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RELATIONSHIP BETWEEN HARD PALATE DIMENSIONS AND THE WIDTH OF MAXILLARY ANTERIOR TEETH

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ABSTRACT

Objective: This study aimed to determine the reliability of selected anthropometric parameters of the hard palate as individual and simultaneous predictors of the width of the anterior maxillary teeth.

Methods: This retrospective cross-sectional observational study used the maxillary casts of 180 subjects from Bosnia and Herzegovina of both genders aged 20 to 40. Hamular distance, hard palate length, distances between the incisive papilla and left and right hamular notch, the widths of the anterior teeth at the level of contact points were measured on the casts using a digital caliper. For each subject, the sum of the widths of the anterior maxillary teeth was calculated and used as the value of a dependent variable. The obtained data were statistically analyzed.

Results: Established mean differences between the width of the anterior maxillary teeth and hard palate dimensions were statistically significant ($p < 0.05$). Significant positive linear relationships ($p < 0.000$) were found, between the hard palate dimensions and the width of anterior teeth, with correlation coefficients ranging $r = 0.247$-0.398. The coefficient of multiple correlation was moderate ($R = 0.438$, $p < 0.000$).

Conclusions: The multiple linear regression model provides a more reliable prediction of the width of the anterior maxillary teeth compared to the simple linear regression models. Nevertheless, the combined influence of the four evaluated hard palate dimensions can explain at most 19% of the teeth width variability in our subjects, which is insufficient for a reliable prediction. Further studies should be examined some other parameters.

Keywords: anterior maxillary teeth, teeth width, hard palate, dimensions, relationship, complete denture

Introduction

The rehabilitation of qualitative and quantitative changes in the stomatognathic system caused by complete tooth loss is very demanding. Although contemporary Prosthodontics has several different therapeutic modalities, the making of conventional complete dentures remains the most common treatment for edentulous patients [1]. Complete dentures should restore original occlusion, lost dentofacial harmony and the appearance of the patient being impossible to achieve without correct selection and setting of artificial teeth. The anterior maxillary teeth are most exposed to view and judgment, and since their appearance affects the dental and smile aesthetics dominantly [2], special attention in denture construction belongs to the selection of artificial maxillary anterior teeth. The anterior teeth are primarily selected to fulfill aesthetic requirements. Patients, especially those receiving complete dentures for the first time, generally expect a similar appearance between artificial and lost natural teeth [3-5]. The adequately selected size of artificial maxillary anterior teeth mostly influences a denture naturalness [6-8]. Pre-extraction records of the natural tooth dimensions, such as study models, photographs, preserved extracted teeth, as well as old radiographs and dentures, may be useful in selecting artificial anterior maxillary teeth [9]. If pre-extraction records are unavailable, determining the appropriate dimensions of artificial maxillary anterior teeth becomes one of the challenges [10], which is not always easy to respond to satisfactorily. The synthesis of knowledge, experience, creativity, imagination and a sense of the aesthetic is necessary to pass successfully through this step avoiding the distinctive artificial appearance of complete denture. It is easier to determine the appropriate length of artificial maxillary anterior teeth than their width [11] since relatively reliable anatomical and functional parameters permit this [12-14]. However, the mesiodistal width of the anterior maxillary teeth is more relevant for the natural appearance and functionality of the denture [4, 12, 13], but also much harder to estimate accurately. To date, several extraoral and intraoral anthropometric landmarks have been proposed to determine the width of artificial anterior maxillary teeth, and the results of previous studies are inconsistent regarding their reliability. An universally applicable anthropometric indicator of the anterior teeth width is yet to be found [15, 16], and their reliability varies among different ethnic groups around the world [3].

Regarding all the above mentioned, this study aimed to determine the reliability of selected anthropometric parameters of the hard palate as individual and simultaneous predictors of the width of the anterior maxillary teeth since that has not been studied in our population previously.

Materials and Methods

The research was performed at the Dental Prosthetics Department of the Faculty of Dentistry of the University of Sarajevo as a retrospective observational study employing a cross-sectional method. In this study, the values of variables obtained by measuring the maxillary casts of 180 subjects from Bosnia and Herzegovina of both genders aged 20 to 40 were used. The maxillary casts of the completely dentate subjects with proper tooth alignment free of fixed prosthetic restorations, fillings, caries, attrition, spacing or crowding of anterior teeth were included in the study. Slight rotations or inclinations of individual teeth and absence of third molars were tolerated, as well as different skeletal classes. Maxillary casts of subjects with confirmed orthodontic treatment, parafunctional habits, congenital or maxillofacial defects and craniofacial trauma were excluded from the study. Maxillary casts were obtained by pouring alginate impressions (Xantalgin® Select, Kulzer GmbH, Hanau, Germany) with a type IV gypsum (Moldastone, Kulzer GmbH, Hanau, Germany). All impressions have been previously disinfected (Aseptoprint® Liquid, OCC Switzerland, Fehraltorf, Switzerland). Following the gypsum

setting process, the casts were removed from the impressions, analyzed to confirm the anatomical landmark structures were well duplicated and then trimmed. The approval by the Ethics Committee of the Faculty of Dentistry of the University of Sarajevo and the informed consent of participants was obtained for taking the impression, making and measuring the maxillary casts used in this research.

By one person using a digital caliper (Emil Lux GmbH & Co. KG, Wermelskirchen, Germany), the following distances on the casts were measured: the distance between the right and the left hamular notch (hamular distance), the distance between the center of the incisive papilla and the fovea palatine (hard palate length), the distance from the right hamular notch to the incisive papilla, the distance from the left hamular notch to the incisive papilla, and the mesiodistal widths of the anterior maxillary teeth at the level of contact points. Each variable was measured three times on each maxillary cast, and the obtained values were recorded on worksheets. The data later were transferred into the Microsoft Excel tables (Microsoft Excel 2016 MSO) to calculate the mean value of three measurements and get the reference value of variables. The sum of the widths of the anterior maxillary teeth was also calculated for each subject to obtain the value of the dependent variable.

The obtained data were statistically analyzed using IBM SPSS Statistics v.21. Descriptive statistical parameters were calculated. Testing of research hypotheses was performed by parametric statistical methods. Differences between two dependent samples were tested by the Paired samples t-test. The correlation and the influence of independent variables on the dependent variable were examined in the first procedure by simple linear regression analysis, while in the second procedure, a standard multiple linear regression analysis, the enter method, was used. Before testing the research hypotheses, the universal statistical assumptions of the used parametric statistical methods were screened, namely: normality of the distribution of variables and the presence of univariate atypical points (Outliers). Additionally, the absence of multicollinearity of independent variables with VIF coefficient for the linear regression analyzes was examined. By checking the stated assumptions, no significant violation of them was noticed. The alpha significance level was set at 5% (0.05).

Table 1. Descriptive values of different evaluated dimensions of teeth and hard palate

Dimensions	n	Minimum	Maximum	95% C.I.Mean	Std. Deviation	Skewness
Width of right central incisor	180	7,30	10,37	8,60±0,09	0,61	0,21
Width of right lateral incisor	180	5,37	8,90	6,76±0,08	0,55	0,27
Width of right canine	180	6,75	9,20	7,85±0,08	0,54	0,18
Width of left central incisor	180	5,40	10,17	8,63±0,09	0,63	-0,55
Width of left lateral incisor	180	5,50	8,70	6,77±0,08	0,55	0,42
Width of left canine	180	6,60	9,50	7,84±0,07	0,49	0,14
The sum of the widths of the anterior maxillary teeth	180	40,40	52,90	46,44±0,38	2,61	0,07
Hamular distance	180	32,00	49,93	42,77±0,50	3,45	-0,32
Hard palate length	180	40,09	52,75	45,93±0,40	2,72	-0,02
Distance from the right hamular notch to the incisive papilla	180	41,60	57,16	49,62±0,44	3,03	0,07
Distance from the left hamular notch to the incisive papilla	180	41,00	57,71	49,49±0,49	3,34	-0,16

Table 2. The differences between the average values of measurements on the right and left sides of the upper jaw

Compared dimensions	n	Paired Differences		t value	P value
		95% C.I.Mean	Std. Deviation		
Width of right central incisor - Width of left central incisor	180	-0,03±0,07	0,45	-0,964	0,336
Width of right lateral incisor - Width of left lateral incisor	180	-0,01±0,08	0,51	-0,281	0,779
Width of right canine - Width of left canine	180	0,01±0,05	0,36	0,205	0,838
Distance from the right hamular notch to the incisive papilla - Distance from the left hamular notch to the incisive papilla	180	0,12±0,26	1,81	0,912	0,363

Results

The descriptive statistics results, including the arithmetic means and confidence intervals, standard deviations, value ranges and asymmetry coefficients for various measured dimensions of the teeth and the hard palate, are shown in **Table 1**.

The dependent t-test examined the mean differences between the measured dimensions on the right and left side of the maxilla and the obtained results are presented in **Table 2**. The average values of the widths of the anterior homologous teeth were not significantly different, nor the average values of the distances from hamular notch to incisive papilla on the right and the left sides of the hard palate.

The Paired samples t-test compared the mean differences between the sum of the widths of the anterior maxillary teeth and the four evaluated dimensions of the hard palate (**Table 3**). The most similar to the widths of the anterior maxillary teeth was the hard palate length with a mean difference of 0.51 ± 0.45 millimeters, while the most different was the hamular distance with a mean difference of 3.67 ± 0.55 millimeters. Nevertheless, the results of the t-tests showed that all established differences between the average values of the sum of the widths of the anterior maxillary teeth and the four evaluated dimensions of the hard palate were statistically significant ($p < 0.05$).

In the separate simple linear regression models, the individual correlation and influence between the measured dimensions of the hard palate and the sum of the widths of the anterior maxillary teeth were quantified. A statistically significant weak positive linear relationship ($r = 0.247$, $p < 0.000$) was found between the hamular distance and the dependent variable. Other evaluated dimensions of the hard palate also had a statistically significant ($p < 0.000$) but a moderate positive linear relationship with correlation coefficients ranging $r = 0.324$-0.398. The results of

Table 3. The differences between the average values of the sum of the widths of the anterior maxillary teeth and the dimensions of the hard palate

Compared dimensions	n	Paired Differences		t value	P value
		95% C.I.Mean	Std. Deviation		
The sum of the widths of the anterior maxillary teeth - Hamular distance	180	3,67±0,55	3,77	13,059	0,000
The sum of the widths of the anterior maxillary teeth - Hard palate length	180	0,51±0,45	3,10	2,214	0,028
The sum of the widths of the anterior maxillary teeth - Distance from the right hamular notch to the incisive papilla	180	-3,18±0,46	3,14	-13,595	0,000
The sum of the widths of the anterior maxillary teeth - Distance from the left hamular notch to the incisive papilla	180	-3,05±0,48	3,32	-12,351	0,000

Table 4. Simple linear regression models for predicting the value of the sum of the widths of the anterior maxillary teeth

Regression models	Mean			Regression parameters			
	X	Y	X/Y	r	a	b	P value
Hamular distance -> The sum of the widths of the anterior maxillary teeth	42,76	46,44	0,92	0,247	38,45	0,19	0,000
Hard palate length -> The sum of the widths of the anterior maxillary teeth	45,93	46,44	0,99	0,324	32,18	0,31	0,000
Distance from the right hamular notch to the incisive papilla -> The sum of the widths of the anterior maxillary teeth	49,62	46,44	1,07	0,388	29,87	0,33	0,000
Distance from the left hamular notch to the incisive papilla -> The sum of the widths of the anterior maxillary teeth	49,49	46,44	1,07	0,398	31,06	0,31	0,000

Table 5. Representativeness of the multiple linear regression model for predicting the value of the sum of the widths of the anterior maxillary teeth

R	R Square	Adjusted R Square	Std. Error	F	P value
0,438	0,192	0,173	2,37	10,386	0,000

Table 6. Realized regression parameters for predicting the value of the sum of the widths of the anterior maxillary teeth

	Unstandardized Coefficients		Standardized Coefficients	t value	P value	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
a	25,621	3,612	-	7,094	0,000	18,493	32,749
Hamular distance (X1)	0,122	0,054	0,162	2,245	0,026	0,015	0,230
Hard palate length (X2)	0,010	0,120	0,010	0,083	0,934	-0,228	0,248
Distance from the right hamular notch to the incisive papilla (X3)	0,119	0,120	0,138	0,992	0,323	-0,118	0,356
Distance from the left hamular notch to the incisive papilla (X4)	0,186	0,108	0,239	1,731	0,085	-0,026	0,399

the performed simple linear regression analysis are shown in **Table 4**.

The multiple linear regression investigated the simultaneous influence of the measured dimensions of the hard palate on the prediction of the sum of the widths of the anterior maxillary teeth. Results confirmed that the regression model with a set of independent variables has a statistically significant moderate multiple linear relationships ($R = 0.438$, $p < 0.000$) with the dependent variable (**Table 5**).

When the individual influences of independent variables in the model on the contribution to the prediction of the value of the sum of the widths of

the anterior maxillary teeth were analyzed, the hamular distance showed a statistically significant contribution (Beta = 0.162, p <0.026) compared to other predictors that did not have statistical significance (**Table 6**). The result of performed multiple linear regression is the multiple linear regression equation with included regression coefficients as follows: The sum of the widths of the anterior maxillary teeth = 25,621+ 0,122 X1 + 0,010 X2 + 0,119 X3 + 0,186 X4, where X1 through X4 are distinct predictor variables given in Table 6.

Discussion

According to the literature, some of the extraoral factors have been frequently used to determine the width of anterior maxillary teeth, particularly the intercommissural, interalar, intercanthal, interpupillary and bizygomatic distance [17]. The relationships between teeth and facial dimensions have been extensively examined, but the results of performed studies are not consistent. Several previous studies have shown that some parts of the face and dimensions of the anterior teeth have a proportional relationship [11, 12, 14, 18-23]. Other studies have not confirmed the correlation [8, 24-29] or found it only in a particular gender [13, 30]. The general opinion is that harmony between the dimensions of the teeth and the patient's face is needed to achieve a satisfactory aesthetic result with dentures, but none of the studied facial dimensions can be recommended as universally applicable and reliable for determination of the width of the artificial anterior maxillary teeth. Additionally, the reliability of using the facial dimensions also compromises the absence of a static relationship of structures due to mobility and possible changes in soft tissue landmarks due to aging [31], body weight variability [32], aesthetic surgical or cosmetic corrections. It is considered that only fixed anatomical landmarks should be used to determine the width of artificial upper anterior teeth, which does not change due to the previously mentioned [33] or some other factors. Several intraorally located structures are known to remain constant throughout life [34]. The hamular notch is located at the junction of the maxilla and the pterygoid hamulus of the sphenoid bone [35]. It is an easily noticeable bilateral landmark that does not change after tooth loss, bone resorption, or due to aging or body weight changes [33]. Previous studies have found that the average values of hamular distance and the sum of individual mesiodistal widths of the anterior maxillary teeth are not significantly different, are significantly correlated and that this dimension of the hard palate is a reliable clinical guide [33, 36-39]. This study revealed that hamular distance was a significant but the weakest predictor of the sum of widths of the anterior maxillary teeth. All other dimensions of the hard palate showed a stronger association with the dependent variable. Similar to other previous studies [32, 40], the present study also found that the average values of the hamular distance and the sum of widths of the anterior maxillary teeth differ significantly. According to a recently published approach, a more reliable determination of the width of the anterior maxillary teeth performs if 10 millimeters are added to a measured value of the hamular distance [4, 15]. However, the results of this and some other studies [27] do not support this method. The incisive papilla is also considered a reliable and relatively stable anatomical landmark [34] that does not change position after tooth loss [41] and even years later [42]. Its center is usually used as a reference point [41, 42]. Larasati et al., founded that the distances between the center of the incisive papilla and the hamular notch on the right and left side and the width of the anterior maxillary teeth are significantly correlated and that these distances may explain 25.7% of tooth width variability [40]. In some studies, the strength of correlation between the distance from the center of the incisive papilla to the hamular notch and the width of the upper anterior teeth varies regarding ethnicity [39] and gender [40], but authors [38] still consider this distance of the hard palate as a reliable guide for determining the width of the upper anterior teeth. In the present study, this distance on the hard palate showed a significant

positive relationship with the width of the anterior maxillary teeth, the strongest of all variables analyzed by simple linear regression.

However, based on the realized coefficients r = 0.388 for the right and r = 0.398 for the left side, the correlation was only moderate. Baker et al., considered a hamular distance a more reliable guideline of the width of the anterior maxillary teeth than the distance between the center of the incisive papilla and the hamular notch [15]. In the present study, multiple regression analyses confirmed a similar result, and the hamular distance contributes significantly (Beta = 0.162, p <0.026) to the estimation of the width of the anterior maxillary teeth, unlike the other three predictors. However, when a simple linear regression examined the individual influence of predictors, the present study found the opposite results, a weak correlation of the width of teeth and the hamular distance, and a moderate correlation between the width of teeth and the length between the incisive papilla and the hamular notch. The hard palate length is another possible intraoral reference distance with boundary points, the center of the incisive papilla and the palatine fovea remaining constant after tooth loss. Previous studies have shown that the average values of this distance are not significantly different in dentate and edentate subjects, and also that through its measurement, the original value of the length of the upper central incisor can be estimated [43]. According to the present study results, four examined dimensions of the hard palate were significantly different in the mean value from the width of the anterior maxillary teeth, and the hard palate length was the most similar, with a mean difference of 0.51 ± 0.45 millimeters. The present study founded a statistically significant moderate positive linear relationship between the hard palate length and the anterior teeth width. Compared to other predictors, hard palate length would be a better guideline than the hamular distance but weaker than the distance between the incisive papilla and the hamular notch. Similar studies examining the relationship between the hard palate length and the width of the anterior maxillary teeth are lacking in the literature.

Conclusion

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

1. There is a significant positive correlation between all evaluated dimensions on the hard palate and the anterior maxillary teeth width, and the multiple linear regression model provides a more reliable prediction of the original value of the width of the anterior maxillary teeth compared to the simple linear regression models constructed in this study.
2. Determination of the width of the artificial anterior maxillary teeth by measurement of the hard palate dimensions can be used as the initial step or combined with other methods for the selection of anterior teeth in denture construction. Some other parameters must be examined since the combined influence of the four evaluated hard palate dimensions can explain at most 19% of the variability of maxillary anterior teeth width in our subjects, which is insufficient for a reliable prediction.

Declaration of interest

There is not any conflict of interest for all authors, between the authors, or for any organization.

References:

1. Sun YC, Sun R, Deng KH, Wang Y, Zhou YS. Research and Development of Digital Design and Fabrication of Complete Denture. Zhonghua Kou Qiang Yi Xue Za Zhi. 2018;53(1):60-65.
2. Oreški NP, Čelebić A, Petričević N. Assessment of esthetic characteristics of the teeth and surrounding anatomical structures. Acta Stomatol Croat. 2017;51(1):22-32.

3. Jain AR, Nallaswamy D, Ariga P, Ganapathy DM. Determination of correlation of width of maxillary anterior teeth using extraoral and intrao-ral factors in Indian population: a systematic review. World J Dent. 2018;9(1):68-75.

4. Ravikumar C, Jain AR. Reliability of pterygomaxillary notch in determination of width of maxillary anterior in Indian and Malaysian po-pulation. Drug Invention Today. 2018; 10(4): 525-530.

5. Ibrahimagić L, Čelebić A, Jerolimov V, Seifert D, Kardum-Ivić M, Filipović I. Correlation between the size of maxillary frontal teeth, the width between alae nasi and the width between corners of the lips. Acta Stomatol Croat. 2001;35(2):175-179.

6. Attokaran G, Shenoy K. Correlation between Innercanthal Distance and Mesiodistal Width of Maxillary Anterior Teeth in a Thrissur, Kerala, India, Population. J Contemp Dent Pract. 2016;17(5):382-387.

7. A L-Kaisy N, Garib BT. Selecting maxillary anterior tooth width by measuring certain facial dimensions in the Kurdish population. J Prosthet Dent. 2016;115(3):329-334.

8. Mishra MK, Singh RK, Suwal P, Parajuli PK, Shrestha P, Baral D. A comparative study to find out the relationship between the inner inter-canthal distance, interpupillary distance, inter-commissural width, inter-alar width, and the width of maxillary anterior teeth in Aryans and Mongoloids. Clin Cosmet Investig Dent. 2016;8:29-34.

9. Bissasu M. Pre-extraction records for complete denture fabrication: a literature review. J Prosthet Dent. 2004;91(1):55-58.

10. Liao P, Fan Y, Nathanson D. Evaluation of maxillary anterior teeth width: A systematic review. J Prosthet Dent. 2019;122(3): 275-281.e7.

11. Abdullah MA. Inner canthal distance and geometric progression as a predictor of maxillary central incisor width. J Prosthet Dent. 2002;88(1):16-20.

12. Al Wazzan KA. The relationship between intercanthal dimension and the widths of maxillary anterior teeth. J Prosthet Dent. 2001;86(6): 608-612.

13. Hasanreisoglu U, Berksun S, Aras K, Arslan I. An analysis of maxillary anterior teeth: facial and dental proportions. J Prosthet Dent. 2005;94(6): 530-538.

14. Kern BE. Anthropometric parameters of tooth selection. J Prosthet Dent. 1967;17(5): 431-437.

15. Baker PS, Morris WJ, Lefebvre CA, Price GA, Looney SW. Relationship of denture cast measurements to width of maxillary anterior teeth. J Prosthet Dent. 2011;105(1):44-50.

16. Zlatarić DK, Kristek E, Celebić A. Analysis of width/length ratios of normal clinical crowns of the maxillary anterior dentition: correlation between dental proportions and facial measure-ments. Int J Prosthodont. 2007;20(3):313-315.

17. Melilli D, Calandra F, Messina P, Scardina GA. A new system for choosing the form and size of complete denture anterior teeth. Dent Hypotheses. 2016;7(4):147-151.

18. Ibrahimagić-Šeper L, Selimović E. Analysis of the correlation between some antropometric parametars of the face and the teeth in reconstruc-tive removable prosthodontics. Med Glas. 2005;2(1):29-33.

19. Gomes VL, Gonçalves LC, Costa MM, Lucas Bde L. Interalar distance to estimate the combined width of the six maxillary anterior teeth in oral rehabilitation treatment. J Esthet Restor Dent. 2009;21(1):26-36.

20. Miranda GA, D'Souza M. Evaulating the reliability of the interalar width and intercommissural width as guides in selection of artificial maxillary anterior teeth: A clinical study. J Interdiscip Dentistry. 2016;6(2):64-70.

21. Isa ZM, Tawfiq OF, Noor NM, Shamsudheen MI, Rijal OM. Regression methods to investigate the relationship between facial measurements and widths of the maxillary anterior teeth. J Prosthet Dent. 2010;103(3):182-188.

22. Gomes VL, Gonçalves LC, do Prado CJ, Junior IL, de Lima Lucas B. Correlation between facial measurements and the mesiodistal width of the maxillary anterior teeth. J Esthet Restor Dent. 2006;18(4):196-205.

23. Banu R, Dandekeri S, Shenoy KK, Shetty S, Bhat V, Ragher M. An In Vivo Study to Compare and Evaluate the Correlation of the Facial Measurements with the Combined Mesiodistal Width of the Maxillary Anterior Teeth between Males and Females. J Pharm Bioallied Sci. 2017;9(Suppl 1):S127-S131.

24. Ellakwa A, McNamara K, Sandhu J, et al. Quantifying the selection of maxillary anterior teeth using intraoral and extraoral anatomical landmarks. J Contemp Dent Pract. 2011;12(6): 414-421.

25. Strajnić L, Vuletić I, Vucinić P. The significance of biometric parameters in determining anterior teeth width. Vojnosanit Pregl. 2013;70(7):653-659.

26. Deogade SC, Mantri SS, Sumathi K, Rajoriya S. The relationship between innercanthal dimension and interalar width to the intercanine width of maxillary anterior teeth in central Indian population. J Indian Prosthodont Soc. 2015;15(2):91-97.

27. Sayed ME, Porwal A, Al-Faraj NA, Bajonaid AM, Sumayli HA. Evaluation of the Current Techniques and Introduction of a Novel Approach for Estimating Maxillary Anterior Teeth Dimensions. J Contemp Dent Pract. 2017;18(7):541-548.

28. Deogade SC, Mantri SS, Saxsena S, Daryani H. Correlation between Combined Width of Maxillary Anterior Teeth, Interpupillary Distance and Intercommissural Width in a Group of Indian People. Int J Prosthodont Restor Dent. 2014;4(4):105-111.

29. Varjão FM, Nogueira SS. Intercommissural width in 4 racial groups as a guide for the selection of maxillary anterior teeth in complete dentures. Int J Prosthodont. 2005;18(6):513-515.

30. al-el-Sheikh HM, al-Athel MS. The relationship of interalar width, interpupillary width and maxillary anterior teeth width in Saudi population. Odontostomatol Trop. 1998;21(84):7-10.

31. Ferrario VF, Sforza C, Dellavia C, Schmitz JH. Harmonic analysis of facial profiles: a 10-year evaluation. Int J Adult Orthodon Orthognath Surg. 2001;16(1):54-60.

32. Guldag MU, Büyükkaplan US, Sentut F, Ceylan G. Relationship between pterygomaxillary notches and maxillary anterior teeth. J Prosthodont. 2010;19(3):231-234.

33. Kumar M, Kumar G, Kumar Singh T, Maula D. Relationship between Pterygomaxillary Notches, Maxillary Anterior Teeth and Dental Arch: An in vivo study. Sch J App Med Sci. 2019;7(7):2322-2328.

34. Ferrario VF, Sforza C, Dellavia C, Colombo A, Ferrari RP. Three-dimensional hard tissue palatal size and shape: a 10-year longitudinal evaluation in healthy adults. Int J Adult Orthodon Orthognath Surg. 2002;17(1):51-58.

35. The Glossary of Prosthodontic Terms: Ninth Edition. J Prosthet Dent. 2017;117(5S):e1-e105.

36. Petričević N, Čelebić A, Baučić M, Antonić R. Importance of Hamular Distance for Calculation of the Width of Maxillary Anterior Teeth. Acta Stomat Croat. 2005;39(3):285-290.

37. Petricević N, Katunarić M, Mehulić K, Simeon P, Rener-Sitar K, Celebić A. Selection of appropriate artificial frontal teeth size using dimensions of hard palate. Coll Antropol. 2006;30(3):573-577.

38. Shivaji JM, Vaidya P, Thippanna RK, Wadhwa R, Wadhwa A, Gandhi P. An Innovative Method to Determine the Width of Maxillary Anterior Teeth with the Help of Measurements Obtained from the Master Cast. J Contemp Dent Pract. 2018;19(12):1487-1492.

39. Shukri NMM, Jain AR. The correlation of bizygomatic width and ridge relationships in determination of width of maxillary anterior teeth. Drug Invent. Today. 2018;10(5):728-734.

40. Larasati AA, Gita F, Indrasari M. Measuring Anatomical Landmark Structures to Determine the Width of Maxillary Anterior Teeth. J Int Dent Med Res. 2018;11(1):169-174.

41. McGee GF. Tooth placement and base contour in denture construction. J Prosthet Dent. 1960;10(4):651–657.

42. Harper RN. The Incisive Papilla: The Basis of a Technic to Reproduce the Positions of Key Teeth in Prosthodontia. J Dent Res. 1948;27(6): 661–668.

43. Ibrahimagić–Šeper L, Čelebić A, Selimović E, Petričević N. The length between incisive papilla and foveola palatine for determination of the length of the central upper artificial incisors. Med Glas. 2005;2(2):75-79.

SOCIO-BEHAVIORAL FACTORS AND EARLY CHILDHOOD CARIES AT PRESCHOOL CHILDREN IN THE SARAJEVO CANTON, BOSNIA AND HERZEGOVINA

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ABSTRACT

Objective: The aim was to investigate the correlation between social factors, parental knowledge and practice about oral hygiene and proper dietary habits of their children with early childhood caries (ECC).

Materials and Methods: The research was conducted as a cross-sectional study. The survey involved intraoral examination of children and the questionnaire filled out by parents. Total number of 165 children aged 3-5 years (mean 4.08 ± 0.79) and their parents participated in the study.

Results: The number of children without caries (dmft=0) was 28 (17%), indicating that prevalence of caries within total sample was 83%. The highest prevalence for decay component of dmft was in 5-year-olds (98.3%). The severity of caries distribution was assessed by Wyne's index. Sixty percent of respondents were classified by as type 1, 15.8% as type 2 and 7.3% were in type 3. Most of the parents 90.9%, responded that caries could be prevented with good oral hygiene. Almost the same number of parents knew about fluorides as a protective factor against caries 67.3%, 70.3% were aware that proper dietary habits can help to prevent caries and 93.9 % were aware of the importance of regular dental visits.

Conclusion: Present results showed the discrepancy between parental knowledge about ECC risk and observable caries indices for examined population. Parents of preschoolers had solid knowledge about ECC risks, but recorded caries prevalence and severity indicated that further researches were necessary to establish clear predictive model for community-based prevention.

Key words: Early childhood caries, social and behavioral factors, preschool children

Introduction

Early childhood caries (ECC) is defined as the presence of one or more decayed (non cavitated or cavitated lesions) teeth, missing (due to caries) teeth or filled tooth surfaces in any primary tooth of a child 71 months old or younger [1]. Early childhood caries is considered as multifactorial disease. [2, 3] ECC as a chronic noncommunicable disease, is still one of the most prevalent pathological conditions within child population [4]. The most frequent risk factors contributing to high prevalence of ECC are inadequate diet, socioeconomic background of parents, lower parental education, and lack of the access to the dental care. Oral health is very important for maintaining the oral functions of eating, speech development and a positive self-image. All those functions are not important only to general health but for grow and development and quality of life as well. In extreme cases ECC can even lead to total loss of tooth structure and the only treatment becomes extraction of the affected primary tooth [5].

Early childhood caries is associated with other health problems, including but not limited to the local pain, infections, abscesses, chewing difficulties, malnutrition, gastrointestinal and sleeping disorders. It is well known that appropriate prophylactic measures applied early in life can minimize the incidence of caries [6, 7, 8, 9].

The aim was to investigate the correlation between social factors, parental knowledge of oral hygiene practice and proper dietary habits of their children with ECC.

Materials and methods

The research was conducted at the University in Sarajevo, Faculty of Dentistry, Department of Preventive Dentistry and Pedodontics and in the three dental departments for preschool children in The Public Health Centre of Canton Sarajevo from December 2013 to March 2014, as a cross-sectional study. It was consisted of an oral health survey of children and a questionnaire for parent-scaregivers. Sampling method was adopted from World Health Organization (WHO) prescribed methodology for Oral Health Surveys for examined population group [10]. Research was conducted in accordance with the ethical standards and 1964 Helsinki declaration and was approved by Faculty of Dentistry, University of Sarajevo (Scientific and Educational Committee, 01-2-155-22/2013). The informed consent was obtained from children's parents. The participants were healthy preschool children aged 3 to 5 and their parents admitted for the first time for dental visit at the location site. Total sample consisted of 165 children and one of the parents who accompanied the child. Response rate was 100%. Main outcomes were to assess and correlate ECC prevalence, distribution and severity, family social factors, parental knowledge and attitude regarding ECC behavioral factors such as: oral hygiene and dietary habits and frequency of dental visits. A standard questionnaire for parentscaregivers' knowledge and attitude about ECC doesn't exist. In order to avoid significant methodological problems, the questionnaire for the research was designed using guidelines for oral health of children from the American Academy of Pediatrics [11]. The questionnaire was designed as a closed type survey with multiple choice or true-false format answers, for anonymous individual response on 32 questions divided in four sections: social factors, oral hygiene, dietary habits and child attitude toward dental visits.

Dental status, ECC severity and oral hygiene were assessed by Wyne index, Schröder and Granath index and WHO methods for dmft/DMFT assessment. [9, 10, 12].

A database in Microsoft Office Excel 2007 was created for the purpose of statistical processing. Statistical program IBM SPSS Statistics 20 was used for processing the final results. The data were processed by statistical method of descriptive statistics, ANOVA test for the significance of differences in the average values of clilinical parameters of ECC among the study groups. The Spearman correlation was used to assess the linkage between dmft, Wyne types, oral hygiene and dietary habits. The level of significance was set at $p<0.05$.

Results

The sample consisted of 165 children aged 3-5. Average age of examined children was 4.08 (SD± 0.79), parental average age was 32.56 (SD±13.46) for fathers and 31.04. (SD±10.30) for mothers.

The sample dmft was 6.79 (SD± 5.25) in total. The number of caries free children (dmft=0) was 28 (17%), indicating that caries prevalence of the total sample was 83%. The highest prevalence for decay component of dmft was in 5-year-olds (98.3%) with dmft value of 8.35 (SD± 4.41). Percentage of caries free patients by the age groups is given in **Table 1**.

The severity of caries distribution was assessed by Wyne's idex (9). Sixty percent of respondents were classified as type 1, and 15.8% as type 2 and 7.3% were in type 3. Score 0 for oral status assessed by Schröder and Granath had 52.7% of examinees, that indicated good oral hygiene.

The questionnaire was filled out anonymously by parents of children aged 3-5. Total number of 165 parents, 37 fathers and 128 mothers were asked to fill out the questionnaire about social factors, oral hygiene, dietary habits and frequency of dental visits of their child. Almost all fathers had high school education (45.5%), and the half of the mothers had university degree (47.9%). Detailed information about parental level of education and employments are shown in **Table 2**. Two parents out of 165 did not answer questions related to employment status.

The statement that caries could be prevented with good oral hygiene practice was indicated by 90.9% of parents and almost the same number were aware of protective effects of fluorides (67.3%), and they use fluoride toothpastes as well. High percentage of parents indicated that caries can be prevented with proper dietary habits (70.3%), and 93.9% taught that with regular dental visit caries could be reduced. Children who

Table 1. Percentage of caries free subjects within children's age

Children's age	Frequency of all subjects in age group	Number of caries free subjects (n)	Percentage of caries free subjects (dmft=0)*
3-year-olds	46	19	41.3%
4-year-olds	59	8	13.6%
5-year-olds	60	1	1.7%
Total	**165**	**28**	**17%**

*dmft = decay, missing due to caries, filled due to caries teeth index

Table 2. Social factors observed by parental level of education and employment

	Variables	Fathers N (%)	Mothers N (%)
Educational level	Elementary	1 (0.6%)	3 (1.8%)
	Secondary	75 (45.5%)	68 (41.2%)
	Higher and University	86 (52.1%)	93 (56.4%)
Employment status	Employed	154 (93.3%)	96 (58.2%)
	Unemployed	10 (6.1%)	68 (41.2%)

Table 3. Parental knowlegde and attitude about the oral hygiene, dietary habits and dental visits

Question	Multiple choice answer	Frequency	Percentage
Who brushes the child's teeth	Child	38	23%
	Parents	102	61.8%
	Noone	3	1.8%
	Child and the parents	22	13.3%
How often do you brush the teeth of your child daily	Never	13	7.9%
	Twice (in the morning and evening)	137	83%
	After every meal	15	9.1%
How long do you brush the teeth of your child	Less then 3 minutes	72	43.6%
	3 minutes	77	46.7%
	More than 3 minutes	16	9.7%
When did you start using toothbrush and toothpaste in the daily oral hygiene routine of your child	In the first year	85	51.5%
	In the second year	79	47.9%
	Didn't use it yet	1	0.6%
In the first two years the child was fed by	Brestfeeding	52	31.5%
	Bottle	49	29.7%
	Brestfeeding and bottle	64	38.8%
When should you stop brestfeeding your child	After age 1	49	29.7%
	Between age 1 and 2	101	61.2%
	I don't know	15	9.1%
How many meals does your child have daily	3 meals	27	16.4%
	Between 3 and 5	121	73.3%
	More than 5	17	10.3%
How often does your child consume sweetend beverages and other sweets	Once a week	5	3.0%
	Once a day	84	50.9%
	A few times daily	76	46.1%
When should you take your child to dental office for the first time	In the first 3 years	152	92.1%
	Before enrolling school	7	4.2%
	I don't know	6	3.6%
When did you take your child to dental office for the first time	In the first year	29	17.6%
	Between age 2 to 4	126	76.4%
	Before enrolling school	10	6.1%
How often does the child go to dental visits	Once a year	12	7.3%
	More than once a year	76	46.1%
	When needed	77	46.7%
What was the reason for the last dental visit of your child	On the regular visit	91	55.2%
	Pain	26	15.8%
	Extraction or filling need	48	29.1%

Table 4. Correlation between the social and behavioral factors and clinical parameters of ECC

Question	Significance	dmft	Wyne class	OHI[1]	LFE[2]	EF[3]	FI[4]	LFM[5]	EM[6]
Sweet consuption frequency	Spearman correlation	.209	.133	.230	-.167	-.078	-.056	.045	.032
	Sig.	.007*	.089	.003*	.032	.320	.474	.563	.681
Night meals	Spearman correlation	-.220	-.211	-.221	.150	.117	.180	.021	-.071
	Sig.	.005*	.007*	.004*	.055	.136	.021*	.785	.365
Frequency of dental visits	Spearman correlation	.366	.347	.322	-.125	-.105	-.170	.093	.142
	Sig.	.000*	.000*	.000*	.108	.181	.029*	.233	.069
Breast feeding	Spearman correlation	.128	.088	.185	-.013	-.050	-.102	.070	.193
	Sig.	.100	.262	.018*	.866	.525	.194	.368	.013*
The begining of oral hygiene	Spearman correlation	.363	.278	.261	-.238	-.214	-.260	.124	.206
	Sig.	.000*	.000*	.001*	.002*	.006*	.001*	.113	.008*
Fluoride tooth paste use	Spearman correlation	.188	.158	.251	-.136	-.120	-.107	.128	.074
	Sig.	.016*	.042*	.001*	.081	.125	.172-	.103	.347
Attitude about flouride protettive effects	Spearman correlation	.290	.182	.342	-.194	-.282	.239	-.045	.128
	Sig.	.000*	.019*	.000*	.012*	.000*	.002*	.563	.102

*Significance (Sig.) at p<0.05;
[1]OHI - Oral hygiene indeks; [2]LFE - The level of fathers education; [3]EF - father employement status;
[4]FI - Avarage family income; [5]LFM - The level of mothers education; [6]EM- mother employment status

started with tooth brushing earlier (age 1 or younger) had lower average dmft and were in lower Wyne types. Positive parental knowledge and attitudes of fluorides and oral hygiene practice are correlated with lower dmft, oral hygiene index and Wyne class. Parental attitude that breastfeeding should have been stopped after the age of 1 are correlated with better oral hygiene. Parents with higher educational level and better financial background started to practice oral hygiene earlier. Results of parental knowledge and attitude regarding caries prevention are shown in **Table 3**.

Significant correlation was found between the level of education, caries prevalence and severity of disease. Caries prevalence was higher in parents with lower level of education. Children who started using toothbrushes and toothpaste earlier, and whose parents had a higher level of education and income, had lower dmft, plaque index and Wyne class. Correlation between clinical parameters, social and behavioral factors is presented in **Table 4.**

Discussion

Prevalence of ECC is increasing in many countries and has become a significant health problem especially in socially disadvantaged population [13]. Epidemiological data shows that ECC is the most common infectious disease that affects children worldwide, being a global problem although the disease itself is preventable. Despite significant progress of preventive dentistry, ECC continues to affect a large number of children globally [14]. Although representative data are sparse, general reports from several countries showed that the prevalence of ECC in 2–3-year-old children was approximately 12% to 27%. [14]. In 4- to 6-year-old children, the prevalence generally ranged from 27% to 48% with more than 76% reported from the Middle East [14, 15, 16, 17, 18].

Countries in socio-economic transition have the highest value of the DMFT index [17, 18, 19]. Unemployment, inflation, low family income and privatization of dental practice leads to the

situation in which the individual is responsible for organizing the use of oral health services based on its conscience and ability, and children are the first victims of such socio-economic situation. Reported caries prevalence for preschool children in Bosnia and Herzegovina was 83% [20].

The current concept of the etiology of childhood caries suggests a strong impact of risk factors like social/behavioral factors, clinical factors and protective factors (exposure to fluorides in drinking water, use of fluoridated toothpaste and regular dental visits) [18]. As it is shown in studies, dietary habits, oral hygiene and parents influence are the main factors that impact the onset of the disease [21, 22]. How much these factors influenced development of ECC depends on attitude and knowledge of the parents and the readiness of the medical staff to educate them. Lack of motivation could be one of key factors for not applying correct knowledge.

The role of pediatric dentist and the importance of regular dental visits at an early age is often underestimated due to believe that the primary teeth are going to exfoliate [22]. Prevention of caries in primary teeth is also important, because the post-eruptive maturation of the permanent tooth enamel can be compromised due to inadequate oral hygiene and high caries rates in primary dentitions, and lead to absence of well mineralized surfaces that make the permanent tooth less resistant [23]. Parenting styles influence the health of their children. Parents play an important role in child's behavior at the dental appointment, especially when they had their own negative experiences with dental treatment. An anxious or fearful parent can affect negatively the child's behavior in the dental office.

Working mechanism of fluorides in caries prevention is well-known as ability to promote and increase remineralization, acid resistance, and anti-microbial activity [24]. Public Health England (2014) reported that children under age of 5, living within fluoridated areas are 15% less likely to suffer from tooth decay than those from non-fluoridated areas [25].

Studies on the prevention of ECC have shown that community-level education about dietary habits and dental care is as important as measures taken every day at home (i.e., brushing and flossing). Establishing and maintaining good dietary and oral health habits while minimizing bad habits has been shown to reduce the occurrence of ECC [26, 27, 28].

Results of the present study reported high prevalence of ECC with decay increase within children's age which are indicating a low level of preventive practice in young children. Parental awareness of proper dietary habits, oral practice and fluoride intake obviously isn't applied in everyday life. The reason for such result could be lack of motivation. Presented results observing parental level of education and financial background could be considered as potential risk factor which impact should be investigated in the future national surveys. Behavior during a pandemic such as Covid-19 could increases potential risk for deterioration of oral health in children [29]. Limitations of the present research were sample size limited on one country location, although per latest epidemiological studies in Bosnia and Herzegovina, results for the capital could be considered as representative for national interpretation, as well as a small portion of risk factors influencing ECC assessed only through questionnaire method [10, 11, 30]. Despite these limitations, presented results highlight necessity for urgent action for ECC disease control in the treated community. Global epidemiological survey for prevalence and severity of ECC with investigation of multifactorial models of risk factors including calculation of prediction for individual and combined risk factors is necessary and highly recommended for future researches.

Conclusion

Present results showed the discrepancy between parental knowledge about ECC risk and observable caries indices for examined population. Parents of preschoolers had solid knowledge about ECC risks, but recorded caries prevalence and severity indicated that further researches were necessary to establish clear predictive model for community-based prevention.

Literature

1. American Academy of Pediatric Dentistry (AAPD). Police on early childhood caries: Unique challenges and treatment options. [serial on the Internet] The reference Manual of Pediatric Dentistry. Chicago, III. American Academy of Pediatric Dentistry 2020 [cited on 10 Oct 2020]; 82-3. Available from: https://www.aapd.org/globalassets/media/policies_guidelines/p_eccuniquechallenges.pdf
2. Welbury R, Duggal M. S, Hosey M.T. Peadiatric Dentistry 5 th ed. Oxford University Press 2018.
3. Syed S, Nisar N, Mubeen N. Early Childhood Caries: A Preventable Disease. [serial on the Internet] Dent Open J. 2015 [cited on 10 Oct 2020]; 2(2) :55-6. Available from: https://www. researchgate.net/publication/281264997_Early_Childhood_Caries_A_Preventable_Disease.
4. Gomez G F. Early Childhood Dental Caries: a rising dental public health crisis Contemporary Issues in Early Childhood. [serial on the Internet] Sage Journals 2013 [cited on 15 Oct 2020]; 14(2): 191-194. Availible from: https://doi.org/10.2304/ciec.2013.14.2.191
5. Karaca S, Ozbay G, Kargul B. Primary Zirconia Crown Restorations for Children with Early Childhood Caries. Acta stomatol Croat. 2013; 47(1): 64-71.
6. Anil S, Anand P.S. Early Childhood Caries: Prevalence, Risk Factors, and Prevention. [serial on the Internet] Front Pediatr. 2017 [cited on 17 Oct 2020]; 5: 157. Available from: doi: 10.3389/fped.2017.00157
7. Naidu R, Nunn J, Donelly-Swift E. Oral health-related quality of life and early childhood caries among preschool children in Trinidad. [serial on the Internet] BMC Oral Health 2016 [cited on 18 Oct 2020]; 16: 128. Available from: doi https://doi.org/10.1186/s12903-016-0324-7.
8. Kraljevic I , Filippi C, Filippi A. Risk indicators of early childhood caries (ECC) in children with high treatment needs. Swiss Dental Journal SSO, 2017; 127: 398–404.
9. Wyne AH. Ealry childhood caries: nomenclature and case definition. Community Dent Oral Epidemiol 1999; 27: 313-15.
10. WHO. Oral Health Surveys: Basic methods. Geneva: WHO; 1997, 4th ed.
11. Arslanagić Muratbegovic A, Markovic N, Zukanovic A, Selimovic Dragas M, Kobaslija S, et al. Oral Health Related to Demographic Features in Bosnian Children Aged Six. Coll. Antropol. 2010; 34 (3): 1027-1033.
12. Schröder U, Granath L. Dietary habits and oral hygiene as predictors of caries in 3-year old children. Community Dent Oral Epidemiol 1983;11: 308-11.
13. Ballatine J L, Carlson J C, Ferreira Zandona A G, Agler C, Zeldin L P, Rozier R G et al. Exploring the genomic basis of early childhood caries: a pilot study. International Journey of Pediatric Dentistry, 2017; 28 (2): 217-225.
14. Seow WK. Early childhood caries. Pediatr Clin N Am, 2018; 65(5): 941–954;
15. Folayan M O. A compendium on oral health of children around the world early childhood caries. Nova Science Publishers Inc, 2018;
16. Kaminska A, Szalewski L, Batkowska J, Wallner J, Wallner E, et al. The dependence of dental caries on oral hygiene habits in preschool children from urban and rural areas in Poland. [serial on the Internet] Ann Agric Environ Med. 2016 [cited on 18 Dec 2020]; 23(4): 660–665. Availible from: http://www.aaem.pl/The-dependence-of-dental-caries-on-oral-hygiene-habits-in-preschool-children-from-urban-and-rural-areas-in-Poland,72487,0,2.html
17. Nota A, Darizeh A, Primozic J, Onida F, Bosco F, et al. Prevalence of Caries and Associated Risk Factors in a Representative Group of Preschool Children from an Urban Area with

High Income in Milan Province, Italy. [serial on the Internet] Int. J. Environ. Res. Public Health 2020 [cited on 18 Dec 2020]; 17 (10). Available from: https: //www.mdpi.com/ 1660-4601/17/10/ 3372/htm

18. Markovic D, Soldatovic I, Vukovic R, Peric T, Campus GG, et al. How Much Country Economy Influences ECC Profile in Serbian Children-A Macro-Level Factor Analysis. Front Public Health. 2019; 7: 285.
19. Juric H, Klaric T, Zagar M, Bukovic D Jr, Jankovic B,et al. Incidence of caries in children of rural and subrural areas in Croatia. [serial on the Internet] Coll Antropol. 2008 Mar [cited on 18 Dec 2020]; 32 (1):131-6. Available from: https://pubmed.ncbi.nlm.nih.gov/18494198 /
20. Sacic L, Markovic N, Arslanagic Muratbegovic A, Zukanovic A, Kobašlija S. The prevalence and severity of early childhood caries in preschool children in the Federation of Bosnia and Herzegovina Acta Medica Academica 2016; 45(1):19-25;
21. Bell L K , Schammer C, Devenish G, Ha D, Thomson M W, Spencer J A et al. Dietary Patterns and Risk of Obesity and Early Childhood Caries in Australian Toddlers: Findings from an Australian Cohort Study. [serial on the Internet] Nutrients 2019 [cited on 26 Oct 2020]; 11(11): 2-15. Available from: https://doi.org/10.3390/nu11112828
22. Djordjevic A. Parents' knowledge about the effects of oral hygiene, proper nutrition and fluoride prophylaxis on oral health in early childhood. [serial on the Internet] Balk J Dent Med. 2018 [cited on 28 Oct 2020]; 22: 2–31. Available from; doi: 10.2478/bjdm-2018-0005
23. Arslanagic A, Markovic N, Bajric E, Burnazovic Ristic L. Demarcated Opacities as Predictors of Progression of the Molar Incisor Hypomineralisation: a Pilot Study. Acta stomatol Croat. 2020; 54(4): 420-430.
24. Lee H N, Lim S R, Lee S Y. Remineralization Assessment of Early Childhood Caries using QLF-D: A Randomized Clinical Trial. Indian Journal of Science and Technology, 2016; 9 (40): 2-7;
25. Greenwood D. Dental Biofilm formation in young children and the long term effects of fluoride varnish [dissertation]. Salford, UK: School of Environment & Life Sciences. University of Salford; 2016.
26. Nishide R, Mizutani M, Tanimura S, Kudo N, Nishii T, Hatashita H. Homecare protective and risk factors for early childhood caries in Japan. Environmental Health and Preventive Medicine,2018; 23 (1):13:57.
27. Pitts N, Baez R, Diaz-Guallory C, et al. Early Childhood Caries: IAPD Bangkok Declaration. [serial on the Internet] Int J Paediatr Dent 2019 [cited on 30 Oct 2020]; 29:384. Availble from: http://www.uccoh.org/uploads/6/0/ 8/9/60892411/bangkok_declaration.pdf.
28. NHS Education for Scotland [database on the Internet] Child Smile Manual, version 3.1. May 2018. [updated 2018 May; citied 2020 Nov 22]. Avalible from: http://www.child-smile.org.uk/uploads/documents/4531-Childsmile%20Programme%20Manual%20July%202016.pdf
29. Daly J, Black A. M. E. The impact of COVID-19 on population oral health. Community Dental Health 2020; 37: 236-238.
30. Muratbegovic A, Markovic N, Kobaslija S, Zukanovic A. Oral Helath Indices and Molar Incisor Hypomineralization in 12 Year Old Bosnians. Acta Stomatol Croat 2008; 42(2):155-163

BALANCE OF MASTICATORY MUSCLES IN SUBJECTS ACROSS DIFFERENT SKELETAL CLASSES

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ABSTRACT

Irregular antero-posterior relationship of the maxilla and mandible causes unstable occlusion and reduced mandibular movements during muscle contraction, which can cause changes in the masticatory muscle function.

Aim: The aim of the present study is to determine whether there is a difference in the asymmetry coefficient (ASIM) of the masticatory muscles (*m. temporalis anterior* and *m. masseter*) in patients classified as Class I, Class II and Class III according to Angle, by using the method of surface electromyography (EMG). An additional aim is to determine whether there are differences in the ASIM coefficient in female and male subjects.

Material and methods: The sample included 180 subjects, males and females. All subjects were divided into 3 groups of 60 subjects (30 males and 30 females) in skeletal classes I, II and III. An examination of muscle function was conducted by a non-invasive method of surface electromyography.

Results: The results of this study showed that there is no statistically significant difference in the ASIM index among groups of respondents (p=0,149).

Conclusion: The conclusion of the present study is that there is no statistically significant difference in the coefficient of asymmetry of the masticatory muscles (*m. temporalis anterior* and *m. masseter*) in patients across Class I, Class II and Class III according to Angle. The difference in the asymmetry coefficient between female and male subjects is also not statistically significant.

Key words: masticatory muscle, EMG, balance

Introduction

Malocclusions are very common irregularity in contemporary generations and are caused by the incorrect position of the teeth within the arch and the incorrect relationship of the dental arches in occlu-sion. [1-3] According to Edward Angle's classification, malocclusions are classified into three classes: Class I, Class II, and Class III. This classification is based on the mesio-distal relationship of the teeth, dental arches and jaws. [4] Understanding the function of masticatory muscles and their influence on craniofacial morphology is essential for orthodontics. [5]

The first attempt to study muscle activity in orthodontics was reported by Moyers back in 1949, when he suggested that different patterns of muscle activity were associated with different types of occlusions. He discovered that changes in the temporal muscle function are an etiological factor in the development of Class II malocclusions. When patients with Class II malocclusion were compared with patients with normal occlusion, an increased level of electromyographic (EMG) activity was found in the temporal muscle both in the rest position and in the intercuspal position. [6]

Irregular antero-posterior relationship of the maxilla and mandible causes unstable occlusion and reduced mandibular movements during muscle contraction which can cause changes in the masticatory muscle function. [7]

Asymmetry is defined as the absence or lack of symmetry or balance and different coordination between individual parts or organs on opposite sides of the body. [8]

Moderate asymmetry is a common finding in the human body. The morphology and function of the paired structures differ on each side. [9] The masticatory muscles activity in persons with proper dentition without pathology of the neuro-muscular system shows a deviation of 2-20% from perfect symmetry. [10-13]

This range of asymmetry is regarded as "physiological" asymmetry. [12]

However, masticatory muscle asymmetry can be associated with a number of pathological conditions. [14-18]

Electromyography (EMG) is the most objective and reliable technique for assessing muscle function and efficiency by detecting their electrical potentials [19]. Surface electromyography (with EMG) is used as a non-invasive method of examining muscle activity by using pairs of electrodes applied to the surface of the skin above the examined muscle. [20]

The introduction of standardized EMG protocols and indices that are used in order to assess the activity of paired masticatory muscles has enabled a number of much more reliable analyses [9]. Ferrario et al. [11 have developed a method for standardization of myoelectric potentials, which calculates the indices representing muscle activity and symmetry of pair muscle contraction in different functional tasks.

This method reduces variability within the sample and can be used to assess jaw muscles activity. [21]

Electromyography can determine the proper physiological activity of the masticatory muscles, but can also be used to perform a passive monitoring of changes in masticatory function and an assessment of the effects of some treatments. [22]

Previous studies have shown that patients with temporomandibular dysfunction (TMD) demonstrate a higher degree of masticatory muscle asymmetry compared with the subjects who have proper temporomandibular function. [13, 23, 24]

There are studies proving that the subjects with unilateral cross-bite have a higher masticatory muscle asymmetry index compared with the subjects who have proper occlusion. [18, 21

These studies have shown that there is a significant relationship between the function and symmetry of the masticatory muscles and the malocclusions in the transversal plane [25, 26], whereas, when it comes to the sagittal anomalies that are the topic of this study, opinions are divided and there is no clear position concerning the relationships of masticatory muscle function across all three skeletal classes. [16, 27]

The aim of the present study is to determine whether there is a difference in the asymmetry coefficient (ASIM) of the masticatory muscles

(*m.temporalis anterior* and *m.masseter*) in patients classified as Class I, Class II and Class III according to Angle, by using the method of surface electromyography (EMG). An additional aim is to determine whether there are differences in the ASIM coefficient in female and male subjects.

Material and methods

The research was conducted at the Faculty of Dentistry, the University of Sarajevo, in the Department of Orthodontics. The sample included 180 subjects. All subjects were divided into 3 groups of 60 subjects (30 males and 30 females) in skeletal classes I, II and III. The skeletal class was identified according to Angle's classification of malocclusions, on the basis of the relationship of the first permanent molars and permanent canines. An examination of muscle function was conducted by a non-invasive method of surface electromyography. During the first examination, patients were informed about the research, and about the reasons and purpose of the research. The research subjects were included in the study after they confirmed their participation consent in writing. The study was approved by the Ethics Committee of the Faculty of Dentistry with Clinics, the University of Sarajevo,

Inclusion criteria:

- Patients with various types of malocclusions of Class I, Class II and Class
- Orthodontically untreated
- With all permanent teeth developed (except third molars), full dentition
- Ages 15-35

Exclusion criteria:

- Patients with congenital and craniofacial deformities
- Patients with TM-dysfunctions, parafunctions
- Patients with transverse anomalies
- Patients with pathological processes within the maxilla or mandible
- Use of any medication that could affect muscle activity, such as antihistamines, sedatives, central nervous system depressants, and psychiatric medications

Electromyography procedure

The study was conducted with a wireless Theetan SpA electromyograph (Milan, Italy). The Theetan device recorded, amplified, digitized and filtered the analog EMG signal. The software program processed the raw electrical signals and generated a set of roots mean square values (RMS values). Thereafter, the RMS values were processed by using an algorithm to generate muscle activity and asymmetry indices.

During the experiment, the subjects were sitting in an upright position with the Frankfurt Plain parallel to the floor. Prior to the start of this recording, the patients were instructed verbally to avoid any stressful situation. One calibrated tester performed all EMG measurements.

The electrical activity was examined on a total of 4 muscles: the temporalis anterior (TA) and masseter muscles (MM) of the right and left side (i.e. the left and right side *musculus masseter* and the left and right side *musculus temporalis anterior)*. Bipolar pre-gelled surface EMG electrodes were placed along the line of muscle fiber direction. Prior to placing the electrodes, the skin was cleaned with an alcohol-based agent and imaging was performed 5-6 minutes later allowing the gel to adequately moisturize the skin surface. Male subjects had a shaved face and female subjects had their potential makeup removed from their faces. Disposable silver-silver chloride bipolar electrodes whose dimensions were 41 mm * 21 mm with a diameter of 10 mm and having an interelectrode distance of 21 ± 1 mm were used as recommended by SENIAM (European Coordinated Action Program in the EMG field for the European Union – designed *inter alia* for surface *EMG* in non-invasive assessment of muscles). The muscle fibers along which the electrodes were placed were

detected by palpation during maximal voluntary masticatory muscle contraction (MVC). For *musculus temporalis anterior* (TA) the electrodes were placed vertically along the anterior edge of the muscle (approximately over the coronary suture). For *musculus masseter* (MMs) they were also placed in parallel to the direction of muscle fibers with the upper pole of the electrode at the intersection between the *tragus-labial commissure* and the *exocanthion-gonion* lines.

At least two sEMG recordings were taken in each session:

The first imaging or calibration presents a maximal voluntary 5-second masticatory muscle contraction (MVC) performed on two 10 mm thick cotton dental rolls, placed between the posterior teeth in the area of the second premolars and the first molars. This image represents the calibration of the EMG device. Without prior calibration, the results would be affected by several factors such as cross-talk (analysis of nearby muscles), skin conductivity (variable depending on tissue composition) and skin condition (sweating), and electrode position. What was analyzed during the calibrations is not occlusion, but maximum muscle activity in ideal conditions without the influence of the tooth-jaw relationship.

The second recording also took 5 seconds and was performed during maximal voluntary contraction of the masticatory muscles, without insertion of any cotton dental rolls in the subject's central occlusion. Thus, during this measurement, the focus was on the strength of the masticatory muscles conditioned by occlusion, which is why these values were compared with the maximum muscle activity measured without the influence of occlusion, i.e. during calibration.

During both recordings, the software has automatically selected 3 seconds of the most stable EMG signal.

The symmetry of the masticatory muscles was determined on the basis of the asymmetry coefficient.

ASIM (asymmetry index). This index is calculated by comparing the activity of the right end pair of masseteric and temporal muscles with the left end pair of musculus masseter and musculus temporalis. ASIM is ranging from -100 percent and + 100 percent; where a value of 0 percent shows perfectly symmetrical activation of the two pairs of muscles. Negative values indicate a greater level of activity of the left end pair; while conversely, positive values indicate a greater level activity of the right end pair. Reference values are -10% ⩽ ASIM ⩽ +10%. (28)

Results

Results were processed by standard statistical methods, using SPSS computer program for Statistical Analysis (SPSS-Statistical Package for Social Sciences) version 21.0. The results were analyzed by ANOVA test, and student t-test for variables that met the requirements for application, respectively appropriate nonparametric tests (Kruskal-Wallis test and Mann-Whitney U test) for variables for which an irregular distribution was found. A value of $p<0.05$ was taken as statistically significant.

The ASIM value in group 1 was -2.15% (-7.92%-3.01%) in group 2 -2.45% (-7.77%-7.07%) while in group 3; 1.73% (-5.23%-12.37%). The determined difference in ASIM values between the examined groups did not differ significantly (p = 0.149) (**chart 1**)

Chart 1. ASIM value in the studied groups

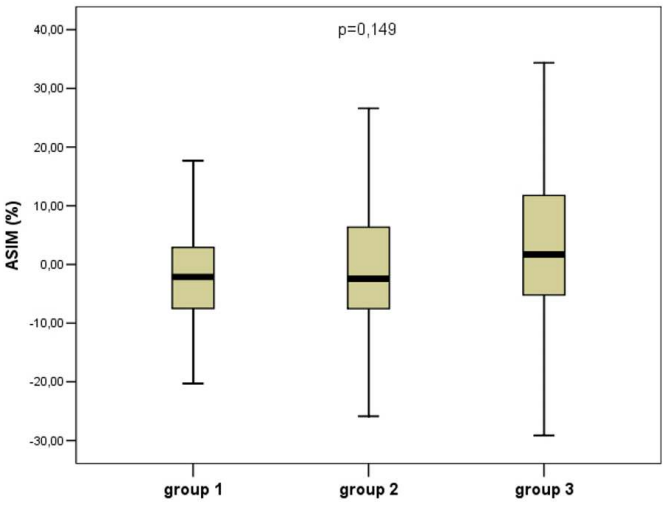
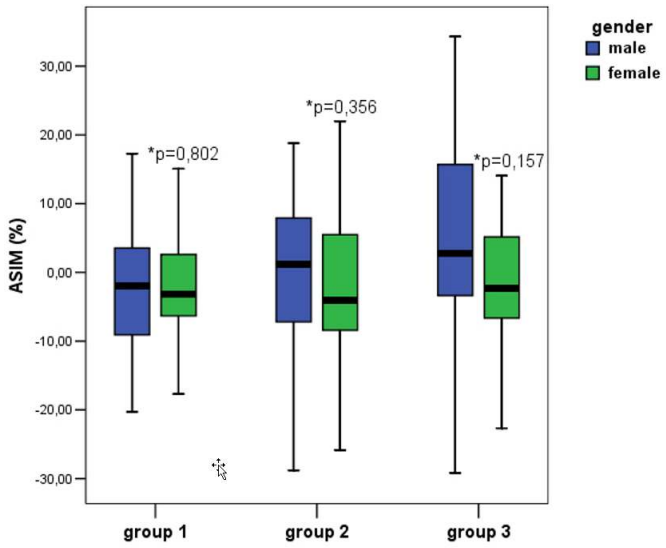


Chart 2. ASIM value in the studied groups in relation to gender



The value of ASIM in group 1 in male subjects was -1.93% (-9.11%-4.27%) and did not differ significantly from the value of ASIM in female subjects of the same group; -3.12% (-6.51%-2.70%) (p = 0.802). The value of ASIM in group 2 in male subjects was 1.19% (-7.20%-7.99%) and did not differ significantly from the value of ASIM in female subjects of the same group; -4.02% (-8.65%-6.27%) (p = 0.356). The value of ASIM in group 3 in male subjects was 2.79 (-3.37-16.25) and did not differ significantly from the value of ASIM in female subjects of the same group; -2.34% (-6.90%-5.81%) (p = 0.157) (**chart 2**).

Discussion

Balanced muscle function and movements of the mandible contribute to normal masticatory activities such as food intake, digestion, mastication, speech and swallowing. Mastication is a very complex and organized neuromuscular activity that involves bones, muscles, teeth and surrounding structures. [29]

An asymmetrical use of the masticatory muscles creates skull torques and, in combination with the occlusal loading, it can cause deformations not only on the maxilla and mandible but also on the distant bones of the skull. The proper functioning of the temporomandibular joint depends on these loadings and the balance of the masticatory muscles. [30]

The results of this study show that there is no statistically significant difference in the masticatory muscle asymmetry coefficient between the subjects in skeletal Class I, Class II and Class III. The ASIM value in the first group was -2.15% (-7.92% -3.01%), in the second group; -2.45% (-7.77% -7.07%) while in the third group it was; 1.73% (-5.23% -12.37%). Considering that in the first and second group the values of ASIM index are negative, we can conclude that a higher level of EMG activity was recorded in the left end pair of musculus masseter and musculus temporalis contrary to the third group where the value of ASIM coefficient is positive and indicates higher EMG activity in the right end pair of musculus masseter and musculus temporalis. The identified difference in ASIM values between the examined groups did not differ statistically significantly (p = 0.149).

There was also no significant statistical difference in relation to the sex of the research subjects. The ASIM value observed in Group 1 in male subjects was -1.93% (-9.11% -4.27%) and did not differ significantly from the ASIM value observed in female subjects of the same group; -3.12% (-6.51% -2.70%) (p = 0.802). The ASIM value observed in Group 2 in male subjects was 1.19% (-7.20% -7.99%) and did not differ significantly from the ASIM value observed in female subjects of the same group; -4.02% (-8.65% -6.27%) (p = 0.356). The ASIM value observed in Group 3 in male subjects was 2.79% (-3.37% -16.25%) and did not differ significantly from the ASIM value observed in female subjects of the same group; -2.34% (-6.90% -5.81%) (p = 0.157).

Similar results were confirmed in a study conducted by Ferrari et al., which concluded that there was no significant difference in the activity and symmetry of *musculus masseter, musculus temporalis* and *musculus sternocleidomastoideus* observed among research subjects in the first class according to Anleu and partly in the first class according to Angle. The only difference they

observed was that the results found in the subjects associated with the first class were more homogeneous, but still without a significant difference present between the groups. [11]

A study examining the activity index and masticatory muscle asymmetry index in women with and without TMD also obtained similar results and concluded that there was no difference in terms of masticatory muscle asymmetry index among the examined groups. [31]

In a study conducted by Wieczorak at al., she concluded that the symmetry of the EMG activity of the musculus masseter and musculus temporalis was not related to the symmetry of the occlusal contacts being the assumption made at the beginning of the study. They concluded that the symmetry of EMG activity in asymptomatic young adults was not related to the symmetry of occlusal contacts. [16]

A different conclusion was reached by a study conducted by Nalamliang et al., whose results show that there is an influence of occlusal contacts on the symmetry of masticatory muscles, as a result of which they concluded that, in healthy subjects with normal dentition, the lateral side with more occlusal contacts shows lower levels of temporal muscle activity and lower total muscle activity compared with these activities observed on the contralateral side. [27]

A study conducted by Wieczorek and Loster [32] found that a comparison between the subjects who were and those who were not orthodontically treated, shows that there was a higher asymmetry index in the group of orthodontically treated patients indicating the presence of greater muscle activity on the right side. A possible explanation for the predominance of the asymmetry index on the right side may lie in the fact that similar to what is characteristic for the overall population, the majority of research subjects were also right-handed. It would be interesting to investigate whether mastication is interrelated with the handedness or the individual preference of using hand, known as the dominant hand. [32] There was no significant difference between the different skeletal classes within the study group, which is also confirmed by some other studies. [16]

Contrary to these results, some researchers have proved that there is an asymmetry during the contraction of the masticatory muscles in healthy young individuals. [12]

Similarly, Suvinen and Kemppainen [33] and Scopel et al. [34] have reported in their studies that even in the resting position of the mandible, muscles were physiologically asymmetric, and that asymmetry and activity indices of 4% and 17%, respectively, should be considered normal. This study shows that most subjects had the dominance of the right temporalis muscle. [34]

The major purpose of our cross-sectional study is to identify the interrelationship between balanced occlusion and masticatory muscle function. The balance of masticatory muscles in sagittal irregularities is not significantly disturbed and it would be highly recommended in any case to evaluate this balance in greater detail in terms of transverse irregularities.

Conclusion

The conclusion of the present study is that there is no statistically significant difference in the coefficient of asymmetry of the masticatory muscles (*m. temporalis anterior* and *m. masseter*) in patients across Class I, Class II and Class III according to Angle. The difference in the asymmetry coefficient between female and male subjects is also not statistically significant.

Declaration of interest

The authors declare no conflict of interest.

Literature

1. Proffit W, Fields H, Sarver D. Contemporary Orthodontics, 6th edition, Mosby, (2018) 43-58.
2. Graber TM, Vanarsdall RL Jr,Orthodontics, Current Principles and Techniques. St Louis: Mosby, (2000) 3: 3-15,.

3. Bishara SE. Textbook of Orthodontics, An approach to the diagnosis of different malocclusion. (2001)13: 146-184,

4. Iyyer B, Bhalajhi SI and Bhalajhi SI. Orthodontics: The art and science. Arya (Medi) Publ, 2012

5. Sumonsiri P. Thongudomporn U. Surface Electromyographic Studies on Masticatory Muscle Activity Related to Orthodontics: A Review of Literature; J Dent Assoc Thai 2017;67:2

6. Moyers RE. Temporomandibular muscle contraction patterns in Angle Class II, Division I malocclusion. Am J Orthod. 1949;35:837–57

7. Palma D E, Tepedino M, Chimenti C, Tartaglia M G, Sforza C; Effects of the functional orthopaedic therapy on masticatory muscles activity. J Clin Exp Dent. 2017 Jul; 9(7)

8. Ferro KJ,Morgano SM, Driscoll CL, Freilich MA, Guckes A, Knoernschild KL, McGarry TJ; The glossary of prosthodontic terms. J. Prosthet. Dent. 2005; 94: 10–92

9. Ferrario VF, Sforza C, Colombo A, Ciusa V. An electromyographic investigation of masticatory muscles symmetry in normo-occlusion subjects. J Oral Rehab. 2000;27:33–40.)

10. Ferrario VF, Tartaglia GM, Luraghi FE, et al. The use of surface electromyography as a tool in differentiating temporomandibular disorders from neck disorders. Man Ther. 2007;12(4):372–379.

11. Ferrario VF, Tartaglia GM, Galletta A, et al. The influence of occlusion on jaw and neck muscle activity: a surface EMG study in healthy young adults. J Oral Rehabil. 2006;33(5):341–348.

12. Ferrario VF, Sforza C, Miani A Jr., et al. Electromyographic activity of human masticatory muscles in normal young people. Statistical evaluation of reference values for clinical applications. J Oral Rehabil. 1993;20(3):271–280

13. Mapelli A, Zanandrea Machado BC, Giglio LD, et al.Reorganization of muscle activity in patients with chronic temporomandibular disorders. Arch Oral Biol. 2016;72:164–171.

14. Moreno I, Sanchez T, Ardizone I, et al. Electromyographic comparisons between clenching, swallowing and chewing in jaw muscles with varying occlusal parameters. Med Oral Patol Oral Cir Bucal. 2008;13(3): 207–213

15. Gomes SG, Custodio W, Faot F, et al. Chewing side, bite force symmetry, and occlusal contact area of subjects with different facial vertical patterns. Braz Oral Res. 2011;25 (5):446–452

16. Wieczorek A, Loster J, Loster BW, et al. Correlation between activity and asymmetry indices and skeletal classes in symptomatic-free young adults. J Stoma.2013;66(6): 750–760.

17. Yamasaki Y, Kuwatsuru R, Tsukiyama Y, et al. Objective assessment of actual chewing side by measurement of bilateral masseter muscle electromyography. Arch Oral Biol. 2015; 60(12):1756–1762

18. Woźniak K, Szyszka-Sommerfeld L, Lichota D. The electrical activity of the temporal and masseter muscles in patients with TMD and unilateral posterior crossbite. Biomed Res Int. ;2015:259372.

19. Witkowska A. An outline of the history of electromyography. The significance of surface electromyography in neurophysiological diagnosis. Nowiny Lekarskie. 2008;77(3): 227–30

20. Schumann NP, Bongers K, Guntinas-Lichius O, Scholle HC. Facial muscle activation patterns in healthy male humans: A multi-channel surface EMG study. J Neurosci Methods 2010;187:120-8

21. Ferrario, V.F., Sforza, C. and Serrao, G. The influence of crossbite on the coordinated electromyographic activity of human mastica

tory muscles during mastication. Journal of Oral Rehabilitation, (1999) 26, 575–581

22. Y Zhang, L Lu, B Li, G Zhang, H Qu The analysis of the masticatory muscle activity in patients with skeletal class III jaw deformity; Int J Clin Exp Med 2019;12(7):9409-9412
23. De Felicio CM, Ferreira CL, Medeiros AP, et al. Electromyographic indices, orofacial myo functional status and temporomandibular disorders severity: A correlation study. J Electromyogr Kinesiol. 2012;22 (2):266–272
24. Hotta GH, Oliveira A, Oliveira A, et al.Electromyography and asymmetry index of masticatory muscles in undergraduate students with temporomandibular disorders. Braz J Oral Sci. 2015;14(2):176–181
25. Kecik, D., Kocadereli, I. and Saatci, I. Evaluation of the treatment changes of functional posterior crossbite in the mixed dentition. Am J Orthod Dentofacial Orthop 2007, 131, 202–215.
26. Martín, C., Palma, J.C., Alamán, J.M., Lopez-Quiñones, J.M. and Alarcón, J.A. Longitudinal evaluation of sEMG of masticatory muscles and kinematics of mandible changes in children treated for unilateral crossbite. Jour of Electrom and Kin,2012, 22; 620–628.
27. N.Nalamliang, P. Sumonsiri, U. Thon gudomporn Are occlusal contact area asymmetry and masticatory muscle activity asymmetry related in adults with normal dentition? Journal Cranimandibular Sleep Practice 2020
28. Botelho, A.L., Silva, B.C., Gentil, F.H., Sforza, C. and da Silva, M.A. Immediate effect of the resilient splint evaluated using surface electromyography in patients with TMD. CRANIO®, 2010, 28, 266–273
29. Seok H, Kim S-G. Correction of Malocclusion by Botulinum Neurotoxin Injection into Masticatory Muscles. *Toxins*. 2018; 10(1):27
30. Herring S. W., Masticatory muscles and the skull: A comparative perspective, Arch of Oral Biol, 2007, 52, 4, 296-299
31. Rodrigues-Bigaton D, Berni KC, Almeida AF, Silva MT. Activity and asymmetry index of masticatory muscles in women with and without dysfunction temporomandibular. Electromyography and Clinical Neurophysiology. 2010 Nov-Dec;50(7-8):333-338.)
32. Wieczorek A, Loster L. Activity of the masticatory muscles and occlusal contacts in young adults with and without orthodontic treatment; BMC Oral Health (2015) 15:116
33. Suvinen T. I. and Kemppainen P., "Review of clinical EMG studies related to muscle and occlusal factors in healthy and TMD subjects," Journal of Oral Rehabilitation, vol. 34, no. 9, pp. 631–644, 2007.
34. Scopel V., Alves Da Costa G. S., Urias D., "An electromyographic study of masseter and anterior temporalis muscles in extra-articular myogenous TMJ pain patients compared to an asymptomatic and normal population" Cranio, 2005 vol. 23, no. 3, pp. 194–203

EFFICIENCY OF THE 445NM-WAVELENGTH DIODE LASER AND SUBGINGIVAL CURETTAGE IN THE TREATMENT OF CHRONIC PERIODONTITIS - A CLINICAL EVALUATION

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ABSTRACT

The aim of this research is to examine the effectiveness of the Sirolaser Blue laser (445nm) in combination with subgingival curettage in the treatment of periodontal pockets by using clinical parameters: plaque index (PI) and periodontal pocket probing depth (PPD).

Materials and methods: The patients with chronic periodontitis were included in this study, and about 230 periodontal pockets were sampled. Patients were divided into two groups: the first group of respondents was treated with a combination of subgingival curettage and irradiation with a SirolaserBlue (445nm) and the second group of respondents was treated only with subgingival curettage. We measured the values before treatment, and evaluation of treatment results was conducted one month after by determining clinical parameters PI and PPD.

Results: The PI value before the treatment in group 1 was 1.74±0.05, whereas after the treatment this value has dropped considerably to 0.52±0.06 ($p<0.001$). The PI value before the treatment in group 2 was 1.29±0.08, whereas after the treatment, it has dropped considerably to 0.84±0.07 ($p<0.001$). Also, the PPD value before the treatment in group 1 was 4.62±0.09, whereas after the treatment this value has dropped considerably to 3.21±0.08 ($p <0.001$). The value of PI before the treatment in group 2 was 4.10±0.08, and after the treatment it has dropped considerably to 3.45±0.07 ($p<0.001$).

Conclusion: The results of the study support the improvement of clinical parameters (PI, PPD) after one month, where both clinical parameters showed a greater reduction in the group where, in addition to subgingival curettage, irradiation with Sirolaser Blue (445nm) was performed. Taking into account all of the above considerations, we can conclude that the blue beam (445nm) has proved to be effective in the treatment of chronic periodontitis challenging us to future task of examining its effectiveness in the treatment of other periodontal diseases.

Keywords: Chronic Periodontitis, Diode laser 445nm, Subgingival Curettage

Introduction

Periodontal disease is an inflammatory condition caused by dental plaque's microorganisms. The most important role in the development and progression of periodontal diseases is presence of anaerobic microorganisms and their by-products [1, 2] being associated more with the progression than with the onset of the disease [3].

Periodontal disease affects up to 90% of the world population and, due to its prevalence, it is characterized as a social problem thus being very important to find a proper and appropriate therapeutic approach (modality). Chronic periodontitis is the most common form of periodontal disease and it occurs as a result of the spread of inflammation from the gingiva to the deeper tissues of the periodontium [4, 5].

It affects nearly 40% of adult population [4]. It begins as a gingivitis, and if not timely treated, it can progress to periodontal disease.

The disease has its main clinical features, such as, for example:

I) it is more common in adults (above 40 years);

II) periodontal destruction is inversely proportional to the level of oral hygiene and the body's vital defense factors;

III) the disease can be localized and generalized [4].

Since the microorganisms are the main cause of periodontal disease, golden standard in periodontal therapy is successful removal of the microorganisms from tooth surfaces (scaling and root planning/SRP). However, some microorganisms remain after SRP can prevent reparation and regeneration of periodontal tissue and can endanger tooth survival. Due to this fact, dentistry is in a continuing search for new techniques and protocols that could contribute to the more efficient removal of microorganisms from periodontal pockets.

Causal (basic) therapy of periodontal disease is the first stage in the therapy and is part of the overall and highly complex treatment of this disease. It is used in all patients suffering from periodontal disease, regardless of the type and severity of the disease. The ultimate goals of causal therapy are:

I) to reduce or eliminate inflammation of the gingiva and other periodontal tissues;

II) to stop the development of the pathological process, and;

III) to raise the biological potential of the tissue in order to create conditions for continued therapy with appropriate surgical procedures [6].

Subgingival curettage is part of causal therapy and as a method it stands distinctively at the borderline between conservative and surgical treatments in periodontology. The aim of subgingival curettage is to remove residual concernments, necrotic cementum, and granulations found on the soft wall of the pocket, without performing gingivectomy or gingiva removal [4].

In addition to a number of standard methods that are widely used to treat this disease, the use of dental laser treatment also occupies an important place. In the therapy of periodontal diseases, due to a high level of complexity associated with the pathology of such diseases, the role of low-level laser or the so-called *soft laser therapy* is particularly interesting, as it should contribute to an accelerated rate of healing of the periodontal tissue by creating a wide range of anti-inflammatory, analgesic and antiedematous effects [7].

According to some authors, low-level or *soft laser therapy* is regarded only as a supporting method in the therapy of periodontal diseases [7, 8].

Results of some studies show the advantages of non-surgical diode laser treatment (with a low-level laser) in patients with chronic periodontitis [9].

Most of the available diode lasers are infrared/red diode lasers. Recently, the blue diode laser (Sirolaser Blue,445nm) was introduced, demonstrating three wavelengths: 970nm, 660 nm and a blue beam wavelength of 445nm. Very few studies have been published so far to show what

results have been achieved with blue beams in any field of dentistry, and thus in periodontology too. The emergence of new techniques and devices on the market requires us to explore various therapeutic possibilities and compare their therapeutic effect with the currently applicable treatment protocols.

The **aim** of this research is to examine the effectiveness of the Sirolaser Blue laser (445nm) in combination with subgingival curettage in the treatment of periodontal pockets in patients with chronic periodontitis, by using clinical parameters of plaque index (PI) and measurement of periodontal pocket probing depth (PPD).

Materials and methods

The research included respondents of both genders who expressed their interest to participate in the research trial at the Department/Clinic for Oral Medicine and Periodontology of the Faculty of Dentistry in Sarajevo in the period between November 2020 and January 2021.

The research was conducted in the form of a clinical prospective study.

All respondents signed the Informed Consent Form confirming their willingness to participate in the trial on a voluntary basis. The study included 15 patients aged between 35 and 65 years, and 59% of them were women and 41% were men. Respondents were divided into two groups. The first group of respondents included the patients suffering from chronic periodontitis who were treated with a combination of subgingival curettage and irradiation with a Sirolaser Blue laser (445nm) (photothermal effect) in the treatment of periodontal pockets, whereas the second group of respondents included the patients suffering from chronic periodontitis who were treated only with subgingival curettage in the treatment of periodontal pockets.

During the of the study, we sampled about 230 periodontal pockets distributed evenly in two groups.

Inclusion criteria:

Respondents who have been clinically and radiologically diagnosed with chronic periodontitis, they have not undergone any periodontal intervention over the past year. There are both smokers and nonsmokers among the respondents and patients without history of systemic diseases and taking any medications in the last three months were included.

All respondents were subjected to a periodontal anamnestic diagnostic protocol and clinical radiological evaluation (OPG image analysis).

The periodontal anamnestic-diagnostic protocol includes general anamnesis, clinical examination, identification of plaque index (PI) and measurement of periodontal pocket probing depth (PPD- Pocket Probing Depth). Evaluation of treatment results was conducted after one month, by determining PI and PPD.

All clinically examined parameters and obtained results were recorded in a number of patient record sheets designed specifically for the purposes of this research.

Patients were divided into two groups, wherein the first group of the patients received SRP and

Sirolaser Blue laser (445nm), while in the second group periodontal therapy consisted of SRP only. The procedure was performed in such a way that, after the classic mechanical treatment of the periodontal pocket, the pocket was subject to debridement with a 320 μm optical fiber. For the purpose of this research, the parameters were set individually at: 445 nm, 2 W, 20-50 Hz, duty cycle 50%, Ø - power=1-1.5 W, for a 320-micron tip which was used to irradiate the periodontal pocket.

In accordance to the recommended precautions, the course of work with the dental laser, the patient, the therapist and the dental nurse wore goggles.

Statistical method:

The results have been processed by using standard statistical methods, through application of the SPSS computer-generated statistics analysis

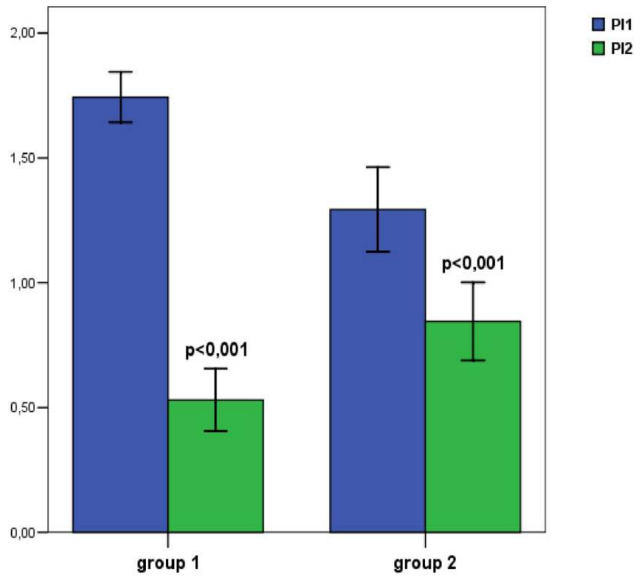

Diagram 1. PI values before and one month after the treatment in the respondent groups

Results are presented as mean± SEM; PI1- value of plaque index before treatment; PI2- value of plaque index one month after treatment; p-relative to the value before treatment of the same group

The PI value before the treatment in group 1 was 1.74±0.05, whereas after the treatment this value has dropped considerably to 0.52±0.06 (p<0.001). The PI value before the treatment in group 2 was 1.29±0.08, whereas after the treatment it has dropped considerably to 0.84±0.07 (p<0.001) (Diagram 1).

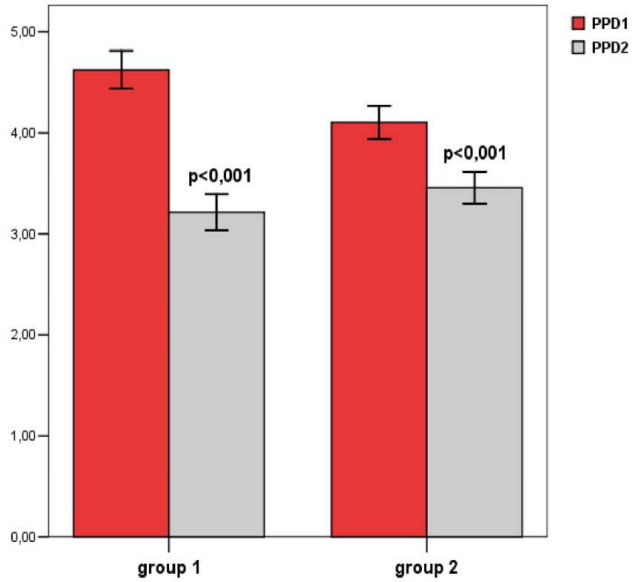

Diagram 2. PPD values before and one month after the treatment in the respondent groups

Results are presented as mean± SEM; PPD1- value of pocket probing depth before treatment; PI2- value of pocket probing depth one month after treatment; p-relative to the value before treatment of the same group.

The PPD value before the treatment in group 1 was 4.62±0.09, whereas after the treatment this value has dropped considerably to 3.21±0.08 (p <0.001). The value of PI before the treatment in group 2 was 4.10±0.08, and after the treatment it has dropped considerably to 3.45±0.07 (p<0.001).

Table 1. Comparative analysis of PI and PPD values between respondent groups before and one month after the treatment

Variable	Group 1 (n=117)	Group 2 (n=116)	p
PI before treatment	1.74±0.05	1.29±0.05	<0.001
PI one month after treatment	0.52±0.06	0.84±0.07	0.002
PPD before treatment	4.62±0.09	4.10±0.08	<0.001
PPD one month after treatment	3.21±0.08	3.45±0.07	0.043

Results are presented as mean ± SEM

The PI value before the treatment in group 1 was 1.74±0.05 and was considerably higher compared with the PI value before the treatment in group 2; 1.29±0.05 (p<0.001). The PI value after the treatment in group 1 was 0.52±0.06 and was considerably lower compared with the PI value after the treatment in group 2; 0.84±0.07 (p=0.002). The PPD value before the treatment in group 1 was 4.62 ± 0.09 and was considerably higher compared with the PPD value before the treatment in group 2; 4.10±0.08(p<0.001). The PPD value after the treatment in group 1 was 3.21±0.08 and was considerably lower compared with the PPD value after the treatment in group 2; 3.45±0.07 (p=0.043).

program called SPSS Statistical Package for Social Sciences version 21.0. The results are presented as a mean value (mean ±) and a standard error of the arithmetic mean (SEM). The Kolmogorov-Smirnov test was used to test the significance of the difference in deviation from the normal distribution. The results have been analyzed by using the Student t-test for independent, or the paired t-test for dependent numerical variables. The value of $p < 0.05$ is considered statistically significant.

Results

The results of our study show that there is a statistically significant difference in terms of plaque reduction observed before and one month after therapy, in both groups, with a larger reduction in group 1. The same results were achieved of a clinical evaluation of periodontal pocket probing depth (diagram 1, 2).

The comparison has been made on the basis of a clinical evaluation of plaque index (PI) and measurement of periodontal pocket probing depth (PPD) that was performed before and one month after the treatment (table 1).

Discussion

During the course of the study, the clinical parameters of plaque index (PI) and periodontal pocket probing depth (PPD) were only monitored. These parameters were established before the treatment and one month after the treatment.

The results of our study show that there is a statistically significant difference in terms of plaque reduction observed before and one month after therapy, in both groups, with a larger reduction in group 1, where respondents were treated with a combination of subgingival curettage and irradiation with a 445nm Sirolaser Blue laser.

Similar results have been achieved in other studies as well.

Caruso et al, in their study conducted in 2015 with the aim of comparing the effectiveness of laser treatment (980nm) as a support to subgingival curettage in the treatment of chronic periodontitis, have compared the clinical PPD parameters (Pocket Probing Depth), CAL (Clinical Attachment Level), GI, and PI. Their plaque index results show a PI value of 1.263 p (0.45) in the group undergoing a combined subgingival curettage and dental laser treatment and a PI value of 1.263 (0.45) in the group undergoing subgingival curettage only. After one month, PI values for the first group were 0.421 (0.50), while for the second group these values were 0.894 (0.56) 10]. As we can see, the PI results recorded for the first group are significantly lower compared to those recorded in the non-laser group, which also corresponds to the results of our study.

The identical results were achieved by Alzoman et al. in 2015 in their study of 32 patients with chronic periodontitis, during which they examined the effectiveness of GaAlAs (685nm) and subgingival curettage [11].

In their study conducted in 2017, Matarese et al. have examined the effectiveness of a diode laser (810nm) as a replacement for subgingival curettage, during which they have examined the plaque index as FMPS (Full-Mouth Plaque Score) in aggressive periodontitis, where they have also observed a statistically significant degree of plaque reduction after an evaluation period of one month [12], which also corresponds to the results of our study.

Similar results were also recorded by other authors [13, 14], while some other authors did not find in their studies any statistically significant differences in PI values between the groups of patients treated with and without laser [15, 18].

Regardless of the results of our own study and the similar results recorded in a number of other studies, there is still insufficient information found in most scientific sources of dentistry literature to confirm the thesis that the use of a laser device can prevent the formation of plaque on the laser irradiated tooth surface [15, 16, 17].

More studies speak in favor of mechanical plaque control and good motivation and education of patients to maintain their oral hygiene.

The most important indicator of periodontal disease is the loss of epithelial attachment which is expressed by the values of pocket probing depth (PPD).

The results of our study show the existence of a statistically significant difference in the average values of pocket probing depth (PPD).

According to that, the average pocket probing depth values have been reduced statistically significantly after laser therapy.

Similar results have been confirmed in a great number of other studies.

A study conducted by Schwarz et al. (2001) a laser (980nm) was used for a "closed" subgingival treatment and root planning, while laser treatment (980nm) was compared to conventional curettage instrumentation (subgingival curettage). The results showed a statistically significant difference in terms of PPD reduction in the group treated with laser 18], which also corresponds to our results.

In their clinical study conducted in 2019 on 51 patients with periodontitis, by dividing patients into three groups, Fotios Katsikanis et al. have compared the levels of efficiency between three therapy groups: i) subgingival curettage as a standalone therapy group, ii) subgingival curettage in combination with laser therapy as the second therapy group (Biolase Ezlase 940 nm), and, iii) subgingival curettage in combination with photodynamic therapy as the third therapy group (GaAlAs 670 nm). A follow-up evaluation conducted after three months shows that there was a certain level of PPD reduction in all three groups, but no statistically significant difference was observed between these three groups. After a 6-month evaluation period, the laser-treated group showed a slightly greater reduction in PPD in the deeper periodontal pockets [15].

Meseli et al. (2017) have evaluated the effects of the diode laser (810 nm), which was used as a support to mechanical periodontal treatment, by examining various clinical parameters and the depth of periodontal pockets, and they found that PPD was statistically significantly lower in the group treated by mechanical cleaning with diode laser irradiation after 8 weeks [14], which also corresponds to the results of our research.

Many authors have published results of their research that speak in favor of the use of diode lasers in the treatment of periodontitis, finding that lasers can be used as a powerful tool in the treatment of periodontal disease, but only in combination with the more extensive therapist education and experience [19, 20, 21].

Marisa Roncati et al. (2017) suggest that laser should be incorporated as an integral and mainstream part of periodontal therapy [20].

The limiting factor of the present study is a relatively short period of time available for evaluation of periodontal pockets. On the other hand, very few studies in dentistry in general have ever been published about the use of a blue-beam diode laser (445nm), which is why it is so difficult to compare the effect of the blue beam with the effect of lasers of other wavelengths.

Some of the studies about the use of the blue beam (445nm) were conducted *in vitro*. Consequently, Sarah Böcher et al. (2019) have compared the laser Sirolaser Blue (445 nm) and its photothermal and photodynamic effects with other therapeutic procedures performed on some specifically designed models of periodontal pockets. The study examined 7 different treatment modalities. The results of this study show that the groups treated with lasers demonstrate the presence of greater effects in eliminating periodontopathogenic microorganisms. The photothermal effect of the blue beam proved to be better compared with its photodynamic effect [22].

In order to provide the best care to patients, we are obliged to constantly search for new treatment modalities and compare them with already known therapeutic protocols.

Conclusion

Regardless of limitations, the results of the present study support the fact that the clinical parameters (such as e.g. PI, PPD) were improved after only one month, while both clinical

parameters showed a greater degree of reduction in the group where – in addition to subgingival curettage – irradiation with Sirolaser Blue laser (445nm) was also performed. Taking into account all above mentioned considerations, we can conclude that the blue beam (445nm) has proved to be effective in the treatment of chronic periodontitis challenging us to the future task of examining its effectiveness in the treatment of other periodontal diseases, as well as the task of comparing it with other treatment modalities.

Literature

1. Đajić D, Đukanović D. Parodontology. Beograd: Draslar Partner; 2006.
2. Burt B. Research, Science and Therapy Committee of the American Academy of Periodontology. Position paper: Epidemiology of periodontal diseases. J Periodontol 2005;76:1406-1419.
3. Topić B. Parodontology : biology, immunopathogeneses, practice. 3.edision. Sarajevo: Faculty of Dentistry; Zagreb: Medicinska naklada, 2005.
4. Lindhe J, Lang NP, Karring T. Clinical paradhontology parodontology and dental implantology. Editor Globus. 4. English version. Zagreb, 2004.
5. Pihlstrom BL, Michalowicz BS, Johnson NW. Periodontal diseases. Lancet 2005; 366(9499): 1809-1820.
6. Dimitrijević B, Leković V, Janković Lj, Ursu-Magdu I, Čakić S, Đukanović D, Janković S, Aleksić Z. Clinical parodontology. Beograd: Institute for text boog edition; 2011.
7. Cobb CM, Low SB, Coluzzi DJ. Lasers and the treatment of chronic periodontitis. Dent Clin North Am 2010; 54(1):35-53.
8. Karthikeyan J, Vijayalakshmi R, Mahendra J, Kanakamedala AK, Chellathurai BNK, Selvarajan S, Namachivayam A. Diode Laser as an Adjunct to Kirkland Flap Surgery-A Randomized Split Mouth Clinical and Microbiological Study. Pho-tobiomodul Photomed Laser Surg. 2019 Feb; 37(2):99-109. doi: 10.1089/photob.2018.4519. Epub 2019 Jan 24. PMID: 31050933.
9. Gojkov-Vukelic M, Hadzic S, Dedic A, Konjhodzic R, Beslagic E. Application of a diode laser in the reduction of targeted periodontal pathogens. Acta Inform Med. 2013 Dec;21(4):237-40. doi: 10.5455/aim.2013.21.237-240. Epub 2013 Dec 4. PMID: 24554796; PMCID: PMC3916176.
10. U Caruso, L Nastri, R Piccolomini, S d'Ercole, C Mazza, L Guida. Use of diode laser 980 nm as adjunctive therapy in the treatment of chronic periodontitis. A randomized controlled clinical trial. New Microbio. 2008; 31:513-518.
11. Alzoman HA, Diab HM. Effect of gallium aluminum arsenide diode laser therapy on Porphyro-monas gingivalis in chronic periodontitis: a randomized controlled trial. Int J Dent Hygiene. 2015; DOI: 10.1111/idh.12169.
12. Matarese G, Ramaglia L, Cicciù M, Cordasco G, Isola G. The Effects of Diode Laser Therapy as an Adjunct to Scaling and Root Planing in the Treatment of Aggressive Periodontitis: A 1Year Randomized Controlled Clinical Trial. Photo-med Laser Surg. 2017 Dec; 35(12):702-709. doi: 10.1089/pho.2017.4288. Epub 2017 Sep 14. PMID: 28945145.
13. Bansal V, Gupta R, Dahiya P, Kumar M, Samlok JK. A clinico-microbiologic study comparing the efficacy of locally delivered chlorhexidine chip and diode LASER as an adjunct to nonsurgical periodontal therapy. J Oral Biology and Craniof Research.2018; doi: 10.1016/j.jobcr. 2018.09.001.
14. Meseli SE, Kuru B, Kuru L. Effects of 810-nanometer diode laser as an adjunct to

mechanical periodontal treatment on clinical periodontal parameters and gingival crevicular fluid volume of residual periodontal pockets. Niger J Clin Pract 2017; 20:427-32

15. Katsikanis F, Strakas D, Vouros I. The application of antimicrobial photodynamic therapy (aPDT, 670 nm) and diode laser (940 nm) as adjunctive approach in the conventional cause-related treatment of chronic periodontal disease: a randomized controlled split-mouth clinical trial. Clin Oral Invest.2019 Avg; https://doi.org/10.1007/s00784-019-03045-1.
16. Saglam M, Kantarci A, Dundar N, Hakki SS.Clinical and biochemical effects of diode laser as an adjunct to nonsurgical treatment of chronic periodontitis: a randomized, controlled clinical trial. Lasers Med Sci.2014; 29:37–46.
17. Cobb CM. Lasers and the treatment of periodontitis: the essence and the noise. Periodontol.2017; 75(1):205–295.
18. Schwarz F, Sculean A, Georg T, Reich E.Periodonal treatment with an Er:YAG laser compared to scaling and root planning. A controlled clinical study. J Periodontol.2001; 72:361367.
19. Dixit S, Doshi Y, Shah MU, Dabholkar CS. Management of chronic generalized periodontitis using diode laser. J Indian Soc Periodontol 2016; 20:88-90.
20. Roncati M et al. Ten-Yaer Nonsurgical Periodontal Treatment Protocol with Adjunctive Use of Diode Laser Monitoring Clinical Outcomes in ⩾ 6mm Pockets: A Retrospective Controlled Case Series. Internat J Periodont and Restorat Dent. 2017; 37(5):647-654.
21. Chandra S, Shashikumar P. Diode laser - a novel therapeutic approach in the treatment of chronic periodontitis in type 2 diabetes mellitus patients: a prospective randomized controlled clinical trial. J Lasers Med Sci. 2019; 10(1):56-63.
22. S. Böcher, et al. Comparison of different laser-based photochemical systems for periodontal treatment.Elsevier.2019; 27:433-439.

THE IMPACT OF MALOCCLUSIONS ON THE QUALITY OF LIFE AMONG CHILDREN BETWEEN 8 AND 14 YEARS

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ABSTRACT

Introduction: More recently, many studies have been carried out among different populations in order to acquire knowledge about malocclusions and their impact on OHRQOL (Oral health quality of life). Therefore, the aim of this study was to carry out a systematic review of quantitative studies on the impact of malocclusions on the quality of life in children, ageing between 8 and 14 years of age.

Material and methods: Two databases were searched: MEDLINE via PubMed and Google Scholar, and articles published between 2010 and 2020. The following criteria were used when selecting articles: population of children, school children between 8 and 14 years of age; cross-sectional study; no orthodontic treatments have been previously performed; the relationship between malocclusions and quality of life; groups with and without malocclusions; assessment of malocclusions and the need for orthodontic treatment by professionals; use of questionnaires in OHRQOL assessment; articles published in English.

Results: Out of a total of 30 articles found and reviewed, based on the initially set criteria, five studies met the initially set conditions. All five studies were cross-sectional studies, and all were rated as high quality since they took into account all important obstacles in their final interpretation of the results. The results of all studies indicated a negative impact of malocclusions on the quality of life of the respondents.

Conclusion: There is a scientific proof that malocclusions, especially those in the aesthetic zone, have a negative impact on the quality of life of school children, aged 8-14 years, especially on their emotional and social well-being.

Key words: quality of life, mixed dentition, malocclusion, orthodontics, children between 8 and 14 years old, school children.

Introduction

Malocclusion affects the function and aesthetics, but also has important social and psychological consequences. [1]

Therefore, most patients seek orthodontic treatment for aesthetic reasons. [2] That is one of the reasons why the presence of malocclusion does not usually mean that the orthodontic treatment is needed, because malocclusions often do not compromise oral function, but may affect the emotional development, self-esteem and social integration. [3] There are various aspects of the need for orthodontic treatment - aesthetic, psychological, social and functional.

The differences between the perception of orthodontists and patients about the aesthetic effect and the needs of orthodontic treatment are significant, and the psychosocial consequences that may arise due to a particular malocclusion cannot be ignored. While in orthodontists, the assessment of the need for orthodontic treatment is dominated by impaired occlusion, mastication and phonation, improving oral health, preventing caries and periodontal disease, and enabling optimal oral hygiene, patients are dominated by the desire for better appearance, self-esteem and society acceptance. [1, 2, 3]

Physical appearance is very important factor in establishing social interactions, especially in adolescents and young adults. Since a smile is an important part of the aesthetic impression of a face, and teeth are its most prominent part, it is reasonable to expect that dental aesthetics affect an individual's psychosocial status. [4]

Oral health quality of life [OHRQOL) is defined as the impact of oral disorders on aspects of everyday life that are important to patients, provided that these impacts are large enough [either in terms of severity, frequency or duration) to affect an individual's overall life perception. The goal of dental treatment will therefore be to improve the quality of life of patients. [5]

OHRQOL was developed to supplement clinical indicators by addressing the functional and psychosocial deficiencies of such disorders and providing a more complete picture of an individual's health. One of the main reasons why people seek orthodontic treatment is dissatisfaction with their tooth appearance, low self-esteem and parental concern about the child's teeth. [6]

Occlusal changes that occur in mixed dentition in most cases affect child's self-image. Therefore, it is important to assess occlusion in mixed dentition and early permanent dentition to avoid further functional and psychological impairment. [7]

The impact of oral diseases or oral health quality disorders [OHRQOL) can be evaluated using quantitative assessments such as questionnaires. More recently, many studies have been conducted among different populations to gain knowledge about malocclusions and their impact on OHRQOL. [8]

Therefore, the aim of this study was to conduct a systematic review of quantitative studies on the impact of malocclusions on quality of life in children, between 8 and 14 years of age.

Material and methods

The literature search was carried out systematically, in the following order:

1. defining the research question,
2. formulating a literature search plan,
3. literature search, and
4. interpretation and evaluation of the selected literature.

Defining a research question

The question addressed in this review paper is: Do malocclusions affect the quality of life of children ageing between 8 and 14 years?

Formulating a literature search plan

The literature search was based on finding all studies assessing the impact of malocclusions on quality of life [OHRQOL). Two databases were searched: MEDLINE via PubMed and Google

Scholar including articles published between 2010 and 2020. The following keywords were used in the search: 'quality of life', 'mixed dentition', 'malocclusion', 'orthodontics', 'children between 8 and 14 years', 'school children'.

Literature search

The following inclusion criteria was used:

- Population of children, school children between 8 and 14 years;
- Cross-sectional study;
- No orthodontic treatments have been previously performed;
- Relationship between malocclusions and quality of life;
- Division of respondents into groups with and without malocclusions;
- Assessment of malocclusions and the need for orthodontic treatment by professionals;
- Use of questionnaires in OHRQOL assessment;
- Articles published in English.

Each version of the article in full text was thoroughly analyzed and evaluated. The reference lists of articles that are deemed to meet the requirements were also searched in order to find additional literature.

Interpretation of the selected literature

The quality of each of the found articles in their full text was analyzed, and further selection of articles depended on: year of publication, study layout, study population, OHRQOL assessment, malocclusion assessment or need for orthodontic treatment, results obtained.

Results

Out of total of 30 articles found and reviewed, based on the initially set criteria, 11 articles in the full text remained for final analysis. Of the remaining 11 articles, after detailed analysis: two articles were rejected due to the age of the respondents [18-25 years) [9, 10], one article was rejected due to poor research methodology [11], one article had a group of respondents who were already orthodontically treated [12], one study was a case-control study [6] and the other review study [13], and for this reason these two studies did not qualify.

The remaining five studies met the initial conditions, included school children aged 8-14 years [in two studies the subjects were children aged 8-10 years, one study examined children aged 8 to 12 years, and two studies examined children of 12 years), the design of the studies is cross-sectional, the methods and material are precisely and in detail stated, the analysis of the data is carried out at a satisfactory level. [7, 14, 15, 16, 17]

In four studies, the Dental Aesthetic Index [DAI) was used to assess the presence of malocclusions and the need for orthodontic treatment, while the Child Perspective Questionnaire [CPQ11-14 or CPQ8-10) was used to assess OHRQOL. [7, 14, 15, 16] In one study, the DHC component of the IOTN index was used to assess the need for orthodontic treatment, and the AC component of the IOTN index was used to assess OHRQOL. [17]

Discussion

This review article including a detailed analysis of five cross-sectional studies indicates that there is a proof that serious malocclusions in the aesthetic zone have a negative impact on the quality of life of children aged between 8 and 14 years.

This negative effect is present in these groups of children because this is the period when they are most vulnerable, and all this reflects in large amount on their self-confidence and psycho-social component of life. Malocclusions in the area of the aesthetic zone as those being most visible, had the greatest impact on OHRQOL.

In the four studies using Dental Aesthetic Index to assess malocclusion, and CPQ questionnaire to

assess the impact of malocclusion on the quality of life, according to the obtained results, the presence of severe malocclusion had a negative impact on quality of life, while less severe malocclusion had no impact on quality of life.

In the study conducted by Guimaraes et al., malocclusion having the largest negative impact was anterior crossed bite [15], while in study conducted by Dutra et al. this malocclusion was maxillary anterior overjet 3 mm. [16]

Dos Santos et al., contrary to the remaining four studies, used two components of the IOTN index to assess the impact of malocclusions on quality of life, and according to their results, malocclusions had an impact on the quality of life of respondents. [17]

The period of mixed dentition and early permanent dentition is a period of life in which the social relations are transferred from the family environment to a friendly environment. Therefore, physical appearance and worries about self-confidence are issues of great importance for children in that period of life, because they seek the approval of their characteristics among peers. The main concerns related to the characteristics of the body are usually the focus on body weight and face lines.[8]

Liu et al., concluded that there is a modest association between the existence of malocclusion and the need for orthodontic treatment and quality of life, and felt that further studies were needed to analyze their relationship in more detail. [8]

Sun at al. in their review study and meta-analysis, also concluded that untreated malocclusions were significantly associated with OHRQOL. The more severe malocclusion meant the worse impact on some physical domains and all psychosocial domains of OHRQOL. [18]

In the future, studies could be conducted to assess the impact of malocclusions on quality of life, but with the use of several different indices to assess the need for orthodontic treatment.

Conclusion

There is a scientific evidence that malocclusions, especially those in the aesthetic zone, have a negative impact on the quality of life in school children, aged 8-14 years, especially on their emotional and social well-being.

An individual with unsightly occlusal traits is faced with more challenges with quality of life than their peers who do not have or have mild need for orthodontic treatment.

Literature

1. Špalj S, Katalinić A, Varga S, Radica N. Orthodontic Outline. Rijeka: Medical Faculty University in Rijeka; 2012.
2. Singh VP, Singh R. Translation and validation of a Nepalese version of the Psychosocial Impact of Dental Aesthetic Questionnaire [PIDAQ). J Orthod. 2014;41[1):6-12.
3. Haq S, Khan N, Durrani O. Assessment of psychosocial impact of dental aesthetics. POJ 2018:10[1)2-7
4. Spalj S, Lajnert V, Ivankovic L. The psychosocial impact of dental aesthetics questionnaire--translation and cross-cultural validation in Croatia. Qual Life Res. 2014 ;23[4):1267-71.
5. Obilade O, Sanu O, Da Costa O. Impact of three malocclusion traits on the quality of life of orthodontic patients. Int Orthod. 2016; 14[3):366-85.
6. Piassi E, Antunes L, Almeida Graca T, Alves Antunes L. The Impact of Mixed Dentition Malocclusion on the Oral Health-Related Quality of Life for Children and Their Families: A Case-Control Study. J Clin Pediatr Dent. 2019;43[3):211-217.

7. Simões R, Goettems M, Schuch H, Torriani D, Demarco F. Impact of Malocclusion on Oral Health-Related Quality of Life of 8-12 Years Old Schoolchildren in Southern Braz Dent J. 2017;28[1):105-112.
8. Liu Z, McGrath C, Hagg U. The impact of malocclusion/ orthodontic treatment need on the quality of life. A systematic review. Angle Orthod. 2009; 79[3): 585–91.
9. Chen M, Feng Z, Liu X, Li Z, Cai B, Wang D. Impact of malocclusion on oral health–related quality of life in young adults. Angle Orthod. 2015; 85[6):986-91.
10. Dalaie K, Behnaz M, Khodabakhshi Z, Hosseinpour S. Impact of malocclusion severity on oral health-related quality of life in an Iranian young adult population. Eur J Dent. 2018;12[1):129-135.
11. Anthony S, Zimba K, Subramanian B. Impact of Malocclusions on the Oral Health-Related Quality of Life of Early Adolescents in Ndola, Zambia. Int J Dent. 2018: 7920973.
12. Liu B, Lee I, Lo L, Ko E. Investigate the oral health impact and quality of life on patients with malocclusion of different treatment needs. Biomed J. 2019 ; 42[6):422-429.
13. Abreu L. Orthodontics in Children and Impact of Malocclusion on Adolescents' Quality of Life. Pediatr Clin North Am. 2018; 65[5):995-1006.
14. Da Rosa G, Del Fabro J, Tomazoni F, Tuchtenhagen S, Alves L, Ardenghi T. Association of malocclusion, happiness, and oral health–related quality of life [OHRQoL) in schoolchildren. J Public Health Dent. 2016; 76[2):85-90.
15. Guimaraes S, Jorge K, Fontes M, Ramos-Jorge M, Araujo C, Ferreira E et al. Impact of malocclusion on oral health-related quality of life among school children. Braz Oral Res. 2018;32:e95
16. Dutra S, Pretti H, Torres Martins M, Baccin Bendo C, Pimenta Vale M. Impact of malocclusion on the quality of life of children aged 8 to 10 years. Dental Press J Orthod. 2018; 23[2): 46–53.
17. Dos Santos P, Meneghim M, Ambrosano G, Filho M, Vedovello S. Influence of quality of life, self-perception, and self-esteem on orthodontic treatment need. Am J Orthod Dentofacial Orthop. 2017;151[1):143-147.
18. Sun L, Wong H, McGrath C. Relationship Between the Severity of Malocclusion and Oral Health Related Quality of Life: A Systematic Review and Meta-analysis. Oral Health Prev Dent. 2017;15[6):503-517.

ORAL-SURGICAL TREATMENT OF MAXILLARY SINUSITIS OF ENDODONTIC ORIGIN

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ABSTRACT

Objectives: Both dental and medical literature recognize tooth pathology as a possible cause of maxillary sinusitis in up to 40% of all cases. Odontogenic sinusitis can be caused by various invasive dental procedures. However, periapical infection, manifesting in the maxillary sinus, remains under-appreciated, and frequently goes undiagnosed. This report aims to show the extent to which maxillary sinusitis of endodontic origin (MSEO) can be manifested and the oral surgical approach in its treatment.

A case report: A 28-year-old woman presented with an acute premaxillary abscess at the beginning of endodontic treatment of her upper right canine. The acute condition was treated with an intraoral incision and a high dose of antibiotics. However, the patient failed to continue endodontic treatment and returned after a year with severe right-sided headache and pressure including unilateral nasal discharge. CBCT imaging revealed the opacification of the right maxillary sinus and periapical periodontitis of tooth 13. After chemo-mechanical preparation of the root canal of tooth 13, intraoperative canal obturation was performed alongside with exploration of the right maxillary sinus and removal of the pathological mucosa. The procedure resulted in the resolution of all symptoms.

Conclusion: When encountered unilateral maxillary sinusitis, endodontic origin of the condition should also be considered. Successful management of the advanced MSEO can be achieved with a combination of endodontics, dental surgery and antimicrobial treatment.

Keywords: odontogenic sinusitis, maxillary sinusitis, endodontic origin

Introduction

Tooth pathology has been reported as a cause of maxillary sinusitis in 10% of cases, but the real incidence could be as high as 25-40% [1]. Despite this prevalence, odontogenic sources of sinusitis are frequently overlooked in the diagnosis and management of chronic sinusitis [2]. Odontogenic sinusitis is generally caused by several factors and conditions, such as the maxillary spread of an endodontic infection, the intrasinus displacement of endodontic materials, tooth fragments, implant or augmentation grafts, perforation of the Schneiderian membrane during tooth extractions, periodontal surgery or sinus floor elevation surgery, dental traumas, or an oroantral fistula [1]. Maxillary Sinusitis of Endodontic Origin (MSEO), a term used in this paper, was introduced by the American Association of Endodontists, and it refers specifically to sinusitis secondary to pararadicular disease of endodontic origin [3].

However, despite substantial scientific findings, the propagation of a periapical infection to the maxillary sinus often goes undiagnosed [3]. This report aims to show the extent to which the MSEO can be manifested, and the efficiency of oral surgical approach to its treatment.

Case Report

The Patient's First Visit
- The Premaxillary Abscess

In March 2018 a 28-year old woman was referred to the Department of Oral Surgery due to severe right-sided premaxillary swelling involving right eylids. Her endodontis informed us that the swelling occurred the day after the root canal treatment (RCT) of the tooth 13 that included chemo-mechanical preparation of the root canal and placement of intracanal medication (calcium hydroxide). Clinical examination revealed a fluctuant abscess in the right vestibule. The incision was made, and purulent content evacuated. A surgical rubber drain was placed in the abscess cavity. She was prescribed antibiotic therapy: Penicillin 2 000 000 IU was given intramuscularly in combination with Metronidazole tablets 500 mg (3 times a day) for 8 days. Ortopantomographic imaging was performed and showed periapical radiolucency of tooth 13 (**Figure 1.**). After the acute inflammation subdued, the patient was advised to continue with endodontic treatment, which she failed to do.

The Patient's Second Visit
- The Acute Unilateral Maxillary Sinusitis

A year later, the patient returned with severe symptoms of unilateral headache and pressure in the right nostril, eye and the right half of the head, as well as mucopurulent nasal discharge with

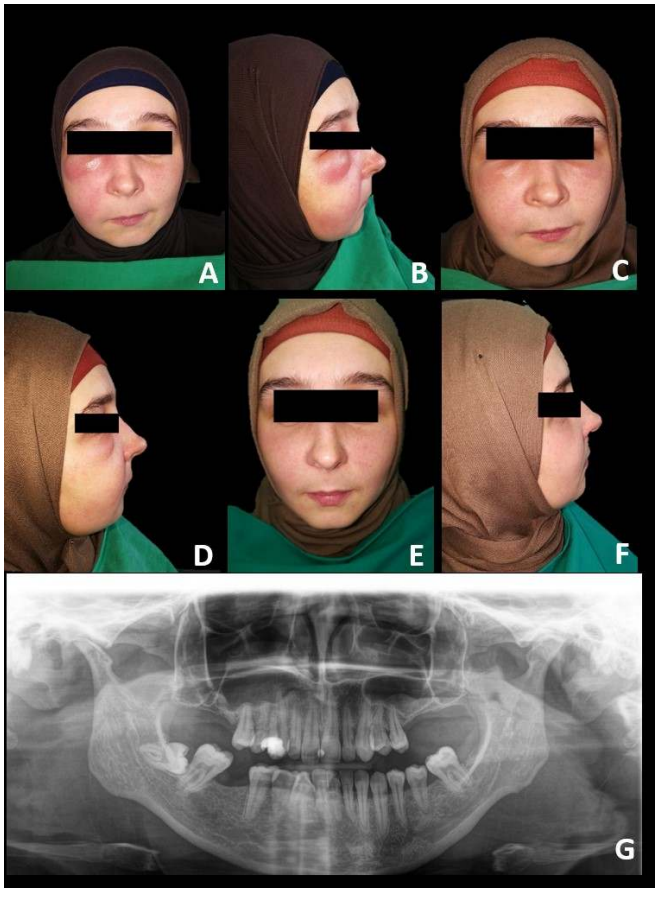

Figure 1. Premaxillary abscess after the initiation of endodontic treatment of the tooth 13.
A, B - Acute phase of the abscess.
C, D, E, F - Phases of resolution of the abscess after the incision was made.
G - Panoramic radiograph of the patient.

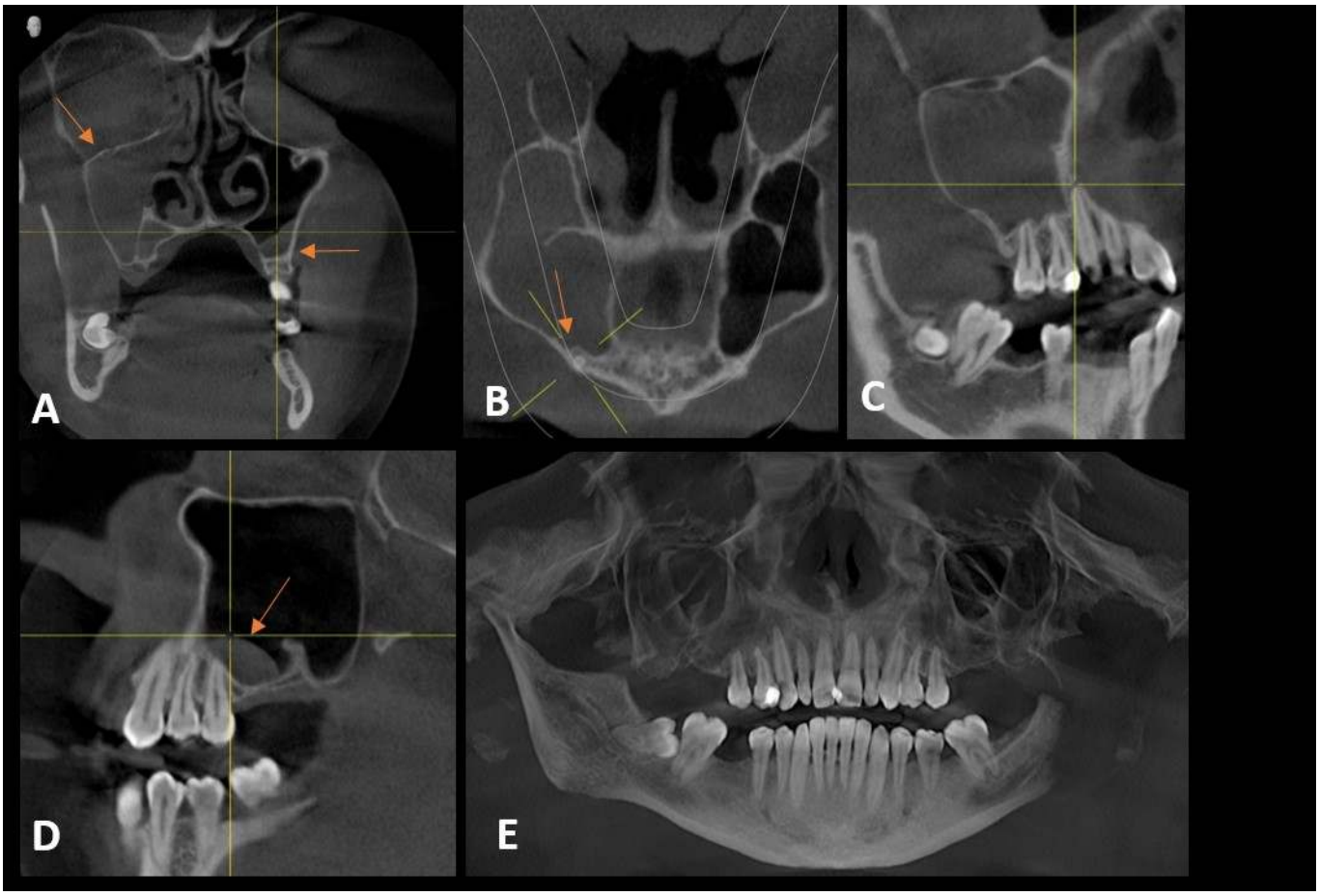

Figure 2. CBCT images showing maxillary sinuses.
A – Coronal CBCT image. Right maxillary sinus is completely radiopaque, whereas dome-shaped opacification on the floor of the left maxillary sinus can be noticed (arrow).
B – Axial CBCT image. Periapical radiolucency of tooth 13. The lesion has displaced sinus cortical floor upward (arrow)
C – Sagittal CBCT image. Completely opacified right maxillary sinus.
D – Sagittal CBCT image. Mucous retention cyst – like opacification of the left sinus (arrow)
E – Reconstructed panoramic CBCT image. Mild radiopacity of the left maxillary sinus.

strains of blood. CBCT imaging revealed complete radiopacity of the right maxillary sinus, whereas the left one showed mild dome-shaped radiopacity basally. The infraorbital ethmoid cells of the right maxillary sinus also showed signs of inflammation (**Figure 2A**). Minor periapical radiolucency of tooth 13 could be noticed. Furthermore, the sinus floor was elevated at the lesion site. Schneiderian membrane of the right maxillary sinus was intact. (**Figure 2B**). The patient was prescribed antibiotic treatment for eight days (2g of Amoxicillin per day) and scheduled for sinus exploration the next day.

Whether tooth 13 will be resected or extracted was to be determined intraoperatively. Therefore, respecting all endodontic principles, cleaning and shaping of the canal was done. The root canal was sealed intraoperatively under direct visualization if we were to choose apicoectomy as therapy. The second stage of operative treatment was a surgical exploration of the maxillary sinus with the removal of pathologic tissue. The treatment was done in the operating ward under sterile conditions. Plexus anesthesia and infraorbital anesthesia were applied. Trapezoid incision in the region of tooth 12 – 15 was made and a full-thickness flap was elevated upon which we were able to observe intact vestibular cortical bone. Therefore, we decided to do root resection of tooth 13 as its survival is biologically indisputable. Corticotomy was made, and the root apex of tooth 13 was

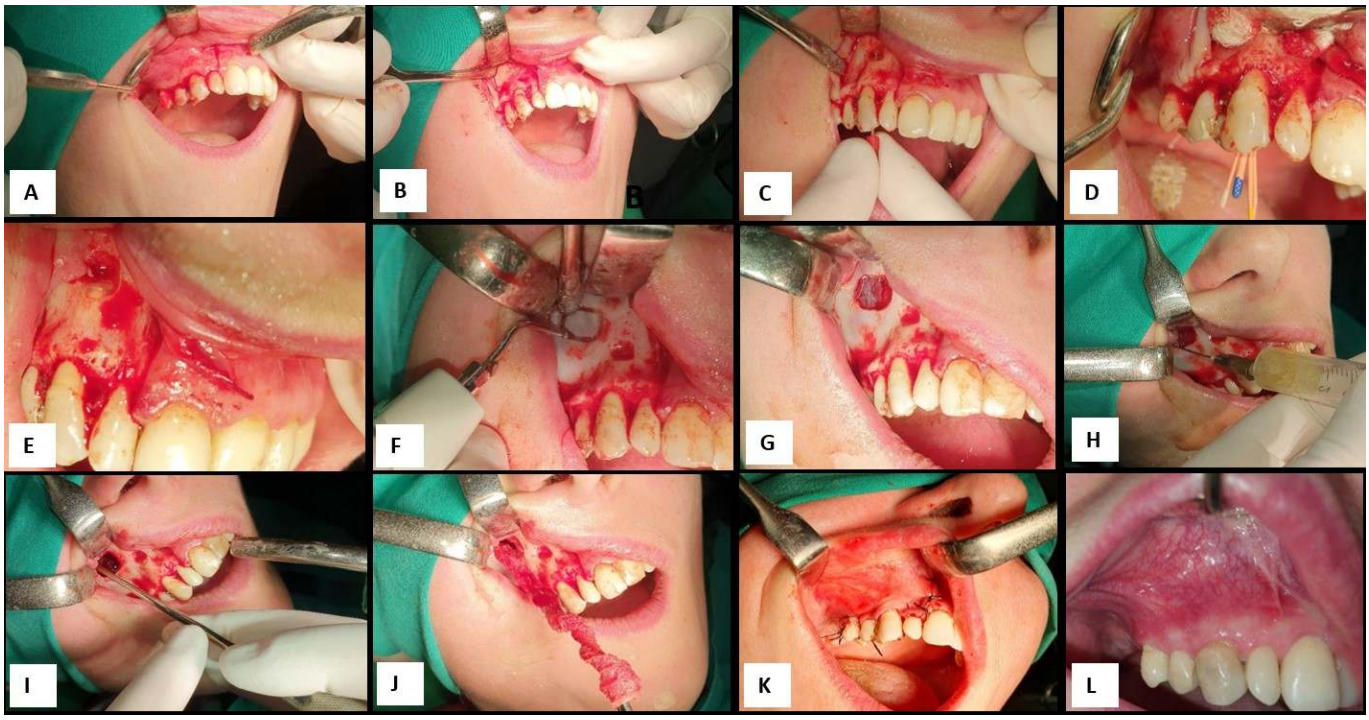

Figure 3. Operative protocol.
A, B – Mucoperiostal flap design. C,D – Root canal obturation E –Root resection.
F,G - Bony opening in the infraorbital fossa. H – Yellow, opalescent aspirate.
I – Exploration of the right maxillary sinus. J – Removal of altered mucosa with a gauze.
K – Repositioned and primarily sutured flap. L – Status of mucosa at the 4-month recall.

visualized. The canal was sealed with gutta-percha and phosphate cement, and root resected. Dry surgical field was managed using surgical bone wax. A bony window was made in the upper right vestibule (infraorbital fossa) and yellow, opalescent fluid was aspirated and sent for cytological analysis. Exploration of the maxillary sinus was performed and the pathologically altered mucosa was removed. The flap was repositioned and the wound was primarily sutured (**Figure 3**). The patient was administered nasal drops for adults for the first 3 days postoperatively. Cytological findings showed inflammatory changes in the form of infiltrate consisting of predominantly neutrophil granulocytes, with some lymphocytes, histiocytes, and siderophages. At the first postoperative appointment, 3 days later, the patient reported complete resolution of the symptoms of pain and pressure. Eight days postoperatively the sutures were removed and continuous nasal irrigation using the Aqua Maris irrigation system was advised. At the 4-month recall appointment, the patient reported no pain. CBCT imaging was planned at the 6-month recall but the patient failed to attend the appointment.

Discussion

Sinusitis is the inflammation of the mucosal lining of the paranasal sinuses [4]. Although odontogenic sinusitis is known cause of maxillary sinusitis, it is frequently misdiagnosed with chronic rhinosinusitis [2]. Proper diagnosis is fundamental for the treatment of any disease, including odontogenic sinusitis. Lack of specific symptoms is what makes clinicians overlook the dental cause of sinusitis. Pokorny and Tataryn [5] found that facial pain, postnasal discharge and congestion were the most common complaints in their study of odontogenic sinusitis - unspecific symptoms that are common for maxillary sinusitis

of different origins. That is why we rely to a great extent on radiography when making a diagnosis of chronic sinusitis.

Although periapical radiographs are the standard radiographs used in endodontics, they are not adequate to reveal the anatomical relationships between the maxillary molars and the sinus floor [6]. Studies comparing 2D radiography and 3D radiography show the superiority of CT scans in detecting periapical bone changes, as well as sinus pathologies, compared to panoramic or periapical radiographs [7-10]. This was the case with our patient as well. The reconstructed panoramic CBCT image, as a 2D image, although showing certain radiopacity of the right sinus, could not show the extent of the pathological process compared to the 3D cross-sections. The 3D evaluation showed dome-like opacification of the left maxillary sinus located basally. As no periapical pathology of the adjacent teeth could be noticed, it was diagnosed as a mucous retention cyst. Mucous retention cysts are frequently found on panoramic views and CT scans of the floor of the maxillary sinus, and are often confused with odontogenic inflammatory cysts [11].

Although chronic sinusitis in our case was unilateral, the severity of sinus changes was out of proportion to the size of the periapical lesion. However, we know that pathologically altered mucosa is impaired and less resistant than healthy mucosa to infection, and is a pathogenic factor in the progression of rhinosinusitis [3]. Furthermore, rhinogenic chronic rhinosinusitis may coexist with odontogenic sinusitis and confound diagnosis [2]. Therefore, we can hypothesize that our patient's MSEO was combined with rhinogenic sinusitis leading to the development of polysinusitis.

The therapeutic protocol of odontogenic sinusitis remains unclear. The American Association of Endodontists, in their Position Statement regarding MSEO, advise that root canal treatment should be a first choice option for sinusitis of endodontic origin, followed by surgical therapy in the case of failure of endodontic therapy [3]. However, there is a substantial amount of data showing that dental treatment alone is rarely sufficient to treat odontogenic sinusitis, and that life-threatening complications of odontogenic sinusitis are possible [6], so we opted for a combined therapeutic approach. Besides, our patient was suffering unbearable pain, and we needed faster therapeutic results than the conventional endodontic therapy offers. Surgery of the maxillary sinus varies from endoscopic techniques to open surgery, depending on the mucociliary transport, anatomic landmarks such as the sinus ostium and the necessity of the width of access to the maxillary sinus floor [12]. Although endoscopic sinus surgery provides for removal of pathological mucosa alone, thus leaving unaffected specialized epithelia that will enable postoperative clearance and drainage [13], it carries the risk of general anesthesia and a longer hospital stay. Our patient requested an alternative to general anesthesia which was provided with an oral surgical approach.

Conclusion

When encountered with unilateral maxillary sinusitis, an endodontic origin of the condition should be considered. Oral surgical treatment, combined with endodontic and antimicrobial therapy, can be successful in the management of the advanced MSEO.

Acknowledgments

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Declaration of interest

The authors declare that there is no conflict of interest.

Literature

1. Taschieri S, Torretta S, Corbella S, Del Fabbro M, Francetti L, Lolato A et al. Pathophysiology of sinusitis of odontogenic origin. J Investig Clin Dent. 2015;8(2):e12202.
2. Workman A, Granquist E, Adappa N. Odontogenic sinusitis. Curr Opin Otolaryngol Head Neck Surg. 2018;26(1):27-33.
3. Tataryn R, Lewis M, Horalek AL, et al. Maxillary sinusitis of endodontic origin: AAE position statement. Chicago (IL): American Association of Endodontists; 2018. Available at:https://www.aae.org/specialty/wp-content/uploads/sites/2/2018/04/AAE_PositionStatement_MaxillarySinusitis.pdf
4. Ferguson M. Rhinosinusitis in oral medicine and dentistry. Aust. Dent. J. 2014;59(3):289-295.
5. Pokorny A, Tataryn R. Clinical and radiologic findings in a case series of maxillary sinusitis of dental origin. Int Forum *Allergy* Rhinol. 2013;3(12):973-979.
6. Vidala F, Coutinhoa TM, Ferreira D, de Souza RC, Goncalves L (2017) Odontogenic sinusitis: a comprehensive review. Acta Odontol Scand 75(8):623–633.
7. Patel N, Ferguson B. Odontogenic sinusitis. Curr Opin Otolaryngol Head Neck Surg. 2012;20(1):24-28.
8. Longhini A, Ferguson B. Clinical aspects of odontogenic maxillary sinusitis: a case series. Int Forum *Allergy* Rhinol. 2011;1(5):409-415.
9. Low K, Dula K, Bürgin W, von Arx T. Comparison of Periapical Radiography and Limited Cone-Beam Tomography in Posterior Maxillary Teeth Referred for Apical Surgery. J Endod. 2008;34(5):557-562.
10. Little R, Long C, Loehrl T, Poetker D. Odontogenic sinusitis: A review of the current literature. Laryngoscope Investig Otolaryngol. 2018;3(2):110-114.
11. Kim SM. Definition and management of odontogenic maxillary sinusitis. Maxillofac Plast Reconstr Surg. 2019;41(1):13.
12. Zirk M, Dreiseidler T, Pohl M, Rothamel D, Buller J, Peters F et al. Odontogenic sinusitis maxillaris: A retrospective study of 121 cases with surgical intervention. J Craniomaxillofac Surg. 2017;45(4):520-525.
13. Aukštakalnis R, Simonavičiūtė R and Simuntis. Treatment options for odontogenic maxillary sinusitis: a review. Stomatologija. 2018; 20(1): 22-26.

TAMOXIFEN AS A POSSIBLE CAUSE OF JAW OSTEONECROSIS

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ABSTRACT

Objectives: Medication-related osteonecrosis of the jaw (MRONJ), an oral complication manifested by exposed jaw bone, attracts scientific attention, especially for its etiology and therapy. The majority of reported cases are related to antiresorptive and antiangiogenic drugs. However, other medications such as tamoxifen can cause MRONJ as well. This case study highlights that the use of tamoxifen could lead to osteonecrotic changes in the jaw bone.

Case report: We presented a case of a breast cancer patient with necrotic jaw changes after single tooth extraction. The patient was using tamoxifen, a selective estrogen receptor modulator. Exposed necrotic bone persisted for more than eight weeks. The patient experienced severe pain. Bone sequestrectomy using a piezo device was performed. The remaining bone was covered with platelet-rich fibrin (PRF) membrane, and the wound was primarily sutured. The postoperative period was uneventful. The lesion was monitored radiologically and clinically. The wound healed completely.

Conclusion: Clinicians must be aware of the possibility that tamoxifen can be related to osteonecrotic jaw changes after tooth extraction. PRF was a good treatment option in the presented case.

Key words: Osteonecrosis of the Jaw; Tamoxifen; Tooth Extraction; Platelet-rich Fibrin (PRF)

Introduction

Osteonecrosis of the jaw is defined as the loss of the bone matrix of the jaw bone. The cause of osteonecrotic changes can be related to the use of certain medication causing changes in the bone microstructure. These medicaments are characterized by quick disposal and accumulation in the bones. They inhibit angiogenesis, i.e., prevent the formation of new blood vessels. The cause of osteomyelitis after bone necrosis can be a local infection, invasive dental procedures and the patient's general health condition [1, 2]. The most significant risk for the occurrence of osteomyelitis of the necrotic bone exists if oral surgical procedures were done [2]. Osteonecrosis of the jaw is mostly found in women aged 55-68 diagnosed with breast cancer or osteoporosis [5]. Osteonecrosis usually affects the jawbones, as they are susceptible to active remodeling [2]. The mandible is more often affected than the maxilla. Drugs known to cause osteonecrotic changes in jaws are from a group of antiresorptive and antiangiogenic drugs. The first case was reported in 2003, and it described a case of osteonecrosis of the jaw caused by antiresorptive drugs - bisphosphonates [3]. However, the list of medicines that may cause this condition expanded, and now we know that other medications such as denosumab, bevaci-zumab, sunitinib, corticosteroids, immunomodulators, and others can cause osteonecrosis as well [1]. Osteonecrosis of the jaw caused by these medications is called *Medication-related osteonecrosis of the jaw* - MRONJ.

MRONJ is clinically manifested in the form of exposed bone, which is present in 94% of cases [6]. Alongside, pain, tooth mobility, ulcers, extraoral fistulae, and symptoms of infection can be present. In the advanced stage of the disease, local infection with a general inflammatory response can occur as well as pathological fractures of the jaw [11].

The diagnosis of MRONJ is based on several criteria: antiresorptive or antiangiogenic drug use in the patient's medical history, clinical exposure of the bone site for more than eight weeks, and no radiotherapy or metastasis in the jaw bone [1].

We aimed to show the therapeutic approach to tamoxifen caused osteonecrosis of the upper jaw following tooth extraction.

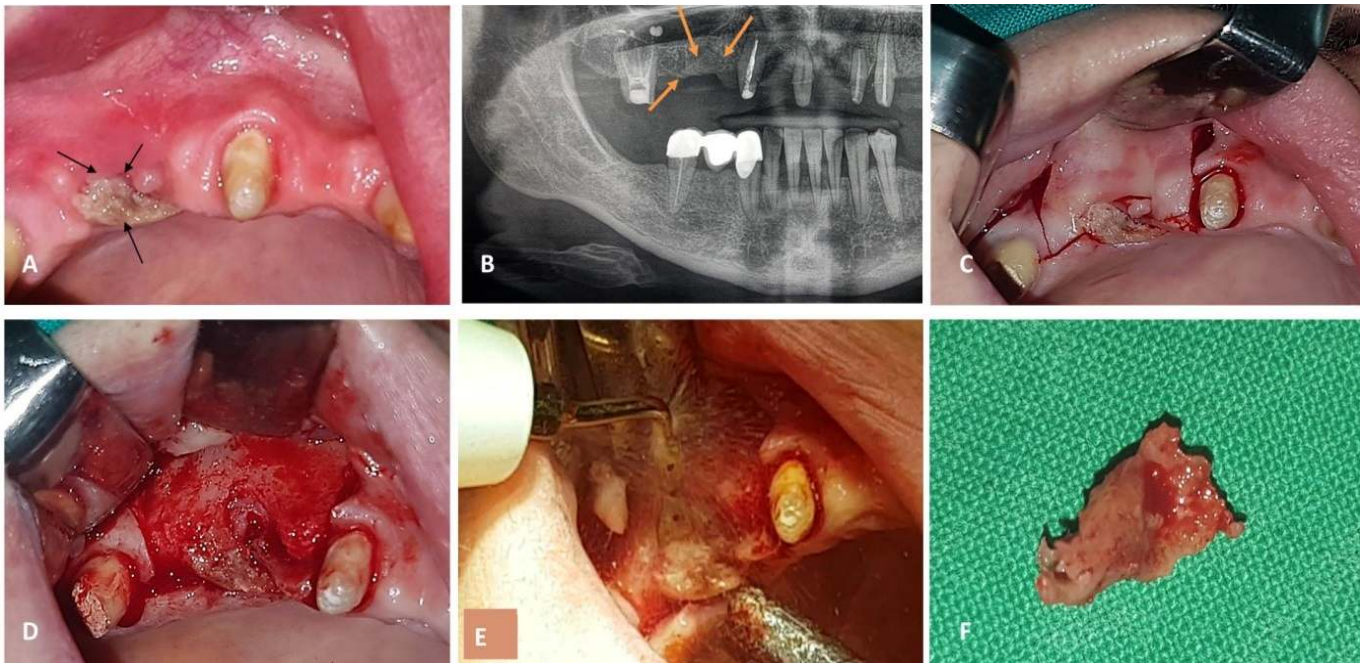

Figure 1. A - An exposed necrotic bone on the right side in the upper jaw;
B - Panoramic X-ray view - osteonecrosis of the jaw in the upper right lateral segment;
C - Incision; D - Elevated mucoperiosteal flap allows insight into the condition of the bone;
E - Removal of the necrotic part of the bone with a piezzo; F - Removed part of the bone

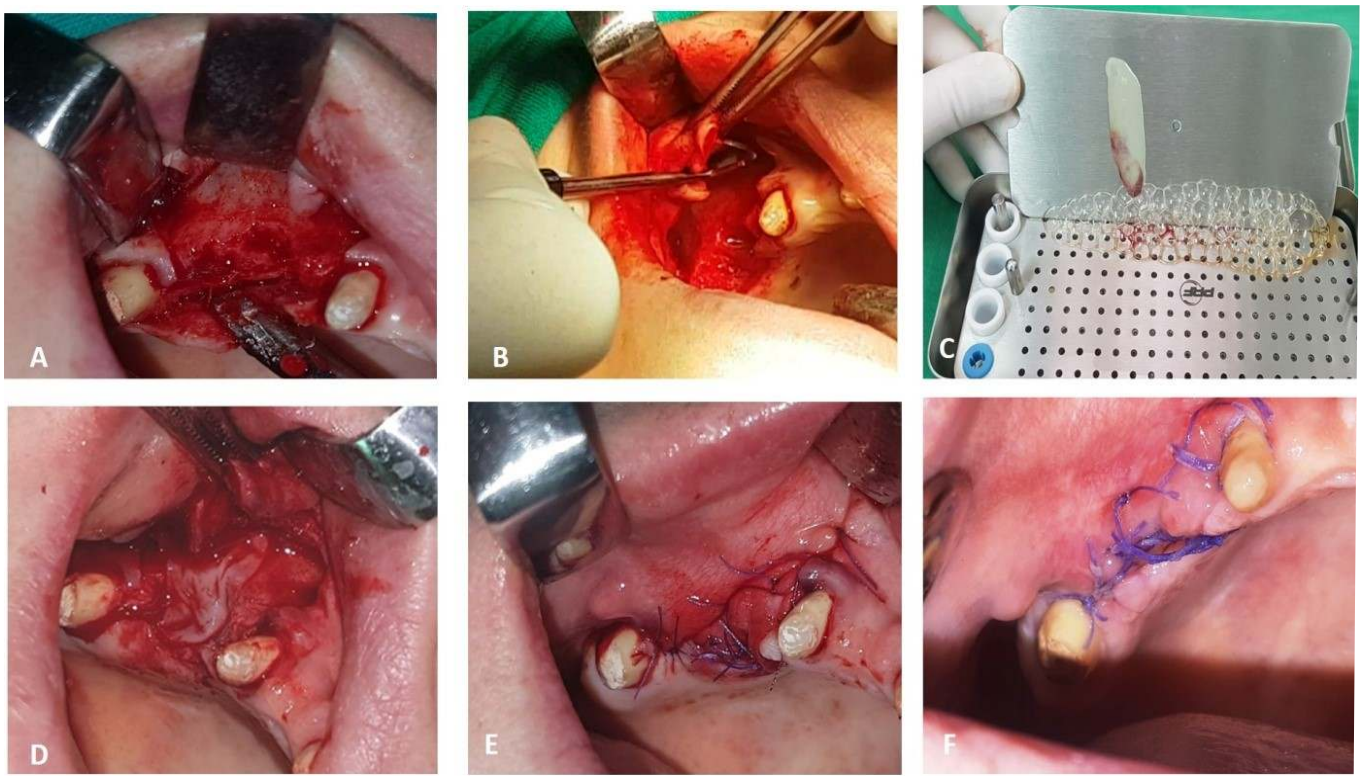

Figure 2. A - The surgical wound after removing bone sequestrum; B - Flap elongation with the 'brushing' technique; C - PRF membrane; D - Application of the PRF membrane into the bone defect; E - Sutures; F - Operative site on the 7th postoperative day.

Patient's Presentation

A 46-years old woman was referred to the Department of Oral Surgery due to pain and prolonged wound healing. She was a breast cancer patient treated with tamoxifen (Nolvadex®, AstraZeneca) that had her tooth 15 extracted, after which the wound did not heal. The tooth was removed three months before her visit. Clinical intraoral examination revealed exposed necrotic bone that persisted for more than eight weeks.

The redness and swelling of soft tissues were notable; ulceration was not present (**Figure 1. A**). The patient did not notice any bleeding at the exposed site. Panoramic X-ray showed necrotic bone changes in the region of the tooth 15 (**Figure 1. B**). Based on the history of tamoxifen consumption and exposed necrotic bone that persisted more than eight weeks, a diagnosis of the MRONJ was made.

The patient was prescribed antibiotic treatment (2g of Amoxicillin per day) and scheduled for the sequestrectomy procedure. The treatment was done in the operating ward under sterile conditions. Infiltration anesthesia in the area of teeth 15-16 was applied, trapezoid incision in the region of tooth 13 – 15 was made, and a full-thickness flap was elevated (**Figures 1. C, D**). With the help of piezoelectric bone surgery, necrotic bone was removed, and sharp bone edges were smoothed (**Figure 1. E**). The removed bone sequestrum was sent for histopathological examination (**Figure 1. F**).

The surgical field was rinsed abundantly with NaOCl (sodium hypochlorite 0.03%), and the PRF membrane was applied in and over the defect (**Figure 2. C, D**). The wound was primarily closed with resorptive sutures using the apical mattress technique to ensure healing without tension (**Figure 2. E**). She was prescribed antibiotics (2g of

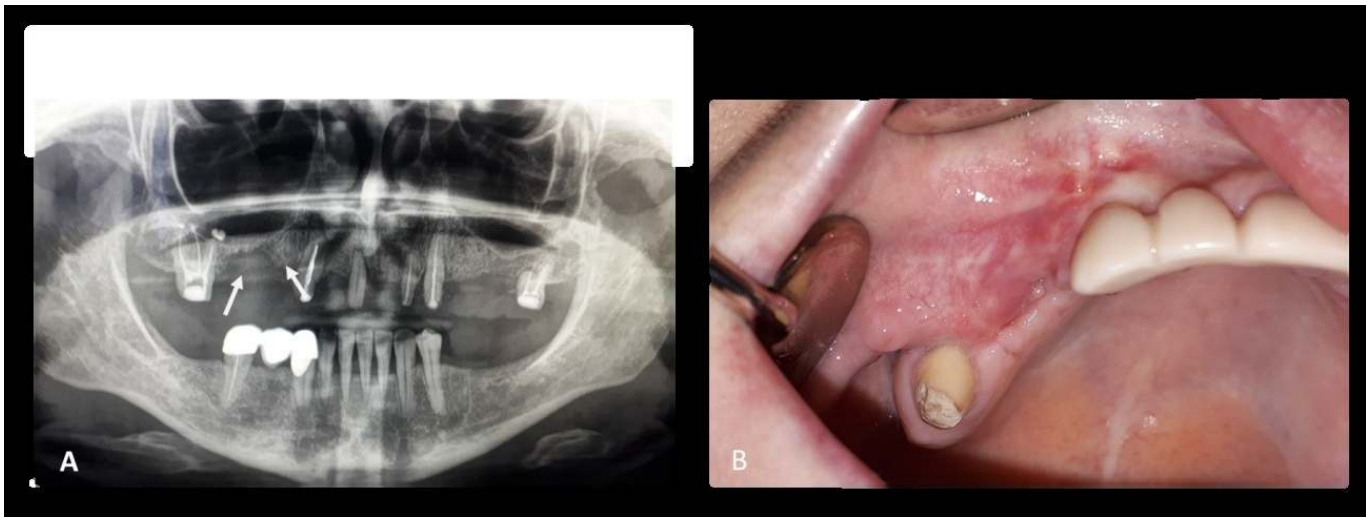

Figure 3.
A - Panoramic X-ray 1 month after the procedure; B - Successful wound healing can be noticed eight weeks postoperatively.

Amoxicillin per day) for 10 days. The patient was monitored radiologically and clinically through periodical follow-ups (**Figure 3.**).

The histopathologic analysis showed empty osteocyte lacunes within the preserved bony trabe-culae. Inflammatory cells and bacteria were present with the necrotic bone. Histopathologic findings confirmed the diagnosis of MRONJ in stage one.

Panoramic X-ray 1 month postoperatively showed bone cavity filled with soft tissue (**Figure 3. A**). At the 3-month follow-up, successful soft tissue healing could be observed (**Figure 3. B**).

Discussion

Osteonecrosis of the jaw is a very severe side-effect of certain medications that are used to treat osteo metabolic or malignant diseases. It was first noticed in 2003 by oral and maxillofacial surgeons, who detected this change in oncologic patients and described it as extraction wounds that do not heal [4].

There are several stages of MRONJ. It starts with prolonged healing of the extraction wound accompanied by pain and swelling of soft tissues. The second phase is reflected in the presence of ulcerous changes of the exposed jaw bone, extraoral fistulas and tooth loss. A more severe clinical picture is presented when osteonecrotic changes are accompanied by a pathological fracture of the jaw bones and paresthesia of the lower lip [4,7].

Since the results of MRONJ therapy are often limited, the treatment requires a serious approach. Pain treating is considered imperative in the treatment of osteonecrosis. Three methods of treatment of MRONJ are described in the literature: conservative, surgical and supplemental. The conservative method includes rinsing the oral cavity with an antibacterial solution such as a 0.12% solution of chlorhexidine, and the use of antibiotics - penicillin or clindamycin combined with metronidazole and antifungal therapy [8].

The surgical method involves surgical debridement, sequestrectomy, tooth extraction with removal of osteonecrotic bone, bone resection and reconstructive surgery. Necrotic bone fragments are usually removed surgically by sequestrectomy [8]. Bone defects occuring after removing the necrotic bone fragment can be repaired in many ways. One of the novel approaches is using PRF - an autologous transplant obtained from the patient's blood [9]. PRF, as a biomaterial that can enhance tissue regeneration and reduce postoperative complications, has proven to be effective in closing bone defects and soft tissue regeneration in patients with MRONJ. [10]

Supplemental therapy which includes ozone therapy, lasers, PRF application, mesenchymal stem cell therapy can be combined with conservative and surgical therapy for better results [8].

Many studies underline that medicines from a group of antiresorptive and antiangiogenic drugs can cause osteonecrotic changes in jaw bones [11]. This report focuses on tamoxifen and its possible effect on development of jaw osteonecrosis in a breast cancer patient after tooth extraction. Tamoxifen is a competitive partial agonist of estrogen receptors. The drug is prescribed as adjuvant therapy in patients with estrogen receptor-positive breast cancer, but also as a preventive therapy in high-risk patients [14].

Contemporary literature lists tamoxifen as a drug that could affect the development of osteonecrosis. From January 2004 to November 2012, 744 patients using tamoxifen were reported with ostenecrotic jaw bone changes by FDA [12]. Tamoxifen can have both positive and negative effects on the bone [14]. It increases bone mineral density in postmenopausal women while it reduces bone density in women of premenopausal age [12, 13]. However, the connection between selective estrogen receptor modulators and osteonecrosis is not quite understandable. In their review, King and associates pointed out that only one patient receiving raloxifene was reported with osteonecrosis [15,16]. It remains to be seen whether the future will show more cases of osteonecrosis caused exclusively by tamoxifen.

Our patient was an oncologic, premenopausal woman that was prescribed tamoxifen as a part of breast cancer therapy. Therefore, she was in a high-risk category for developing osteonecrosis. All this data, combined with the presence of an extraction socket that did not heal for eight weeks, led us to the diagnosis of MRONJ.

It is evident now that osteonecrosis of the jaw can be caused by a spectrum of medications mostly used in oncology patients that directly or secondly affect bone metabolism. Alongside we are witnessing an increased incidence of cancer patients worldwide, many of which at some point need dental treatment. Therefore raising awareness of MRONJ and a multidisciplinary approach to this problem of both medical and dental specialists would contribute significantly to the prevention of MRONJ.

Literature

1. Brajdić D, Salarić I, Zajc I, Đanić P, Granić M, Biočić J, Knežević D, Macan D. Guidelines for managing the patients with a risk for medication-related osteonecrosis of the jaw. In1st International congress of the School of Dental Medicine University of Zagreb 2015 Jan 1.

2. Ruggiero SL, Dodson TB, Fantasia J, Goodday R, Aghaloo T, Mehrotra B, O'Ryan F. American Association of Oral and Maxillofacial Surgeons position paper on medication-related osteonecrosis of the jaw—2014 update. Journal of oral and maxillofacial surgery. 2014 Oct 1;72(10):1938-56.

3. Assael LA. A time for perspective on bisphosphonates. Journal of oral and maxillofacial surgery. 2006 Jun 1;64(6):877-9.

4. Marx RE. Oral and intravenous bisphosphonate-induced osteonecrosis of the jaws. Chicago, Ill, USA: Quintessence. 2007.

5. Fedele S, Bedogni G, Scoletta M, Favia G, Colella G, Agrillo A, Bettini G, Di Fede O, Oteri G, Fusco V, Gabriele M. Up to a quarter of patients with osteonecrosis of the jaw associated with antiresorptive agents remain undiagnosed. British Journal of Oral and Maxillofacial Surgery. 2015 Jan 1;53(1):13-7.

6. Otto S, Schreyer C, Hafner S, Mast G, Ehrenfeld M, Stürzenbaum S, Pautke C. Bisphosphonate-related osteonecrosis of the jaws–characteristics, risk factors, clinical features, localization and impact on oncological treatment. Journal of Cranio-Maxillofacial Surgery. 2012 Jun 1;40(4):303-9.

7. Eckert AW, Maurer P, Meyer L, Kriwalsky MS, Rohrberg R, Schneider D, Bilkenroth U, Schubert J. Bisphosphonate-related jaw necrosis–severe complication in maxillofacial surgery. Cancer treatment reviews. 2007 Feb 1;33(1):58-63.

8. Rollason V, Laverrière A, MacDonald LC, Walsh T, Tramèr MR, Vogt-Ferrier NB. Interventions for treating bisphosphonate-related osteonecrosis of the jaw (BRONJ). Cochrane Database of Systematic Reviews. 2016(2).

9. Mourao CF, Calasans-Maia MD, Del Fabbro M, Vieira FL, de Mello Machado RC, Capella R, Miron RJ, Alves GG. The use of Platelet-rich Fibrin in the management of medication-related osteonecrosis of the jaw: A case series. Journal of stomatology, oral and maxillofacial surgery. 2020 Feb 1;121(1):84-9.

10. Gönen ZB, Yılmaz Asan C. Treatment of bisphosphonate-related osteonecrosis of the jaw using platelet-rich fibrin. Cranio®. 2017 Sep 3;35(5):332-6.

11. Kuroshima S, Sasaki M, Sawase T. Medication-related osteonecrosis of the jaw: a literature review. Journal of oral biosciences. 2019 Jun 1;61(2):99-104.

12. Hećimović I. *Oralne nuspojave kao posljedica liječenja karcinoma dojke* (Doctoral dissertation, University of Zagreb. Faculty of Pharmacy and Biochemistry. Department of pharmacology.).

13. Taichman LS, Gomez G, Inglehart MR. Oral health-related complications of breast cancer treatment: assessing dental hygienists' knowledge and professional practice. American Dental Hygienists' Association. 2015 Jun 1;89(suppl 2):22-37.

14. Hirbe A, Morgan EA, Uluçkan Ö, Weilbaecher K. Skeletal complications of breast cancer therapies. Clinical Cancer Research. 2006 Oct 15;12(20):6309s-14s.

15. King R, Tanna N, Patel V. Medication-related osteonecrosis of the jaw unrelated to bisphosphonates and denosumab—a review. Oral surgery, oral medicine, oral pathology and oral radiology. 2019 Apr 1;127(4):289-99.

Pontes HA, de Souza LL, Uchôa DC, Cerqueira JM. Mandibular osteonecrosis associated with raloxifene. Journal of Craniofacial Surgery. 2018 May 1;29(3):e257-9.

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Books:

Heger JW, Niemann JT, Criley JM. Cardiology, 5th ed. Philadelphia: Lippincott, Williams & Wilkins; 2003.

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