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Acta Stomatologica Naissi, Clinic of Dental Medicine, 52 Dr Zoran Djindjić Boulevard, 18000 Niš, Serbia
www.medfak.ni.ac.rs/ASN/
Telefon/Phone: +381 (0)18 453 86 55

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NAJČEŠĆA BOLEST ZUBA U OČIMA STUDENTSKE POPULACIJE

THE MOST COMMON DENTAL DISEASE IN THE EYES OF THE STUDENT POPULATION

Aleksandra S. Milovanović[1], Marija M. Nikolić[2,3], Aleksandar D. Mitić[2,3], Jelena Z. Popović[2,3], Nenad M. Stošić[2,3], Antonije S. Stanković[2]

[1]UNIVERZIET U NIŠU, MEDICINSKI FAKULTET, STUDENT DOKTORSKIH STUDIJA, NIŠ, SRBIJA
[2]UNIVERZITET U NIŠU, MEDICINSKI FAKULTET, KATEDRA BOLESTI ZUBA I ENDODONCIJA, NIŠ, SRBIJA
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[1]UNIVERSITY OF NIŠ, FACULTY OF MEDICINE, DOCTORAL STUDIES, NIŠ, SERBIA
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[3]CLINIC OF DENTAL MEDICINE, DEPARTMENT OF RESTORATIVE DENTISTRY AND ENDODONTICS, NIŠ, SERBIA

Sažetak

Uvod: *Karijes predstavlja jednu od najčešćih bolesti usne duplje i značajan javnozdravstveni problem, naročito zbog visokog procenta obolelih i posledica koje izaziva. Premda je prevencija karijesa moguća, učestalost ove bolesti i dalje je visoka, delimično zbog nedovoljne informisanosti o njenim uzrocima i merama prevencije.*
Cilj: *Cilj ovog istraživanja bio je da se ispita nivo informisanosti studenata Univerziteta u Nišu o nastanku karijesa, budući da je to od velikog značaja za razvoj efikasnih edukativnih strategija. Materijal i metode: Istraživanje je sprovedeno korišćenjem onlajn ankete koja je obuhvatila dvesta dvadeset šest studenata na različitim fakultetima Univerziteta u Nišu; pritom, studenti stomatologije nisu bili uključeni u istraživanje. Upitnik se sastojao od dvanaest pitanja zatvorenog tipa koja su se odnosila na znanje o zubnom karijesu.*
Rezultati: *Veliki broj ispitanika posećuje stomatologa tek kada oseti bol (48,7%), dok 32,7% njih redovno odlazi na preventivne preglede. Većina ispitanika prepoznaje ugljene hidrate kao glavni uzrok nastanka karijesa, a 65,5% njih smatra da je četkica za zube važnija od paste za zube. Takođe, većina ispitanika ne primenjuje specifične tehnike pranja zuba.*
Zaključak: *Pokazalo se da nivo informisanosti studentske populacije o karijesu ostavlja prostora za unapređenje, posebno kada je reč o oblasti tehnikama održavanja oralne higijene i razumevanja mehanizama nastanka ove bolesti.*

Ključne reči: *zubni karijes, studenti, oralno zdravlje, stavovi*

Abstract

Introduction: *Caries is one of the most common diseases of the oral cavity and represents a significant public health problem, especially due to the high percentage of affected patients and its consequences. Although the prevention of caries is possible, the incidence of this disease remains high, partly due to the lack of adequate information about its causes and preventive measures.*
Aim: *This study aimed to examine the level of information among students at the University of Niš regarding the development of dental caries, which is crucial for developing effective educational strategies.*
Material and Methods: *The research was conducted via an online survey that included 226 students from various faculties, excluding dental students, using 12 closed-ended questions related to knowledge of dental caries.*
Results: *A large number of respondents visit the dentist only when they experience pain (48.7%), while 32.7% of them regularly undergo preventive examinations. The majority of respondents recognize carbohydrates as the main cause of dental caries, while 65.5% believe that the toothbrush is more important than toothpaste. The majority of respondents do not employ specific tooth-brushing techniques.*
Conclusion: *The awareness of the student population about caries leaves room for improvement, especially in the areas of oral hygiene techniques and the understanding of how this condition develops.*

Key words: *dental caries, students, oral health, attitudes*

Corresponding author:
Aleksandra S. Milovanović, DMD, PhD student,
University of Niš, Faculty of Medicine
81 Dr. Zorana Djindjića Blvd., Niš, Serbia
E-mail: aleksandra.milovanovic98@gmail.com

Introduction

Caries is one of the most common diseases that begins in early childhood[1,2,3,4]. Caries is the primary cause of pain in the orofacial region and tooth loss[3,4,5]. It can be stopped in its early stages, but it is often not self-limiting, and without proper treatment, caries can progress until the destruction of the tooth[4]. Dental caries is defined as localized demineralization of hard dental tissues and represents one of the most common oral health problems. Based on information provided by the World Health Organization, 2.4 billion people worldwide (more than 90% of the total population) have caries[6]. Modern lifestyle also influences diet, and therefore, the appearance of caries.

Despite significant advances in dental science and preventive measures, the incidence of caries remains high[7]. Being informed about the causes, symptoms of caries, and preventive measures is key to reducing its frequency and improving oral health. Some studies have shown that oral hygiene education and regular dental examinations significantly reduce the risk of caries development[8,9]. According to research, a low level of information about oral health is often associated with higher caries rates, especially in populations with lower socioeconomic status[10,11,12]. Also, the source of information that people use, such as the media, the Internet and health professionals, has a significant impact on their knowledge and behavior related to oral health[13]. The importance of people being informed about oral health indicates the necessity of examining that information, which would indicate the measures and actions that should be taken in order to raise that level. This research aimed to examine the level of information among students of the University of Niš about the occurrence of caries.

Materials and Methods

The study involved 226 students from the University of Niš, with dental students being excluded due to the assumption that they had already acquired knowledge on this topic as part of their academic programs. The study sample consisted of 175 female participants with an average age of 22.56 ± 2.46 years and 51 male participants with an average age of 23.24 ± 2.37 years. The average age of all participants was 22.71 ± 2.45 years.

The study was conducted through an online survey created in Google Forms, to which participants voluntarily accessed via social media. The questions were designed in accordance with the objectives of the study, following the steps for designing and applying online surveys defined by Regmi et al.[14]. The questionnaire consisted of 12 closed-ended questions related to students' awareness of dental caries. These questions are shown in Table 1.

The responses were collected and statistically processed using the methods of non-parametric descriptive statistics, using the IBM SPSS version 26.0 program. To determine the statistical significance of the difference in the answers to the questions in relation to the sex of the respondents, the age of the respondents and the faculty where the respondents study, the chi-square test was used with a significance of $p < 0.05$.

Table 1. Questions used in the survey

	Questions about students' familiarity with caries
1.	Do you go to the dentist only when you have a toothache or for regular preventive examinations?
2.	Which foods do you think contribute to the appearance of caries?
3.	When brushing your teeth, is the brush or the toothpaste more important?
4.	What brushing technique do you use?
5.	Do you think that, in adulthood, caries is more common in men or women?
6.	Do you think pregnancy causes tooth decay?
7.	Do you think that the tendency to caries is inherited?
8.	Do you think that caries is only a disease of the teeth or a disease that can also cause disease of other organs?
9.	Do you think that caries can be an infectious disease (can it be transmitted through kissing)?
10.	Do you think that drugs can cure caries?
11.	Where did you gain the most knowledge about caries?
12.	How do you rate your knowledge about caries?

Results

The obtained results are shown in Tables 2–13.

Table 2. Question No. 1. When do you go to the dentist?

	Number of respondents	**%**
As soon as my tooth hurts, or when I notice something on the tooth	110	48.7
When the pain becomes unbearable	11	4.9
When I have had a toothache for a long time	31	13.7
Preventive (twice a year)	74	32.7
Total	226	100

****There is no statistically significant difference in relation to gender***
χ^2 = 2.391; DF = 3; p = 0.495

Table 3. Question No. 2. Which foods do you think are responsible for caries?

	Number of respondents	**%**
Fats	4	1.8
Proteins (eggs, milk, meat, yoghurt)	3	1.3
Carbohydrates (bread, sweets, sodas)	219	96.9
Total	226	100

****There is no statistically significant difference in relation to gender***
χ^2 = 0.199; DF = 2; p = 0.905

Table 4. Question No. 3. What is more important when brushing your teeth?

	Number of respondents	**%**
Brush	76	33.7
Don't know	3	1.3
Paste	7	3.1
Equal	140	61.9
Total	226	100

****There is a statistically significant difference in relation to gender***
$\chi2$ = 13.712; DF = 3; p = 0.003

Table 5. Question No. 4. What brushing technique do you use?

	Number of respondents	**%**
Other	15	6.6
I don't have a special technique	84	37.2
On the advice of the Internet	4	1.8
On the advice of the dentist	123	54.4
Total	226	100

****There is no statistically significant difference in relation to gender***
χ2 = 6.129; DF = 3; p = 0.101

Table 6. Question No. 5. Do you think that caries are more common in adulthood?

	Number of respondents	**%**
The same	107	47.3
For males	19	8.4
For females	37	16.4
I don't know	63	27.9
Total	226	100

****There is no statistically significant difference in relation to gender***
χ2 = 1.779; DF = 3; p = 0.619

Table 7. Question No. 6. Do you think pregnancy causes caries?

	Number of respondents	**%**
Yes	70	31
No	91	40.2
I don't know	65	28.8
Total	226	100

****There is a statistically significant difference in relation to gender***
χ2 = 10.261; DF = 2; p = 0.006

Table 8. Question No. 7. Do you think that the tendency to caries is inherited?

	Number of respondents	**%**
Yes	104	46
No	70	31
I don't know	52	23
Total	226	100

****There is a statistically significant difference in relation to gender***
χ2 = 9.558; DF = 2; p = 0.008

Table 9. Question No. 8. Do you think that caries is ...?

	Number of respondents	**%**
Exclusively dental disease	75	33.2
A disease that can cause disease of other organs and possibly become life-threatening	144	63.7
Only an aesthetic problem	7	3.1
Total	226	100

****There is no statistically significant difference in relation to gender***
$\chi 2 = 1.329$; DF = 2; p = 0.515

Table 10. Question No. 9. Do you think that caries can be an infectious disease (can it be transmitted through kissing)?

	Number of respondents	**%**
Yes	25	11.1
No	176	77.8
I don't know	25	11.1
Total	226	100

****There is no statistically significant difference in relation to gender***
$\chi 2 = 7.834$; DF = 2; p = 0.20

Table 11. Question No. 10. Do you think that some medicines can cure caries?

	Number of respondents	**%**
Antibiotics	12	5.3
Fluorides	22	9.7
Medicines cannot cure caries	192	85
Total	226	100

****There is a statistically significant difference in relation to gender***
$\chi 2 = 11.462$; DF = 2; p = 0.003

Table 12. Question No. 11. Where did you get the most knowledge about caries?

	Number of respondents	**%**
At the dentist	93	41.2
On the Internet	32	14.2
I was not interested in caries	55	24.3
In the family	19	8.4
At school	27	11.9
Total	226	100

****There is no statistically significant difference in relation to gender***
$\chi 2 = 0.229$; DF = 4; p = 0.994

Table 13. Question No. 12. How do you rate your knowledge about caries?

	Number of respondents	**%**
Sufficient	126	55.7
Insufficient	84	37.2
Excellent	16	7.1
Total	226	100

****There is no statistically significant difference in relation to gender***
$\chi 2 = 2.435$; DF=2; $p = 0.296$

There is no statistical significance in relation to the years and faculties that the respondents attended.

Discussion

The use of surveys as a methodological technique enables a detailed study of patterns and changes in health perceptions within different groups of people[15]. Although surveying in psychometrics has certain weaknesses, such as responses aligned with social norms and the representation of behavior rather than actual observations, it remains a key tool for measuring and analyzing differences among people[16].

The research results indicate a similar pattern of behavior, where a significant percentage of respondents (48.7%) visit the dentist only in case of pain or visible changes in the tooth. Nevertheless, the fact that some respondents recognize the importance of preventive examinations is encouraging, since 32.7% of students undergo examinations twice a year. Croatian researchers[17] reached similar results, where a third of the respondents (32.9%) visit the dentist only after the onset of symptoms such as pain or swelling, while 59.8% of the respondents regularly undergo preventive dental examinations.

When it comes to the cause of caries, the respondents are aware that carbohydrates (bread, sweets, carbonated juices, etc.) cause caries to the greatest extent. Almost 97% of respondents believe that this food is the biggest cause of caries. In a similar study by Luis F. Duany et al.[18], where a study was conducted among the population with caries and without caries, it showed that there were significant differences in the way of eating. The group with caries consumed more carbohydrates than the group without caries.

The majority of respondents (65.5%) concluded that avoiding chocolate contributes to the preservation of dental health. However, a smaller percentage of respondents (23.4%) believe that the method of chocolate consumption, and not the consumption itself, plays a key role in the occurrence of caries. The cariogenicity of carbohydrates significantly depends on their concentration, physical properties and speed of elimination from the oral cavity. Greater cariogenicity is associated with the consumption of carbohydrates in sticky form, such as, for example, chocolates[19].

A third of respondents consider a toothbrush more important, while only 3.1% prefer toothpaste. The majority of respondents (61.9%) rate both elements as equally important for oral hygiene. These findings are in line with the research conducted by Luka Pool[20] where it was found that the majority of students (66.3%) use both a brush and a paste as caries prevention. There is a statistically significant difference ($p = 0.030$) between male and female respondents regarding the opinion of what is more important when brushing teeth, with men more often perceiving the paste as more important than the brush. When it comes to tooth brushing techniques, the research results reveal worrying data that more than a third of respondents (37.2%) do not use a specific tooth brushing technique. These data indicate insufficient education on proper tooth brushing technique, which can lead to worse results in maintaining oral health. Interestingly, only 1.8% of respondents brush their teeth based on internet advice, while the majority, 54.4%, follow recommendations from their dentists. Although the internet is becoming an increasingly common source of information, the results indicate that students still recognize dentists as the main authorities regarding proper oral hygiene maintenance. This information may indicate the need for greater

involvement of dentists in the education and promotion of oral health, both in the advisory and digital environment, through verified and accurate information.

In scientific circles, the question is often raised whether gender has an influence on the occurrence of caries. Based on the conducted research, it was determined that 47.3% of respondents believe that gender does not play a significant role in the occurrence of caries and that its frequency is equal in men and women in adulthood. On the other hand, 8.4% of respondents believe that caries is more common in men, while 16.4% believe that it is more common in women. However, the research by Ferraro M et al.[21] indicates that almost half of the respondents have the wrong assumption that gender does not affect the prevalence of caries. Women have a higher caries prevalence rate compared to men, which is explained by earlier tooth eruption and longer exposure to a potentially cariogenic environment.

According to the research results, 31% of respondents believe that pregnancy causes caries, 40.3% believe that it does not. However, it cannot be said that pregnancy is the cause of caries, because the mechanisms connecting pregnancy and oral health are not completely clear[22]. Hormonal changes, inadequate education of pregnant women about oral hygiene and increased sugar consumption during pregnancy are key risk factors for caries[23]. A statistically significant difference ($p = 0.006$) exists between male and female respondents regarding the opinion of whether pregnancy causes tooth decay, with female respondents showing greater awareness of the connection between pregnancy and tooth decay compared to male respondents.

About half of the respondents believe that the tendency to caries is inherited. There is data in the literature that indicates the influence of the hereditary factor. Researchers from India found that children whose mothers had high levels of S. mutans bacteria were more likely to develop caries[24]. Studies[25,26] based on whole genome analysis have provided evidence for a genetic role in caries etiology. There is a statistically significant difference ($p = 0.008$) between male and female respondents, with women more likely to believe that caries is inherited compared to men.

Over 60% of respondents believe that caries can contribute to the development of diseases of other organs and even endanger life. The rest believe that caries is exclusively a disease of the teeth (33.6%). Such findings can be explained by the growing number of scientific evidences that indicate complex and significant relationships between oral microorganisms and various systemic diseases, as well as the potential role of oral microorganisms in the pathogenesis of systemic human diseases[27].

When it comes to the transmission of caries as an infectious disease, the research results show that 77.9% of respondents believe that caries is not an infectious disease and that it is not transmitted by kissing, while 11.1% believe that caries is an infectious disease. A similar study conducted in Italy showed a different distribution of attitudes, where 54% of respondents recognized caries as an infectious disease, while 33% did not consider caries to be contagious[28]. The differences in results between the two studies can be attributed to the fact that the samples consisted of respondents of different ages, which probably influenced the responses and perceptions of the research topic. Differences in the perception of caries transmission can be partly explained by the fact that microorganisms, such as Streptococcus mutans, which are responsible for the formation of caries, can be transmitted through saliva, thus increasing the risk of disease transmission through kissing.

Regarding the treatment of caries, the majority (85%) of the surveyed students are well informed, because they believe that drugs cannot cure caries. Interestingly, 15% of respondents have the opinion that caries can be cured with drugs (5.3% think that caries can be cured with fluorides, while 9.7% think that it can be cured with antibiotics). Caries is a process of decomposition of hard dental tissues, caused by the action of acids produced by bacteria in dental plaque. Once destruction occurs, it cannot be regenerated with drugs[29]. There is a statistically significant difference between male and female respondents, whereby women believe to a greater extent that drugs cannot cause caries compared to men.

Although caries is one of the most widespread diseases in the human population[30], it is interesting that almost a quarter of respondents (24.3%) did not show interest in acquiring information about this disease. On the other hand, 14.2% of respondents use the Internet as a source of information about caries, and their veracity is questionable[31]. The smallest number of respondents acquire knowledge about dental caries in the school environment (11.9%), or in the family environment (8.4%), whereby information obtained from parents positively

correlates with their level of education[32]. Researchers from Korea also recorded a low level of information about caries that is acquired at school (only 1.3%), but also a slightly higher percentage of information that is acquired in the family environment[33]. Differences in results can be attributed to cultural specificities. An encouraging result is that the largest share of respondents (41.2%) receives information about caries primarily from a dentist who is a medical authority regarding the prevention and treatment of this disease[34].

Analysis of answers to questions about preventive measures and caries treatments shows that students are often not fully aware of all aspects of oral hygiene, which can be attributed to a lack of adequate education and information. Accordingly, a large number of respondents (37.2%) rate their knowledge about caries as insufficient, 55.8% as sufficient, and only 7.1% as excellent. Insufficient knowledge about caries can affect students' ability to recognize and apply effective strategies for caries prevention and treatment.

Conclusion

Based on the research results, there is a significant mismatch between students' actual knowledge about dental caries and the required level of awareness regarding preventive measures. Although students are generally aware of the basic risk factors for developing caries, such as a diet rich in carbohydrates, the study shows a lack of education on preventive measures and caries treatment, as well as a low interest in acquiring information about this disease. It is positive that the majority of respondents are aware that caries can have systemic consequences, and that despite the abundance of available information, the dentist is still regarded as the primary authority.

Due to all of the above, it can be concluded that there is room for better education and further emphasis on the importance of oral health.

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ORALNE MANIFESTACIJE POVEZANE SA CELIJAKIJOM KOD SIRIJSKIH PACIJENATA: STUDIJA PRESEKA

ASSOCIATION OF ORAL MANIFESTATIONS WITH CELIAC DISEASE IN SYRIAN PATIENTS: A CASE-CONTROL STUDY

Aliaa H Al Shaar[1], Omar H Hamadeh[1], Ayman F Ali[2]

[1]UNIVERZITET U DAMASKU, FAKULTET DENTALNE MEDICINE, KATEDRA ZA ORALNU MEDICINU, DAMASK, SIRIJA
[2]UNIVERZITETE TISHREEN, MEDICINSKI FAKULTET, KATEDRA ZA INTERNU MEDICINU, LATAKIJA, SIRIJA

[1]DEPARTMENT OF ORAL MEDICINE, FACULTY OF DENTAL MEDICINE, DAMASCUS UNIVERSITY, SYRIA
[2]DEPARTMENT OF INTERNAL MEDICINE, FACULTY OF MEDICINE, TISHREEN UNIVERSITY, SYRIA

Sažetak

Uvod: *Celijakija je autoimuno oboljenje koje primarno izaziva unos glutena iz pšenice, ječma i ovsa. Može se manifestovati i simptomima koji ne zahvataju digestivni trakt; činjenica da gastrointestinalne tegobe mogu izostati otežava pravovremenu dijagnozu i smanjuje dijagnostičku prepoznatljivost ove bolesti. Oralne manifestacije predstavljaju važne indikatore u identifikaciji celijakije kod pacijenata. Prepoznajući karakteristične oralne znakove i upućujući pacijente na konačnu dijagnostičku evaluaciju, stomatolozi igraju ključnu ulogu u ranom otkrivanju celijakije. Cilj ove studije bio je da se ispitaju oralne manifestacije povezane sa celijakijom.*
Materijali i metode: *Sprovedena je studija tipa slučaj–kontrola sa sedamdeset ispitanika, koji su bili podeljeni u dve grupe: u prvoj grupi bilo je trideset pet osoba sa dijagnostikovanom celijakijom, a u drugoj trideset pet zdravih ispitanika, koji su činili kontrolnu grupu. Oralni nalazi – rekurentne aftozne stomatitis (engl. Reccurent Aphtosus Ulcers – RAU), blede i ispucale usne, angularni heilitis (žvale), atrofični glositis (glatki jezik) i benigni migrirajući glositis (geografski jezik) – pregledani su pod halogenim osvetljenjem, uz pomoć sterilnog stomatološkog ogledala.*
Rezultati: *U studiji je korišćen X^2 test, koji je ukazao na postojanje značajnih razlika između grupe ispitanika sa celijakijom i kontrolne grupe. Statistički značajna povezanost uočena je između celijakije i RAU-a ($p = 0,000$), [A4.1][MN4.2]atrofičnog glositisa ($p = 0,041$) i benignog migrirajućeg glositisa ($p = 0,000$). Nasuprot tome, između posmatranih grupa nije zabeležena statistički značajna razlika kada je reč o učestalosti pojave bledih i ispucalih usana ($p = 0,066$) i angularnog heilitisa ($p = 0,779$).*
Zaključak: *Rezultati ove studije preseka pružili su uvid u oralne manifestacije povezane sa celijakijom. Takođe, u studiji je istaknut značaj rutinskih stomatoloških pregleda i ranog prepoznavanja oralnih manifestacija kod osoba sa celijakijom, s obzirom na to da one mogu biti važni klinički indikatori pomenutog autoimunog poremećaja.*

Ključne reči: *celijakija, oralne manifestacije, rekurentni aftozni stomatitis*

Corresponding author:
Aliaa H Al Shaar, DDS, Department of Oral Medicine, Faculty of Dental Medicine, Damascus University
E-mail: aliaa.alshaar@damascusuniversity.edu.sy
ORCID: 0009-0003-8114-8399

Abstract

Introduction: *Celiac disease is an autoimmune condition that is primarily elicited by the ingestion of gluten from wheat, barley and oats. Celiac disease may present with extra-intestinal symptoms despite the absence of gastrointestinal complaints, complicating timely diagnosis and leading to underrecognition. Oral manifestations are valuable indicators for identifying patients with celiac disease. In this context, dentists are pivotal in the early detection of celiac disease by recognizing characteristic oral signs and referring patients for definitive diagnostic evaluation. The objective of this study was to explore the oral manifestations associated with celiac disease.*
Materials and Methods: *A case-control study was conducted involving 70 participants grouped as follows: 35 individuals diagnosed with celiac disease and 35 individuals representing the control group. Oral findings—recurrent aphthous ulcers (RAU), pallor and fissured lips, angular cheilitis, atrophic glossitis, and geographic tongue—were examined under halogen illumination using a sterile dental mirror.*
Results: *The study employed chi-square analysis to identify significant differences between the celiac disease group and the control groups. Significant associations were detected between celiac disease and recurrent aphthous ulcerations ($p = 0.000$), atrophic glossitis ($p = 0.041$), and geographic tongue ($p = 0.000$). However, no significant difference was observed in the incidence of pallor and fissured lips ($p = 0.066$) and angular cheilitis ($p = 0.779$) between the two groups.*
Conclusion: *The outcomes of this cross-sectional study provide valuable insights into the oral manifestations associated with celiac disease. The study underscores the significance of routine dental examinations and the early identification of oral manifestations in individuals diagnosed with celiac disease, as they may serve as crucial clinical indicators of the underlying autoimmune disorder.*

Key words: *celiac disease, oral manifestations, recurrent aphthous ulcers*

Introduction

Celiac disease, an autoimmune disorder affecting the gastrointestinal tract in genetically susceptible individuals, can manifest at any age as a result of the immune response to gluten found in wheat, barley and oats. Intestinal damage leads to malabsorption of crucial nutrients, resulting in vitamins (vitamin D), minerals (iron, calcium), and folic acid deficiencies, contributing to conditions such as osteoporosis, delayed growth, enamel degradation, and oral manifestations[1]. Diagnosis of celiac disease involves initial serological tests followed by histological examination of duodenal biopsies. The sole treatment for celiac disease currently entails strict adherence to a lifelong gluten-free diet[2]. Primary symptoms of celiac disease typically include chronic diarrhea, abdominal pain, weight loss, and muscle weakness[3]. Typically, the disease may manifest with symptoms outside the digestive system such as short stature, non-responsive anemia, dermatitis herpetiformis, and joint pain, alongside various oral manifestations including recurring oral ulcers, pale and fissured lips, angular cheilitis (is an inflammation at the commissures of the lips), atrophic glossitis (is characterized by the partial or complete absence of filiform papillae on the dorsum of the tongue), and geographic tongue (there is the recurrent appearance and disappearance of red areas on the tongue)[4,5]. Although there is a clear association between celiac disease and oral manifestations, the current medical literature lacks conclusive research establishing a direct connection between oral signs and celiac disease. Dentists have a vital role in detecting celiac disease through its atypical or extra-intestinal presentations. The presence of these oral manifestations can assist in identifying celiac disease even when digestive symptoms are absent[6,7]. The prevalence of celiac disease in the general population ranges from 0.5% to 1%, with a high proportion of undiagnosed cases until adulthood[8]. The prevalence of celiac disease in Arab countries was investigated in a review study, which included 35 studies from 12 Arab countries published between 1996 and 2019. The highest prevalence of celiac disease was in Saudi Arabia (3.2%), and the lowest prevalence was in Tunisia (0.1%)[9]. This study aimed to investigate the prevalence of oral manifestations associated with celiac disease in individuals from the Syrian Arab Republic, specifically in the city of Damascus.

Materials and Methods

A case-control study was conducted in Damascus, Syrian Arab Republic between September 2022 and April 2023. This study represents the first of its kind in this region. Patients visiting Gastroenterology Clinic of Damascus hospital and the Department of Oral Medicine at the Faculty of Dentistry, Damascus University were included in the study. Ethical approval for the study was obtained from the Ethics Committee at Damascus University under approval number DN-241023-8-H7.

Inclusion and exclusion criteria involved individuals diagnosed with celiac disease confirmed by duodenal biopsy, aged 18 years and above, with no history of systemic diseases other than celiac disease. The control sample comprised individuals matched for age and gender with the study sample, with no history of any digestive diseases. None of the participants were on any medication regimen or had any systemic diseases, such as hemolytic anemia or chronic renal failure.

This study comprised 70 individuals, allocated into two groups as follows: 35 patients diagnosed with celiac disease and 35 individuals representing the control group. The allocation of participants into these groups was determined using the G*Power 3.1.9.2 program with a significance level set at 0.05, confidence level at 0.95, and a size effect of 0.8.

The participants received comprehensive details on the study's objectives and procedures, and written informed consent was obtained from each individual. Additionally, the patient has granted consent for the publication of their case details and images. Demographic information encompassing age, gender, the patients' history, medication intake, and oral lesions was methodically documented. A sole examiner, adequately trained, meticulously examined the oral cavity using a sterile dental mirror under halogen light in a clinical setting. The examiner meticulously assessed the presence of various oral manifestations, such as recurrent aphthous ulcerations (RAU), atrophic glossitis, pallor and fissured lips, geographic tongue, and angular cheilitis. The clinical presentation of each oral condition—including lesion size, frequency of episodes, and associated discomfort—was systematically recorded. The documented clinical appearances were based on both the patients' medical history and

observed clinical manifestations, ensuring reliability in the assessment process while minimizing examiner variability and bias.

Data were tabulated and analyzed using SPSS software (SPSS Version 20, IBM SPSS Inc., Chicago, IL, USA). Statistical tests, such as the chi-square, were used to test the research hypotheses. Results presented in appropriate tables were considered significant if the p-value was < .05.

Results

This case-control study included 70 participants, divided equally into two groups: 35 patients diagnosed with celiac disease and 35 healthy controls. The mean age of the celiac group was 36.45 ± 9.63 years, while the control group had a mean age of 36.00 ± 9.63 years, as shown in Table 1. Gender distribution was similar across groups.

As illustrated in Table 2 and Figure 1, recurrent aphthous ulcers were found in 85.3% of patients with celiac disease (n = 29), compared to 38.2% of controls (n = 13). This difference was statistically significant (χ^2 = 15.941, p < 0.001).

Atrophic glossitis was observed in 32.4% of celiac patients (n = 11), versus 11.8% of controls (n = 4), showing a significant association (χ^2 = 4.191, p = 0.041). Geographic tongue was present in 73.5% of patients with celiac disease (n = 25) and 26.5% of controls (n = 9), also statistically significant (χ^2 = 15.059, p < 0.001).

In contrast, no significant difference was found between the two groups in the occurrence of pallor and fissured lips (χ^2 = 3.376, p = 0.066) or angular cheilitis (χ^2 = 0.780, p = 0.779). These findings are detailed in Table 2 and further illustrated in Figures 2–5.

Table 1. Descriptive statistics of this study

Groups				Male		Female	
	Number	average age	Standard deviation	number	percentage	number	Percentage
Control	35	36	9.63	12	35.8%	22	64.7%
Celiac	35	36.45	9.63	13	38.2%	20	58.8%

Table 2. Descriptive analysis and study of the presence of a significant difference

Variables in the celiac group		Number	Percentage	Variables in the control group		Number	Percentage	Chi-square test	P-value	Significance test
Recurrent aphthous ulcerations	No	5	14.7%	Recurrent aphthous ulcerations	No	21	61.8%	15.941	0.000	There is a statistically significant difference
	Yes	29	85.3%		Yes	13	38.2%			
Atrophic glossitis	No	23	67.6%	Atrophic glossitis	No	30	88.2%	4.191	0.041	There is a statistically significant difference
	Yes	11	32.4%		Yes	4	11.8%			
Geographic tongue	No	9	26.5%	Geographic tongue	No	25	73.5%	15.059	0.000	There is a statistically significant difference
	Yes	25	73.5%		Yes	9	26.5%			
Pallor and fissured lips	No	26	76.5%	Pallor and fissured lips	No	27	79.4%	3.376	0.066	There is no statistically significant difference
	Yes	14	41.2%		Yes	7	20.6%			
Angular cheilitis	No	26	76.5%	Angular cheilitis	No	25	73.5%	0.78	0.779	There is no statistically significant difference
	Yes	8	23.5%		Yes	9	26.5%			

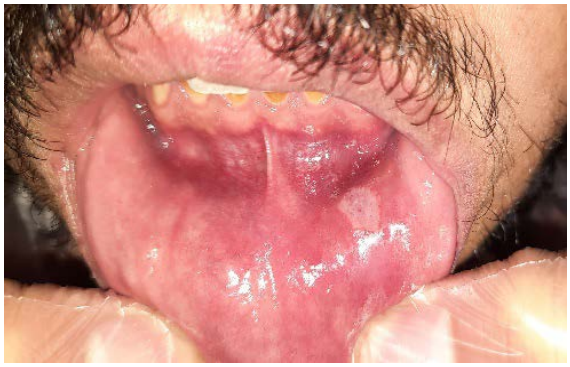

Figure 1. The occurrence of oral lesions in the study sample

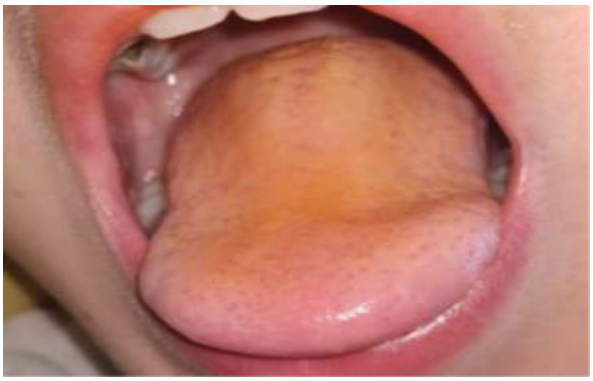

Figure 2. Recurrent oral ulcer in a patient with celiac disease

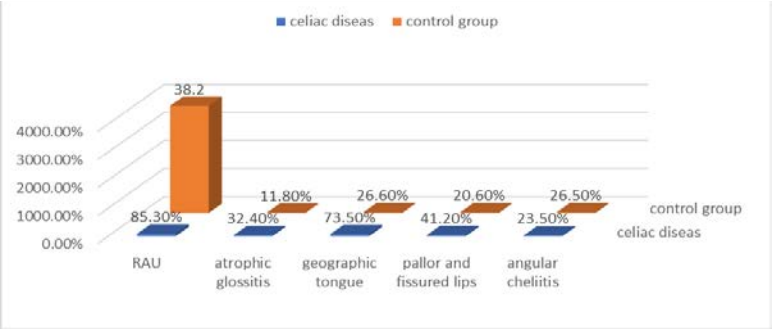

Figure 3. Atrophic glossitis in a patient with celiac disease

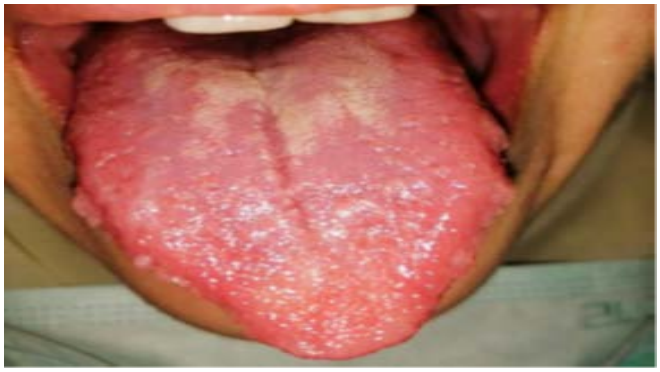

Figure 4. Geographic tongue in a patient with celiac disease

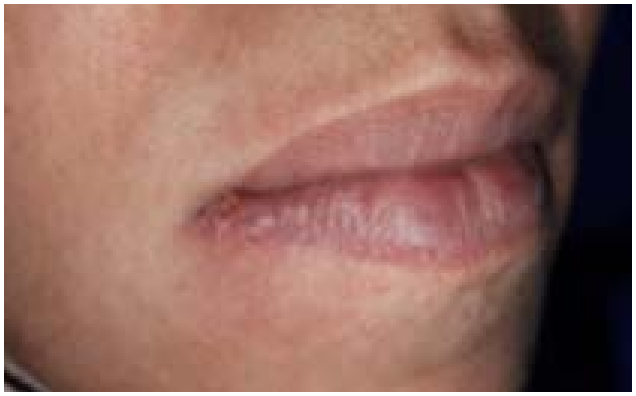

Figure 5. Angular cheilitis in a patient with celiac disease

Discussion

Celiac disease is a chronic autoimmune disorder of the small intestine, characterized by villous atrophy and triggered by gluten ingestion in genetically susceptible individuals. Although classical gastrointestinal symptoms such as diarrhea, malabsorption, and weight loss were once hallmark indicators, their prevalence has declined, and many patients—particularly adults—now exhibit a non-classical or asymptomatic form. This atypical presentation contributes significantly to delayed or missed diagnoses. The anatomical and functional interplay between the gastrointestinal tract and the oral cavity has highlighted a frequent association between celiac disease and extra-intestinal manifestations, notably oral soft tissue lesions. These oral signs, particularly common among individuals with nonclassical celiac disease, emphasize the pivotal role of dental examinations in facilitating early detection and improving clinical outcomes[10].

Recurrent aphthous ulceration (RAU) is a common oral lesion in patients with celiac disease, characterized by painful ulcers bordered by an erythematous halo. Its unclear etiology is attributed to immune dysregulation, genetic factors, and deficiencies in iron, folic acid, or vitamin B12[11]. In this study, RAU was the most frequently observed manifestation, occurring in 85.3% of cases, which is consistent with previous literature[12–14]. In contrast, the other studies reported no statistically significant difference in the occurrence of recurrent aphthous ulcers in patients with celiac disease compared to the control group[3,15,16].

However, variations in prevalence across studies may reflect differences in patient age, geographic distribution, or diagnostic criteria. While earlier research predominantly focused on younger individuals, the current findings suggest significant RAU expression in adults, raising questions about age-related trends. Further research is essential to clarify the pathophysiological mechanisms and to determine the role of nutrient deficiencies and malabsorption in RAU development within this population[17].

Atrophic glossitis and geographic tongue also appeared significantly more often in the celiac group compared to controls, supporting findings from earlier literature. These conditions may reflect the impact of nutrient malabsorption, especially iron and vitamin B-complex deficiencies commonly associated with untreated celiac disease[6,12,18].

Conversely, angular cheilitis and pallor and fissured lips did not differ significantly between groups, in contrast to some published reports, suggesting that these features may be less specific indicators of celiac pathology[6,7,19].

Limitations

This study was subject to several methodological limitations. First, the relatively small sample size may restrict the generalizability of the findings to broader populations. However, the sample was deliberately selected to align with a parallel investigation examining serum and salivary levels of tissue transglutaminase enzyme (tTG) in celiac patients and matched controls, which required strict inclusion criteria and sample matching across both research arms[20].

Second, oral examinations were conducted by a single trained examiner, which may introduce observer bias despite efforts to ensure consistency and standardization of assessment procedures. The use of one examiner was necessitated by the need for clinical continuity and data harmonization with the concurrent biochemical study.

While these constraints should be considered when contextualizing specific outcomes, the integrated design offers a unique opportunity to correlate clinical oral findings with immunological markers. Future studies are recommended to involve larger and more diverse populations, employ multiple calibrated examiners, and incorporate longitudinal monitoring to further validate and expand upon these results.

Conclusion

This study highlights a significant association between celiac disease and specific oral manifestations such as recurrent aphthous ulcers, atrophic glossitis, and geographic tongue. These findings reinforce the critical role of dental practitioners in the early detection of systemic conditions, particularly when gastrointestinal symptoms are absent.

Routine oral examinations in dental settings should incorporate screening protocols for identifying patterns indicative of celiac disease and other systemic diseases. Dentists should be trained to recognize these manifestations and refer patients for further medical evaluation when appropriate.

Future research is recommended to include larger and more diverse populations, assess serum nutritional levels, and control for dietary factors to better understand the underlying mechanisms linking oral health with systemic disease. Such efforts will contribute to more integrated approaches between dentistry and general medicine, ultimately improving patient outcomes.

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Conflicts of Interest

The authors declare no possible conflict of interest

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ISTRAŽIVANJE KONFIGURACIJA KANALA KORENA DRUGOG MANDIBULARNOG MOLARA I NJIHOVA BLIZINA MANDIDULARNOM KANALU: ANALIZA POPREČNOG PRESEKA KOMPJUTERIZOVNE TOMOGRAFIJE KONUSNOG ZRAKA

EXPLORING MANDIBULAR SECOND MOLAR ROOT CANAL CONFIGURATIONS AND THEIR PROXIMITY TO MANDIBULAR CANAL: A CROSS-SECTIONAL CONE-BEAM COMPUTED TOMOGRAPHY ANALYSIS

Jyothirmai Koneru[1], Harshitha Kantheti[2], R Sudhakara Reddy[1], Ramesh Tatapudi[1], Bhargavi Chinnamurthy[2], Lokam Janeswari[1]

[1]STOMATOLOŠKI KOLEDŽ, DEPARTMAN ZA ORALNU MEDICINU I RADIOLOGIJU, KOVVADA, IDINA
[2]KOLEDŽ ZA DENTALNU NEGU, GUNUR, INDIJA

[1]VISHNU DENTAL COLLEGE, DEPARTMENT OF ORAL MEDICINE AND RADIOLOGY
[2]CARE DENTAL COLLEGE, GUNTUR, INDIA

Sažetak

Cilj: *Cilj ove studije bio je da se proceni konfiguracija kanala korenova drugih donjih molara u odnosu na mandibularni kanal primenom kompjuterizovne tomografije konusnog zraka (engl. Cone Beam Computed Tomography – CBCT) u populaciji savezne države Andra Pradeš u jugoistočnoj Indiji.*
Materijali i metode*: Analizirana su sto trideset četiri CBCT snimka drugih donjih molara radi utvrđivanja Vertučijeve klasifikacije kanala, broja korenskih kanala, udaljenosti mandibularnog nervnog kanala od apeksa korenova, stepena zakrivljenosti korenova, učestalosti pojave dodatnih korenova i prisustva kanala u obliku slova C. Povezanost između starosti i udaljenosti mandibularnog nervnog kanala od apeksa korenova procenjena je X^2 testom, sa nivoom statističke značajnosti $p < 0,05$. Analiza podataka sprovedena je uz pomoć softverskog paketa IBM SPSS, verzija 23.0.*
Rezultati: *Tri korenska kanala identifikovana su u 94,7% drugih donjih molara. U mezijalnom korenu najčešće je bila zastupljena konfiguracija tipa V, za kojom sledi konfiguracija tipa IV; u distalnom korenu dominirao je pak tip I. Prosečan stepen zakrivljenosti iznosio je 23,48°. Konfiguracije kanala u obliku slova C sa sraslim korenovima uočene su kod 5,3% ispitanika. Srednja udaljenost od apeksa mezijalnog korena do mandibularnog kanala iznosila je 3,66 mm, a udaljenost od apeksa distalnog korena 2,98 mm, što ukazuje na to da je distalni koren bliži mandibularnom kanalu nego mezijalni. Takođe, prosečna udaljenost bila je manja kod žena nego kod muškaraca. Što su ispitanici bili stariji, to je udaljenost između apeksa korena i mandibularnog nervnog kanala bila veća.*
Zaključak: *Ova studija ukazuje na anatomske varijacije drugih donjih molara koje su od ključnog značaja za uspešno sprovođenje endodontskog lečenja, ali i za forenzičku analizu, s obzirom na to da se morfologija korenova može razlikovati u zavisnosti od geografske pripadnosti, rase i pola pacijenata. Razumevanje ovih etničkih varijacija može dovesti do toga da kliničari optimizuju terapijski pristup, kako bi ishodi lečenja pacijenata bili bolji.*

Ključne reči: *drugi donji molari, zakrivljenost kanala, korenski kanal u obliku slova C, mandibularni kanal, morfologija korenskih kanala, koren*

Corresponding author:
Vishnupur, Bhimavaram, Kovvada, Andhra Pradesh 534202, India
E-mail: harshitha.kantheti@vdc.edu.in

Abstract

Aim: *The study aimed to assess the canal configuration of mandibular second molar roots and their relationship to the mandibular canal using Cone-Beam Computed Tomography (CBCT) in the Andhra Pradesh population.*
Materials and Methods: *One hundred and thirty-four CBCT-scans of mandibular second molars were examined to determine Vertucci's canal configurations, number of root canals, distance of mandibular nerve canal from the root apices, degree of curvature of roots, incidence of additional roots, and C-shaped canals. The relationship between age and distance from the mandibular nerve canal to root apices was assessed using the chi-square test, with a significance level set at $p < 0.05$. Data analysis was conducted using IBM SPSS Version 23.0.*
Results: *Three root canals were identified in 94.7% of mandibular second molars. In the mesial root, Type V was the most common canal configuration, followed by Type IV, while Type I was predominant in the distal root. The average curvature was 23.48°. C-shaped canal configurations with merged roots were observed in 5.3% of patients. The mean distance from the mesial root apex to the mandibular canal was 3.66 mm, whereas the distance from the distal root apex was 2.98 mm, indicating that the distal root was closer to the mandibular canal than the mesial root. Additionally, the mean distance was shorter in females than in males. As age increased, the distance from the apices of the root to the mandibular nerve canal also increased.*
Conclusions: *This study highlights anatomical variations of the mandibular second molar crucial for successful endodontic treatments and also helps in forensic analysis as root morphology can differ based on geographic location, patient's race and gender. By understanding these ethnic variations, clinicians can optimize treatment strategies for better patient outcomes.*

Key words: *mandibular second molars, canal curvature, C-shaped root canal, inferior alveolar canal, root canal morphology, radix*

Introduction

Understanding root canal anatomy, including the number of roots, the number and position of canals in each root, the cross-sectional dimensions, the prevalent curvatures (particularly in buccolingual sections), and the overall outline form in all dimensions, is crucial for successful root canal treatment[1–3]. A lack of knowledge about pulp anatomy and canal variations can lead to treatment failures. Therefore, it is essential to be well-versed in both the typical anatomy of the pulp and the potential variations. Familiarity with the different types of normal and abnormal pulpal anatomy allows dentists to prepare special techniques tailored to the specific anatomy encountered[4,5].

The anatomical arrangement of roots and canals in first and second mandibular molars is diverse[5–9]. Typically, these molars have roots that are positioned mesiodistally and three root canals (mesiobuccal, mesiolingual, and distal). Consistent anatomical features within specific tooth types and among different races suggest a genetic basis for these traits[10,11]. Studies in diversified populations often show a high proportion of Vertucci's Type II canal configurations in mesial roots. However, in second mandibular molars of Asians with mesial and distal roots, Vertucci's Type IV is commonly found in mesial roots and Type I in distal roots6. The internal and external anatomy of mandibular second molars varies significantly according to race and geographic origin[12–15]. Although dissimilarities in the anatomy of second mandibular molars' root canal have been well-recognized in some populations[16–19], it is now well-known that root canal anatomy is influenced by ethnic factors, highlighting the importance of identifying root canal morphologies specific to different racial types[20]. Additionally, forensic dental identification is crucial in determining the identity of unidentfied individuals because of the distinctive dental patterns associated with different races. Dental records have been utilized to identify victims in mass disasters, including the September 2001 terrorist attacks and the 2004 Indian Ocean Tsunami, where dental information identified approximately 80% of non-Thai victims in Thailand[21]. The relative position of the second mandibular molars to the mandibular nerve canal and its correlation with the patient's age is also crucial.

Any damage can be caused to the Inferior Alveolar Nerve (IAN) during various endodontic procedures. Various proposed mechanisms include neurotoxic effects from root canal filling materials that penetrate the IAN, mechanical pressure on the nerve due to overextension of filling materials, over-instrumentation with hand or rotary files, or an increase in temperature near the IAN exceeding 10 °C. These factors can lead to mechanical or chemical damage to the mandibular nerve, making the positioning relative to the mandibular canal crucial[21].

The primary etiological factor in the development of a C-shaped root configuration is the failure of adhesion of Hertwig's epithelial root sheath to the buccal and lingual root surfaces[22]. The prevalence of C-shaped root canals in mandibular second molars varies widely, ranging from 2.7% to 44.5%, depending on the population studied[23,24]. This indicates that there are ethnic variations in the prevalence of C-shaped root canal configurations.

CBCT is a non-invasive and highly precise technique with numerous advantages for epidemiologic endodontic research[22,24]. These benefits include the reduction or elimination of superimposition of adjacent structures, three-dimensional reconstruction in axial, coronal, and sagittal planes[24], high precision, fast scanning speed, and a low radiation dose[22,24]. CBCT can produce images of multiple teeth with a radiation dose comparable to that of two periapical radiographs[25]. Due to the scarce literature on the morphological variations in root canal configurations of second mandibular molars and their affiliation to the mandibular nerve canal in the Andhra residents, this CBCT study was conducted to assess the canal configurations of second mandibular molars and their proximity to the mandibular nerve canal in this demographic area.

Materials and Methods

This study was approved by the Ethics Committee (IECVDC/23/PG01/OMR/IVT/69), and the scans were gathered from patients who visited Vishnu Dental College and Hospital Bhimavaram, from March 2022 to February 2023. These patients were recommended to undergo CBCT imaging for diagnostic reasons unrelated to this study, including the surgical extraction of impacted teeth, orthodontic treatment planning, implant planning, or other pathological maxillofacial conditions.

Inclusion and Exclusion Criteria

We included 134 CBCT scans in the study performed with a CBCT unit CRANEX 3D with a flat panel detector. The scan was set at 90 kV and 10 mA as recommended by the manufacturer, with different fields of view (FOV) 61 x 41 mm and 61 x 78 mm with standard resolution of 200 µm and 300 µm

voxel size, respectively. The scans were of sufficient quality for diagnostic purposes, free of artifacts, and showed fully erupted permanent second molars without any periapical lesions and patients in the age range of 15–60 years, were included. The study excluded teeth with certain conditions, such as incomplete root formation, mesial drift of permanent third molars, generalized disorders, open root canal apices, resorption and calcification of second mandibular molars, as well as those with root canal fillings, posts, and crown restorations.

The CBCT-generated radiographic images were analyzed according to the parameters of the present research. The root canal patterns were evaluated and classified based on Vertucci's 1984 classification[26], as follows:

Type I—One canal runs all the way from the pulp chamber to the apex.

Type II—Two canals begin from the pulpal chamber and merge near the apex to form a single canal.

Type III—Single canal leaving the pulp chamber, within the root splits into two, and then merges into one canal at the apex.

Type IV—Two canals extend from the pulp chamber to the apex.

Type V—one canal leaves the pulp chamber and splits into two individual canals with a distinct foramina at the apex.

Type VI—Two canals exit the pulp chamber, join in the middle, and then split again to distinct canals with two apical foramina.

Type VII—Single canal exits the pulp chamber, splits and unites within the canal, and then divides again into two separate canals near the apex.

Type VIII—Three separate canals are present within one root.

For C-shaped canals, Fan et al.[27] classification was employed. The canals were categorized as:

C1—C-shaped canal, continuous without any divisions

C2—A semicolon-shaped canal, where dentine separates one canal from another, and a C-shaped buccal or lingual canal

C3—Comprising two or more distinct canals

C4—One round or oval-shaped canal

C5—Canal lumen was not visible.

Evaluation of Data

CBCT scans were obtained, and the Digital Imaging and Communications in Medicine (DICOM) files of these scans were evaluated in sagittal, coronal, and axial sections. The scans were assessed for the following parameters: the distance of the root apex of mandibular second molars from the mandibular canal in sagittal sections (Figure 3A), the number of root canals in axial sections (Figure 3B), the configuration of the root canal system in sagittal (Figure 3C) and coronal sections, the presence of any extra roots (radixes) in mandibular second molars in axial sections, and C-shaped canals in axial and coronal slices (Figure 3D). Additionally, the degree of curvature in any of the root canals was evaluated in sagittal or coronal sections (Figure 3E).

The CBCT scans were categorized into three age groups: Group I—below 30 years of age, Group II—31 to 50 years of age, and Group III—above 50 years of age. The distance from the root apex to the mandibular canal was calculated for each group.

Statistical Analysis

The study examined the total number of roots and root canals, root canal configurations, the incidence of anatomical variations in root canal configurations, the degree of root curvature, the distance from the root apex to the mandibular canal, and correlations between these occurrences in males and females. The data were statistically analyzed using the Pearson chi-squared test, Fisher's exact test, and ANOVA in IBM SPSS Version 23 for Windows, with significance set at $p < 0.05$.

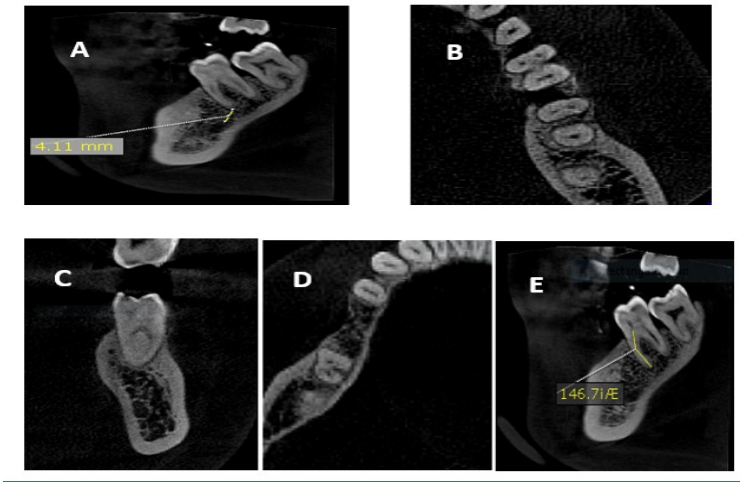

Figure 3. A) Sagittal section showing distance of mandibular canal from apices of second mandibular molar roots B) Total number of root canals in axial sections. C) The root canal system configuration in sagittal section. D) C-shaped canal present in mandibular second molar. E) Degree of curvature of second mandibular molar roots in sagittal section

Results

A total 134 CBCT scans with one tooth per scan were evaluated, out of them 73 (54.5%) were males and 61 (45.5%) were females.

Number of Roots and Root Canals

Among 134 mandibular second molars examined, the most common morphology identified was the presence of two distinct roots positioned mesiodistally, accounting for 94.7% of cases, while fused roots were present in 5.3% of cases.

Vertucci's classification was employed to categorize root canal configurations of mesial and distal roots of these mandibular second molars. In two-rooted molars, the most common pattern in mesial roots was Type V, followed by Type IV, while Types I, II, and III were less frequent. Most of the distal roots exhibited Type I canals (Table 1).

The prevalence of C-shaped canal in lower second molar among 134 CBCT scans was 5.3%, cross-sectional canal configuration according to Fan et al. observed in the coronal third was C3b (3%) followed by C1(1.5%), the middle third C3b (3%), followed by C2 (2.2%), apical third C3b (2.2%) followed by C2 and C4 (1.5%). Mandibular second molar root canals persisted some degree of curvature with a mean curvature of 25.88° ± 12.09°, and the range was between (0–45°).

Table 1. Root canal configuration

ROOT	VERTUCCI'S CLASSIFICATION	MALES	FEMALES	TOTAL PERCENTAGE
	TYPE I	3 (2.4%)	10 (7.9%)	13 (10.2%)
	TYPE II	10 (7.9%)	7 (5.5%)	17 (13.4%)
MESIAL	TYPE III	10 (7.9%)	2 (1.6%)	12 (9.4%)
	TYPE IV	25 (19.7%)	15 (11.8%)	40 (31.5%)
	TYPE V	24 (18.9%)	21 (16.5%)	45 (35.4%)
DISTAL	TYPE I	72 (56.7%)	55 (43.3%)	127 (100%)

Association of the Distance of the Root Apex from the Mandibular Canal and Age

The study found that the distance between the root apex and the mandibular canal tended to increase with age. Specifically, Group III (> 50 years) had the largest distances (mesial root 4.06 mm, distal root 3.42 mm), followed by Group II (31–50 years) (mesial root 3.71 mm, distal root 3.03 mm), and Group I (≤ 30 years) (mesial root 3.62 mm, distal root 2.95 mm). However, statistical analysis using the chi-square test showed that this association between age and distance was statistically insignificant for both the mesial root ($p = 0.538$) and distal root ($p = 0.889$) from the mandibular canal. This suggests that although there is a trend of increasing distance with age, it is not significant enough to establish a clear relationship between age and the distance of the roots from the mandibular canal (Figure 1).

Association of the Distance between the Root Apex and the Mandibular Canal and Sex

The study examined the relationship between gender and the distance between the root apex and the mandibular canal. It was found that males had a mean distance of 3.81 mm for the mesial root and 3.16 mm for the distal root, while females had a mean distance of 3.66 mm for the mesial and 2.98 mm for the distal root. Statistical analysis using the chi-square test revealed that there was no statistically significant association between males and females regarding the distance of the mesial root ($p = 0.425$) or distal root ($p = 0.228$) apex from the mandibular canal. However, it was observed that the distance from the root apex to the mandibular canal tended to be greater in males compared to females (Figure 2).

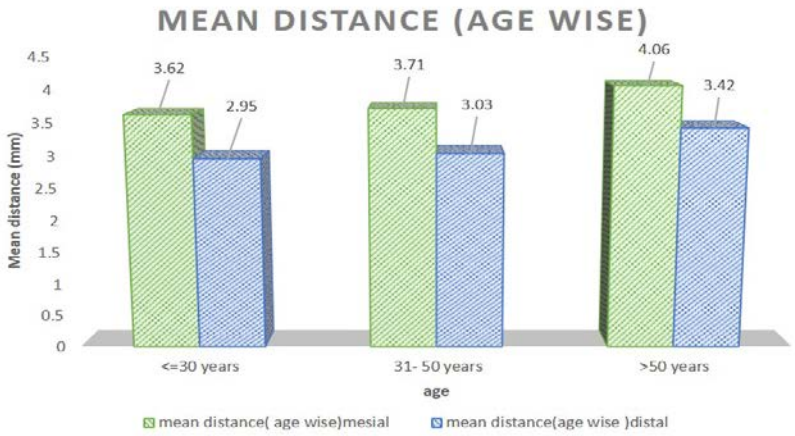

Figure 1. Age-wise difference in average distances between the mesial and distal root apex from the mandibular canal

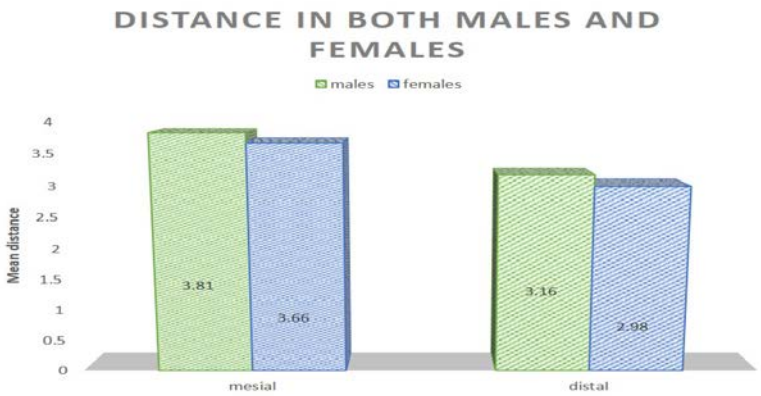

Figure 2. Average distance of both the root apices from the mandibular canal between the two genders

Discussion

Mandibular second molars are known for their significant variations in patterns of root and canal morphologies. The present study investigated the second mandibular molars' root canal anatomy and their relationship to the mandibular nerve canal in Andhra residents. Studies conducted in Europe, North America, and Australia reported that patients of Asian descent displayed diverse proportions of canal configurations compared to ethnic groups from other continents[28].

The most frequently observed morphology of the roots was the existence of two distinct roots, accounting for 94.7% of cases. This finding is consistent with the results of 76% in the Asian population reported by Maning et al., and in 87.8% of the Indian population found by Neelakantan et al.[29]. However, it differs from the study conducted by Gulabivala et al.[7], which reported a 58.2 occurrence in the Burmese population. Additionally, this study found no mandibular second molars with three roots, which aligns with Gulabivala et al's[7] findings in the Burmese population, where three-rooted mandibular second molars were also absent. In contrast, the study by Kantilieraki et al.[30] on the Greek population reported a 4.9% incidence of three-rooted mandibular second molars.

In two-rooted mandibular second molars, the most commonly observed root canal pattern in the mesial root was Vertucci's Type V, occurring in 35.4% of cases, followed by Type IV in 31.5%. This is consistent with Gulabivala et al.'s study on the Thai population[8], which found Type IV in 57.4% of cases. However, it contrasts with Ingle et al.'s[3] study on the American population, where 49% of mesial roots exhibited Vertucci's Type II, and Shah N. et al.'s study on the Gujarat population, where 57.7% of mesial roots showed Vertucci's Type II. These differences in root canal configurations can be attributed to geographical variations among populations.

The distal roots predominantly displayed Vertucci's Type I configuration in 94.7% of cases. This finding aligns with Dae Pablo et al.[31] systematic review, which analyzed around 22 studies and found Type I to be the most common configuration in 62.7%. It is also consistent with the study by Neelakantan et al.[29] on the Indian population, where 77.7% of distal roots exhibited Type I canal configuration.

The incidence of C-shaped canals with merged roots of 5.3% in our study is comparable to a study by Singh RD[32] et al., which reported 6.72% in the North Indian population. However, this is lower than the 14% found by Shah N. et al. in the Gujarat population. These variations within the Indian subcontinent underscore the need for population-specific studies. According to Fan et al.'s classification, the most common cross-sectional canal configuration in our study was C3b (3%) in the coronal third, followed by C1 (1.5%); in the middle third, it was C3b (3%), followed by C2 (2.2%); and in the apical third, it was C3b (2.2%), followed by C2 and C4 (1.5%). This contrasts with the findings of Wadhwani S. et al.[33] in the Turkish population, where the common coronal level canal configuration was C1 followed by C2 with 3.1% and 2.3%, respectively.

The average distance from the mesial root apex of the mandibular second molar to the mandibular canal was 3.66 mm, and for the distal root apex, it was 2.98 mm. These findings are similar to those of Aljarbou et al.[34] in the Saudi population, which reported distances of 2.33 ± 2.16 mm for the mesial root and 1.68 ± 1.98 mm for the distal root. Another study by Lvovsky et al.[35], which used CBCT to measure the distance between the root apex and the inferior alveolar canal in three different populations, found significant differences: 4.60 mm in Israel, 5.45 mm in South Korea, and 4.35 mm in India. These variations highlight that different ethnic groups and populations may have distinct craniofacial characteristics affecting the spatial relationship between mandibular second molar roots and the inferior alveolar nerve. Genetic predispositions and evolutionary adaptations likely contribute to these differences.

Our study observed that females generally have shorter distances to the mandibular canal compared to males. This is consistent with the findings of Simonton et al.[36] in the Texas population, which reported the distances of 4.9 ± 2.2 mm for females and 6.2 ± 2.6 mm for males, indicating that females consistently have shorter distances. This difference may be due to the larger body size typically seen in males, which can result in greater distances between the mandibular canal and root apices. Clinically, this suggests that females may be at a higher risk of iatrogenic nerve injury compared to males[36].

The distance from root apices to the mandibular canal was found to increase with age, with the greatest distances observed in individuals over 50 years old. Similar trends were noted by Kovista et al.[37] in a study on the American population. These verdicts suggest

that the craniofacial complex continues to change during the course of life, leading to variations in vertical dimension from the IAN, bone thickness, and anteroposterior distance[36]. Teeth can erupt and migrate slightly over time, particularly in response to occlusal forces and changes in dentition, affecting the proximity of tooth roots to the mandibular canal.

In current study, 92% of mandibular second molars exhibited root curvature, either mesially or distally. These findings closely mirrored those of Gambarini et al.[38] in the European population, where 85% of molars displayed similar root curvatures. Understanding the radius of these root curvatures is crucial for planning precise root canal instrumentation, effectively mitigating the challenges posed by anatomical variations.

Clinical Implications

Root canal morphology exhibits variations influenced by the race and gender of patients. Understanding these ethnic differences allows clinicians to optimize treatment approaches. Cone-beam computed tomography, a three-dimensional, high-resolution imaging system, is invaluable for visualizing internal tooth anatomy and accurately measuring distances to the mandibular canal, which conventional radiography cannot achieve. For dental practitioners, understanding common anatomical variations such as the total number of root canals, incidence of additional roots, C-shaped canals, curvatures of the roots, and distances from the mandibular nerve canal in both genders is essential for successful endodontic treatment. This enhances treatment precision and improves overall treatment outcomes.

Conclusion

In the observed sample, the study found that the mesial root of the mandibular second molar most frequently exhibited Vertucci's Type V canal configuration, followed by Type IV, while the distal root predominantly showed Type I. Additionally, C-shaped configuration with merged roots was found in 5.2% of scans observed. The distal root was closer to the canal than the mesial roots, and the average distances from the apices of the root to the canal were shorter in females than in males. Moreover, the distance from the root apex to the mandibular canal tended to increase with age.

This study provides insights into the anatomical variations of the mandibular second molar, which are critical for the success of endodontic treatments as root morphology can vary based on the patient's race and gender and also relevant in forensic contexts, different populations may exhibit variations in the morphology and number of root canals in teeth. These variations can be influenced by genetic factors, geographical ancestry, and environmental factors. Forensic odontologists can use these variations to help identify the likely ancestry or geographic origin of an individual based on dental remains. By understanding these ethnic variations, clinicians can optimize treatment strategies for better patient outcomes.

Ethical Approval

This study was approved by the Ethics Committee, IECVDC/23/PG01/OMR/IVT/69, and the scans were gathered from patients who visited Vishnu Dental College and Hospital Bhimavaram, from March 2022 to February 2023.

Conflict of Interest

The authors of the study declared no conflicts of interest in publishing the research work.

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EFEKTIVNOST INTRAORALNE I KOMBINOVANE INTRAORALNE I EKSTRAORALNE FOTOBIOMODULACIONE TERAPIJE NA SIMPTOME ORALNOG MUKOZITISA KOJI PRIJAVLJUJU PACIJENTI: RANDOMIZOVANA KONTROLNA STUDIJA

EFFECTIVENESS OF INTRAORAL AND COMBINED INTRAORAL-EXTRAORAL PHOTOBIOMODULATION THERAPY ON PATIENT-REPORTED ORAL MUCOSITIS SYMPTOMS: A RANDOMIZED CONTROLLED TRIAL

Marwa Khalil[1], Omar Hamadah[1], Maher Saifo[2,3]

[1]UNIVERZITET U DAMASKU, STOMATOLOŠKI FAKULTET, KATEDRA ZA ORALNU MEDICINU, DAMASK, SIRIJA
[2]UNIVERZITET U DAMASKU, MEDICINSKI FAKULTET, KATEDRA ZA MEDICINSKU ONKOLOGIJU, DAMASK, SIRIJA
[3]UNIVERZITETSKA BOLNICA ALBAIROUNI, UNIVERZITET U DAMASKU, DAMASK, SIRIJA

[1]DEPARTMENT OF ORAL MEDICINE, FACULTY OF DENTISTRY, DAMASCUS UNIVERSITY, DAMASCUS, SYRIAN ARAB REPUBLIC
[2]DEPARTMENT OF MEDICAL ONCOLOGY, FACULTY OF MEDICINE, DAMASCUS UNIVERSITY, DAMASCUS, SYRIAN ARAB REPUBLIC
[3]ALBAIROUNI UNIVERSITY HOSPITAL, DAMASCUS UNIVERSITY, DAMASCUS, SYRIAN ARAB REPUBLIC

Sažetak

Uvod: *Ova studija je sprovedena s ciljem da uporedi efekte dvaju kliničkih protokola – intraoralnog crvenog lasera i kombinacije ekstraoralnog infracrvenog lasera i intraoralnog crvenog lasera – na skali simptoma oralnog mukozitisa koje prijavljuju pacijenti (engl. Patient-Reported Oral Mucositis Symptoms – PROMS) kod pacijenata na hemioterapiji.*
Metode: *U ovoj prospektivnoj randomizovanoj dvostruko slepoj kliničkoj studiji četrdeset pet pacijenata bilo je raspoređeno u tri grupe, usklađene prema uzrastu, polu, tipu hemioterapije koju primaju i prvobitnom stanju oralnog zdravlja. Grupa 1 je imala samo standardnu oralnu negu, Grupa 2 je pored standardne oralne nege primala i intraoralnu fotobiomodulaciju (engl. Intraoral Photobiomodulation – IOPBM) pomoću diodnog lasera talasne dužine 635 nm, dok je Grupa 3 uz standardnu oralnu negu dobijala i kombinaciju intraoralne terapije laserom od 635 nm i ekstraoralne terapije laserom od 980 nm. Skala simptoma oralnog mukozitisa koje prijavljuju pacijenti procenjivala se nedelju dana i dve nedelje nakon početka hemioterapije.*
Rezultati: *Zabeležene su značajne razlike među grupama na PROMS skali i u jednom i u drugom periodu merenja (p = 0,000). Poređenja parova grupa pokazala su poboljšanje u obema grupama koje su primale fotobiomodulacionu (engl. Photobiomodulation – PBM) terapiju u odnosu na kontrolnu grupu. S druge strane, nije zabeležena statistički značajna razlika između dvaju PBM protokola.*
Zaključak: *Fotobiomodulaciona terapija, bez obzira na to da li se sprovodi samo intraoralnim laserom ili kombinacijom intraoralnog i ekstraoralnog lasera, ima značajnu ulogu u poboljšanju kvaliteta života pacijenata sa gastrointestinalnim karcinomima koji primaju hemioterapiju.*

Ključne reči: *fotobiomodulacija, hemioterapija, simptomi oralnog mukozitisa koje prijavljuju pacijenti*

Corresponding author:
Marwa Khalil, Department of Oral Medicine, Faculty of Dentistry, Damascus University, Syrian Arab Republic
E-mail: hsnkhal@gmail.com

Abstract

Background: *This study was conducted to compare the effects of two clinical protocols—intraoral red laser versus a combination of extraoral infrared laser and intraoral red laser—on the Patient-Reported Oral Mucositis Symptoms (PROMS) scale in patients undergoing chemotherapy.*
Methods: *In this prospective randomized double-blind clinical trial, 45 patients were assigned to three groups, matched by age, sex, chemotherapy type, and baseline oral health status. Group 1 received standard oral care alone, Group 2 received standard oral care plus intraoral photobiomodulation (PBM) using a 635 nm diode laser, and Group 3 received standard oral care combined with both intraoral 635 nm and extraoral 980 nm laser therapy. The PROMS scale was assessed 1 week and 2 weeks after the start of chemotherapy.*
Results: *Significant differences were observed between groups on the PROMS scale at both time points (p = .000). Pairwise comparisons showed improvements in both PBM groups compared to the control group, though no significant difference was found between the two PBM protocols.*
Conclusion: *Photobiomodulation therapy, whether with intraoral laser alone or with intraoral and extraoral lasers, has a significant role in improving the quality of life of gastrointestinal cancer patients undergoing chemotherapy.*

Key words: *photobiomodulation, chemotherapy, patient-reported oral mucositis symptoms.*

Introduction

Cancer treatments, including radiotherapy and chemotherapy, are known to profoundly impact patients' quality of life, with numerous studies documenting a general decline from the initiation of treatment onward[1]. Among the most distressing side effects is oral mucositis (OM), a common and debilitating condition that significantly exacerbates the deterioration in health-related quality of life[2,3]. This complication typically arises shortly after the beginning of treatment and persists throughout its duration, causing severe discomfort and impairing daily functioning.

In 2023, a systematic review by Potrich et al. highlighted the consistent association between the onset of OM and a decline in quality of life across all examined studies[1]. These findings emphasize the critical need for effective interventions to prevent and manage OM, aiming to improve patients' overall well-being during cancer treatment.

Photobiomodulation (PBM) therapy, a non-thermal light-based intervention utilizing non-ionizing sources such as lasers, LEDs, and broad-spectrum light within the visible and infrared spectrum, has emerged as a promising strategy. By engaging endogenous chromophores, PBM triggers photophysical and photochemical events at various biological levels, facilitating therapeutic outcomes[4].

Several studies have demonstrated the efficacy of PBM in both preventing and treating OM, in patients undergoing PBM reporting notable improvements in quality of life compared to control groups[5–10]. In 2021, Martins et al. utilizing the PROMS questionnaire, confirmed that severe OM corresponded to lower quality of life scores in placebo groups, further validating the therapeutic potential of PBM[11]. However, despite its promise, the use of PBM for the treatment or prevention of OM is still in its early stages and faces challenges in clinical practice, particularly regarding the lack of a standardized protocol. Considerable variability has been observed between studies in terms of irradiation parameters[12].

Therefore, this study was conducted to compare the effects of two clinical protocols—intraoral red laser versus a combination of extraoral infrared laser and intraoral red laser—on the PROMS scale in patients undergoing chemotherapy

Materials and Methods

Trial Registration and Ethics approval

This clinical trial was officially registered in the ISRCTN registry under the identifier ISRCTN70634383 on July 24, 2023 (https://doi.org/10.1186/ISRCTN70634383).

Ethical Approval was obtained from Scientific Research Council at Damascus University (Damascus University, Damascus, 00963, Syria; +963 11 33923000; president@damasuniv.edu.sy), ref: 2027 on 18/01/2023. Also, all participants in this study provided a signed, informed consent.

Inclusion Criteria

The study included patients diagnosed with digestive tract cancer undergoing their first chemotherapy cycle at Albairouni Hospital in Damascus, Syria. Participants were required to have a similar risk for oral mucositis and receive either the FOLFOX regimen (leucovorin calcium, fluorouracil, oxaliplatin) or the XELOX regimen (oxaliplatin, capecitabine). Additional eligibility criteria included a neutrophil count of $\geq$ 1500 cells/μL, a platelet count of $\geq$ 100,000 cells/μL, clinically healthy oral mucosa, and a Karnofsky Performance Status (KPS) score above 60[13].

Exclusion Criteria

Patients were excluded if they had a history of head or neck radiotherapy, oral malignant or potentially malignant lesions, oral infections or bleeding, or diabetes. Patients already using any oral mucositis prevention strategies or those unable to comply with study requirements were also excluded.

Intervention

Participants were randomly allocated into three groups prior to initiating chemotherapy:

• Group 1 participants received standard oral care instructions, including guidance on brushing, flossing, rinsing, and dietary recommendations[14].

• Group 2 participants received intraoral PBM therapy using a diode laser (635 nm, 100 mW, 4 J/cm²) in addition to the oral care instructions. The treatment was applied to multiple sites in the oral cavity, including the buccal mucosa, labial mucosa, tongue, floor of the mouth, and soft palate.

• Group 3 participants received the same oral care and intraoral PBM therapy as Group 2, with the addition of extraoral PBM therapy administered via a diode laser (980 nm, 100 mW, 4 J/cm²) at six predefined neck points[15] (Table 1).

The six neck points for extraoral PBM are anatomically defined as follows:

• The top two points are located just below the jawline, approximately 1–2 cm lateral to the midline of the chin on each side.

• The middle two points are situated about 3–4 cm below the top points, near the larynx and close to the neck's midline.

• The bottom two points are positioned near the base of the neck, approximately 3–4 cm below the middle points.

Table 1. Laser parameters used

	Wavelength nm	Power Density mW/cm^2	Time per Spot, s	Energy Density J/cm^2	Spot Size cm^2	No. of Sites	Duration
Intraoral PBM	635	200	20	4	0.5	24	Before the start of the first chemotherapy session (on the same day)
Extraoral PBM	980	200	20	4	0.5	6	Before the start of the first chemotherapy session (on the same day)

Patient-Reported Oral Mucositis Symptom Scale

The PROMS scale assesses the most common symptoms experienced by patients who develop oral mucositis, including oral pain, difficulty speaking due to mouth pain, speech restriction, difficulty eating solid foods, difficulty eating soft foods, eating restriction, difficulty drinking, drinking restriction, difficulty swallowing, and taste changes. These symptoms are presented as ten questions, each accompanied by a 10 cm visual analog scale (VAS). Patients indicate the point on the scale that corresponds to the extent to which oral mucositis affects their daily activities and quality of life. The final score is calculated as the sum of the individual scores from all ten questions, with higher scores indicating more severe oral mucositis and, consequently, a poorer quality of life. The maximum possible score is 100[16].

The PROMS scale was assessed at two time points:

• One week after the first chemotherapy session

• Two weeks after the first chemotherapy session

Statistical Analysis

The Chi-square test was utilized to compare the clinical and demographic characteristics of participants across the three study groups. To verify the normality of parametric variables, the Kolmogorov–Smirnov test was conducted. Subsequently, a one-way analysis of variance (ANOVA) was applied to compare the mean values among the three groups at each time point. For evaluating pairwise differences between the two time periods separately, a paired sample t-test was performed.

Results

Our study included 45 patients, who were equally distributed into three groups matched for age, sex, type of chemotherapy and oral status before treatment.

Statistically significant differences were observed among the three groups after one week of follow-up ($p = .000$). Pairwise comparisons revealed significant differences between the control group and both the intraoral laser group ($p = .002$) and the combined intraoral and extraoral laser group ($p = .000$). However, no statistically significant differences were detected between the two laser groups ($p = .071$) (Figure 1).

After two weeks of follow-up, statistically significant differences were observed among the three groups ($p = .000$). Pairwise comparisons revealed statistically significant differences between the control group and both the intraoral laser group and the intraoral-extraoral laser group ($p = .003$ and $p = .000$, respectively). However, no statistically significant difference was observed between the two laser groups ($p = .059$) (Figure 2).

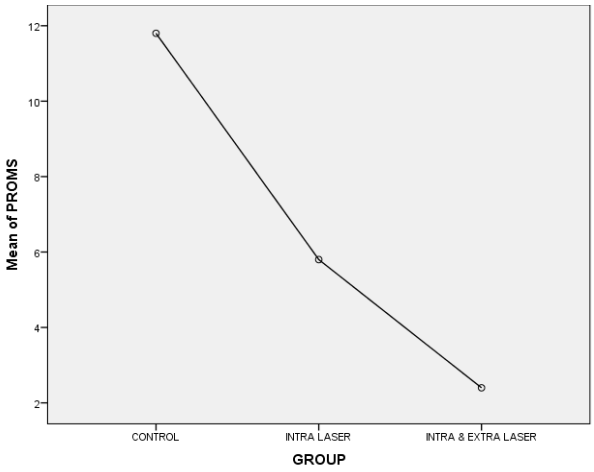

Figure 1. Mean PROMS scores after one week of follow-up

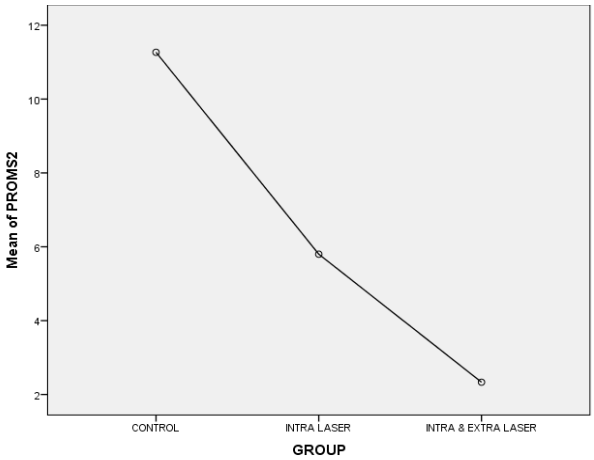

Figure 2. Mean PROMS scores after two weeks of follow-up

In detail, differences were observed among the three groups regarding pain, difficulty eating hard foods, difficulty eating soft foods, difficulty drinking, difficulty swallowing, and taste changes. However, no statistically significant differences were observed among the three groups concerning difficulty speaking, eating restriction, or drinking restriction after one week and two weeks of follow-up (Table 2).

In pairwise comparisons between each group, significant differences were observed regarding pain, difficulty eating solid foods, difficulty eating soft foods, and taste alterations between the control group and both laser groups.

Statistically significant differences were noted between the two laser groups concerning the consumption of both solid and soft foods, while no significant differences were observed regarding pain and taste alterations.

Regarding difficulty drinking and difficulty swallowing, no statistically significant differences were found when comparing the control group with the intraoral laser group. However, significant differences were observed when comparing the control group with the combined intraoral and extraoral laser group, as well as when comparing the two laser groups.

No statistically significant differences were observed when comparing the two follow-up periods ($p = .473$) (Figure 3).

Table 2. Mean scores of PROMS items among the three groups

		One week			Two weeks		
		Mean	Standard Error	Sig	Mean	Standard Error	Sig
Pain	Control Group	2.67	.422	.000	2.40	.363	.000
	Intraoral Laser Group	.53	.256		.47	.274	
	Intra-Extraoral Laser Group	.60	.289		.40	.235	
Difficulty Speaking	Control Group	.13	.133	.553	.00	.000	1
	Intraoral Laser Group	.00	.000		.00	.000	
	Intra-Extraoral Laser Group	.07	.067		.00	.000	
Speech Restriction	Control Group	.00	.000	1	.00	.000	1
	Intraoral Laser Group	.00	.000		.00	.000	
	Intra-Extraoral Laser Group	.00	.000		.00	.000	
Difficulty Eating Hard Foods	Control Group	3.13	.401	.000	2.80	.296	.000
	Intraoral Laser Group	1.60	.363		1.47	.350	
	Intra-Extraoral Laser Group	.60	.235		.60	.254	
Difficulty Eating Soft Foods	Control Group	1.07	.228	.000	1.07	.228	.000
	Intraoral Laser Group	.53	.192		.53	.192	
	Intra-Extraoral Laser Group	.00	.000		.00	.000	
Eating Restriction	Control Group	.00	.000	.376	.00	.000	.376
	Intraoral Laser Group	.20	.200		.20	.200	
	Intra-Extraoral Laser Group	.00	.000		.00	.000	
Difficulty Drinking	Control Group	.93	.300	.017	.93	.300	.017
	Intraoral Laser Group	.67	.252		.67	.252	
	Intra-Extraoral Laser Group	.00	.000		.00	.000	
Drinking Restriction	Control Group	.00	.000	1	.00	.000	.376
	Intraoral Laser Group	.00	.000		.13	.133	
	Intra-Extraoral Laser Group	.00	.000		.00	.000	
Difficulty Swallowing	Control Group	1.27	.371	.006	1.13	.363	.013
	Intraoral Laser Group	.80	.279		.80	.279	
	Intra-Extraoral Laser Group	.00	.000		.00	.000	
Taste Changes	Control Group	2.67	.303	.003	2.73	.267	.001
	Intraoral Laser Group	1.47	.291		1.47	.291	
	Intra-Extraoral Laser Group	1.13	.350		1.00	.352	

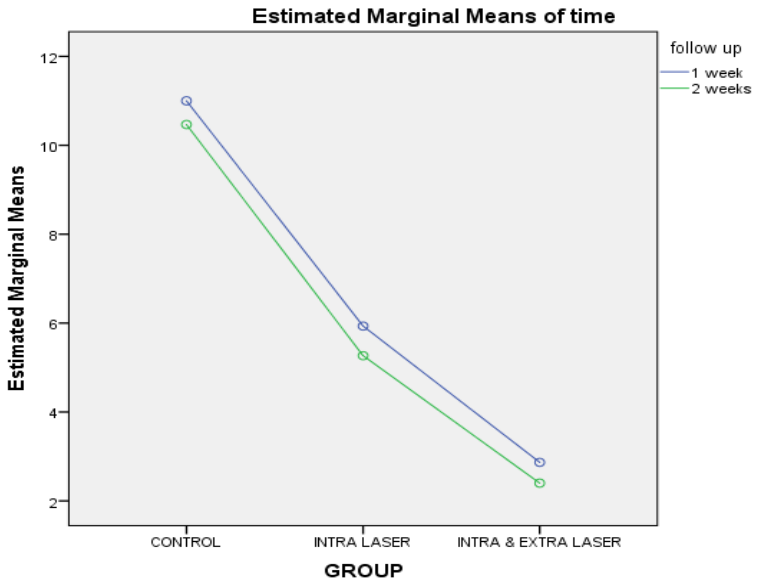

Figure 3. Mean scores of PROMS items after one week and two weeks of follow-up

Discussion

In our study, we compared two PBM protocols. The first protocol employed intraoral irradiation at a wavelength of 635 nm, following the guidelines established by the World Association for Laser Therapy (WALT)[17]. The second protocol combined intraoral red laser therapy with extraoral infrared laser application to effectively target deeper tissues, such as the oropharynx15. Both protocols adhered to the power settings recommended by Bensadoun et al.[18] and followed the energy density parameters suggested by Cronshaw et al.[19], ranging from 2 to 5 J/cm² for lesion prevention and tissue healing. We observed that the PROMS scale, was better in the PBM group, whether the laser was applied intraorally alone or both intraorally and extraorally. This improvement can be attributed to the role of PBM in reducing the incidence of OM and xerostomia, which subsequently alleviates symptoms such as pain, difficulty eating, dysphagia, taste changes, and other physical and psychological consequences that impact patients' quality of life.

These findings align with several studies, such as the study conducted by Malta et al. in 2022, which demonstrated that PBM improved overall health status and quality of life in breast cancer patients undergoing chemotherapy[20]. Similarly, the study by Gautam et al. conducted in 2013, which investigated patients with head and neck cancer undergoing combined chemotherapy and radiotherapy, found that PBM was effective in enhancing patients' subjective experiences with OM and improving their overall quality of life[8]. Likewise, in 2023, Silva et al. reported that PBM improved the quality of life in head and neck cancer patients treated with radiotherapy[21]. Our results also agree with the 2021 findings of Martins et al., which indicated that higher PROMS scores were associated with severe OM in the placebo group, resulting in a reduced quality of life[11].

Our only discrepancy was with the 2011 study by Djavid et al., which did not find any impact of PBM therapy on the quality of life of cancer patients who received PBM therapy[22].

Regarding swallowing changes, the PBM protocol combining intraoral red laser and extraoral infrared laser demonstrated greater efficacy compared to intraoral red laser alone in preventing chemotherapy-related swallowing dysfunction. Notably, no statistically significant effect was observed for the intraoral red laser alone when compared to the control group. These findings can be attributed to the enhanced effectiveness of PBM when the intraoral red laser and the extraoral infrared laser are combined. This combination maximizes the benefits of both laser types and improves targeting of potentially affected tissues. PBM not only prevents inflammation and alleviates pain associated with oral mucositis but also helps manage excessive fibrosis. Furthermore, it reduces irritation in key areas such as the base of the tongue, pharyngeal and laryngeal muscles, and the sympathetic nerve plexus, which are critical in the development of dysphagia[23]. Our results align with those of de Lima et al., obtained in 2012, who observed improvement in severe dysphagia in the intraoral PBM group (660 nm, 10 mW, 2.5 J/cm²) among patients with head and neck cancer[24]. In contrast, our findings differ from those of Gautam et al., obtained in 2012, who used intraoral PBM only (632.8 nm, 24 mW, 0.3 J/cm²) and reported that PBM reduced the incidence of acute dysphagia, the need for total parenteral nutrition, and the use of opioids23. Regarding the combined use of intraoral and extraoral laser therapy, our findings align with the case report by El Mobadder, Farhat, and Nammour in 2019, where the use of a 980 nm diode laser both intraorally and extraorally proved effective in managing dysphagia as a side effect of hormone therapy in a cancer patient[25]. Similarly, in a case series conducted by El Mobadder et al. in 2019, the application of PBM intraorally and extraorally, this time using red laser wavelengths, demonstrated efficacy in managing cancer treatment-induced dysphagia[26].

Regarding taste changes, we observed that both PBM protocols were effective in preventing chemotherapy-induced taste alterations. This finding aligns with the 2022 study by Malta et al., which evaluated the efficacy of PBM in preventing dysgeusia in breast cancer patients undergoing treatment with doxorubicin-cyclophosphamide (AC). That study reported less taste loss, better quality of life, and a reduction in the incidence of cachexia, loss of appetite, diarrhea, oral mucositis, and vomiting[20].

Recent studies have begun to explore the effects of photobiomodulation (PBM) on voice, but the field remains in its infancy[27,28]. Furthermore, no study has specifically investigated the effect of PBM on chemotherapy-induced voice changes. In our study, we did not observe any impact of PBM on voice, possibly due to the relatively short follow-up period, which may not have been

sufficient to allow for the development of noticeable voice-related issues. Overall, the lack of research on PBM's effect on voice could be attributed to its classification as a secondary concern, often overshadowed by more prominent issues such as xerostomia and oral mucosal ulcers.

Study limitations

One limitation of this study is the relatively short follow-up period, which restricted our ability to assess long-term outcomes. Additionally, a longer follow-up could introduce potential confounding factors, as patients experiencing side effects might receive various interventions, such as pain management, potentially influencing the precise evaluation of PBM therapy's effectiveness in preventing oral complications. Furthermore, the study's small sample size and the inherent difficulty in standardizing non-surgical treatments across patients may have influenced the consistency of the findings.

Conclusion

Photobiomodulation therapy, whether with intraoral laser alone or with intraoral and extraoral laser, has a significant role in improving the quality of life of gastrointestinal cancer patients undergoing chemotherapy.

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DILACERACIJA KRUNE ZUBA: PRIKAZ SLUČAJA SA PREGLEDOM ETIOLOGIJE I UPRAVLJANJA LEČENJEM

DILACERATION OF THE CROWN: A CASE REPORT WITH OVERVIEW OF ETIOLOGY AND MANAGEMENT

Joanna Sancharita Biswas[1], Anand S Tegginamani[2], Vanishree H. S.[2], Shanthala B. Mallikarjun[3]

[1]STOMATOLOG U PRIVATNOJ PRAKSI, PEDODONCIJA I PREVENTIVNA STOMATOLOGIJA, HOVRAH, INDIJA
[2]UNIVERZITET SEGI, STOMATOLOŠKI FAKULTET, KOTA DAMANSARA, MALEZIJA
[3]COORG INSTITUTE ZA STOMATOLOŠKE NAUKE, DEPARTMAN ZA PEDIJATRIJSKU STOMATOLOGIJU, VIRAJPET, KARNATAKA, INDIJA

[1]PRIVATE DENTAL PRACTITIONER, PEDODONTICS AND PREVENTIVE DENTISTRY, HOWRAH, INDIA
[2]SEGI UNIVERSITY, FACULTY OF DENTISTRY, KOTA DAMANSARA, MALAYSIA
[3]COORG INSTITUTE OF DENTAL SCIENCES DEPARTMENT OF PEDIATRIC DENTISTRY, VIRAJPET, KARNATAKA, INDIA

Sažetak

Osnove problema*: Impakcija odnosno retencija stalnih gornjih sekutića, koja predstavlja relativno retku pojavu u stomatološkoj praksi, može u značajnoj meri uticati na govor, žvakanje i estetski izgled lica obolelih. Deca su posebno podložna dentalnim traumama, naročito u toku prve dve godine života. Dilaceracije su najčešće posledica povrede mlečnih zuba; ređe se javljaju u predelu krune nego u predelu korena, i to uglavnom na maksilarnim i mandibularnim sekutićima. Terapija obično podrazumeva hirurško otkrivanje zuba, za kojim sledi ortodontska trakcija ili ekstrakcija impaktiranog zuba.*
Metoda rada*: U ovom radu predstavljen je slučaj dilaceracije krune maksilarnog stalnog centralnog sekutića, s posebnim osvrtom na etiologiju i pridružene kliničke karakteristike.*
Rezultati*: Ovaj slučaj ističe važnost individualizovanog tretmana, gde su hirurško vađenje i naknadna rehabilitacija bili neophodni zbog nepovoljnog položaja i ugla impaktnog zuba.*
Zaključak*: Uspešno lečenje zahteva multidisciplinarni pristup koji uključuje pedodontiste, ortodonte, parodontologe, hirurge i protetičare.*

Ključne reči: *dilaceracija krune, dilaceracija zuba, dobro zdravlje i blagostanje, maksilarni centralni sekutić, mlečna denticija, trajna denticija, povreda zuba*

Abstract

Basis of the problem: *Impaction of maxillary permanent incisors, a relatively uncommon event in dental practice, can significantly influence speech, chewing, and facial appearance in affected patients. Children are particularly susceptible to dental trauma, especially during the first two years of life. Dilacerations are often caused by trauma to a primary tooth. Dilaceration in the crown is less common than in the root and occurs more frequently in the maxillary and mandibular incisors. Typically, treatment involves surgical exposure of the tooth, followed by orthodontic traction or extraction.*
Methods of work*: Here, we present a case of crown dilaceration of the maxillary permanent central incisor, along with an update on the etiology and other associated features.*
Results*: This case highlights the importance of individualized treatment, where surgical extraction and subsequent rehabilitation were necessary due to the unfavourable position and angulation of the impacted tooth.*
Conclusion*: Successful management requires a multidisciplinary approach involving pedodontists, orthodontists, periodontists, surgeons, and prosthodontists*

Key words: *crown dilaceration, dilaceration of tooth, good health and well-being, maxillary central incisor, primary dentition; permanent dentition, trauma*

Corresponding author:
Joanna Sancharita Biswas
31/2 Rammohan Mukherjee, Howrah-711102, India
E-mail: pianist.forever94@gmail.com

Introduction

The most common effects of primary tooth trauma on the development of permanent teeth are enamel discoloration, enamel hypoplasia, coronal dilaceration, root dilaceration, odontoma-like abnormalities, and eruption changes. The term dilaceration (Latin: dilacerare = to tear up) was first coined in 1848 by Tomes. Dilaceration can develop anywhere along the tooth's length, including the crown, the cement-enamel junction, the root, and the root apex. Approximately fifty percent of crown-dilacerated teeth become impacted, with the remainder erupting normally or in a labiolingual direction. Dilaceration can occur in both dentitions. The International Classification of Diseases (ICD-9th revision-clinical modification) classified dilaceration under the ICD-9-CM 520.4(a) code[1–5]. The impaction of the maxillary central incisor is multifactorial. Tooth deformities or dilacerations can cause a failure of eruption. Although uncommon, maxillary permanent central incisor impaction presents a significant challenge for patients and specialists due to the location of the central incisors; their absence has a substantial impact on a person's facial aesthetics, function, phonetics, and psychology. Crown dilacerations are classified into three types based on their eruption status: completely impacted, partially erupted, and fully erupted. Treatment choices differ based on this; in most cases, surgical exposure of the tooth is followed by orthodontic traction or extraction of the tooth[6–9]. Here, we present an instance of left maxillary permanent central incisor crown dilaceration with labial angulation, along with a brief update on its occurrence, causes, and management.

Case Presentation

A 17-year-old girl presented to the dental clinic with an aesthetic concern related to a missing tooth in the maxillary anterior region. She was otherwise healthy, with no significant family history of systemic disorders. Regarding her dental history, her mother recalled an injury at the age of 2 to 2.5 years, when she had sustained an injury to the maxillary anterior region, resulting in the avulsion of her deciduous teeth. Then, the trauma was not regarded as significant because it involved primary teeth. During intraoral examination, a missing permanent maxillary central incisor (FDI tooth number 21) was noted.

The crown was palpable near the base of the labial frenum in an angled position, with the incisal edge directed toward the vestibule and the cervical portion aligned with the marginal gingiva of adjacent teeth. This raised the suspicion of an impacted tooth, prompting radiographic evaluation. A periapical radiograph (Radiovisiography—RVG) confirmed the presence of an impacted central incisor (Figure 1a). Given the history of primary tooth trauma and its long-term effects, a diagnosis of crown dilaceration was established. To gain a precise assessment of the tooth’s position and its relation to surrounding anatomical structures, cone-beam computed tomography (CBCT) was recommended. CBCT imaging revealed a severely dilacerated tooth with nearly a 90-degree angulation (Figure 1b). After consultation with an orthodontist, extraction was advised due to the unfavourable angulation and position of the tooth.

A treatment plan was formulated involving the administration of local anaesthesia with adrenaline (1:200,000). A trapezoidal mucoperiosteal flap was elevated to expose the crown (Figure 1c, d). As the tooth was immobile, guttering of the bone was performed using a 701-fissure bur. The tooth was subsequently extracted (Figure 1e), and the flap was closed using 3-0 silk sutures (Figure 1f). Postoperative follow-up demonstrated satisfactory healing (Figure 1g).

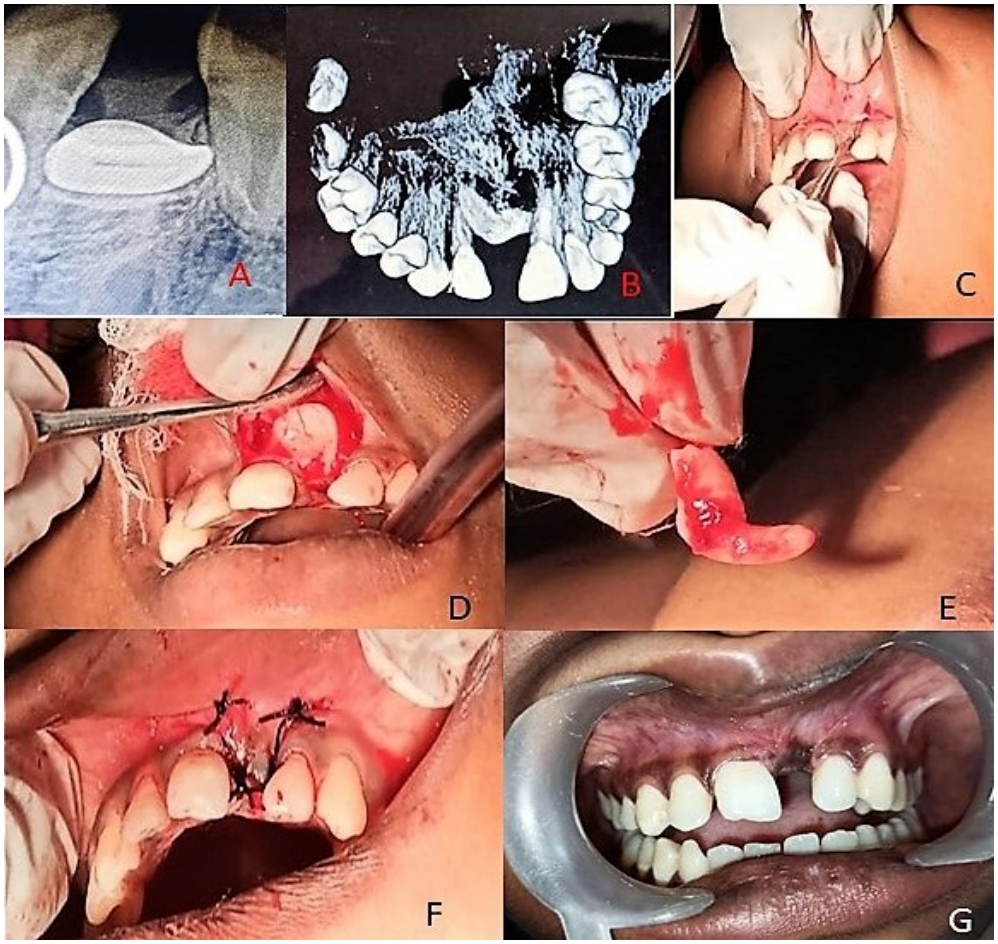

Figure 1. Cone beam computed tomography (CBCT) image of an impacted left permanent maxillary central incisor showing a severely dilacerated tooth with a nearly 90-degree angulation (A) and the curvature elevation of a full-thickness trapezoidal flap extending from the mesial aspect of 11 to the mesial aspect of 22 (B, C). The 3-0 sutures were used to close the flap (D), the dilacerated crown of a maxillary central incisor was surgically removed (F), and 10 days after surgery, there was complete healing (F).

Discussion

The tooth is considered impacted if it fails to reach the occlusal plane within the expected age of eruption, especially when its contralateral counterpart has fully erupted for at least six months and the root development is complete[10]. Compared to root dilacerations, crown dilacerations are less frequent, and the most common condition affecting maxillary permanent incisors is palatally angulated crowns. Permanent mandibular incisors typically exhibit labial angulation[4,9,10]. In the present case, the maxillary permanent incisor crown dilaceration was labially angulated.

Prevalence of Crown Dilaceration

Many studies have investigated the frequency of tooth impaction. Impacted maxillary central incisors occur at a rate of 0.03%–2.1%, which is lower than that reported for permanent canines[11]. Teeth with dilacerated crowns in the mandible erupt in approximately 75% of cases, whereas maxillary teeth with crown dilaceration frequently remain unerupted[12,13]. In a survey of 15,987 samples, 320 unerupted permanent incisors were identified, of which 29 (around 9%) were maxillary central incisors with crown dilaceration[14]. This contrasts with findings from a recent study by Mushtaq Bhat[15], which reported no cases of central or lateral incisor impaction, consistent with other research[16]. The prevalence of tooth impaction varies significantly among different populations and ethnic groups and is influenced by factors such as age, timing of tooth eruption, and radiographic criteria[17].

Gender Predilection for Dilaceration

While some studies report no significant gender predilection for dilaceration[1], other studies have documented a higher prevalence of unerupted maxillary central incisors in males compared to females, suggesting a possible involvement of sex chromosomes in the etiology of tooth eruption disturbances. Conversely, in another retrospective study, impaction of the permanent maxillary central incisor was observed more frequently in females than in males[14,19,26].

Table1. Causes of crown dilaceration

Crown dilaceration		
Probable factors	**Observations**	**Confounding factors**
Delayed eruption can be divided into two categories A) Genetic factors[1]	Supernumerary teeth, cleft lip/palate, odontoma, aberrant tooth/tissue ratio, cleidocranial dysostosis, generalized delayed eruption, and gingival fibromatosis, and many other factors	Hereditary causes affecting eruption
B) Environmental factors[1]	Trauma, early extraction/loss of primary teeth (with/without space loss), retained primary teeth, cystic formation, endocrine disorders, bone disease, and many other conditions	External influences affecting the eruption
Prevalence of dental trauma[20,21]	4% to 33% population prevalence; ~30% of children (aged 7) experience trauma to one primary incisor.	Among them, approximately 40% of children visit a dentist for dental trauma
Influencing factors on trauma effects[3,21,22]	Type of trauma (intensity and direction), child's age at the time of trauma, relationship between primary tooth apices and permanent tooth buds, and developmental stage of root formation	Modulates the severity and nature of damage to permanent successors
Common trauma types causing dilaceration[1,9,21,23]	Avulsion, invasive luxation	These injuries to primary teeth often cause dilaceration in permanent successors
Common permanent successor sequelae[1,9,21,23]	Enamel discoloration, hypoplasia, root and crown dilacerations, and odontoma	Crown dilacerations are more common in maxillary and mandibular incisors due to the close primary tooth location
Incidence of crown dilacerations among trauma sequelae[1,2,4,23–25]	The incidence of crown dilacerations is about 3% to 9%	Severe injury to the primary tooth and or the tooth region
Cause of dilaceration[4]	Mainly attributed to trauma to the primary teeth	Dilaceration in permanent teeth is uncommon relative to primary tooth trauma incidence
B) Idiopathic/Non-traumatic crown dilaceration[2,4,25]	a) Sometimes trauma is not reported. b) Early childhood injuries may be unnoticed or forgotten (parental recall limitations) c) No evident history of injury	The primary cause may be ectopic tooth germ growth rather than trauma

Although the exact cause of dilaceration remains uncertain and is still debated among researchers, trauma to the primary tooth is considered the most plausible explanation. Many cases of dilaceration are associated with a history of trauma to the primary tooth, but this is not universal. Additionally, the occurrence of dilaceration in permanent successor teeth is relatively uncommon and appears disproportionate to the frequency of primary tooth injuries (Table 1)[4].

Pathophysiology of Crown Dilaceration

Several theories have been proposed in the literature regarding the pathophysiology of crown dilaceration. This condition often results from the intrusion or avulsion of a primary incisor when a child is around two years of age, a critical time when about half of the permanent successor's crown is already formed. Trauma to the primary predecessor can cause non-axial displacement of the developing hard tissue portion of the crown at an angle relative to its longitudinal axis. This displacement involves the enamel epithelium and the mineralized portion of the tooth relative to the dental papilla and cervical loops, leading to dilaceration. Specifically, the permanent tooth crown may twist lingually over the dental papilla after the primary tooth's apex invades the partially developed follicle. The enamel epithelium, misplaced from its normal position, may become activated in the new location, resulting in abnormal enamel morphology that can protrude into the pulp canal or externally at the crown-root junction, causing notable deformities[2,3,5,21,25–28].

Impacted Central Incisor Tooth and Pathology

Impacted teeth can lead to various pathological conditions and thus require

appropriate management. Several pathologies associated with unerupted or impacted permanent incisors are well documented, including[29–33]:

a) Enlarged follicle or cystic changes, such as odontogenic cysts or tumors

b) Root resorption and premature exfoliation of adjacent teeth

c) Ectopic eruption, displacement, or rotation of the impacted incisor itself or of adjacent teeth and structures.

The exact cause of crown dilaceration—whether idiopathic or traumatic—affecting the permanent maxillary central incisor is not fully understood. In the present case, the tooth was impacted, and the patient had a history of dental trauma at the age of 2.0–2.5 years, during which she suffered an avulsion of the primary maxillary central incisor.

Conventional radiographs provide a two-dimensional image of three-dimensional structures, which limits their ability to clearly visualize complex dental morphology, especially in the anterior teeth. This limitation can be addressed by using cone beam computed tomography (CBCT), which is particularly valuable in cases involving severe crown dilacerations. CBCT plays a crucial role in clinical practice for the detection of impacted maxillary central incisors and in formulating precise treatment plans. CBCT offers a detailed qualitative evaluation of dental and osseous structures, morphological alterations, and the three-dimensional positioning of unerupted teeth relative to adjacent anatomical structures. Clinical guidelines from the Royal College of Surgeons of England (Royal College of Surgeons of England) and the American Academy of Pediatric Dentistry (AAPD) are to be followed as a general principle during the radiographic assessment of unerupted permanent incisors[2,13,33–36].

In this case, CBCT showed the impacted central incisor's crown oriented labially, with the cingulum being the first structure exposed during flap elevation. The root's long axis was positioned palatally, forming a 90-degree angle at the cementoenamel junction with the crown. The tooth had complete root formation. This precise CBCT information was crucial for planning treatment.

Table 2. Management options for dilaceration

Depending upon the eruption status	**Treatment options**	**Keynotes**
Eruption status Totally impacted[8,24,26,37–39]	Surgical exposure with or without orthodontic traction; aesthetic periodontal surgery	High success rates reported
Partially erupted[8,24]	Surgical extrusion	Multidisciplinary options are used to bring the tooth into the correct position
Fully erupted[8,24]	Buccal and/or palatal contouring and composite resin restoration (if crown-root angle is minimal)	A conservative approach is preferred if the deviation is mild
Treatment options		**Keynotes**
General management[26,37–9]	Multidisciplinary approach involving pediatric dentistry, orthodontics, periodontics, surgery, and prosthodontics	Treatment success is influenced by the degree of dilaceration, vertical tooth position, and root maturity
Orthodontic-surgical	Surgical exposure followed by orthodontic traction or extraction	Treatment based on impaction type and severity; extraction is considered when angulation/position is unfavourable

For the present case, the opinion of an orthodontist was obtained, and it came to the consensus that the tooth needed surgical extraction. The tooth's unusual angulation and position rendered extraction the only viable option, followed by rehabilitation to restore both function and aesthetics (Table 2).

Conclusion

Dilacerations are believed to be caused by trauma to the primary tooth, but not all cases of dilaceration result from dental trauma. Successful management requires a multidisciplinary approach involving pedodontists, orthodontists, periodontists, surgeons, and prosthodontists. Treatment success depends on factors like degree of dilaceration, tooth position, and root maturity, and other factors such as the patient's age, cost, and convenience should also be considered to ensure rational and patient-centred treatment planning. This case highlights the importance of individualized treatment, where surgical extraction and subsequent rehabilitation were necessary due to the unfavourable position and angulation of the impacted tooth.

***Conflicts of Interest*:** No conflict of interest.

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NEOBIČNO TROŠENJE SEKUTIĆA: DIJAGNOSTIČKI ZNAK DIJETALNIH NAVIKA

UNUSUAL INCISOR TOOTH WEAR: A DIAGNOSTIC SIGN OF DIETARY HABITS

Vanishree H. S., Anand S Tegginamani

UNIVERZITET SEGI, STOMATOLOŠKI FAKULTET, KOTA DAMANSARA, MALEZIJA

SEGI UNIVERSITY, FACULTY OF DENTISTRY, KOTA DAMANSARA, MALAYSIA

Sažetak

Uvod: *Nekarijesni gubitak tvrdih zubnih tkiva predstavlja čest klinički nalaz u stomatološkoj praksi. Može nastati kao posledica kombinovanog dejstva različitih faktora, uključujući hemijsku eroziju, mehaničku atriciju i abraziju usled kontakta sa stranim objektima. Abrazija nastaje dejstvom egzogenih mehaničkih faktora na površinu zuba; njenu pojavu mogu izazvati brojni činioci povezani sa profesijom i načinom ishrane.*
Cilj: *Cilj ovog rada bio je da predstavi osam slučajeva nekarijesnog gubitka tvrdih zubnih tkiva povezanog sa navikama u ishrani.*
Zaključak: *Faktori povezani sa načinom ishrane predstavljaju značajan ali često zanemaren uzrok nekarijesnog gubitka tvrdih zubnih tkiva. Mada su semenke, poput semenki suncokreta i semenki lubenice, nutritivno korisne, način na koji se konzumiraju može doprineti nastanku nekarijesnog gubitka tvrdih zubnih tkiva. Niz slučajeva prikazan u ovom radu ukazuje na specifičan etiološki faktor, koji se ne prepoznaje u dovoljnoj meri, i naglašava potrebu za edukacijom pacijenata usmerenu na očuvanje oralnog zdravlja.*

Ključne reči: *abrazija, atricija, nekarijesni gubitak tvrdih zubnih tkiva, jestive semenke, semenke suncokreta, semenke lubenice*

Abstract

Introduction: *Dentists frequently encounter cases of tooth wear, which can be caused by a variety of reasons, such as food erosion, physical attrition, and abrasion due to contact with foreign objects. Abrasion is caused by exogenous material rubbing against tooth surfaces; it is multifactorial linked to occupational or dietary habits.*
Aim: *The aim was to present a series of eight cases of tooth wear caused by dietary habits.*
Conclusion: *Food is the most prevalent cause of tooth wear, yet it is also the most disregarded. Seeds such as sunflower and watermelon can be beneficial to one's health, but the public needs to be educated on several other ways to eat these seeds and keep their teeth healthy.*

Key words: *abrasion, attrition, edible seeds, sunflower seeds, tooth wear, watermelon seeds*

Corresponding author:
Anand S Tegginamani
No 9, Jalan Teknologi, Kota Damansara PJU 5, 47810
Petaling Jaya, Selangor, Malaysia
E-mail: anandsiddappa@segi.edu.my

Introduction

Tooth surface loss, or tooth wear (TW), is the permanent loss of dental hard tissue caused by non-cariogenic factors that typically interact to cause damage. Tooth wear can be classified as either physiological or pathological. It is considered multifactorial. Attrition, erosion, abrasion, and abfraction are the four types of tooth wear. Generally, the extent of tooth wear correlates with age. Tooth wear in a young person may be perceived as pathological, whereas the same amount in an older individual might be normal or physiological. Abrasion results from abnormal mechanical processes where friction from external material being forced over tooth surfaces causes wear. Patients consuming a coarse, abrasive vegetarian diet may experience significant tooth wear[1–6].

Case reports

The study included a total of eight patients who had the habit of peeling sunflower seeds. Their age ranged from three to six decades. A detailed social and occupational history was elicited, and occupational and pica tooth wear were the exclusion criteria for the study.

The patients' occupational history revealed no significant associations with the incisal edge notches. None of the patients had worked in occupations such as tailoring, shoemaking/cobbling, or other occupations where it is common for individuals to hold objects (pins, clamps, or nails) between their teeth. They did not have a habit of removing bottle tops, pen-chewing, or smoking a tobacco pipe. The one thing they all had in common was a dietary history of cracking or peeling sunflower seeds between their upper and lower teeth.

Results

A total of eight patients, of whom one was Iranian, were included with an equal distribution among the genders (4 males and 4 females). In total, 22 teeth exhibited notching of the incisal edges attributed to the seed-eating habit: 6 out of 22 notches were found on tooth number 11 (27.27%), 5 out of 22 on tooth number 21 (22.73%), 2 out of 22 on tooth number 32 (9.09%), 3 out of 22 on tooth number 31 (13.64%), 3 out of 22 on tooth number 41 (13.64%), and 3 out of 22 on tooth number 42 (13.64%) (Figures 1a–d, 2a–d).

The maxillary permanent right central incisor was the most affected, and the mandibular left central incisor was the least affected in the study.

Discussion

Abrasion occurs due to abnormal mechanical processes wherein the friction of exogenous material being forced over tooth surfaces results in the wearing of tooth substance[3,5,6]. Less common forms of abrasion may be associated with the occupation or habits of the patient. Notching the incisal edges of the central incisors often indicates habitual holding of objects such as nails, tacks, and bobby pins between the teeth[3]. Similarly, the use of teeth as tools in patients with abnormal eating habits may also result in notching. Although a variety of foreign substances, including toothbrushes, can cause abrasion, food is the most common yet the most neglected. The action on a tooth surface is non-anatomically specific, meaning that it happens along the entire occlusal surface, resulting in a wear area[6].

In general, the sunflower is valued for its nutritional and therapeutic properties. Sunflower seeds have been recognized as a functional food or nutraceutical due to their good health impacts, but their full potential has yet to be realized. Sunflower seeds are high in antioxidants, flavonoids, phenolic acids, procyanidins, phytosterols, amino acids, dietary fiber, potassium, and arginine, monounsaturated and polyunsaturated fatty acids, all of which contribute to the enhancement of human health[7]. Jordan, Syria, Iraq, Saudi Arabia, Lebanon, and Egypt are among the Middle Eastern countries that consume dried, roasted edible seeds such as watermelon, pumpkin, and sunflower seeds[8]. Tooth wear can also be caused by the consumption of vegetables that have not been properly washed[9]. In a review of literature by Warreth A. et al., abrasion lesions due to the consumption of dry sunflower seeds are shown[10]. The seeds are placed between the incisal edges of the upper and lower anterior teeth, and sufficient biting force is exerted to open the seed so the inside core can be eaten. The splitting or compressive force of the seed, its hardness, and the abrasiveness of the seed's shell are directly related to the degree of incisal abrasion. The lesion appears as a notch extending over the incisal edge of the anterior tooth. The occurrence of the notching is bilateral and is normally restricted to anterior teeth, indicating that the patient distributes the seeds' eating in the anterior region.

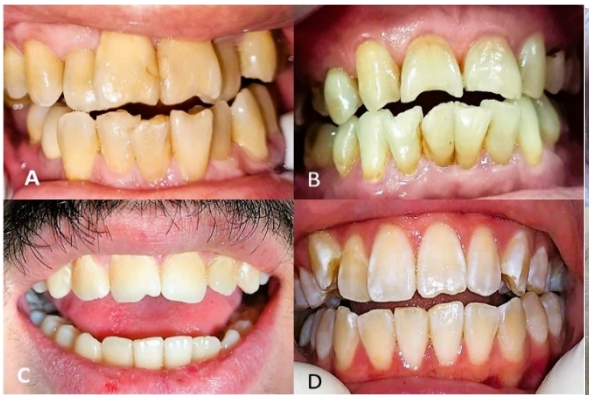

Figure 1. Afected incisors in 4 cases.
1a. Case 1—Incisal edge notching on teeth number 11, 21, 31, 32, 41, and 42
1b. Case 2—Incisal edge notching on teeth number 11, 21, 31, 32, 41, and 42
1c. Case 3—Incisal edge notching on tooth number 11
1d. Case 4—Incisal edge notching on tooth number 21

Figure2. Afected incisors in 4 cases
2a. Case 5—Incisal edge notching on teeth number 11, 31, and 41
2b. Case 6—Incisal edge notching on teeth number 11, 21
2c. Case 7—Incisal edge notching on teeth number 11 and 42
2d. Case 8—Incisal edge notching on tooth number 21

The placement of seeds between incisor teeth and the incisal edges results in variable amounts of abrasion in the form of notching of those edges[8,11].

Consumption of dried roasted seeds results in significant tooth surface loss on incisal edges/tips of central incisors and canines. There has been little work in the literature to describe the adverse dental effects of consumption of dried roasted seeds[8,12–14].

Epidemiological studies on the prevalence of tooth wear have demonstrated a wide range of findings. It was found that the prevalence of general tooth wear among individuals with at least one lesion was 99.8%, but, the study was limited to adolescents in Kuantan, and the results could not be generalized to adolescents in Malaysia[15]. Tooth wear can affect any tooth surface. It is caused by changes to the tooth caused by attrition, erosion, and abrasion. Although each type of tooth wear has its own distinct clinical appearance when present alone, the four types may occur together and interact to form a mixed lesion, which can complicate diagnosis. Tooth wear often remains asymptomatic, so that patients may be unaware of it, and it is only detected during a clinical examination. Accurate prevalence data for each classification are unavailable because indices often only measure a single etiology, or the study populations are too heterogeneous in terms of age and features.

Identifying the characteristics associated with each etiology will influence how teeth are treated in each categorization. Some situations may necessitate restorative methods, while others may not[10,16].

Preventive assessments and regular follow-up will assist in monitoring and avoiding future destruction in mild to moderate tooth wear without functional or cosmetic issues. Management considerations are multidimensional. The choice of materials and the economic differences among various options are factors that significantly influence both patients and clinicians, depending on the severity and impact of wear, along with the patient's preferences. Both professionals and patients care about aesthetic lifespan and the necessity for cosmetic corrections. Restorative intervention is usually best postponed for as long as possible. When such intervention is warranted and agreed upon with the patient, a conservative, minimally invasive approach is advised, supplemented by supportive preventive measures[17–23].

The morphology of the affected tooth may change. It could, however, be asymptomatic, which suggests the patient is unaware of it[10]. As seen in the current cases, notching of the incisal margins of the central/lateral incisors is not always connected

with the patient's work or pica habits, and a full food history may aid in the appropriate diagnosis of tooth wear.

Patients were instructed to avoid peeling seeds with their teeth but to continue consuming seeds in other ways, such as choosing unshelled/hulled seeds to peel with a fingernail or using a nut opener. (Sunflowerseed peeling machine manual and battery-operated, which are lightweight and portable, and a manual nut opener are available).

The detection of abnormal tooth wear is critical. Normal levels of attrition necessitate no therapy, with intervention reserved for cases of a pathological degree of tooth loss or when the patient expresses significant aesthetic concerns. Early identification and treatment may help to preserve the permanent dentition. Identifying the causes of tooth structure loss and preserving the remaining dentition are also significant objectives. Restorative methods that do not need major removal of remaining tooth structure are desirable for patients with extensive tooth wear. Intervention should focus on precise diagnosis, preventive actions, and long-term monitoring. Patients should be advised on how to effectively maintain their oral health. Dietary recommendations may be part of this[10,24–30].

Conclusion

Although many tooth wear mechanisms have been identified, most reports in the literature focus on cases where erosion and attrition are the main causes. This article describes a case series of abrasive tooth wear. The consumption of sunflower seeds may be beneficial and protein-rich, but it can also cause irreversible tooth wear. Food history may aid in the appropriate diagnosis of this kind of tooth wear. A greater awareness should be raised among patients about various ways to eat these seeds to maintain their dental health.

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Klinika za Stomatologiju

Bul. Zorana Đinđića 52

18000 Niš, Srbija

E-mail: tarana.simona@gmail.com, tijanicm@yahoo.com

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Results: (describe the results of the work and the final outcome),

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ACKNOWLEDGEMENTS

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Journals:

1. Standard journal reference. (Note: list all authors if six or less; when seven or more, list only first three and add et al): Glass DA, Mellonig JT, Towle HJ. Histologic evaluation of bone inductive proteins complexed with coralline hydroxyapatite in an extraskeletal site of the rat. J Periodontol 1989;60:121-125.

2. Corporate author: Federation Dentaire Internationale. Technical Report No.28. Guidelines for antibiotic prophylaxis of infective endocarditis for dental patients with cardiovascular disease. Int Dent J 1987;37:235.

3. No author given: Coffee drinking and cancer of the pancreas (editorial). BMJ 1981;283:628.

4. Volume with supplement: Magni R, Rossoni G, Berti R, BN52021 protect guinea pig from heart anaphylaxis. Pharmacol Res Commun 1988; 20 Suppl 5:75-8.

Books or other monographs:

5. Personal author(s): Tullman JJ, Redding SW. Systemic Disease in Dental Treatment. St. Louis: The CV Mosby Company; 1983:1-5.

6. Chapter in a book: Rees TD. Dental management of the medically compromised patient. In: McDonald RE, Hurt WC, Gilmore HW, Middleton RA, eds. Current Therapy in Dentistry, vol. 7. St. Louis: The CV Mosby Company; 1980:3-7.

7. Dissertations and thesis: Teerakapong A. Langerhans Cells in human periodontally healthy and diseased gingiva. (Thesis). Houston, TX: University of Texas; 1987.92 p.

Other published material:

8. Newspaper article: Shaffer RA.Advances in chemistry are starting to unlock mysteries ofthe brain. The Washington Post 1989Ang 7; Sect.A:2 (col. 5).

References - electronic quotations:

9. Online journals without volume and page information. Berlin JA, Antman EM. Advantages and limitations of metaanalytic regressions of clinical trials data. Online J Curr Clin Trials (serial online). June 4; doc 134. Accessed July 20, 2000.

10. Online journals with volume and page information. Fowler EB, Breault LG. Ridge augmentation with a folded acellular dermal matrix allograft: A case Report. J Contemp Dent Pract (serial online). 2001;2(3):31-40. Available from: Procter&Gamble Company, Cincinnat, OH. Accessed December 15, 2001.

11. World Wide Web.Centers for Disease Control and Prevention. Preventing emerging infectious diseases: Addressing the problem of antimicrobial resistance. Available at: http://www.cdc.gov/ncidod/emergplan/antiresist/. Accessed November 5, 2001.

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Clinic of Dental Medicine Bul. Zorana Djindjića 52

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E-mail: tarana.simona@gmail.com , tijanicm@yahoo.com

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