUSSION

Today, the source of obtaining health-related information differs from traditional communication tools. As a result of this differentiation, video-sharing sites that can be accessed via the internet can be seen as an important source of information. Observing that the source and method of obtaining information have changed, researchers have tended to examine the quality of information on websites and/or video-sharing sites such as YouTube.

Despite the evaluation of many dental issues, this study was planned because no study was found that analyzed the information content, accuracy and quality of English YouTube™ videos on endocrowns.

Video information is not reviewed by professionals, may not be evidence-based, and may not be enforced according to quality controls, and these restrictions may result in the creation of irrelevant or incomplete video content.[17]

YouTube is easily accessible to both laymen and dentists, and our study highlights the volume of information available on endocrown. Video information is not peer-reviewed, may not be evidence-based, and is not subject to quality controls, and these limitations may lead to irrelevant or incomplete content.

In a review of studies conducted in the field of health through digital, social, and mobile technologies, it was reported that approximately half of the relevant articles (49.6%) showed correct data.[18] Evidence-based information and studies on the reliability and quality created by the YouTube videos on the endocrown on dentists and patients are invaluable. For this reason, the results of this study conducted with the keyword endocrown via YouTube are of great importance. Thirty videos were analyzed out of 250 videos, and most of them were not included in the study because the videos were silent, irrelevant and the language was not in English (88%).

JAMA benchmark criteria Silberg et al.[19] is a measurement tool that enables evaluation under the titles of authorship, bibliography, patent rights, and actuality. A total of 0 to 4 points can be obtained, and an increase in the score indicates an increase in quality.[19]

The original DISCERN consists of 16 questions scored from 1 to 5. A higher score indicates better quality.[20] Singh et al.[16] It replaced DISCERN for YouTube with five questions assessing clarity, stability, reliability, listing additional sources of information, and mentioning areas of uncertainty. A score between 0 and 5 is given for each criterion provided, and an increase in the score indicates an increase in quality.[16,21]

In this endocrown study, JAMA was 2.3, GQS was 2.3, and DISCERN was 2.2. The results show that the endocrown-related information from YouTube is of poor quality, and users are provided with insufficient and unverified information. Our results appear to be similar to those of previous medical YouTube video studies.[22-25]

Before applying to the clinic, it is much more difficult to accurately inform and persuade patients for treatment and to get rid of their prejudices, who research and obtain false information about their diseases. Since we clinicians do not have the opportunity to check and edit videos posted on YouTube or other sources, it is important that we have an understanding of how the Internet is impacting patients on the most commonly used treatments in the clinic. This is the most important purpose of our plan for this study.

Most of the videos evaluated in our study were uploaded to the YouTube platform by professionals. 25 of the evaluated videos contain technical information prepared especially for medical professionals. Due to the visuality and ease of access to information, patients also use this platform to get information before treatment. However, patients cannot evaluate the accuracy of the information obtained. Because the quality of information is variable and uneven, the situation can mislead patients and disrupt the balance between information and knowledge in the clinician-patient relationship.[15]

Our study showed that although only a few videos gave an idea about the cost of endocrowns, the cost was generally not mentioned. In most of the videos evaluated, the workflow is explained and information is given on this subject. In a study examining the quality of YouTube videos shared about dental implants, it was stated that although dental implant prices were frequently searched on the internet by patients, only a few of the videos included in the study contained information about the costs of dental implants. The study stated that the cost of dental implants varies from one country to another. Likewise, the cost of all dental procedures varies depending on the country.[26] The absence of cost data for the endocrown may be attributed to the fact that

costs can vary significantly from one country to another.

Of the videos analyzed according to this study; It was seen that 16.9% had medium, 33.3% had poor content, and 23.3% had good content quality. The initial hypothesis that video content would often be weak and misleading was accepted. Many studies evaluating YouTube content found the quality of the content to be poor, similar to this study. Abukaraky et al.'s [26] study on dental implants also showed that 114 videos mostly have poor content. Menziletoglu et al. [27] also showed that 74.32% of the 74 videos they reviewed about dental implants had poor information quality.

The findings of our study showed that the number of videos with good quality informational content on endocrown on the YouTube™ video platform is quite low. While it was reported that the information content quality of the videos was sufficient in some of the studies evaluating the videos on dental applications on the YouTube™ video platform; [28,29] In some studies, it is reported that the information content of the videos is of insufficient quality.[26,30] Similar to the current study, in the study conducted by Aydin & Yilmaz [31] in which the information content quality of the videos on the YouTube™ video platform about space maintainers was evaluated, it was stated that there were very few videos with good quality information content. In addition, in the study of Simsek et al.[32] evaluating the quality of videos on oral habits on the YouTube™ platform, it was determined that the number of videos with medium and good quality information content was higher than those with low quality. It is thought that the observation of different results in the studies may be due to the variability of factors such as the difference in the evaluation parameters used, the difference in the number of videos watched, and the topicality of the researched subject.

In a study conducted among medical doctors, it was seen that 85% of the participants encountered a patient who came with information from the internet at least once, and 75% of them found this situation useful. While the participants were of the opinion that the correct information that the patients obtained from the internet was beneficial, they thought that incorrect and irrelevant information would harm the quality of the treatment they would receive, effective use of time, and the patient-physician relationship.[33] This research was found to be important in terms of showing the importance of the accuracy of information in the field of health on the Internet.

In our study, the average duration of the videos evaluated as good in terms of quality was found to be statistically significantly higher than the videos with poor quality. Lena and Dindaroğlu [34] also found that videos with rich content have a longer duration in their study where they examined the content of videos related to Lingual Orthodontics. This can be explained by the fact that content-rich videos have a longer video duration due to more topical mentions.

Youtube is a dynamic environment [28] and the order of search results also changes with the interaction caused by the viewers and over time.[35] As in similar studies, the fact that the data collection method is instant is one of the limitations of the study.[3] The results of the study will vary as new videos are uploaded to the YouTube™ video platform or as added videos are deleted. In addition, only a small number of videos in English were analyzed in this study. The inclusion of different languages in the analysis will affect the study results.

CONCLUSION

According to the results of this research, it has been seen that the information about the endocrown on the YouTube video platform is limited. Considering that the YouTube platform has an important role in influencing patient preferences and treatment decisions, it is thought that it would be beneficial for specialist dentists, public health institutions, or academics to provide objective and realistic information on this platform.

Ethical Approval

Since sources obtained from humans or animals were not used in this study, ethics committee approval was not obtained.

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Conflict of Interest

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

Author Contributions

Design: ÖKK, ÖSK, Data collection and processing: ÖKK, ÖSK, Analysis and interpretation: ÖKK, Literature review: ÖKK, ÖSK, Writing: ÖKK, ÖSK.

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Evaluation of the Radiopacity of Pulp Capping Materials

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Article Info	ABSTRACT
	Aim: Many pulp capping materials are commercially available, but the radiopacity levels of these materials are not clearly known. In this study, the radiopacity values of ten different pulp capping materials were evaluated by digital radiography. **Material and Methods:** Ten different pulp capping materials were prepared and placed in 3 mica plate moulds according to the manufacturer's instructions. In addition, a 1 mm thick molar crown section and an 11-step aluminium penetrometer were prepared for use in this study. After initial setting, the materials were kept at 37 °C in a humid environment. One specimen from each group was radiographed with an aluminium penetrometer and a 1 mm thick molar crown section. The digital radiographic images were transferred to the computer and the radiographic densities of the specimens were determined using the computer programme. After these values were converted to millimetre aluminium (mmAl), one-way ANOVA and post-hoc Tamhane tests were applied as statistical analysis. **Results:** Neoputty (5.19 mmAl) group showed the highest radiopacity values, while Dycal (1.23 mmAl) group showed the lowest radiopacity value (p < 0.05). While the radiopacity values of Dycal, Calcimol LC, Theracal LC, Therecal PT were lower than enamel (p < 0.05); there was no statistically significant difference with dentin (p > 0.05). **Conclusion:** Among the pulp capping materials tested, MTA-containing pulp capping materials showed acceptable radiopacity and may allow radiological detection during vital pulp treatment.

Pulpa Kuafaj Materyallerinin Radyopasitesinin Değerlendirilmesi

Makale Bilgisi	ÖZET
	Amaç: Birçok pulpa kuafaj materyali ticari olarak mevcuttur, ancak bu materyallerin radyopasite seviyeleri net olarak bilinmemektedir. Bu çalışmada, on farklı pulpa kuafaj materyalinin radyopasite değerleri dijital radyografi ile değerlendirilmiştir. **Gereç ve Yöntemler:** Çalışmada on farklı pulpa kuafaj materyali 3 adet mika plak kalıp içine üretici firmanın talimatına göre hazırlanıp yerleştirildi. Ayrıca bu çalışmada kullanmak için 1mm kalınlığında büyük azı dişi kuron kesiti ile 11 basamaklı alüminyum penetrometre hazırlandı. Başlangıç sertleşmelerini tamamlayan materyaller nemli bir ortamda 37 °C'de bekletildi. Her gruptan alınan birer numune, alüminyum penetrometre ve 1mm kalınlığında büyük azı dişi kuron kesitinin radyografisi çekildi. Elde edilen dijital radyografik görüntüler bilgisayara aktarıldı ve bilgisayar programı kullanılarak numunelerin radyografik yoğunlukları belirlendi. Bu değerler milimetre alüminyum'a (mmAl) çevrildikten sonra elde edilen verilere istatistiksel analiz olarak One-way ANOVA ve post-hoc Tamhane testleri uygulandı. **Bulgular:** Neoputty (5,19 mmAl) grubunda en yüksek radyoopasite değerleri gözlenirken, Dycal (1,23 mmAl) grubu en düşük radyoopasite değerini göstermiştir (p < 0,05). Dycal, Calcimol LC, Theracal LC, Therecal PT'nin radyoopasite değerleri mineden daha düşük iken dentinle istatistiksel olarak anlamlı bir farklılık yoktu (p < 0,05). **Sonuç:** Test edilen pulpa kuafaj materyallerinden MTA içerikli pulpa kuafaj materyalleri kabul edilebilir radyopasite göstermiştir ve vital pulpa tedavisi sırasında radyolojik tespit yapılmasına olanak sağlayabilir.

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INTRODUCTION

The base, lining or restorative materials used in the restoration of teeth must have sufficient radiopacity. Materials with sufficient radiopacity allow the detection of overflowing fillings and caries and the control of the contour of the restored tooth. With radiopaque restorative materials, it is easy to differentiate dental tissues.[1,2] Restorative materials such as pulp capping materials, cements and composite resins can be made radiopaque by adding elements such as ytterbium, zirconium, barium and strontium. An ideal radiopacitor should be durable and safe. Radiopacitors should provide clear radiographic images without side effects.[3] Unfortunately, in order to protect commercial rights, incomplete or limited information is provided about the chemical content of dental materials.

Many pulp capping materials have been used from past to present. Calcium hydroxide is the most well-known and frequently used pulp capping material.[4] In addition, tricalcium silicate based cements (Mineral Trioxide Aggregate -MTA) and resin modified calcium silicate based cements are currently popular pulp capping materials.[5] These materials should have sufficient radiopacity to be easily distinguished from anatomical structures.[6] Pulp capping materials are tried to increase their radiopacity by adding filler or radiopaque components at various ratios by the manufacturers.[7] The degree of radiopacity required for optimal clinical performance varies according to the type of material.[8]

The American National Standards Institute/American Dental Association standards and the International Organisation for Standardisation (ISO 6876:2012 and ISO 13116:2014) set the radiopacity standard for materials used in endodontic treatments, such as pulp capping materials. This requires more than 3 mm Al for a 1 mm thick material.[9-11] It has been reported that aluminium penetrometer and occlusal film should be used to evaluate the radiopacity of the materials. In addition, the voltage of the X-ray device should be 65±5 kVp and the X-ray device-object distance should be 30 cm.[11,12] When determining the radiopacity of a material, a disc-shaped sample of a specific thickness and height is obtained from the material and radiographed. The radiographic image obtained is compared with the radiographic image of a wedge made of aluminium.[13]

There are many pulp capping materials on the market with different chemical contents and different radiopacity values. Although most of these materials are stated to be radiopaque by the manufacturer, it is not known that they have sufficient radiopacity.

In the literature analysis, there is no study evaluating the radiopacities of MTA-containing pulp capping materials and calcium hydroxide-containing pulp capping materials. Therefore, the aim of this study was to investigate the radiopacities of ten different pulp capping materials and to compare them with the radiopacities of enamel, dentin and pure aluminium penetrometer. The null hypothesis tested was as follows: The pulp capping materials analysed have acceptable radiopacities and show higher radiopacity values than enamel and dentin.

MATERIAL AND METHODS

Ten different pulp capping materials were used in this study. The manufacturers and contents of the materials are given in Table 1. This study was approved by Afyonkarahisar Health Sciences University Clinical Research Ethics Committee with the report dated

03.11.2023 and numbered 2023/464.

Table 1 Content and Manufacturer of Materials tested Information

Materials	Type	Composition	Manufacturer	Batch no
Dycal	Two-paste self-setting calcium hydroxide	Base paste: Disalicylate ester of 1, 3 butylene glycol, calcium phosphate, calcium tungstate, zinc oxide, iron oxide. Catalyst paste: Calcium hydroxide, ethyl toluenesulfonamide, zinc state, titanium dioxide, zinc oxide, iron oxide.	Dentsply Caulk Milford, DE, USA	094786
Calcimol LC	Resin-modified calcium hydroxide	Calcium hydroxide, fumed silica, UDMA, TEGDMA	Voco Gmbh,Cuxhaven, Germany	PK21222032
TheraCal LC	Resin-modified calcium silicates	Portland cement (calcium silicates), fumed silica, barium zirconate BisGMA,polyglycoldimethacrylate	Bisco, Schamburg, IL,USA	2200005522
TheraCal PT	Dual-cured resin-modified calcium silicate	SG-Mix cement, Bis-GMA, barium zirconate, ytterbium fluoride, initiator	Bisco Inc. Shaumburg, IL, USA	2300002400
NeoPUTTY,	Bio- ceramic mineral trioxide aggregate	Tricalcium silicate, calcium aluminate, dicalcium silicate, tricalcium aluminate, calcium sulfate, tantalum oxide proprietary organic liquid and stabilizers	NuSmile Ltd (Avalon Biomed). 3315 West 12th Street Houston, TX 77008 USA	2022121601
BIOfactor MTA	Mineral trioxide aggregate	Powder: tricalcium silicate, dicalcium silicate, tricalcium aluminate, ytterbium oxide as a radiopacifier Liquid: 0.5%–3% hydrosoluble carboxylated polymer, demineralized water	Imicryl Dental, Konya, Turkey	225998
BioMTA+	Mineral trioxide aggregate	Powder: calcium oxide, hydroxyapatite, oxides of: silicon, iron, aluminum, sodium, potassium, bismuth, magnesium, zirconium; calcium phosphate. Bio MTA+ liquid: Ph. Eur. purified water, calcium catalyst	Cerkamed. Wojciech Pawłowski 37-450 Stalowa Wola, Kwiatkowskiego, Poland	1904231
MTA Angelus	Mineral trioxide aggregate	Silicon dioxide or silica (SiO2), potassium oxide (K2O), aluminum oxide (Al2O3), sodium oxide (Na2O), iron oxide (Fe2O3), sulfur trioxide (SO3), calcium oxide (CaO), bismuth trioxide (Bi2O3), magnesium oxide (MgO), potassium sulphate (KSO4), sodium sulphate (NaSO4), crystalline silica.	QED Ltd., Bakewell Road, Orton Southgate; Peterborough, Brazil	60203
MTA Cem	Mineral trioxide aggregate	CaO, silica, barium sulphate (BaSO4)	Nexobio Co. Ltd, Chungbuk, Korea	MC230220
NeoMTA2	Mineral trioxide aggregate	Powder and gel system consisting of an extremely fine, inorganic powder of tricalcium and dicalcium silicate, which is mixed with the water-based gel, tantalum oxide/tricalcium aluminate	Nusmile Inc., (Avalon Biomed). Houston, TX; USA	2023010302

Preparation of Sample

In order to create samples from the pulp capping materials, 3 mica plates with 5 slots of 5 mm inner surface diameter and 1 mm depth were prepared. In addition, a 1 mm thick rectangular mica plate was prepared with a 1 mm thick molar crown section and a 1 mm thick rectangular mica plate where the aluminium penetrometer would be placed. After all pulp capping materials were placed in the moulds, they were covered with a microscope slide for proper hardening of the surfaces. Then, the microscope slide was removed and the top of

the specimen was irradiated for 20 s using an LED light curing unit (Ellipar S10; 3 M ESPE, St. Paul, MN, USA) with an output irradiance of 1200 mW/cm^2 and standard curing mode. A radiometer (Demetron LED Radiometer; Kerr Corp., Orange, CA, USA) was used to control the output irradiance of the LED unit. The diameter of the light tip was 9 mm and the wavelength range of the device was 430-480 nm. There was no distance between the light tip of the LED unit and the top surface of the sample. Three standardised samples were obtained for each material. These samples were incubated at 37 °C in a humid environment until completely set.

Digital radiography

An 11-step 99.6% pure aluminium penetrometer with each step 1 mm thick was used for radiopacity comparison (Figure 1). The mica plate with the discs on which the materials were placed, the aluminium penetrometer and the section of enamel and dentine was mounted on a phosphor plate (Dürr-Dental, Bietigheim, Germany).

Figure 1: Digital radiographic image of pulp capping materials, molar crown section and aluminium block
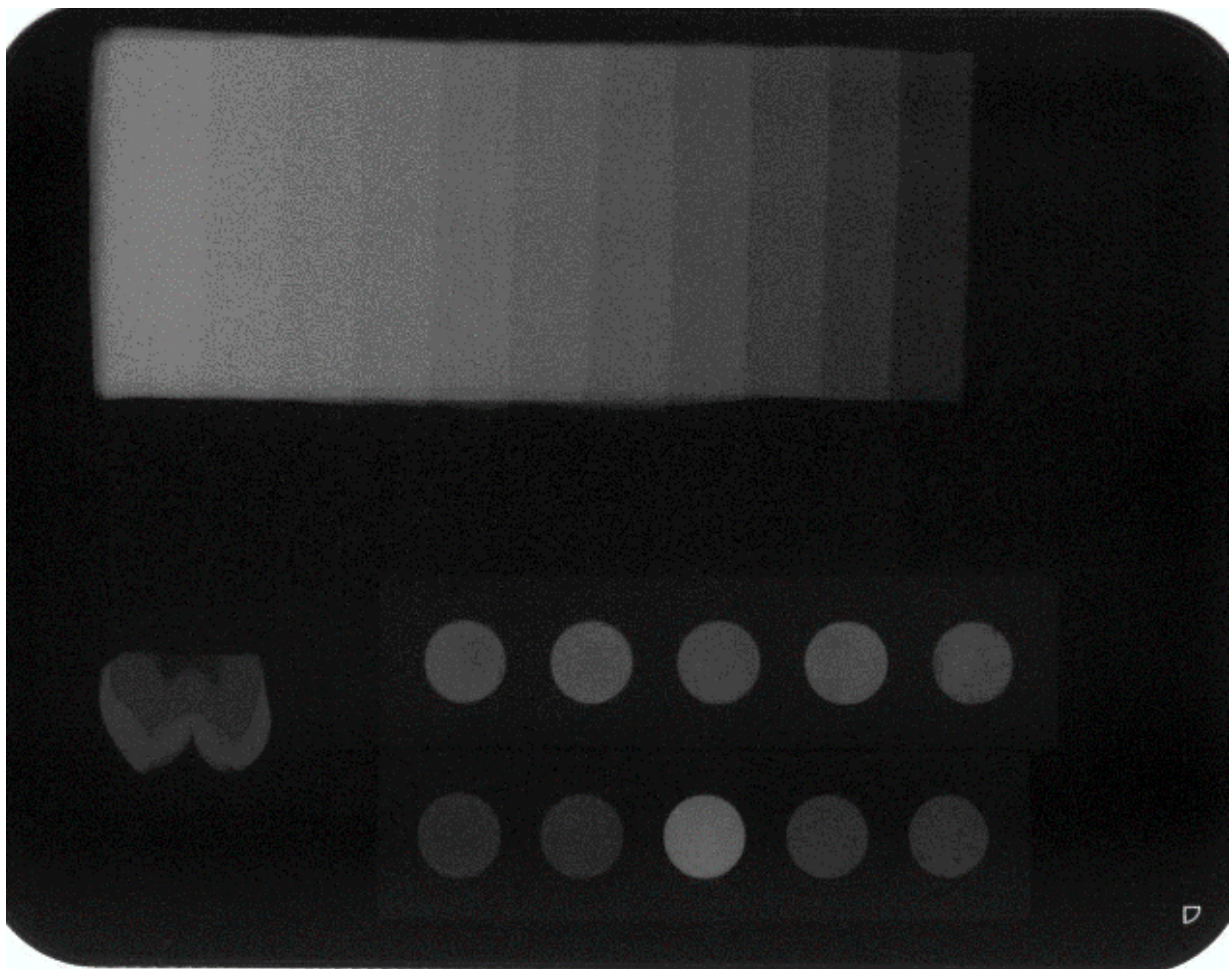
This study started immediately after the annual calibration of the dental X-ray machine. After the dental X-ray machine (ORIX 70; Ardet Dental & Medical Devices, Milan, Italy) was set at 65 kVp, 7 mA and 0.2 s irradiation parameters with an object-beam distance of 30 cm, the X-ray subject was adjusted at a 90° angle to the surface of the mica plate and irradiation was performed. The phosphor plate was scanned with a scanner (ScanX®, Air Techniques, Hicksville, NY, USA) and the images were digitised (Mediadent V8, ImageLevel, Kruibeke, Belgium).

Evaluation of digital images

In the digital images obtained after irradiation, the radiopacity of each step of the aluminium penetrometer, pulp capping materials, the tooth crown cross-section were determined using ImageJ 2.14.0/1.54f software (National Institutes of Health, Maryland, USA). The examination areas were selected to centre the materials and the average radiopacity of the selected areas was determined using the average intensity determination feature of the programme (Figure 1). Five measurements from each sample (15 measurements for each material) were made with the programme and the average of the values was calculated. The obtaining of radiographic images and radiopacity measurements of the samples were performed by a single researcher to ensure standardisation. Based on the average pixel values obtained by imageJ of the radiopacity, the equation was used to determine which aluminium step radiopacity of the materials was equivalent in millimetre aluminium (mmAl).[14,15]

$$\frac{X - Y}{Z - Y} \times \text{Sample Thickness} +$$
mmAl below material MGVC

MGV= Mean Grey Values

X = MGV of the specimen – MGV of the step of step wedge immediately below the specimen's MGV.

Y= MGV of the step of step wedge immediately above the specimen's MGV – MGV of the step of step wedge immediately below the specimen's MGV.

Z=MGV of the aluminum step wedge increment immediately above the material's MGV.

Statistical Analysis

In order to eliminate the differences that may occur during the mixing of the pastes and to evaluate the consistency of the radiopacities of the pastes, 5 different X-rays were taken from the samples prepared with the same paste. For each sample and each step of the penetrometer, 5 colour assessments were made on the digital images and the average of these 5 assessments was taken. One-way ANOVA and post-hoc Tamhane test were applied for statistical analysis of the data obtained. The significance level was set as $p < 0.05$.

RESULTS

For each material, 15 images were evaluated. The OGD values of the aluminium block in a randomly selected image are given in Table 2. The radiopacity values of the material groups in mmAl are given in Table 3.

Table 2 Aluminum block in a randomly selected image OGD values according to steps

	Mean +Sd
1 mm	33.21±6.75
2 mm	47.76±6.7
3 mm	60.76± 6.47
4 mm	72.48± 6.42
5 mm	82.52± 6.17
6 mm	91.40±6.25
7 mm	99.62± 6.17
8 mm	107.21± 6.14
9 mm	115.16± 6.12
10 mm	121.31± 6.03
11 mm	127.31± 5.97

Table 3 Radiopacity values of the Materials (Mean and standard deviation)

Materials	Mean± SD
Dycal	1.23 ± 0.4 [e]
Calcimol LC	1.35 ± 0.43 [e]
Theracal LC	1.52 ± 0.43 [ed]
Therecal PT	1.24 ± 0.38 [e]
Neoputty	5.19 ± 0.87 [a]
Biofactor MTA	2.71 ± 0.43 [c]
BioMTA+	3.75 ± 0.38 [b]
MTA Angelus	3.10 ± 0.44 [c]
MTA Cem	3.71 ± 0.97 [cb]
NeoMTA2	3.20 ± 0.45 [cb]
Dentine	1.21 ± 0.23 [e]
Enamel	1.96 ± 0.32 [d]

Different top symbol letters indicate statistically significant difference. ($p < 0.05$)

The results of the one-way ANOVA test showed that there was a significant difference between the groups (p < 0.05). Neoputty (5.19 mmAl) group showed the highest radiopacity values, while Dycal (1.23 mmAl) group showed the lowest radiopacity value (p < 0.05). Among the MTA groups, the highest radiopacity value was in the Neoputty group, while the lowest radiopacity value belonged to the Biofactor MTA (2.71 mmAl) group. There was no statistical difference between Therecal LC (1.52 mmAl) and Therecal PT (1.24 mmAl) groups (p = 0.993). In addition, Dycal, Calcimol LC, TheraCal groups and BIOfactor MTA groups had radioactivity values lower than 3 mmAl, which is the minimum radioactivity value determined by ISO (6876/2001) and ANSI/ADA (57/2000). While the radiopacity values of Dycal, Calcimol LC, Theracal LC, Therecal PT were lower than enamel, there was no statistically significant difference with dentin (p < 0.05).

DISCUSSION

This study aimed to investigate the radiopacities of ten different pulp capping materials and compare them with the radiopacities of enamel, dentin and pure aluminum penetrometer. The present in vitro study partially rejects the null hypothesis that the tested pulp capping materials exhibit acceptable radiopacity and have high radiopacity values compared to enamel and dentin.

Although radiology has been used in medicine for many years, intraoral digital radiographs have been used in dentistry since 1980. [16] In dentistry, radiographs are frequently used to control restorative treatments and to monitor restorations. Therefore, restorative materials must have radiopaque properties. Radiopaque materials are more easily distinguished from surrounding tissues. In addition, it is easier to evaluate the restorative

treatment borders, condensation and quality of the material on radiographs. The use of radiopaque materials in restorations enables the detection of secondary caries, restoration adaptations, defective proximal contacts and marginal defects.[17] In case of accidental ingestion of radiopaque restorative materials or if they enter the respiratory tract, it is easier to detect them as foreign material.[18]

To evaluate the radiopacities of materials used in dentistry, the digitised images of conventional radiographs or the direct method with digital radiography can be preferred.[19,20] In the radiographic image of a material obtained with digital radiography, the radiopacity of the material may have a different value compared to conventional radiography.[21] Digital radiography reduces the amount of radiation exposure and eliminates the need for film developing chemicals used in conventional radiography. Thus, less environmental pollution occurs. Clearer radiographic images can be obtained with digital radiography.[22] In addition, digital radiography has become more advantageous than conventional radiographs because it is faster and easier to obtain images.[23] Due to these features, digital radiographic imaging is frequently used to evaluate the radiopacities of dental materials in in vitro studies. Two different systems can be used in digital radiography: direct sensor systems (CCD) and phosphor plates (PSP) semi-direct image plate systems. Phosphor plates (PSP) are used more frequently because they are wireless and flexible.[24] In digital radiography, the image is formed by combining the x and y coordinates of the image elements (pixels) and the degrees of grey values. The grey values at the coordinates defined by the pixels are measured and the radiopacity of the material is determined by assigning a value between 0 and 255 to this measurement with a software program.[25] The radiopacity values of the materials are then converted to mmAl.[26] In the study, digital

images of the samples were analysed using Image J software to determine the radiopacity of pulp capping materials.[15]

To assess the radiopacity of dental materials, materials of a given thickness under controlled radiographic conditions (65 kVp, 7 mA, exposure, 0.2 seconds) are compared with an aluminium step block.[27] In this study, an object-focus distance of 30 cm, the same exposure parameters (65 kVp, 7 mA, exposure 0.2 seconds) were maintained for each sampling, and an aluminium block with 11 mm steps in 1 mm increments was used.

The International Organisation for Standardisation (ISO:4049) has recommended that an Al step wedge of 99.6% purity be used as a reference when assessing radiopacity. It also recommends that the radiopacities of the materials tested should be equal to or greater than aluminium of the same thickness and that any value claimed by the manufacturer should not be less than 0.5 mm.[28] Aluminium is used as a reference in radiopacity evaluations because it is easy to produce and shows similar radiopacity to dentin.[29] The purity of the aluminium step is very important. The presence of 4% copper content in the aluminium alloy leads to lower radiopacity measurements and errors compared to 99.5% aluminium alloy.[30] In this study, a special stepped wedge made of 99.6% purity aluminium blocks was used. ANSI/ADA[9] recommends that aluminium step block should be manufactured in thicknesses ranging from 1 to 10 mm, with steps of 1 mm each. In radiopacity studies, an absolute white image (grey scale value 255) can be found when the aluminium step block is manufactured up to 10 mm thick. Gu et al.[25] found a grey scale value of 255 using aluminium step wedges with thicknesses ranging from 1 to 15 mm. In this study, the steps of the 11-step aluminium block were represented on a scale of approximately 33.21-127.31 instead of 0-255. In this study,

Teflon moulds with a diameter of 5 mm were used to prepare test samples according to ANSI/ADA Specification No. 57 for the evaluation of the radiopacities of the materials.[9] Thus, the volume of the samples was reduced and more samples were placed on the phosphor plate.[31]

The use of tooth sections (enamel, dentin) has served as a reliable control in studies investigating the radiopacity of materials used in dentistry.[32] The inorganic content of enamel is structurally higher than the inorganic content of dentin. Enamel prisms have a different structure than dentin canals. For these reasons, the radiopacity of enamel is higher than the radiopacity of dentin.[33] In a study, the radiopacities of enamel and dentin were determined as 2.19 and 1.25 mmAl, respectively.[15] In accordance with the literature, the radiopacity value of enamel and dentin was 1.96 mmAl and 1.21 mm Al, respectively.

In this study, the radiopacity of pulp capping materials used to maintain the vitality and function of the dental pulp was investigated. Neoputty (5.19 mmAl) group showed the highest radiopacity values, while Dycal (1.23 mmAl) group showed the lowest radiopacity value ($p < 0.05$). Pulp capping materials should be distinguishable from dentin.[34] In addition, a threshold of 3 mmAl, the minimum radiopacity value specified by ISO (6876:2012) and ANSI/ADA (57/2000), was used when interpreting these materials.[11,35] While MTA Angelus was found to have a radiopacity value higher than 6 mmAl in radiopacity studies, it showed a radiopacity value of 3.66 mmAl in another study.[36,37] Bismuth oxide was added to MTA Angelus to give it radiopaque properties. In the studies carried out, it was stated by the researchers that bismuth oxide negatively affects the hardening reaction of the material.[38] Bismuth oxide has also been found to be toxic to human dental pulp cells.[39] It has been reported that the addition of bismuth oxide to

the content of Portland cement creates defects in the physical structure of the material and causes a porous structure. This may increase the solubility and degradation of the material.[40] Powder: liquid mixing ratios of materials can affect radiopacity values. Although a 3:1 ratio is recommended by the manufacturer, changing this mixing ratio leads to a change in the radiopacity value. For example, it has been reported that the preparation of White MTA in the form of 4:1 powder/liquid ratio can obtain high radiopacity.[41] Although the high radiopacity of the material provides a benefit, the extent to which this affects the physical and mechanical structure of the material is a matter of debate. In order not to reduce the quality of the treatment applied, the powder / liquid ratio recommended by the manufacturer should be followed.

The radiopacity value of BIOfactor MTA, one of the materials tested in this study, was below 3 mmAl according to the standard set by ISO[10] and ANSI/ADA.[9] However, no statistical difference was found when compared with Angelus MTA, MTA Cem and NeoMTA2 groups. Mutlu and Akbulut[37] found the radiopacity value of BIOfactor MTA higher than 3 mmAl, which is different from the results of our study. Unlike other calcium silicate based materials, BIOfactor MTA contains yttrium oxide as radiopaque agent. Costa et al.[42] reported that ytterbium oxide showed higher cell viability and was more biocompatible than bismuth oxide. Ytterbium oxide does not affect the physicochemical and biological properties of calcium silicate based materials as well as maintaining their bioactive potential.[42] Further research should be conducted to evaluate the biocompatibility, bioactivity and physicochemical properties of BIOfactor MTA. NeoPUTTY (5.19 mmAl), which showed the highest radiopacity value in our study, is a commercially available bioceramic material that is premixed and contains bioactive

properties. It contains radiopaque tantalum oxide (tantalite). It has also been reported that its hardness, non-stickness, resistance to washing, bioactivity and ability to be used without waste make this material more preferable in the clinical environment.[43] NeoMTA2 (3.20 mmAl) has the same content as NeoPUTTY but showed a lower radiopacity value. The manufacturer did not provide information on the amount of radiopaque tantalum oxide in these two materials.[44] We think that the fact that NeoPUTTY was previously mixed and ready to use and NeoMTA2 was in powder-liquid form may cause differences in radioactivity. Since the materials in powder-liquid form are mixed at different ratios, differences in radiopacity may occur.

The radiopacity values of Calcimol LC, TheraCal LC and TheraCal PT groups, which are light-cured pulp capping materials, were below 3 mmAl and no statistical difference was found between these groups. (p> 0.05) This may be related to the different ratios and types of radiopacifying agents and fillers.[45] TheraCal LC is a methacrylate-based resin combined with tricalcium silicate and barium zirconate as radiopacifiers. It was introduced as a light-curing material for vital pulp treatments. TheraCal PT, on the other hand, is a material with a dual cure curing reaction and is especially recommended for pulpotomy treatments, but it is also stated by the manufacturer that it can be used in direct and indirect pulp capping. This material contains barium zirconate and ytterbium fluoride as radiopacifiers.[5] No study evaluating the radiopacity of ThereCal PT, which came to the market in 2019, was found in the literature. Gandolfi et al.[46] found the radiopacity of TheraCal LC and Dycal to be below 3 mmAl, which is consistent with our study. In another study evaluating the radiopacity of Dycal, MTA was found to have a lower radiopacity than Angelus.[47]

BioMTA+ (3.75 ± 0.38) contains calcium zirconium complex as radiopacifier and its radiopacity was found higher than 3 mmAl in our study. In a study evaluating the radiopacity of MTAs, the radiopacities of BioMTA+ and MTA Angelus were found to be higher than 3 mmAl in accordance with our study. However, in this study, the radioactivity of MTA Cem was lower than 3 mmAl, while the radioactivity of MTA Cem was 3.71 mmAl in our study.[48] The difference in the radioactivity of MTA Cem may be due to the fact that the material is in powder-liquid form and the preparation conditions are different. Radiopacity studies performed in vitro cannot completely simulate intraoral conditions. The limitation of this study is that the effects of humidity, temperature and ageing in the oral environment could not be analysed. In addition, the release of ions such as barium, silicon and strontium from the material can reduce the radiopacity. The amount of dust and liquids in radiopacity studies is not quantitatively measured, which causes differences in the results of the study. Methodological differences such as x-ray source, current, voltage, irradiation time and film-focus distance affect the results of radiopacity studies.[49,50] Further studies in oral conditions and simulating the ageing procedure are needed.

CONCLUSIONS

Within the limitations of this in vitro study, Neoputty (5.19 mmAl) had the highest radiopacity value, while BioMTA+, MTA Angelus, MTA Cem and NeoMTA2 showed radiopacity values higher than enamel and dentin and above 3 mmAl. Dycal, Calcimol LC, Theracal LC, Therecal PT had radiopacity values close to the radiopacity of dentin. Studies evaluating the radiopacity of pulp capping materials should be carried out periodically, and manufacturers should regularly renew the formulation of their products to obtain better properties.

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Comparison of Rotary and Manual Techniques for Pulpectomy Treatment in Primary Teeth

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Article Info	ABSTRACT
	Aim: Primary teeth present anatomical and morphological challenges during endodontic procedures. Rotary file systems were recently developed to overcome these endodontic challenges with primary teeth and to reduce the treatment period. The use of rotary file systems is increasingly popular as an alternative to conventional manual techniques. The introduction of several file systems raises the question of whether there are any appreciable variations in success rates. The objective of this review is to analyze multiple current studies that compare the use of rotary and manual instruments concerning the following subtopics: antimicrobial activity, quality of obturation, cleaning efficiency and instrumentation time, clinical and radiographic success, assessment of post-operative discomfort, and extrusion of apical debris. **Material and Methods:** The last five years' worth of publications (2018-2023) was the main focus of the literature review. The Google Scholar and PubMed databases were searched using the primary search phrases. This review examined case reports, in vitro studies, randomized controlled trials, and systematic review studies that investigated the use of manual and rotary file systems in primary teeth. **Results:** The outcomes of studies comparing rotary and manual instrument systems across various categories have been provided. **Conclusion:** This review will guide to dentists under various criteria in evaluating the benefits and possible causes of different instrument systems used during and after the pulpectomy treatment applied to primary teeth.

Süt Dişlerinin Kanal Tedavisinde Kullanılan Döner ve Manuel Tekniklerinin Karşılaştırılması

Makale Bilgisi	ÖZET
	Amaç: Süt dişlerinin endodontik tedavileri sırasında birtakım anatomik ve morfolojik zorlukları mevcuttur. Son yıllarda kullanılan döner eğe sistemleri süt dişlerinin endodontik girişimlerinin mevcut zorluklarını aşmak ve tedavi süresini kısaltmak için geliştirilmiştir. Günümüzde döner eğe sistemlerinin kullanımı, geleneksel manuel tekniklere alternatif olarak giderek daha popüler hale gelmektedir. Birçok döner eğe sisteminin geliştirilmesi ve piyasaya sunulması, başarı oranlarında herhangi bir farkın olup olmadığı sorusunu da gündeme getirmektedir. Bu derlemenin amacı; döner ve manuel aletlerin kullanımını antibakteriyel aktivite, obturasyon kalitesi, kök kanal sistemini temizleme verimliliği ve enstrümantasyon süresi, klinik ve radyografik başarı, postoperatif ağrı değerlendirmesi ve kök kanal sisteminin dışına apikal debris taşması gibi alt başlıklar açısından karşılaştıran çeşitli mevcut çalışmaları analiz etmektir. **Gereç ve Yöntemler:** Literatür taramasının ana odak noktasını, son beş yılın (2018-2023) yayınları oluşturmaktadır. Google Scholar ve PubMed veri tabanları, temel arama kelimeleri kullanılarak taranmıştır. Bu derlemede; süt dişlerinde manuel ve döner eğe sistemlerinin kullanımını araştıran vaka raporları, in vitro çalışmalar, randomize kontrollü çalışmalar ve sistemik derlemeler incelenmiştir. **Bulgular:** Çeşitli başlıklar altında değerlendirilen döner eğe sistemi ve manuel eğe sistemlerini karşılaştıran çalışmaların sonuçlarına yer verilmiştir. **Sonuçlar:** Bu derleme, diş hekimlerine, süt dişlerine uygulanan pulpektomi tedavisi sırasında ve sonrasında kullanılan farklı enstrüman sistemlerinin faydalarını ve olası nedenlerini değerlendirme konusunda çeşitli kriterler altında rehberlik sağlayacaktır.

INTRODUCTION

Pulpectomy is a commonly employed treatment method for primary teeth, serving as an alternative to extraction in cases of irreversible pulpitis and necrosis. This procedure allows for the symptom-free retention of the relevant primary teeth within the dental arch until the physiological resorption process takes place, especially in situations where irreversible pulp pathologies preclude the possibility of reversal. Primary teeth play crucial roles such as guiding the eruption of permanent teeth, contributing to the child's jaw development, influencing speech, and contributing to aesthetic appearance. Despite these advantages, pulpectomy treatment in primary teeth has certain limitations, including the complex anatomical structure of primary teeth, the presence of numerous lateral canals, and the thin dentin structure. Moreover, the effectiveness of pulpectomy treatment is contingent upon the reduction of the existing microbiota within the root canal system, in conjunction with proficient cleaning and obturation capabilities. In contemporary practice, there has been a transition from conventional approaches and manual instruments to Nickel-Titanium rotary instruments for debridement and cleaning procedures. The primary motivation behind this transition is the potential for iatrogenic errors and longer procedural durations associated with root canal preparation using hand instruments.[1,2] The utilization of rotary file systems in primary teeth offers various advantages, such as reduced treatment duration, the ability to shape the root canal system according to its anatomy, homogeneous application of filling material, efficient removal of debris within the root canal, and improved patient cooperation. However, there are also drawbacks, including the risk of perforation and file fracture, potential canal overflow due to excessive filling material, high costs, and the necessity for operators to receive training for these instruments.[3] This literature review aims to explore different studies comparing rotary and manual instruments across various criteria and subtopics.

MATERIAL AND METHODS

Search Strategy

The literature review primarily focused on articles published after 2018. However, studies conducted on the relevant topic in the last decade were also included. Relevant articles were collected through comprehensive searches on Google Scholar and PubMed, following the specified publication year limitations. The following key search terms were used for all databases: "'rotary instruments in primary teeth,' 'manual and traditional instrumentation,' 'pulpectomy treatment in primary teeth,' 'comparison of rotary file system and manual system".

Selection Criteria

This review examined case reports, in vitro studies, randomized controlled trials, and systematic review studies that investigated the use of manual and rotary file systems in primary teeth.

Inclusion Criteria

Randomized controlled trials comparing rotary and manual file systems in primary teeth under various criteria, case reports evaluating the instrumentation phase of pulpectomy treatment and articles including in vitro and in vivo studies conducted on two different file systems were included in the review study.

Exclusion Criteria

Studies comparing the effectiveness of manual and rotary file systems on permanent teeth were excluded from this review.

DISCUSSION

Pulpectomy treatment is a comprehensive procedure that involves mechanical cleaning of the infected pulp tissue in the root canals of primary teeth, followed by

effective disinfection and irrigation of the canal system, proper shaping of the canal system according to its anatomy, and finally filling it with a resorbable material.[4] In contemporary practice, there is a transition from traditional manual instruments to the current rotary file systems in the pulpectomy treatment of primary teeth. However, the technical success of rotary and manual file systems in pulpectomy treatment has not yet been definitively determined.[2]

Antimicrobial Activity

The primary objective of the pulpectomy procedure is to diminish bacterial density within the root canal system, effectively controlling existing infections. However, the complex anatomy of primary teeth, often featuring lateral canals, poses challenges to achieving adequate root canal disinfection.[4] Successful shaping necessitates careful instrument selection, prompting a growing preference for rotary instruments over traditional manual methods due to their efficiency and reduced treatment duration.

In a study focused on the microbial evaluation of root canals after biomechanical preparation, 45 primary molar teeth were categorized into three groups to compare manual and rotary instrument systems. Post-instrumentation, all three systems exhibited a significant reduction in microbial density. The group employing rotary instruments (Kedo-S) demonstrated greater efficacy in reducing microbial load, followed by traditional H-files and K-files, with no statistically significant difference observed among the groups.[5] Similarly, Subramaniam et al.[6] assessed microbial loads in primary molars across three groups (Group A: Rotary Ni-Ti files, Group B: Hand Ni-Ti files, and Group C: Hand stainless steel files). Following root canal instrumentation, all three groups demonstrated a substantial reduction in microbial flora, concluding that rotary NiTi files were as effective as traditional hand instruments in reducing root canal microflora significantly.

In a 2020 study, Elmancy et al.[7] specifically evaluated the removal of Enterococcus faecalis after instrumentation in the root canal system of primary molars, comparing rotary and manual instruments. Post-instrumentation, the rotary instrument system proved more effective in reducing the count of Enterococcus faecalis compared to manual files.

Additionally, a 2021 study by Sankar and Jeevanandan[8] included 30 children aged between 4 to 8 years, dividing pulpectomy treatment into two groups based on the instrument system. Results indicated that the Ni-Ti rotary instrument system exhibited a higher potential for reducing microbial load compared to manual K-type files, with this difference being statistically significant.

Obturation Quality

The success of pulpectomy treatment is contingent upon the meticulous filling of the root canal anatomy, as high-quality obturation prevents future bacterial leakage, thereby enhancing the long-term success of the procedure. Adequate cleaning and shaping of the canals are crucial for achieving proper obturation. While there may not be a significant difference in the success of apical, middle, and coronal shaping between rotary and manual files, the impact of these file systems on obturation has been investigated using various criteria.[9]

In a study by Preethy et al.[10] 45 teeth were divided into three groups, and the canals were filled with calcium hydroxide and iodoform-based filling pastes after irrigation and shaping with three different file systems. The obturation quality was assessed as optimal, overfilled, or underfilled. While no statistically significant difference in obturation quality was noted among the utilization of manual K files, ProTaper Gold rotary files, and Kedo-S rotary files, both rotary file types demonstrated a superior optimal filling rate.

Another similar study reported that

ProFile rotary files achieved superior obturation quality and reduced obturation time compared to manual instrumentation.[11] In a study emphasizing numerical data, statistically significant differences were found. For the manual technique, out of 20 teeth, 10 (50%) were optimally filled, 8 (40%) were underfilled, and 2 (10%) were overfilled. In contrast, for the rotary technique, out of 20 teeth, 16 (80%) were optimally filled, 2 (10%) were underfilled, and 2 (10%) were overfilled.[12] Lastly, Pawar et al.[9] conducted a study dividing 75 primary molars into three groups based on the rotary file system used, comparing instrumentation time and obturation quality. According to their findings, utilizing the XP Endo Shaper system resulted in optimal obturation quality and reduced treatment time compared to the Kedo-S rotary file system and manual K-type file system.

Cleaning Efficiency and Instrumentation Time

Pulpectomy in primary teeth aims to eliminate pulp remnants and infected dentin from the root canal system, facilitating thorough cleaning and shaping. This process allows irrigation solutions to reach the apical third and creates an optimal space for filling. Traditional hand instruments have been the predominant choice for cleaning and shaping root canals. However, the advantages of rotary instruments, such as speed, shape memory, and flexibility, contribute to improved cleaning efficiency and reduced treatment time.[13]

In a study by Kalita et al.[13] teeth were randomly divided into three groups, each consisting of 40 teeth. The research revealed that Kedo-S rotary files exhibited significantly better cleaning effectiveness in the coronal, middle, and apical thirds of root canals compared to ProTaper and K files. The study observed maximum cleaning in the middle third of root canals across all groups, with the minimum cleaning observed in the apical third. Additionally, both rotary systems showed shorter instrumentation times compared to

manual techniques. Similarly, in another study utilizing micro-computed tomography, the cleaning efficiency of the ProTaper rotary system was compared to that of manual K-files. The results showed that ProTaper rotary files left fewer uncleared root canal surfaces in the coronal, middle, and apical sections compared to manual K-files.[14]

Conversely, Jeevanandan's[15] study reported that the average instrumentation time with the pediatric rotary file system Kedo-S was significantly shorter than that with manual K files. This study indicated the superiority of pediatric rotary files over manual files in terms of obturation quality and procedural time. Another study comparing instrumentation time achieved a significant time gain in the rotary file group compared to the manual technique.[10] In Crespo et al.'s[11] study, where the time factor was compared, significantly shorter instrumentation times with rotary files were reported compared to manual files, yielding similar results. This reduction in treatment time is likely to foster increased collaboration between patients and clinicians, contributing to enhanced treatment quality.

Clinical and Radiographical Success

The success of pulpectomy treatment is typically assessed at intervals such as 3, 6, 12, and 24 months, considering both clinical and radiographic perspectives. Evaluation criteria for the clinical success of the treatment should include attention to the absence of clinical scenarios such as percussion sensitivity, the formation of an abscess or fistula, and abnormal mobility.

A study conducted in 2015, comparing clinical success rates, employed two rotary file systems and one manual file system. During the 12-month follow-up period, the RaCe rotary file system exhibited the highest success rate, followed by the ProTaper rotary file system and the manual K-file system, respectively.[16] Likewise, another set of proportional data on

this topic was reported by Morankar et al.[17] in their study conducted in 2018, where they used Hyflex rotary files and manual K-files. According to their study, the clinical success rates for the 24-month follow-up period were reported as 85.2% for rotary (Hyflex CM) and 92.3% for manual techniques. Data obtained from radiographic follow-ups is one of the success criteria for pulpectomy treatment. These data include criteria such as the presence of internal or external resorption, the presence of radiolucency following treatment, and whether there is any increase in the width of pre-existing radiolucency. The two studies mentioned above have also determined radiographic success rates following the use of manual and rotary files in pulpectomy treatment. In the study by Morankar et al.[17] it was indicated that the rotary file system was found to be slightly more successful compared to the manual technique. However, the 12-month follow-up results of Elheeny et al. [16] reported that both rotary file systems exhibited a superior success rate compared to the manual technique.

A recent controlled grouping study conducted by Babu and Kavyashree[18] in 2021 presented data on the radiographic and clinical comparison of rotary and manual files. The highest radiographic success rate was recorded for the Kedo-S pediatric rotary file system after a two-year follow-up period. Following this, in order, were the HERO rotary file system and the traditional K-type Ni-Ti file system.

In all three conducted studies, pulpectomy treatments performed with rotary file systems reported higher clinical and radiographic success rates compared to pulpectomy treatments performed with manual files.[16–18] Nevertheless, it has been consistently emphasized in nearly all studies on this topic that the success rate depends on various criteria such as effective shaping, adequate irrigation, and a filling method that conforms to standards.

In summary, the success of pulpectomy

treatment is primarily determined by a series of procedures and appropriate treatment planning.

Post-operative Pain Assessment and Apical Debris Extrusion

The postoperative pain experience following pulpectomy treatment has a significant impact on the assessment of the success of the treatment, both for permanent and primary teeth. The postoperative pain experience commonly observed in children is often associated with increased anxiety during or after the treatment. Nevertheless, achieving minimal postoperative pain experience remains one of the primary objectives of an optimal pulpectomy.[19]

Necrotic dentin and pulp tissues, inaccessible microorganisms, and irrigation fluids used during pulpectomy treatment can potentially overflow from the apical area during the root canal shaping and cleaning phase. The accumulation of debris and these materials in the periapical tissues due to overflow can lead to undesirable conditions such as delayed healing, post-operative pain, and inflammation following treatment.[20]

Several studies have been conducted to compare the amount of debris overflowing from the apex in pulpectomy treatments performed with manual files or rotary instruments, considering the impact of accumulated waste in periapical tissues on postoperative pain. Pawar et al.[21] described the objective of their study as evaluating the debris extrusion from the apex during the shaping of primary canine teeth using three different endodontic file systems. In this study, manual K-type files, Kedo-S rotary files, and XP-endo-type rotary files were utilized. Debris extruded during the procedure was collected and examined. The two rotary file types used significantly extruded less debris compared to the manual K-type files. A separate study that reached a similar conclusion reported that the use of three different rotary file systems of the new generation resulted in less debris extrusion from the apex compared to manual files.[22] Similarly, in a study conducted by

Thakur et al.[23] in 2017, using a manual Kfile and three different rotary file systems, they found that the SAF rotary file system resulted in the least debris extrusion, while manual files exhibited the highest amount of debris extrusion. Another study, conducted by Preethy et al.[24] similarly reported the debris extrusion rate of manual instruments compared to rotary file systems. They also observed that manual files exhibited the highest debris extrusion rate from the apex. An additional study from 2019, like other studies comparing debris extrusion from the apex, also reported the highest rate of debris extrusion in manual techniques.[25]

As reported in the studies presented above, it has been observed that the highest amount of apical debris is extruded as a result of instrumentation with manual files, in contrast to different rotary file systems. Examining the impact of file systems on post-operative pain, many studies have indicated that rotary instruments extrude debris in lesser amounts from the apex compared to manual files, indirectly suggesting a positive effect on post-operative pain narratives. However, it's worth noting that there are studies in the literature specifically investigating post-operative pain associated with both manual files and rotary file systems. For instance, Panchal et al.[19] conducted a study in which they performed pulpectomy treatment on primary molar teeth using two manual files, as well as Kedo-S rotary files. The results of their treatments showed that the pediatric rotary file system, Kedo-S, resulted in fewer postoperative pain narratives at 6 and 12-hour intervals compared to manual K and H-type files. However, this post-operative pain narrative did not exhibit a significant difference in the 24, 48, and 72-hour follow-up periods. Similarly, Nair et al.[26] reported that utilizing two rotary file systems (Kedo-S and MTwo rotary systems) for root canal shaping resulted in less postoperative pain compared to shaping with the manual file system. Another study on this subject was conducted in 2017. In this comprehensive

study, the presence of postoperative pain in treatments performed using manual techniques and rotary file systems was evaluated at 6, 12, 24, 48, 72 hours, and one week after the treatment. The study concluded that excluding the results evaluated at 72 hours and one week, patients who underwent shaping with manual instruments reported a more intense postoperative pain narrative compared to those prepared with Revo-S rotary files. Although postoperative pain decreased over time in both groups, the study concluded that there was a greater presence of postoperative pain following pulpectomy performed with hand instruments compared to those performed with rotary file systems.[20] As an example of a recent study in 2023, Thakur et al.[27] aimed to compare postoperative pain following pulpectomy treatment using two different rotary systems and a manual K-type instrument. In their study, teeth were instrumented with XP-Endo files, and compared to the other investigated file types, less postoperative pain was reported within 6 and 12 hours. However, at 24, 48, and 72-hour intervals, no significant difference in postoperative pain was reported among the three groups. Additionally, the number of children requiring any analgesic medication was the lowest in the XP-Endo group, followed by the Kedo-S group, and lastly, the manual K-file group.

After pulpectomy treatment, it is known that the incidence of postoperative pain in children is not very low. Minimizing the perception of pain holds unquestionable importance in the field of pediatric dentistry. The possibility of any treatment leaving lasting impressions on children during and after the procedure, and its potential to affect future dental treatments, should be taken into consideration.[28]

The studies conducted have shown a significant reduction in the occurrence of apical debris extrusion and postoperative pain history with treatment protocols shifting from

traditional methods towards rotary instrument systems.

CONCLUSION

One of the critical stages in pulpectomy treatment for primary teeth is the shaping of the root canals. Over the years, various instrument systems have been preferred to enhance the effectiveness of canal shaping. The popularity of Ni-Ti rotary instruments has significantly increased in contemporary practice due to their ability to shape the canals without the need for excessive pre-curve, their shape memory, and their measurable reduction in treatment duration. However, rotary instruments do come with disadvantages, such as reduced tactile sensitivity, the need for technical skills and knowledge, and increased costs. Despite these drawbacks, their capacity to achieve anatomically suitable treatment outcomes for primary teeth and the reduction in chair time have led to their increasing preference over manual instruments.

Ethical Approval

An ethics statement was not required for this study type and no human or animal subjects or materials were used.

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Conflict of Interest

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

Author Contributions

Design: GT, PSÖ, SD, Data collection and processing: GT, PSÖ, Analysis and interpretation: GT, PSÖ, SD, Literature review: GT, PSÖ, Writing: GT,SD.

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Management of Necrotizing Periodontal Diseases at Different Stages: A Case Series

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Article Info	ABSTRACT
	Necrotizing periodontal diseases (NPD) are acute diseases of bacterial dental plaque origin and they are divided into four categories based on the affected tissues: Necrotizing gingivitis, necrotizing periodontitis, necrotizing stomatitis and noma. According to studies, these diseases are rarely seen in the practice of industrialized countries (0.19% to 0.5%) when it does occur, it tends to affect young individuals more frequently in accordance with its etiological factors. The disease presents specific clinical features such as necrotic papillae resembling punched-out lesions, severe pain and the formation of pseudomembrane. Diagnosis is typically based on clinical findings. The development of the disease is influenced by host response and along with predisposing factors such as systemic conditions, HIV infection and stress. The treatment of the disease consists of the acute phase treatment and the supportive/maintenance phase treatment. Between these two main stages, there are stages for controlling the predisposing factors and correcting the sequelae resulting from the disease. In this case series, we have reported on the clinical examination, diagnosis, treatment, and follow-up of three patients referred to the Department of Periodontology Ege University Faculty of Dentistry, diagnosed with Necrotizing Periodontal Diseases (NPD). The changes in terms of social and oral care habits during the 3-6 months post-treatment period and maintenance phase were also documented.

Farklı Seviyelerdeki Nekrotizan Periodontal Hastalıkların Yönetimi: Olgu Serisi

Makale Bilgisi	ÖZET
	Nekrotizan periodontal hastalıklar (NPH) bakteri plağı kökenli akut seyirli hastalıklardır ve etkilediği dokulara göre dört gruba ayrılırlar: Nekrotizan gingivitis, nekrotizan periodontitis, nekrotizan stomatitis, noma. Yapılan çalışmalara göre, bu hastalıklar sanayileşmiş ülkelerin pratiğinde nadiren görülür (0,19% ile 0,5%) ancak görüldüğü zaman, etyolojik faktörlerine uygun olarak genç bireyleri daha sık etkiler. Hastalığın zımba deliği görünümlü nekrotik papillalar, şiddetli ağrı, psödomembran formasyonu gibi spesifik klinik bulguları mevcuttur ve tanısı klinik bulgular doğrultusunda alınmaktadır. Hastalığın gelişiminde konak cevabı ve sistemik durum, HIV enfeksiyonu, stres gibi hazırlayıcı faktörler etkili olmakla birlikte tedavisi birbirini takip eden aşamalardan oluşmaktadır. Bunlar sırasıyla akut faz tedavisi ve destekleyici/idame fazı tedavisidir. Bu iki ana aşama arasında ise hazırlayıcı faktörlerin kontrolü ve hastalık sonucu oluşan sekellerin düzeltilmesi aşamaları yer almaktadır. Bu olgu serimizde Ege Üniversitesi Diş Hekimliği Fakültesi Periodontoloji Anabilim Dalına yönlendirilen ve NPH teşhisi konulan 3 hastanın klinik muayene, tanı, tedavi ve tedavi sonrası 3-6 aylık takibi ve idame dönemindeki sosyal ve ağız bakımı alışkanlıkları açısından ne tür değişikerin olduğu aktarılmıştır.

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INTRODUCTION

Necrotizing periodontal diseases (NPD) are severe oral conditions characterized by destruction of periodontal tissues that can accompany systemic diseases. Depending on the tissues affected and the severity, the condition can vary from a situation that disrupts papillary architecture to Noma, which results in severe destruction.[1]

Diseases classified as Necrotizing Ulcerative Gingivitis and Necrotizing Ulcerative Periodontitis in the 1999 classification were updated in the 2017 classification to include Necrotizing Gingivitis (NG), Necrotizing Periodontitis (NP), Necrotizing Stomatitis (NS) and Noma.[2,3] Studies have shown that these diseases are different stages of the same condition, with common clinical findings and treatment methods.[3]

Necrotizing periodontal diseases are rarely seen, in studies conducted in industrialized countries, the prevalence of NPD ranged between 0,19% and 0,5%,[4,5] they remain significant in countries that are still developing and are encountered in the clinical practice.

The diagnosis of NPD is primarily based on clinical findings.[6] These clinical manifestations include necrosis at the apex of the interdental papilla (resembling a punched-out lesion), pain, bleeding gums, pseudomembrane formation, metallic taste and halitosis. Systemically, lymphadenopathy, general weakness and fever may also be observed.[5,6,7]

At the core of NPD lies the dominance of bacterial strains responsible for the disease, triggering inflammatory processes, like other periodontal diseases leading to bacterial dysbiosis and responses in periodontal tissues.[1] Microbiological factors, host response/systemic condition and predisposing factors plays a role in the development of NPD. These predisposing factors include conditions such as HIV/AIDS, malnutrition (especially in developing countries),[8] psychological stress, inadequate sleep, poor oral hygiene, history of previous NPD, smoking and alcohol use, young age, racial characteristics and seasonal factors.[9,10]

The treatment of NPD involves careful and regular implementation of several stages. These include the acute phase treatment and supportive/maintenance phase treatment, with the correction of predisposing factors and sequelae resulting from the disease between these two stages.[10] Due to the nature of NPD (severe tissue destruction, acute course and pain), diagnosis and treatment should be carried out as quickly as possible and supportive methods should be employed if necessary.[11,12] The two main goals of acute phase treatment are to halt the progression of the disease and tissue destruction and to reduce the patient's symptoms.[13] Treatment involves gently removing superficial attachments, using mouthwash containing hydrogen peroxide and/or chlorhexidine, administering systemic antimicrobial therapy if necessary, providing oral hygiene education and recommending a soft brush. Once the acute condition is under control, the next stage involves controlling predisposing factors. This stage includes professional oral care procedures (scaling and root plaining), regulating the patient's oral hygiene habits and correcting overhanging restorations.[7] Factors such as smoking, emotional stress, inadequate sleep and other systemic conditions should be managed during this stage.[10] The next stage involves correcting changes in morphology due to the disease. Flap surgeries, regenerative procedures, gingivectomy / gingivoplasty procedures are performed during this stage.[7] The final stage in the treatment of NPD is the supportive / maintenance phase treatment, which involves ensuring the patient's compliance with oral hygiene practices and regular monitoring of

predisposing factors.[7]

CASE REPORT-1

A 22-year-old male patient was referred to our periodontology department in July 2023 with main complaints of gingival pain and bleeding during eating and toothbrushing. The patient was systemically healthy and smoking 20 cigarettes per day.

Upon clinical examination (taking systemic and dental anamnesis, detection of clinical findings, periodontal probing), bleeding spots, pseudomembrane formation and necrosis on the papilla's apex were observed and intraoral photographs of the patient were taken (Figure 1. a, b, c). The radiological examination and the determination of clinical attachment levels through periodontal probing (within tolerable limits due to patient's pain) revealed no alveolar bone loss (Figure 2). Panoramic radiographs alone are insufficient for accurate detection alveolar bone loss. However, in this case clinical examination does not reveal clinical attachment loss and panoramic radiographs are corroborated by clinical findings, no additional radiographic imaging is required.

Figure 1. a,b,c: Initial Intraoral Photographs

Figure 2: Panaromic Radiograph

Based on the anamnesis and clinical/radiological examinations, Necrotizing Gingivitis was diagnosed. The patient was informed about the treatment process and the informed consent was obtained.

During the first appointment, the patient underwent supragingival scaling with ultrasonic scaler to a tolerable level. At the end of the appointment, the patient was prescribed a mouthwash containing hydrogen peroxide to target the anaerobic flora responsible for the disease in the mouth (3% hydrogen peroxide diluted 1:1 in warm water) (Dermosept® Oxygenated Water, ALG, Istanbul) and an antibiotic (Flagyl® 500 mg tablet, Sanofi, Istanbul) due to systemic symptoms (fever, weakness) (to be taken 3 times a day). The patient was instructed to perform oral care with a soft toothbrush throughout the treatment period and advised to quit smoking.

During the patient's second appointment, which took place 2 days later, supragingival and subgingival calculus was removed. Following this appointment, the patient was advised to use a chlorhexidine-containing mouthwash (Kloroben®, Drogsan, Ankara) for a week instead of the hydrogen peroxide-containing mouthwash.

At the patient's third (one week after the second appointment) and fourth appointments (one week after the third appointment), a general assessment was conducted and the status of complaints was queried. The patient reported that initial complaints of pain and bleeding had completely ceased and he could comfortably perform eating and oral care activities.

At the end of the fourth appointment, the bleeding spots and pseudomembranes had completely disappeared, although the loss resulting from necrosis on the papilla's apex was still noticeable.

The acute phase treatment for the patient was completed and he transitioned to the supportive/maintenance phase. In addition, intraoral photographs of the patient were taken again (Figure 3. a, b, c).

Figure 3: Fourth Appointment Intraoral Photographs

A follow-up appointment was scheduled for the patient in January 2024, with a six-month interval. During the appointment, the patient reported the absence of any remaining symptoms, which were confirmed by the clinical examination. The patient was queried about potential contributing factors to the disease during the specified period and any alterations in their social and oral care practices since that time. These questions asked to the patient are intended to ensure the control of etiological factors addressed during treatment, as well as to assess the adequacy of oral care and behaviors established to manage the condition. The patient reported being extremely stressed due to school during that period and reported reducing cigarette consumption from 20 cigarettes per day to 5-6 cigarettes per day. The patient reported that he has modified his oral hygiene habits in accordance with the recommendations. Intraoral photographs were taken at this appointment (Figure 4. a, b, c). As seen in the photographs taken at the 6-month follow-up appointment, some recovery of the papillary losses associated with necrosis seen during the active phase of the disease had occurred. The missing mandibular left first molar and the mandibular right first molar and maxiller first molar with excessive material loss

of the patient were not evaluated during the acute treatment phase because there were no complaints from these teeth. After completing the acute treatment phase, necessary treatments for the missing mandibular left first molar and the mandibular right first molar with excessive materail loss in the relevant sites were explained to the patient, and he was referred to the appropriate departments.

Figure 4: a,b,c: 6-Month Follow-up Photographs

CASE REPORT-2

A 22-year-old male patient was referred to our periodontology department in June 2023 with main complaints of bleeding gums, pain and difficulty when opening his mouth and chewing. The patient was systemically healthy and smoking 3-4 cigarettes per day.

As a result of the clinical examination (taking systemic and dental anamnesis, detection of clinical findings, periodontal probing), white plaque formation on the buccal surfaces of the lower and upper teeth and redness in the papilla peaks were observed. The patient's mouth opening was limited due to pain, intraoral photographs were taken as much as possible (Figure 5. a,b). The radiological examination and the determination of clinical attachment levels through periodontal probing (within tolerable limits due to the patient's pain) revealed no alveolar bone loss. (Figure 6) Panoramic radiographs alone are insufficient for accurate detection alveolar bone loss. However, in this case clinical examination does not reveal clinical attachment loss and panoramic radiographs are corroborated by

clinical findings, no additional radiographic imaging is required.

Figure 5. a,b: Initial Intraoral Photographs

Figure 6: Panaromic Radiograph

Based on the anamnesis and clinical/radiological examinations, Necrotizing Gingivitis was diagnosed. The patient was informed about the treatment process and the informed consent was obtained.

During the first appointment, the removal of superficial attachments (dental plaque, supragingival calculus) could only be applied to a limited extent due to intense pain experienced by the patient. Given the absence of systemic symptoms, antimicrobial therapy was not initiated. Instead, the patient was instructed to use a mouthwash containing hydrogen peroxide to target the anaerobic flora responsible for the disease in the oral cavity (3% hydrogen peroxide diluted 1:1 in warm water) (Dermosept® Oxygenated Water, ALG, Istanbul). The patient was instructed to perform oral care with a soft toothbrush throughout the treatment period and advised to quit smoking. During this process, a blood test was requested to monitor the patient's general condition.

During the patient's second appointment, scheduled two days later, the results of the blood test were reviewed, revealing C-reactive Protein (CRP) levels above the normal range indicative of active inflammation (21,21 mg/L,

reference range 0-5 mg/L). Supragingival scaling was performed. Instead of hydrogen peroxide-containing mouthwash, the patient was instructed and prescribed to use a chlorhexidine-containing mouthwash (Kloroben®, Drogsan, Ankara) for one week. Additionally, at the end of the session, the patient was asked to undergo an ELISA test due to suspected viral illness.

At the patient's third appointment the initial high CRP levels had approached normal levels in the test conducted three days later (5,93 mg/L, reference range 0-5 mg/L). The ELISA test of the patient was negative.

After the third (one week after the second appointment) and fourth appointments (one week after the third appointment), all of the patient's complaints have disappeared and acute treatment phase has been terminated, transitioning to a supportive/maintenance phase. In the fourth appointment, intraoral photographs were taken from the patient (Figure 7). As seen in the captured image, the redness in the papilla's apex has disappeared, the membranes on the gingiva surfaces have disappeared.

Figure 7: Fourth Appointment Intraoral Photograph

The patient has been called for 7th-month follow-up appointment in January 2024. The patient's complaints had abated, with only minimal gum bleeding in the upper anterior region during brushing. Clinical observation indicated that the patient was in good health. The patient was queried about potential contributing factors to the disease during the specified period and any alterations in social and oral care practices since that time. These

questions asked to the patient are intended to ensure the control of etiological factors addressed during treatment, as well as the adequacy of oral care and behaviors established to manage the condition. The patient reported experiencing insomnia due to changes in social life during that period and having an irregular eating pattern. Furthermore, it was disclosed that the patient adheres to a regimen of regular oral hygiene and has managed to reduce his cigarette consumption to a maximum of three or four per day. At the end of the appointment, intraoral photograph was taken (Figure 8). The missing mandibular right first molar of the patient were not evaluated during the acute treatment phase because there were no complaints from this site. After completing the acute treatment phase, necessary treatments for the missing mandibular right first molar in the relevant site were explained to the patient, and he was referred to the appropriate departments.

Figure 8: Seventh Month Intraoral Photograph

CASE REPORT-3

A 18-year-old male patient was referred to our periodontology department in May 2023 with main complaints of bleeding gums, pain and halitosis. The patient was systemically healthy and smoking 30 cigarettes per day.

As a result of the clinical examination (taking systemic and dental anamnesis, detection of clinical findings, periodontal probing) necrosis and ulceration of the interdental papilla's, bleeding and crater-like defects occurring in the upper anterior region and increase in pocket depth were detected. Intraoral photographs were taken from the patient (Figure 9. a,b,c).

Figure 9. a,b,c: Initial Intraoral Photographs

A comparison was made between the panoramic radiograph taken in 2018 during the patient's previous visit to our department and the panoramic radiograph taken in May 2023. It was noticed that there was alveolar bone loss and increased pocket depth observed during periodontal probing in the upper jaw anterior region (Figure 10,11). In this case, a comparison of a radiograph taken five years prior with a current one demonstrated significant attachment loss. As this loss was substantiated by clinical examination, further radiographic imaging was thought unnecessary.

Figure 10: Panaromic Radiograph Dated 2018

Figure 11: Panaromic Radiograph Dated May 2023

Based on the anamnesis and clinical/radiological examinations, Necrotizing Periodontitis was diagnosed. The patient was

informed about the treatment process and the informed consent was obtained.

At the first appointment, limited supragingival scaling could be performed due to intense pain of the patient. Given the absence of systemic symptoms, antimicrobial therapy was not initiated. Instead, the patient was instructed to use a mouthwash containing hydrogen peroxide to target the anaerobic flora responsible for the disease in the oral cavity (3% hydrogen peroxide diluted 1:1 in warm water) (Dermosept® Oxygenated Water, ALG, Istanbul). The patient was instructed to perform oral care with a soft toothbrush throughout the treatment period and advised to quit smoking.

During the follow-up appointment two days later, it was observed that the complaints of the patient was decreased and non-surgical periodontal treatment was continued. Root plaining procedures were performed in areas with attachment loss. Following this appointment, the patient was advised to use a chlorhexidine-containing mouthwash (Kloroben®, Drogsan, Ankara) for a week instead of the hydrogen peroxide-containing mouthwash.

After the third (one week after the second appointment) and fourth follow-up appointments (one week after the third appointment), the patient's complaints had completely disappeared and transitioned to the supportive/maintenance phase of treatment.

The patient was called for a follow-up appointment in August 2023 (3rd month). It was learned that the patient had no remaining complaints and felt motivated upon seeing the improvement in gum health, consequently paying close attention to oral hygiene. Clinically, improvements in the necrotic areas of the papilla's apex were observed. The patient was queried about potential contributing factors to the disease during the specified period and any alterations in social and oral care practices

since that time. These questions asked to the patient are intended to ensure the control of etiological factors addressed during treatment, as well as the adequacy of oral care and behaviors established to manage the condition. It was revealed that the patient experienced stress and pressure due to job searching during that period, reduced of daily cigarette consumption from 30 to 15 and adhered to oral care habits regularly. At the end of the session, intraoral photographs were taken from the patient (Figure 12. a,b,c).

Figure 12. a,b,c: Third Month Intraoral Photographs

DISCUSSION

In the management of necrotizing periodontal diseases, it is of the importance to exercise the utmost care in the detection, diagnosis and treatment of the condition. Necrotizing periodontal diseases begin with Necrotizing Gingivitis, which is limited to the soft tissue in its early stages and if not detected and treated in a timely and appropriate manner, they can progress to Noma, presenting as a severe condition. Hence, early detection and appropriate treatment are crucial.

Although necrotizing periodontal diseases primarily originate from bacterial dysbiosis.[1] Immunassays and polymerase chain reaction studies have identified the involvement of spirochetes in the disease.[14,15,6] In addition to spirochetes, Prevotella intermedia, Treponema, Selenomonas, and Fusobacterium species have also been detected.[17] Many of the pathogens implicated in the disease are opportunistic pathogens commonly found in healthy

individuals, underscoring the importance of the balance between oral flora and host susceptibility/response.[1]

Evaluating them solely from a microbiological perspective would be incorrect. In addition to microbiological factors, the host response/systemic condition and various predisposing factors play a significant role in the development of the disease.[9,10] It is essential for clinicians to recognize these predisposing factors and intervene accordingly whenever possible. It was found that all patients in this case series were in emotionally stressful periods (such as job searching, education, social relationships, etc.) when they were affected by the disease. Among the predisposing factors, HIV/AIDS[9,10] was investigated in our second patient through the requested ELISA test, but no supportive results were found. Smoking,[9,10] another predisposing factor, was observed in all three cases and efforts were made to motivate the patients to quit smoking. Patients were motivated to quit smoking by emphasizing that smoking is a significant factor in the development of this disease and that the disease is likely to recur if they continue to smoke.

In the treatment of NPDs, staged therapy and careful implementation are of utmost importance. In this case series, the treatment of the disease in all three patients has been applied according to the stages mentioned in the current literature.[10] In the first stage, known as acute phase treatment, the progression of the disease and tissue destruction were aimed to be stopped and the patient's symptoms were controlled.[13] According to the current literature, the purpose of using metronidazole-containing antibiotics in the acute phase of treatment is to effectively target anaerobic bacteria in the fusospirocetal complex that cause the development of necrotizing periodontal disease. In cases where the use of metronidazole is inappropriate, the use of amoxicillin-containing antibiotics has also been reported to be appropriate.[1,18] Depending on the patient's systemic symptoms,

supplementation with antimicrobials may be necessary.[19] Among the patients we reported in this case series, systemic antimicrobial therapy was only used in one case (Case 1). However, the treatments applied to all three patients were successful. This indicates that antimicrobials may not be indicated for every patient in the treatment of dysbiosis and eradication of the anaerobic environment, which are the main goals of treatment. After effectively implementing acute phase treatment, the subsequent stages of controlling predisposing conditions, correcting sequelae resulting from the disease and applying maintenance / supportive phase treatments are crucial.[7] As recommended in the current literature, the maintenance phase was initiated in the treatment of all 3 patients; the aim of this phase is to keep the disease, risk factors and the oral hygiene under control.[1] During this stage, necessary recommendations for disease control have been reiterated at each appointment of follow ups, and the recommended practices for patients have been verified (oral care habits, quit smoking). These patients were informed that their condition could recur if not properly controlled and that they would be scheduled for follow-up appointments to prevent recurrence. Specific recommendations have been provided for the missing teeth and/or excessive material loss in the first and second patient, who has been referred to the relevant departments accordingly. Following 3-6 months of long-term follow-up, it has been observed in all three patients discussed in this case series that treatment has been successful. Symptoms experienced during the acute phase have resolved, indicating compliance with recommendations.

CONCLUSION

Necrotizing periodontal diseases (NPDs), named according to the tissues they affect, are encountered in today's clinical practice in our country. NPDs can be prevented from

progressing to advanced tissue loss with early clinical diagnosis based on disease-specific clinical findings and effective treatment planning. In this case series, after the diagnostic process of these three patients at different stages of the disease, treatment planning and implementation were carried out according to the literature. As a result, all of the cases have been managed effectively according to treatments outlined in the literature and it was observed that periodontal health was maintained during the 3-6 month period in this case series. Advanced studies describing the management of more severe stages of necrotizing periodontal diseases and longer-term patient follow-up could contribute to the literature in the coming period.

Ethical Approval

An ethics statement was not required for this study type and no human or animal subjects or materials were used.

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Conflict of Interest

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

Author Contributions

Design: MK, DE, SB Data collection and processing: MK, DE, Analysis and interpretation: MK, SB Literature review: MK, SB, Writing: MK, DE, SB.

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A Large Radicular Cyst Mimicking Pleomorphic Adenoma: A Case Report

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Article Info	ABSTRACT
	This case report aimed to explain the diagnosis and treatment of a radicular cyst that is located on the palate, expands towards the nasal cavity, and causes breathing difficulty in the patient because it puts pressure on the nasal cavity. A 17-year-old female patient presented to our clinic with palatal swelling and difficulty breathing. Intraoral examination revealed a lesion on the right side of the hard palate that spread to the base. Radiographic examination revealed a unilocular radiolucent lesion with loss of border definition involving the roots of the right maxillary first molar, extending towards the nasal cavity. Since the clinical appearance was characteristic of minor salivary gland tumors, the differential diagnosis included pleomorphic adenoma. In aspiration biopsy, cyst fluid was aspirated from the lesion and the preliminary diagnosis was revealed as an odontogenic cyst. Due to the large size of the cyst, treatment was started with surgical marsupialization and incisional biopsy to protect the surrounding anatomical structures. The biopsy result was a benign inflamed cyst. The lesion was excised completely in the 6th month. Any recurrence was observed at a 1.5-year follow-up.

Pleomorfik Adenom ile Benzerlik Gösteren Büyük Radiküler Kist: Olgu Sunumu

Makale Bilgisi	ÖZET
	Bu olgu sunumunda sağ maksiller birinci molar dişten kaynaklanan, damakta şişlik oluşturan, nazal kaviteye genişlediği ve baskı yaptığı için nefes alma zorluğuna sebep olan radiküler kistin ayırıcı tanısı ve tedavisi anlatıldı. Damakta şişlik ve nefes alma zorluğu olan sistemik olarak sağlıklı on yedi yaşında kadın hasta kliniğimize başvurdu. Ağız içi muayenede sert damağın sağ tarafında tabana yayılan karakterde lezyon izlendi. Radyografik muayenede sağ maksiller birinci molar dişin köklerini içine alan, nazal kavite doğru genişlemiş, uniloküler radyolusent lezyon görüldü. Klinik görüntüsünün minör tükürük bezi tümörlerinin karakteristiğine uyması nedeniyle ayırıcı tanıda bening bir tükürük bezi tümörü olan pleomorfik adenom göz önüne alındı. Aspirasyon biyopsisinde lezyon içerisinden kist sıvısı aspire edildi. Ön tanı odontojenik kist olarak kondu. Kistin boyutlarının geniş olması sebebiyle, çevre anatomik yapıları koruma amaçlı tedaviye cerrahi marsüpyalizasyon ve insizyonel biyopsi ile başlandı. Biyopsi sonucu benign inflame kist olarak geldi. Marsüpyalizasyon tedavisi sonucu 6. ayda kitle total eksize edildi. 1,5 yıllık takip sonucunda nüks gözlenmedi.

INTRODUCTION

Radicular cysts are the most common cysts among all odontogenic cysts, with a rate of 57.3%. These lesions appear to be associated with tooth roots that have lost their vitality due to deep dentin caries and a history of trauma. [1] The most common places are anterior maxilla, posterior mandible and anterior mandible, respectively. Although it is seen in a wide age range, it peaks in the fourth and fifth decades. [2]

Radicular cysts are observed on radiological examination as well-circumscribed, radiolucent lesions associated with the apices of the affected tooth roots. It is uniform and unilocular. It is asymptomatic unless infected and does not grow too large and create asymmetry. They can be detected incidentally during radiological examination. [3] Although radiographic findings are similar to many cysts, the most important finding in the differential diagnosis of radicular cysts is that the involved teeth are nonvital. [2]

In treating radicular cysts, various methods are used such as root canal treatment, apical resection, marsupialization, enucleation, or enucleation following marsupialization. Preferred treatment; It is determined based on the size of the lesion, its proximity to vital structures, its location, and the presence of teeth and dental germs that need to be protected or maintained. [3]

This case report aimed to explain the diagnosis and treatment of a radicular cyst that is located on the palate expands towards the nasal cavity, and causes breathing difficulty in the patient because it puts pressure on the nasal cavity.

CASE:

A 17-year-old female patient applied to our clinic with complaints of swelling in the right palate and difficulty breathing through the nose (Figure 1).

According to the anamnesis, no systemic disorder was detected in the patient. During intraoral examination, a lesion measuring 15x15 mm in size, covered with healthy mucosa, slightly fluctuant on palpation, and spread to the floor was observed in the right maxilla palatal region (Figure 1).

Figure 1: Preoperative intraoral image

Panoramic x-ray examination revealed that the right maxillary first molar tooth had root canal treatment. A radiolucent unilocular lesion involving the apical part of this tooth, with clear borders at the lower end and indistinct borders at the upper end, was noticed.

Due to cone beam computed tomography (CBCT) examination, a lesion with a homogeneous, hazy appearance was observed, extending from the palatal root of the right maxillary molar tooth towards the hard palate and nasal cavity, measuring 30x30mm, with blurred borders in places (Figure 2).

Figure 2: Cone Beam Computed Tomography A: Coronal cross-section B: Sagittal cross-section C: Axial cross-section
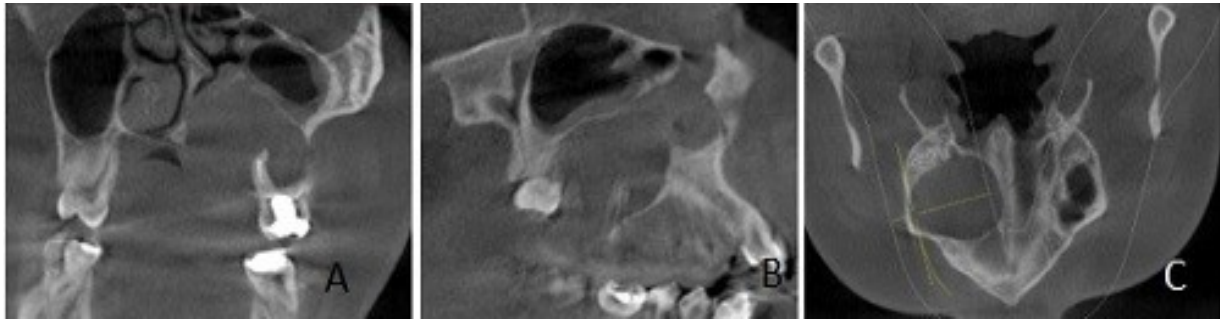
In the differential diagnosis, radicular cyst, pleomorphic adenoma, and odontogenic keratocyst were considered. A puncture biopsy was performed on the swelling with a 10cc syringe to understand the content of the lesion and help with the preliminary diagnosis. The resulting material was light yellow. When the gas was spread on the cloth, reflections of bright cholesterin crystals were observed. These findings strengthened the diagnosis of a radicular cyst. The root canal-treated right maxillary first molar tooth in the area supported this preliminary diagnosis. Since the lesion had expanded into the nasal cavity, marsupialization treatment was planned for protection instead of total excision. After the extraction of the right maxillary first molar tooth, a sample was taken from the lesion epithelium for biopsy. The lesion content was evacuated. The area was irrigated with saline. To create a marsupialization space, a sterile plastic tube was inserted and secured to the surrounding tissue using non-absorbable suture. The daily irrigation procedure was explained to the patient. The patient was prescribed antibiotics (amoxicillin + clavulanic acid 1 g, 2x1), analgesic (naproxen sodium 550 mg, 2x1), and antiseptic oral gargle (chlorhexidine gluconate 3x1) for pain and infection control. The rubber tube was removed during the 1st-week checkup. The patient reported that she could breathe easier than previously after the operation. The patient was regularly monitored to assess the closure of the cyst opening (Figure 3).

Figure 3: Intraoral image taken on the 10th day after the operation

The incisional biopsy result was reported as an inflamed cyst lined with benign-squamous epithelium. In the CBCT taken at the sixth month, it was noticed that the cyst had moved away from the nasal cavity and bone had formed in the maxilla (Figure 4). Enucleation of the lesion was planned as the second surgery. Infiltration anesthesia was applied to the area from the buccal and palatal regions A cut was made with a no. 15 scalpel around the area where marsupialization was performed. The cyst epithelium in the area was completely removed. The wound was sutured with a 3/0 non-absorbable suture. After the surgery, the patient was given important instructions for the recovery process and was given a prescription.

During patient follow-up, bone formation was observed in the relevant area and any recurrence was observed (Figure 5).

Figure 4: CBCT image of the lesion at 6 months after marsupialization. A: Coronal cross-section, B: Sagittal cross-section. C: Axial cross-section
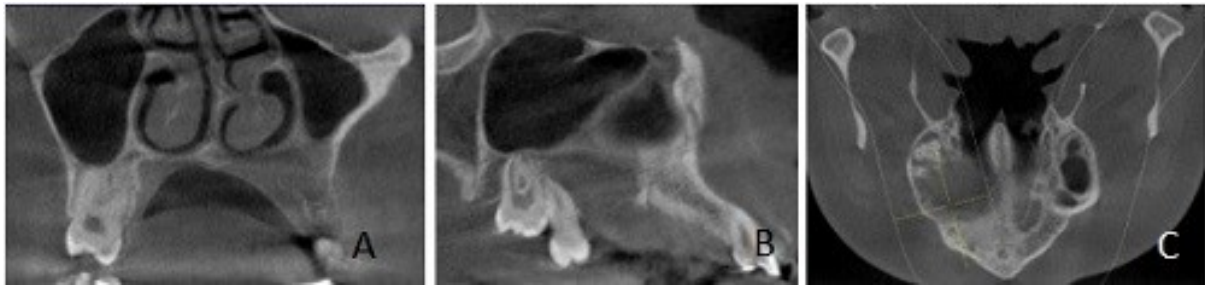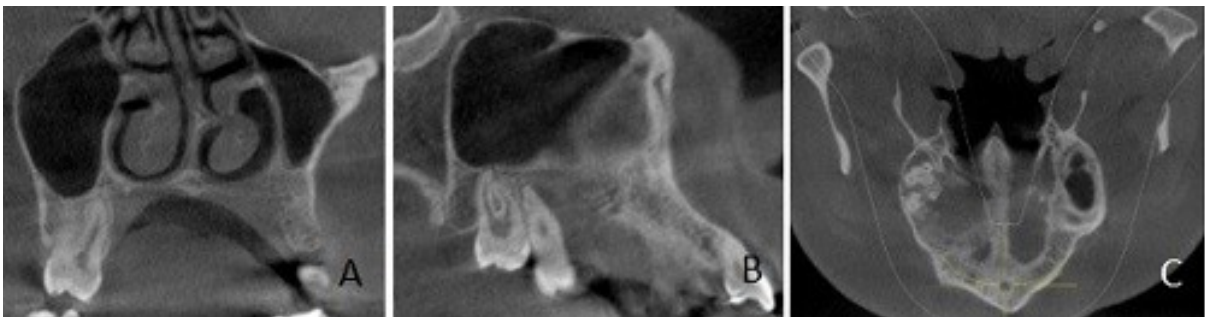

Figure 5: CBCT image of the lesion at 6 months after enucleation. A: Coronal cross-section. B: Sagittal cross-section. C: Axial cross-section.

DISCUSSION

Radicular cyst constitutes the inflammatory odontogenic cysts group of odontogenic cysts. Following necrosis of the dental pulp, epithelial residues in the periodontal ligament are stimulated due to apical granuloma, and the ground is prepared for a radicular cyst. A radicular cyst is routinely diagnosed during radiographic examination or when it shows acute symptoms. [4] Radicular cysts have a 60% higher prevalence in the maxilla than in the mandible. Radicular cysts grow slowly, can expand in the buccal or palatal region, and cause root resorption, displacement, and mobility of the teeth. When infected, it can lead to symptoms such as pain and swelling. [5] In this case, the radicular cyst caused swelling on the right side of the patient's palate and caused difficulty in breathing due to pressure on the nasal cavity. The lesion was detected after the patient applied due to these complaints. No root resorption or displacement was observed in the teeth, except for mild mobility in the right

maxillary first molar tooth. The asymptomatic course of radicular cysts may change as the cyst grows. Crepitation may occur due to thinning of the bone around the cyst, or fluctuation may develop following erosion under the soft tissue. [6] In our case, it was observed that the cyst caused bone erosion in the hard palate.

Radiographically, a radicular cyst appears as a round and unilocular radiolucency at the apex of a necrotic tooth, with radiopaque borders that are continuous with the lamina dura. However, this apparent radiopaque border may not be present in rapidly expanding cysts. [6] Panoramic radiographs may be insufficient to determine the anteroposterior dimension of the cyst. In this case, CBCT or computed tomography needs to be utilized for ascertaining the surgical margins. In our case, there was an image with unclear borders on the panoramic radiograph. In the CBCT images, it was seen that the borders of the cyst expanded from the right maxillary molar tooth to the hard palate and nasal cavity.

The hard palate is a special area of the mouth. It is lined with ortho-keratinized epithelium that adheres tightly to the underlying bone. The posterolateral part of the palate is thicker and softer. The submucosal region is rich in minor salivary glands, nerves, and vessels. Pathological lesions arising from the surrounding teeth, minor salivary glands, connective tissue, epithelium, bone, vessels, and nerves may cause lesions in this region. [7] In their study, Biswas and Crank conducted a prospective examination of the etiology and pathogenesis of maxillary swellings. According to the report, odontogenic cysts were identified as the most prevalent non-cancerous cause. Since there may be many reasons for swelling in the palate, diagnosis can sometimes be difficult. [8]

The differential diagnosis of radicular cysts includes Periapical granuloma, traumatic bone cyst, surgical ciliated cyst, globulomaxillary cyst, aneurysmal bone cyst, periapical cemental dysplasia, periapical cemento-osseous dysplasia, periapical scar, periapical surgical defect.[9] In this case, due to the clinical appearance, the primary differential diagnosis considered is pleomorphic adenoma; however, radicular cyst and keratocyst were also considered. The resemblance of the clinical picture to pleomorphic adenoma, a salivary gland tumor, was eliminated by the brightly yellow appearance of the material obtained in the aspiration biopsy. The endodontic treatment of the right maxillary first molar tooth in the area confirmed that the preliminary diagnosis was a radicular cyst.

Radicular cysts rarely reach sizes large enough to involve adjacent anatomical structures. Massive radicular cysts can sometimes extend into the maxillary sinuses. However, in this case, the pathological lesion started from the palatal root of the right maxillary first molar tooth and reached the nasal cavity via the hard palate. The cyst compressing the right nasal cavity caused breathing difficulty in the patient.

Surgical treatment options for cystic lesions; apical-resection, enucleation, and marsupialization. Treatment preferences are based on the cyst's size, location, wall integrity, and proximity to vital tissues. [10] Marsupialization is an effective surgical treatment technique preferred before enucleation in the treatment of cysts that have reached large sizes, due to its low complication rate. [11] Reducing the risk of postoperative fractures and preserving anatomical structures can be considered among the advantages of the marsupialization technique. [12] This technique has a drawback as it takes a significant amount of time to complete the treatment. It should be applied to patients who cooperate well. Marsupialization also provides decompression in the lesion area until the incisional biopsy result is confirmed. [13] In this case, marsupialization treatment was preferred because the cyst included the nasal cavity. During marsupialization, the patient was called at regular intervals to check patient cooperation and if the drainage opening was closed. In cases where patient cooperation is poor, enucleation should be considered as a treatment option. Marsupialization time is influenced by both the characteristics of the cyst and patient factors. Cases followed for 8 to 40 months have been reported in the sources. [14] In our case, marsupialization treatment was continued for 6 months. By the end of the sixth month, CBCT was taken again to evaluate the size of the cyst. It was observed that the cyst sizes decreased, bone formation began around the nasal cavity and the cyst was completely enucleated. The prognosis of radicular cysts after enucleation is quite good. However, in the cases where apical resection was performed instead of tooth extraction, recurrence may occur and a second surgery may be required. Although very rare, primary intraosseous carcinoma has been reported to develop in untreated cases. [2] In the

current case, no recurrence was observed during the 1.5-year follow-up after enucleation.

CONCLUSION

Accurate diagnosis and intervention are very important since swellings on the hard palate can occur due to various reasons. The differential diagnosis should be determined carefully and the most likely preliminary diagnosis should be made with accurate examinations. Since odontogenic cysts are not noticed until they cause symptoms, they can reach large sizes. Choosing marsupialization treatment for cysts that have reached a large size can reduce the risk of complications.

Ethical Approval

An ethics statement was not required for this study type and no human or animal subjects or materials were used.

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The authors have no relevant financial or non-financial interests to disclose.

Conflict of Interest

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

Author Contributions

Design: RTAÇ, Data collection and processing: RTAÇ, Analysis and interpretation: RTAÇ, Literature review: RTAÇ, Writing: RTAÇ, BB.

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