ORIGINAL ARTICLE
ORIGINALNI RAD
https://doi.org/10.2298/SGS2302071D
UDC: 616.314.5:616.314.16-73(497.6)

Dentin thickness of the mesio-buccal root wall of the lower first molar using cone beam computerized tomography (CBCT)

Aleksandra Đeri[1], Irena Radman-Kuzmanović[1], Nikola Moravac[2], Milan Tejić[3], Renata Josipović[1], Adriana Arbutina[1], Saša Marin[1], Nataša Trtić[1], Valentina Veselinović[1]

[1]University of Banja Luka, Faculty of Medicine, Department of Dental Medicine, Bosnia and Herzegovina;
[2]ZU "Simić", Banja Luka, Bosnia and Herzegovina;
[3]ZU "Institute of Dentistry", Banja Luka, Bosnia and Herzegovina

SUMMARY

Introduction The aim of this work was to check the average thickness of dentinal wall of the mesio-buccal root of the first lower molar using CBCT axial sections of intact teeth.

Material and method In this cross-sectional study, 100 CBCT images of mandibular first molars from the Promax 3Dent radiology center in Banja Luka, Bosnia and Herzegovina were evaluated. A Planmeca Promax3D Max apparatus (Planmeca, Helsinki, Finland) was used, with a field of view (FOV) of 8 × 8 cm and a resolution of 0.1 mm. Analysis was performed using Romexis Viewer software version 3.1.1 (Planmeca, Helsinki, Finland). At an axial thickness of 0.1 mm, transverse sections with a distance of 1 mm were made below the furcation area (at a magnification ×10) at a distance of 1, 2, 3, 4, 5 mm from the furcation. The data were then analyzed by paired t-test.

Results The thickness of dentinal wall of the mesio-buccal root of the lower first molar was significantly smaller at 2 mm and 3 mm than when measured at 1, 4 and 5 mm ($p < 0.05$). There was no significant difference between measurements at 1, 4 and 5 mm below the furcation area ($p = 0.001$).

Conclusion Due to the small thickness of dentinal wall at 2-3 mm below the furcation in the root canal, caution is required when instrumenting mesio-buccal canal of the lower first molar and correct selection of the instrumentation technique in order to avoid transportation or stripping perforation that may lead to root fracture.

Keywords: cone beam computerized tomography; mandibular molars; dentin thickness

INTRODUCTION

In human dentition, lower first molar is the first of the group of permanent molars that appears in the oral cavity already at the age of six. The early appearance of caries is the reason why it is one of the most frequently treated teeth in restorative and endodontic treatments. In preventative dentistry, lower first molar is the tooth that usually gets fisure sealant applied. From the point of view of dental oclussion, it is a tooth that is responsible for the height of bite, while in orthodontics, it is responsible for maloclussion. Because of the above, knowledge of the morphology of the lower first molar is of great importance in dentistry. Mandibular first molars (MFM) are frequently treated endodontically, with an incidence of 17.0% [1].

The first mandibular molar has a complex morphology, one mesial and one distal root. Mesial roots of mandibular molars usually have two main canals: mesiobuccal (MB) and mesiolingual (ML). The specificity in the anatomical structure of the lower first molars is reflected in the greater concavity of the distal surface of the mesiobuccal root. The thickness of this wall is limited, which should be taken into account during endodontic treatment in order to avoid over-instrumentation and root fracture [2]. Molar furcation area is recognized as one of the most vulnerable areas. The thickness of dentin in distal walls of mesial canals is also mentioned as a risk zone [3, 4, 5].

The appearance of perforations and root fractures during endodontic therapy occurs more often in these areas, and a good understanding of the internal anatomy can help prevent excessive loss of dentin tissue in the danger zone, which can lead to tooth root fractures under functional load [6].

If the clinician neglects the thickness of the dentin wall during the treatment process, he will face perforation of the root canal wall. Perforation occurs especially in curved root canals where canal has been carelessly treated with larger diameter canal instruments [7].

Mesial root of lower first molar is characterized by a wide buccolingual and narrow mesiodistal dimension, while distal root is mostly conical. The morphology of each tooth is individual and may be associated with certain ethnic groups. It was found that the danger zone in Chinese and Indian population is located 4 to 6 mm below the entrance of the root canal and minimum thickness of the distal dentin was located between 1 and 2 mm below furcation [8, 9, 10].

Address for correspondence: Aleksandra ĐERI, Nikole Pašića 36, Banja Luka, Bosna i Hercegovina;
aleksandra.djeri@med.unibl.org

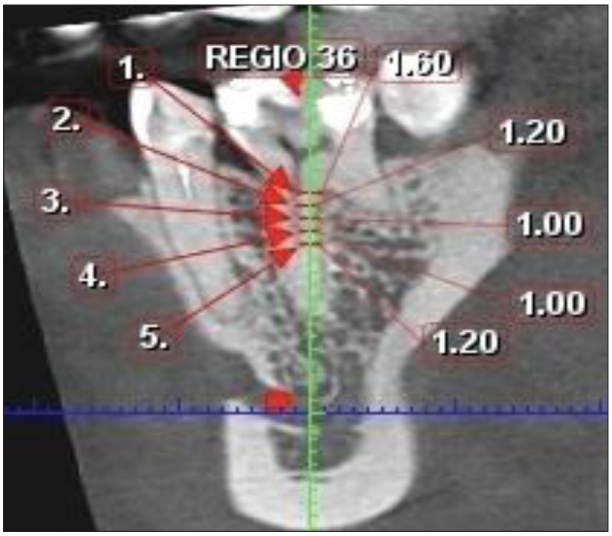

Figure 1. Axial CBCT section with marked dentin thickness measurement sites
Slika 1. Aksijalni CBCT presek sa označenim mestima merenja debljine dentina

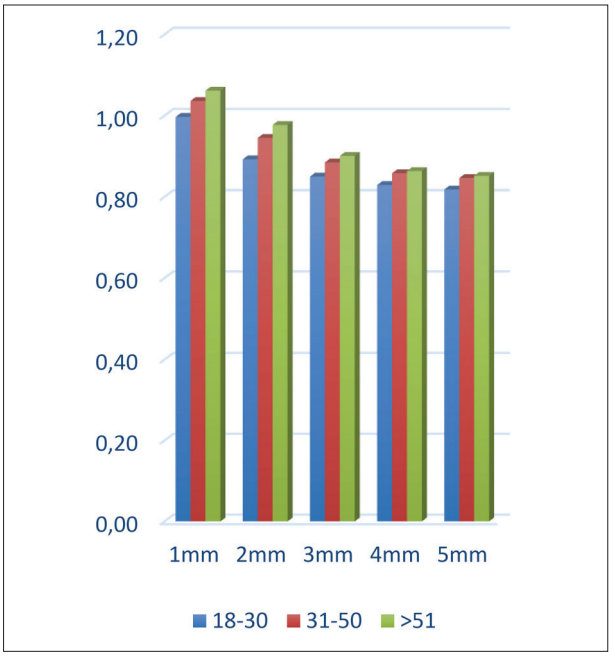

Figure 2. Dentin thickness ratio of MB root in relation to the measurement point in male population
Slika 2. Odnos debljine dentina meziobukalnog korena u odnosu na tačku merenja kod muške populacije

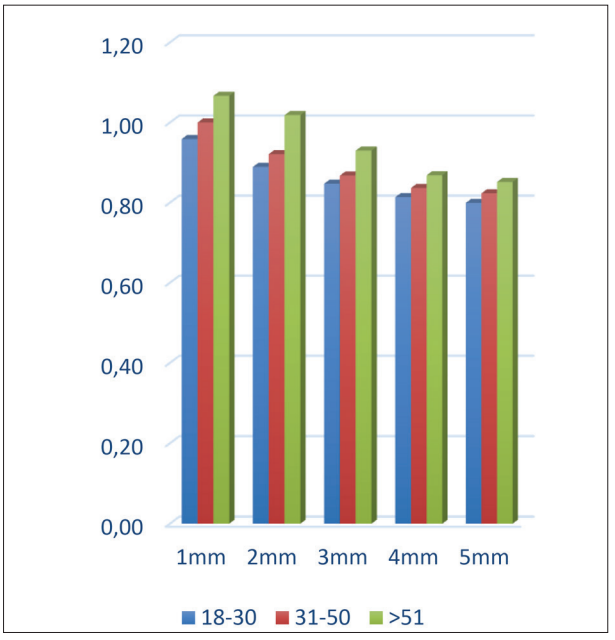

Figure 3. Dentin thickness ratio of MB root in relation to the measurement point in female population
Slika 3. Odnos debljine dentina meziobukalnog korena u odnosu na tačku merenja kod ženske populacije

It was also observed that there is a correlation between the thickness of the dentin below the furcation and the long / short root. The highest number of canal perforations was found in longer roots [11, 12]. Today, cone beam computerized tomography (CBCT) allows us to analyze the internal morphology of teeth in three dimensions.

The aim of this work was to check the average thickness of dentinal wall of the mesio-buccal root in first mandibular molar using CBCT axial sections of intact teeth.

MATERIAL AND METHODS

Based on a total of 372 examined CBCT images, 100 CBCT sections of teeth were selected, which were classified according to the following criteria: gender, age, length of the tooth and side of the jaw. Inclusion criteria of the teeth on which the measurement was performed:

1. CBCT images of the mandibular first molar (left or right)
2. Teeth without root fracture
3. Teeth without external and internal resorption
4. Teeth without root canal treatment
5. Teeth without calcification

According to gender, respondents were divided into the two groups (female and male), and according to age into the three age groups: 18–30 years, 31–50 years and older than 50 years. In relation to the side of the jaw, a division was made into the teeth of the left and right side. According to root length, teeth are classified into the three groups measured from the root furcation into: short root (7–9 mm), medium-length root (9–11 mm) and long root (over 11 mm). The distal wall of the mesiobuccal and mesiolingual root canals was designated as the risk zone of the mesial root of the lower first molar. The reason for this is the canal morphology of the tooth itself, as well as the infectious processes that occur in the pulpo-dentinal complex during life and that affects dentin thickness in the risk zones. Axial sections on CBCT images were used to measure dentin thickness. Dentin thickness was measured at the distance from the root furcation in the amount of: 1 mm, 2 mm, 3 mm, 4 mm and 5 mm (Figure 1).

RESULTS

The relationship between the side of the jaw and the distance from the root furcation shows that there is no

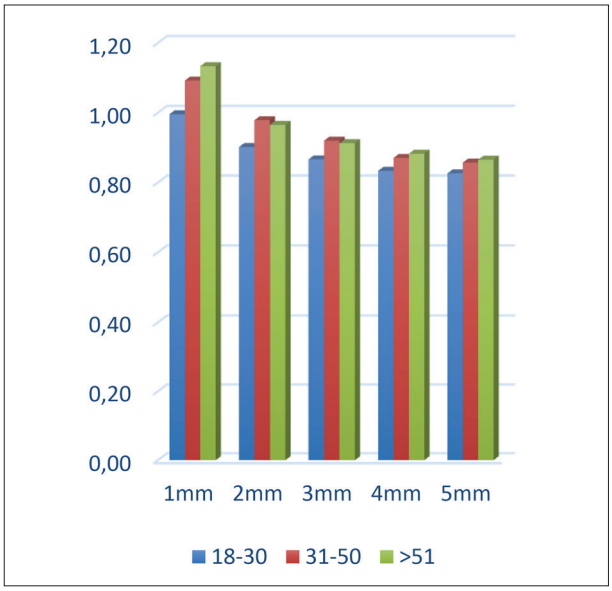

Figure 4. Dentin thickness ratio of ML root in relation to the measurement point in male population
Slika 4. Odnos debljine dentina meziolingvalnog korena u odnosu na tačku merenja kod muške populacije

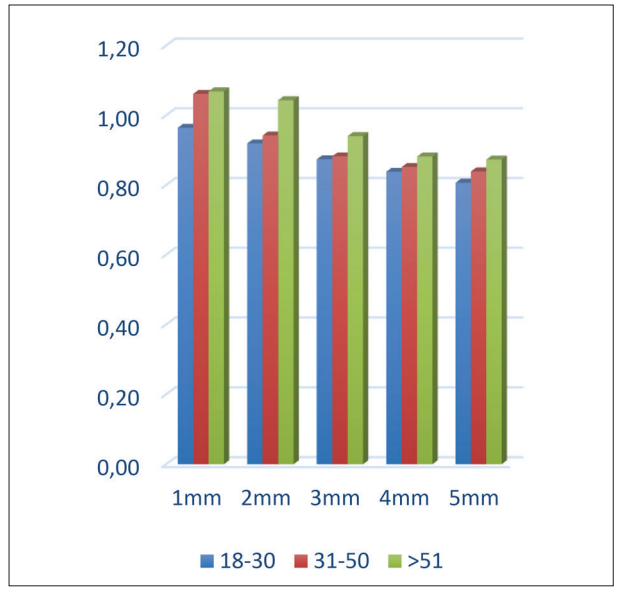

Figure 5. Dentin thickness ratio of ML root in relation to the measurement point in female population
Slika 5. Odnos debljine dentina meziolingvalnog korena u odnosu na tačku merenja kod ženske populacije

Table 1. Dentin thickness in teeth at different lengths in short, medium and long roots in both genders
Tabela 1. Debljina dentina na različitoj razdaljini u odnosu na dužinu korena (kratki, srednji, dugi) kod oba pola

ROOT LENGTH DUŽINA KORENA	Mesiobuccal root – male population Meziobukalni koren – muška populacija				
	1 mm	2 mm	3 mm	4 mm	5 mm
SHORT KRATKI	1.03 ± 0.10	0.91 ± 0.06	0.86 ± 0.03	0.84 ± 0.03	0.83 ± 0.03
MEDIUM SREDNJI	1.05 ± 0.08	0.95 ± 0.08	0.89 ± 0.07	0.86 ± 0.05	0.84 ± 0.05
LONG DUGI	0.97 ± 0.06	0.91 ± 0.06	0.86 ± 0.05	0.84 ± 0.03	0.84 ± 0.03
ROOT LENGTH DUŽINA KORENA	Mesiolingual root – male population Meziolingvalni koren – muška populacija				
	1 mm	2 mm	3 mm	4 mm	5 mm
SHORT KRATKI	1.06 ± 0.11	0.95 ± 0.06	0.90 ± 0.04	0.85 ± 0.03	0.85 ± 0.03
MEDIUM SREDNJI	1.11 ± 0.11	0.97 ± 0.09	0.91 ± 0.08	0.87 ± 0.06	0.86 ± 0.05
LONG DUGI	0.99 ± 0.08	0.92 ± 0.08	0.88 ± 0.04	0.86 ± 0.03	0.84 ± 0.03
ROOT LENGTH DUŽINA KORENA	Mesiobuccal root– female population Meziobukalni koren – ženska populacija				
	1 mm	2 mm	3 mm	4 mm	5 mm
SHORT KRATKI	1.00 ± 0.07	0.92 ± 0.07	0.87 ± 0.05	0.84 ± 0.04	0.83 ± 0.04
MEDIUM SREDNJI	1.00 ± 0.10	0.94 ± 0.08	0.88 ± 0.06	0.83 ± 0.03	0.81 ± 0.02
LONG DUGI	1.00 ± 0.00	0.92 ± 0.00	0.85 ± 0.00	0.82 ± 0.00	0.82 ± 0.00
ROOT LENGTH DUŽINA KORENA	Mesiolingual root – female population Meziolingvalni koren – ženska populacija				
	1 mm	2 mm	3 mm	4 mm	5 mm
SHORT KRATKI	1.01 ± 0.09	0.94 ± 0.07	0.88 ± 0.04	0.85 ± 0.03	0.84 ± 0.04
MEDIUM SREDNJI	1.03 ± 0.10	0.95 ± 0.08	0.88 ± 0.05	0.85 ± 0.04	0.83 ± 0.04
LONG DUGI	1.03 ± 0.00	0.95 ± 0.00	0.89 ± 0.00	0.85 ± 0.00	0.82 ± 0.00

statistically significant difference in dentin thickness in both male and female populations. This refers to mesiobuccal or mesiolingual canal in the mesial root ($p>0.05$). When it comes to the relationship between the length of the root and the distance from the furcation, there are differences in dentin thickness greater than 0.05 mm in both genders, as well as in both mesial canals, with the difference being more pronounced in male population. In the mesiobuccal root, it is observed that the difference in dentin thickness is most pronounced at 1, 2 and 3 millimeters of the canal and that it is the largest in the group of patients over 51 years of age, regardless of gender ($p < 0.05$) (Figures 2, 3).

Deviations in the thickness of dentin in different genders of mesiolingual root are statistically significant and most pronounced at 2 mm from the furcation of the roots ($p < 0.5$). Differences in thickness are more pronounced at 1 mm and 3 mm than at 4 mm and 5 mm of root furcation, but without statistical significance ($p > 0.5$) (Figures 4, 5).

At a distance of 1 and 2 mm from furcation, the thickness of dentin is greater in medium and short roots, and as the distance increases, these values increase in favor of long roots and thus equalize. This difference is more pronounced in mesiolingual root than in mesiobuccal, but without statistical significance, which is attributed to the morphology of the root itself and the process of dentinogenesis ($p = 0$) (Table 1).

When it comes to the relationship between age and distance from furcation, dentin thickness consistently increases with age. It is believed that sclerotic changes occurring in the

pulpo-dentinal complex are responsible for it. Primarily, there is a reduction of pulp chamber itself, which reduces its volume, so this is one of the reasons why endodontic treatment in elderly is difficult due to narrow and calcified canals. In older people, pulp chamber decreases due to reduced blood supply and formation of secondary physiological dentin, created more and more as the number of years increases, while in younger people, the pulp chamber is more voluminous. These changes occur equally in both genders and in both canals of the mesial root of the lower first molar ($p < 0.05$).

DISCUSSION

CBCT (Cone Beam Computerized Tomography) is based on cone beams, which are directed to a narrow area of interest and thus has a significantly reduced effective dose of radiation compared to conventional CT, high differentiation of details, accurate quantitative and qualitative values, economy and simplicity in the use of images. During life, pulpo-dentinal complex is changed by the physiological deposition of secondary dentin, which results in decrease of the size of the pulp chamber as well as the diameter of root canal. Consequently, in elderly, root canals are narrow and present a challenge to the clinician over time, while in younger individuals pulp chamber is more voluminous [7].

The risk zone of the tooth root represents the place of the smallest dentin thickness, which tends to decrease significantly during the formation of the tooth. Therefore, a better knowledge of the anatomy of the risk zone itself can reduce the risk of an adverse event.

In this paper, using CBCT imaging of one hundred lower first molars, measurements were made of the minimum thickness of the distal dentinal wall of mesiobuccal (MB) and mesiolingual (ML) canals at different distances from the furcation (1, 2, 3, 4 and 5 mm).

The results showed that in most cases the thickness of dentin in the risk zone was greater in male population compared to female population. As a result, women have a higher risk of unwanted perforation occurring during root canal treatment. It was also proven that minimal thicknesses of distal dentinal wall of MB and ML canals increased with age in each age group in both men and women at each measurement point.

When looking at the relationship between root length and furcation distance, in both genders there was a difference in dentin thickness greater than 0.05 mm for both mesial root canals, with this difference being more pronounced in men. When looking at the distance at 1 and 2 mm from furcation, dentin thickness is greater in short and medium roots, and by increasing distance, this value becomes equal to that of long roots. Due to morphology of the root, this difference is more pronounced in the mesiolingual canal. Some other studies have also shown that the thickness of the distal wall of the mesial root is smaller in longer teeth and therefore the risk of perforation is higher in teeth with longer roots [5, 6].

In the population of Banja Luka, the risk zone of dentin thickness is located at a distance of 2 to 3 mm from furcation with a range of 0.85 to 0.97 mm, while at a distance of 1 mm the value of dentin thickness is significantly higher 0.98 to 1.11 mm. It is precisely this zone that represents site exposed to canal perforation during endodontic treatment. Some studies found dentin thickness of 0.67 mm at a distance of 3 to 4 mm from furcation, which is much less than usually reported [4]. Another study conducted on 50 molars showed that the thinnest point of the risk zone is 3 mm from furcation with a mean thickness of 0.81 mm [1]. Similar results were obtained in some other studies [2, 5, 6, 9]. Some other authors such as Asgary et al. reported a decrease in average dentin thickness from 1.17 to 0.90 mm, confirming that the greatest decrease in dentin thickness occured at the level of the cervical third of the root [1].

Renato Menezes and his collaborators performed an examination by cutting 100 mesial roots 2 mm below the furcation and the thickness of distal dentinal wall was measured using microscope. The results obtained were that the average dentin thickness was 0.79 mm, and no significant differences were observed between mesiobuccal and mesiolingual canals [10].

Overinstrumentation of the root canal space can lead to perforation, according to Lim and Stock, a dentin thickness of 200 to 300 μm should be maintained after preparation to withstand forces during obturation and prevent perforation or vertical root fracture. During root canal treatment, instruments should be directed towards the lateral and mesial walls, which have much thicker dentin, and in the risk zone, the dentin should be thinned no more than 0.5 mm [7].

Vesal Feiz Azimi et al. state that the mean dentin thickness is 2 mm below furcation in mandibular molars from 0.78 to 1.27 mm. By comparing the thickness of dentin, they came to the conclusion that there are differences in the thickness of 2 mm below furcation between long and short roots [11]. The thinnest walls were measured on the distal walls of the longest roots, so caution is recommended when instrumenting the canal and avoiding the use of larger diameter canal instruments to avoid perforations. Analysis of root morphology by CBCT is necessary due to different root canal morphology and genetic conditioning. Today, it is known that ethnicity determines morphological characteristics, which provides a framework for endodontic therapy. Endodontic treatment involves mechanical use of instruments in combination with chemical agents. If during all these stages, we do not know the morphology of the root and dentin thickness, the appearance of unwanted complications is possible - mechanical, chemical or thermal nerve injuries that can cause neuropathic pain or anesthesia in its innervation zones.

Even 10% of the lower second molars have the possibility of injury to the lower alveolar nerve. To better inform the clinician, it is important to assess differences in root and canal shape among different racial populations and subpopulations [12, 13]. The prevalence of root fusion in first and second lower molars is 0.7% and 12.6%,

respectively, which can affect the thickness of the dentin in danger zone, i.e. the curvature of their mesial roots [14].

Also, research indicates an increase in diversity in the number and shape of root canals of mandibular molars. The most common morphological variation in lower molars is a supernumerary root located either lingually (radix entomolaris) or buccally (radix paramolaris) and occurs with varying frequency in all permanent mandibular molars (for Europeans – less than 4% frequency) [15, 16].

CONCLUSION

This research showed that the smallest thickness of dentinal walls of the risk zone is located 2 to 3 mm below furcation. Knowing this location leads to greater caution and a better plan during endodontic treatment to avoid unwanted consequences. You should also pay more attention to younger patients, especially if their teeth have longer roots.

REFERENCES

1. Pinto SSL, Lins RX, Marceliano-Alves MFV, Guimarães MD, Fonseca BA, Radetic AE, et al. The internal anatomy of the danger zone of mandibular molars: A cone-beam computed tomography study. J Conserv Dent. 2018;21(5):481–4. [DOI: 10.4103/JCD.JCD_271_18] [PMID: 30294106]
2. Ordinola-Zapata R, Martins JNR, Versiani MA, Bramante CM. Micro-CT analysis of danger zone thickness in the mesiobuccal roots of maxillary first molars. Int Endod J. 2019;52(4):524–9. [DOI: 10.1111/iej.13025] [PMID: 30295947]
3. Chen X, Min Y, Gao Y, Peng L. Microcomputer tomography measurement of minimum residual dentin thickness in mandibular first molars after virtual fiber post placement. J Prosthet Dent. 2020;123(3):506–13. [DOI: 10.1016/j.prosdent.2018.11.018] [PMID: 31227234]
4. De-Deus G, Rodrigues EA, Belladonna FG, Simões-Carvalho M, Cavalcante DM, Oliveira DS, et al. Anatomical danger zone reconsidered: a micro-CT study on dentine thickness in mandibular molars. Int Endod J. 2019;52(10):1501–7. [DOI: 10.1111/iej.13141] [PMID: 31066080]
5. Sauáia TS, Gomes BPFA, Pinheiro ET, Zaia AA, Ferraz CCR, Souza-Filho FJ, et al. Thickness of dentine in mesial roots of mandibular molars with different lengths. Int Endod J. 2010; 43(7):555–9. [DOI: 10.1111/j.1365-2591.2010.01694.x] [PMID: 20636516]
6. Dwivedi S, Dwivedi CD, Mittal N. Correlation of root dentin thickness and length of roots in mesial roots of mandibular molars. J Endod. 2014;40(9):1435–8. [DOI: 10.1016/j.joen.2014.02.011] [PMID: 25146027]
7. Zhou G, Leng D, Li M, Zhou Y, Zhang C, Sun C, et al. Root dentine thickness of danger zone in mesial roots of mandibular first molars. BMC Oral Health. 2020;20(1):43. [DOI: 10.1186/s12903-020-1026-8] [PMID: 32028960]
8. Keles A, Keskin C, Alqawasmi R, Versiani MA. Evaluation of dentine thickness of middle mesial canals of mandibular molars prepared with rotary instruments: a micro-CT study. Int Endod J. 2020;53(4):519–28. [DOI: 10.1111/iej.13247] [PMID: 31705697]
9. Tabrizizadeh M, Reuben J, Khalesi M, Mousavinasab M, Ghana Ezabadi MK. Evaluation of Radicular Dentin Thickness of Danger Zone in Mandibular First Molars. J Dent (Tehran). 2010;7(4):196–9. [PMID: 21998796]
10. Garcia Filho PF, Letra A, Menezes R, Carmo AM. Danger zone in mandibular molars before instrumentation: an in vitro study. J Appl Oral Sci. 2003;11(4):324–6. [DOI: 10.1590/s1678-77572003000400009] [PMID: 21394408]
11. Azimi VF, Samadi I, Saffarzadeh A, Motaghi R, Hatami N, Shahravan A. Comparison of dentinal wall thickness in the furcation area (danger zone) in the first and second mesiobuccal canals in the maxillary first and second molars using cone -beam computed tomography. Eur Endod J. 2020;5(2):81–5. [DOI: 10.14744/eej.2020.18189] [PMID: 32766516]
12. Mufadhal AA, Madfa AA. The morphology of permanent maxillary first molars evaluated by cone-beam computed tomography among a Yemeni population. BMC Oral Health. 2023;23(1):46. [DOI: 10.1186/s12903-023-02752-2] [PMID: 36703140]
13. Đeri A, Brestovac N, Subotić S, Radman Kuzmanović I, Arbutina A, Marin S. CBCT analysis of apical distance between second lower premolars, first and second lower molars and mandibular canal. Serb Dent J. 2021;68(3):122–30. [DOI: 10.2298/SGS2103122D]
14. Martins JN, Mata A, Marques D, Caramês J. Prevalence of Root Fusions and Main Root Canal Merging in Human Upper and Lower Molars: A Cone-beam Computed Tomography In Vivo Study. J Endod. 2016;42(6):900–8. [DOI: 10.1016/j.joen.2016.03.005] [PMID: 27087629]
15. Przesmycka A, Jędrychowska-Dańska K, Masłowska A, Witas H, Regulski P, Tomczyk J. Root and root canal diversity in human permanent maxillary first premolars and upper/lower first molars from a 14th-17th and 18th-19th century Radom population. Arch Oral Biol. 2020;110:104603. [DOI: 10.1016/j.archoralbio.2019.104603] [PMID: 31835191]
16. Al Shehadat S, Waheb S, Al Bayatti SW, Kheder W, Khalaf K, Murray CA. Cone beam computed tomography analysis of root and root canal morphology of first permanent lower molars in a Middle East subpopulation. J Int Soc Prevent Communit Dent. 2019;9(5):458–63. [DOI: 10.4103/jispcd.JISPCD_41_19] [PMID: 31620378]

Received: 2.3.2023 • Accepted: 25.5.2023

Određivanje debljine dentina bukomezijalnog korena donjeg molara kompjuterizovanom konusnom tomografijom

Aleksandra Đeri[1], Irena Radman-Kuzmanović[1], Nikola Moravac[2], Milan Tejić[3], Renata Josipović[1], Adriana Arbutina[1], Saša Marin[1], Nataša Trtić[1], Valentina Veselinović[1]

[1]Univerzitet u Banjoj Luci, Medicinski fakultet, Odsek za dentalnu medicinu, Bosna i Hercegovina;
[2]ZU „Simić", Banja Luka, Bosna i Hercegovina;
[3]ZU „Zavod za stomatologiju", Banja Luka, Bosna i Hercegovina

KRATAK SADRŽAJ

Uvod Cilj ovog rada je bio da se proveri prosečna debljina distalnog zida mezijalnog korena prvog donjeg molara kod stanovnika Banjaluke primenom CBCT aksijalnih preseka intaktnih zuba.

Metode U ovoj studiji poprečnog preseka procenjeno je 100 CBCT slika prvih mandibularnih molara iz radiološkog centra Promax 3Dent u Banjoj Luci, u Bosni i Hercegovini. Korišćen je aparat Planmeca Promax3D Max (Planmeca, Helsinki, Finska), sa vidnim poljem (FOV) od 8 × 8 cm i rezolucijom od 0,1 mm. Analiza je vršena pomoću softvera Romexis Viewer verzije 3.1.1 (Planmeca, Helsinki, Finska). U aksijalnoj debljini 0,1 mm poprečni preseci sa razmakom od 1 mm su pravljeni ispod područja furkacije (pri povećanju od ×10) na rastojanju 1, 2, 3, 4, 5 mm od furkacije. Podaci su zatim analizirani uparenim t-testom.

Rezultati Debljina dentinskog zida u kanalu bukomezijalnog korena donjeg prvog molara bila je značajno manja na visini 2 mm i 3 mm nego merenjem na 1, 4 i 5 mm ($p < 0,05$).

Nije bilo značajne razlike između merenja na 1, 4 i 5 mm ispod područja furkacije ($p = 0,001$).

Zaključak S obzirom na malu debljinu dentinskog zida na 2-3 mm ispod furkacije u korenskom kanalu, potreban je oprez pri obradi bukomezijalnog kanala donjeg prvog molara i ispravan odabir tehnike preparacije kako ne bi došlo do transportacije kanala ili frakture korena.

Ključne reči: konusna kompjuterska tomografija; mandibularni molari; debljina dentina

UVOD

U ljudskoj denticiji, donji prvi molar je prvi iz grupe stalnih molara koji se pojavljuje u usnoj šupljini i to već u šestoj godini života. Rana pojava karijesa je razlog zbog kojeg je on jedan od češće tretiranih zuba u okviru restaurativnih te endodontskih tretmana. Na području dečije stomatologije donji prvi molar je zub na kojem se vrši zalivanje fisura. Sa tačke gledišta stomatološke protetike to je zub koji pripada grupi zuba koji su odgovorni za visinu zagrižaja, dok je u ortopediji vilica jedan od zuba koji se posmatra prilikom određivanja ortodontske nepravilnosti. Zbog navedenog, poznavanje morfologije donjeg prvog molara je od velike važnosti u stomatologiji. Prvi molari mandibule su tretirani endodontski, sa incidencom od 17% [1].

Prvi mandibularni molar ima složenu morfologiju, jedan mezijalni i jedan distalni koren. Mezijalni koreni mandibularnih molara obično imaju dva glavna kanala: meziobukalni i meziolingvalni. Specifičnost u anatomskoj građi donjih prvih molara ogleda se u većoj konkavnosti distalne površine bukomezijalnog korena. Debljina dentina na distalnoj površini bukomezijalnog korena donjeg prvog molara je ograničena, što treba imati u vidu pri endodontskom tretmanu kako bi se izbegla preinstrumentacija i fraktura korena zuba [2]. Područje furkacije molara prepoznato je kao jedno od najranjivijih područja. Kao zona rizika posebno se navodi i debljina dentina u distalnim zidovima mezijalnih kanala [3, 4, 5].

Pojava perforacija i preloma korena tokom endodontske terapije se češće javlja u ovim područjima, te dobro razumevanje unutrašnje anatomije može pomoći u prevenciji prekomernog gubitka dentinskog tkiva u opasnoj zoni, što može dovesti do preloma korena zuba pod funkcionalnim opterećenjem [6].

Ako kliničar zanemaruje debljinu zida dentina tokom procesa lečenja, suočiće se sa perforacijom zida kanala korena zuba. Perforacija se javlja posebno u zakrivljenim kanalima korena gde je kanal nepažljivo obrađivan kanalnim instrumentima većeg promera [7].

Mezijalni koren karakteriše široka bukolingvalna i uska meziodistalna dimenzija, dok je distalni koren uglavnom koničan. Morfologija svakog zuba je individualna i može biti povezana sa određenim etničkim grupama. Utvrđeno je da se opasna zona kod kineske i indijske populacije nalazi 4 do 6 mm ispod ulaza u kanal korena zuba, a minimalna debljina distalnog dentina nalazila se između 1 i 2 mm ispod furkacije [8, 9, 10].

Takođe je uočeno da postoji korelacija između debljine dentina ispod furkacije i dugih/kratkih korenskih zuba. Najveći broj perforacija korenskih kanala je pronađen u najdužim zubima [11, 12]. Danas nam kompjuterizovana tomografija sa konusnim snopom (CBCT) omogućava trodimenzijalnu analizu unutrašnje morfologije zuba.

Cilj ovog rada je bio da se proveri prosečna debljina distalnog zida mezijalnog korena prvog donjeg molara kod stanovnika Banjaluke primenom CBCT aksijalnih preseka intaktnih zuba.

MATERIJAL I METODE

Na osnovu ukupno pregledana 372 CBCT snimka izdvojeno je 100 CBCT preseka zuba koji su svrstani prema sledećim kriterijumima: pol ispitanika, životna dob ispitanika, dužina korena zuba i strana vilice. Inkluzioni kriterijumi zuba na kojima je izvršeno merenje bili su:

1. CBCT slike prvog molara mandibule (leva ili desna)
2. zubi bez preloma korena
3. zubi bez spoljne i unutrašnje resorpcije
4. zubi bez tretmana korenskog kanala
5. zubi bez kalcifikacije

Prema polu ispitanici su podeljeni na ženski i muški pol, a prema životnoj dobi u tri starosne grupe: 18–30 godina, 31–50 godina i stariji od 50 godina. U odnosu na stranu vilice, izvršena je podela na zube leve i desne strane. Prema dužini korena, zubi su klasifikovani u tri grupe prema udaljenosti od furkacije korena: kratki koren (7–9 mm), koren srednje dužine (9–11 mm) i dugi koren (preko 11 mm). Kao rizična zona mezijalnog korena donjeg prvog molara označen je distalni zid meziobukalnog i meziolingvalnog kanala korena zuba. Razlog za to je kako sama kanalna morfologija zuba, tako i infektivni procesi koji se dešavaju u pulpo-dentinskom kompleksu tokom života i koji utiču na debljinu dentina u rizičnim zonama. Za merenje debljine dentina korišćeni su aksijalni preseci na CBCT snimcima.

Merena je debljina dentina na udaljenosti od furkacije korena u iznosu od: 1 mm, 2 mm, 3 mm, 4 mm i 5 mm (Slika 1).

REZULTATI

Odnos između strane vilice kojoj pripada zub i udaljenost od furkacije korena pokazuje da ne postoji statistički značajna razlika u debljini dentina kako kod muške tako i kod ženske populacije. Ovo se odnosi na meziobukalni, odnosno meziolingvalni kanal u mezijalnom korenu, $p > 0,05$. Kada je u pitanju odnos između dužine korena i udaljenosti od furkacije, postoje razlike u debljini dentina veće od 0,05 mm kod oba pola, kao i kod oba kanala mezijalnog korena, s tim što je kod muške populacije ta razlika izraženija. Kod bukomezijalnog korena se uočava da je razlika u debljini dentina najizraženija na 1, 2. i 3. milimetru kanala korena zuba i da je najveća u grupi pacijenata preko 51 godine života bez obzira na pol ($p < 0,05$) (Grafikoni 1 i 2).

Odstupanja u debljini dentina kod različitih polova lingvomezijalnog korena su statistički značajna i najviše izražena na 2 mm od furkacije korenova ($p < 0,5$). Razlike u debljini su izraženije na 1 mm i 3 mm nego na 4 mm i 5 mm od furkacije korenova, ali bez statističke značajnosti ($p > 0,5$) (Grafikoni 3 i 4).

Na udaljenosti 1 i 2 mm od furkacije debljina dentina je veća kod srednjih i kratkih korenova da bi se povećanjem udaljenosti te vrednosti povećale u korist dugih korenova i na taj način izjednačile. Ova razlika je izraženija u meziolingvalnom korenu nego u meziobukalnom, ali bez statističke značajnosti, što se pripisuje samoj morfologiji korena i procesu dentinogeneze ($p = 0$) (Tabela 1).

Kada je u pitanju povezanost između starosne dobi i udaljenosti od furkacije, debljina dentina se konstantno povećava sa povećanjem broja godina. Smatra se da su za to odgovorne sklerotične promene koje se dešavaju u pulpo-dentinskom kompleksu. Prvenstveno dolazi do smanjenja same pulpne komore, koja smanjuje svoj volumen, pa je i to jedan od razloga zbog kojih je endodontska terapija kod starijih osoba otežana usled uskih i neprohodnih kanala. Kod starijih osoba se pulpna komora smanjuje zbog smanjene prokrvljenosti, a i zbog formiranja sekundarnog fiziološkog dentina, koji se sve više stvara kako se povećava broj godina, dok je kod mlađih osoba pulpna komora voluminoznija. Ove promene se podjednako dešavaju kod pripadnika oba pola i kod oba kanala mezijalnog korena donjeg prvog molara. Uočava se statistički značajna razlika u debljini dentina između prve i treće starosne grupe na svim mernim tačkama, koja iznosi između 0,04 mm i 0,06 mm ($p < 0,05$).

DISKUSIJA

Kompjuterizovana tomografija sa konusnim snopom temeljena je na konusim zracima, koji su usmereni na usko područje interesa, te tako ima bitno smanjenu efektivnu dozu zračenja u odnosu na konvencionalnu kompjuterizovanu tomografiju, visoku diferencijaciju detalja, tačne kvantitativne i kvalitativne vrednosti, ekonomičnost i jednostavnost u korišćenju snimaka. Tokom života pulpo-dentinski kompleks se menja fiziološkim taloženjem sekundarnog dentina, što za posledicu ima smanjenje veličine pulpne komore kao i promera korenskog kanala. Posledično, kod starijih osoba su kanali korena zuba uski i tokom vremena predstavljaju izazov za kliničara, dok je kod mlađih osoba pulpna komora voluminoznija [7].

Rizična zona korena zuba predstavlja mesto najmanje debljine dentina, koja ima tendenciju značajnog smanjenja tokom oblikovanja kanala korena zuba. Zbog toga, bolje poznavanje same anatomije rizične zone može smanjiti rizik od neželjenog događaja.

U ovom radu su, korišćenjem CBCT snimanja stotinu donjih prvih molara, vršena merenja najmanje debljine distalnog dentina meziobukalnih i meziolingvalnih kanala na različitim udaljenostima u odnosu na furkaciju (1, 2, 3, 4 i 5 mm).

Rezultati su pokazali da je u većini slučajeva debljina dentina rizične zone veća kod muške populacije u odnosu na žensku populaciju. Samim tim je kod žena veći rizik da se dogodi neželjena perforacija tokom obrade kanala korena zuba. Takođe dokazano je da se minimalne debljine distalnog dentina meziobukalnih i meziolingvalnih kanala povećavaju s godinama u svakoj starosnoj skupini i kod muškaraca i kod žena na svakoj mernoj tački.

Kada se posmatra odnos između dužine korena i udaljenosti od furkacije, kod oba pola postoji razlika u debljini dentina koja je veća od 0,05 mm za oba kanala mezijalnog korena, s tim što je ta razlika izraženija kod muškaraca. Kada se gleda udaljenost na 1 i 2 mm od furkacije, debljina dentina je veća kod kratkih i srednjih korenova da bi se povećanjem udaljenosti ta vrednost izjednačila sa dugim korenovima. Zbog same morfologije korena ova razlika je značajnije izražena u meziolingvalnom kanalu. Neke druge studije su takođe pokazale da je debljina distalnog zida mezijalnog korena manja kod dužih zuba, te je samim tim veći rizik od perforacije kod zuba sa dužim korenom [5, 6].

Kod populacije u Banjaluci rizična zona debljine dentina se nalazi na 2 do 3 mm udaljenosti od furkacije sa rasponom od 0,85 do 0,97 mm, dok je na udaljenosti od 1 mm vrednost debljine dentina znatno veća – 0,98 do 1,11 mm. Upravo ova zona predstavlja predilekciono mesto za nastanak perforacije kanala prilikom endodontskog tretmana.

Vredi napomenuti da su neke studije dolazile do rezultata da je debljina dentina 0,67 mm na udaljenosti 3 do 4 mm od furkacije, što je dosta manje nego što se obično navodi [4].

Druga studija, koja je rađena na 50 molara, pokazala je da je najtanja tačka rizične zone na 3 mm od furkacije sa srednjom debljinom od 0,81 mm [1]. Slični rezultati su dobijeni i u nekim drugim studijama [2, 5, 6, 9]. U ovoj studiji se navodi da su neki drugi autori, kao što su Asgary i saradnici, prijavili smanjenje prosečne debljine dentina sa 1,17 na 0,90 mm, potvrđujući da se najveće smanjenje debljine dentina događa na nivou cervikalne trećine korena [1].

Renato Menezes sa saradnicima je vršio ispitivanje tako što je 100 mezijalnih korenova prerezano 2 mm ispod furkacije i nakon toga je uz pomoć mikroskopa vršeno merenje debljine distalnog dela dentina. Dobijeni su rezultati da je prosečna debljina dentina iznosila 0,79 mm, te da nisu uočene značajne razlike između meziobukalnih i meziolingvalnih kanala [10].

Prekomerno proširenje prostora kanala korena može dovesti do perforacije. Lim i Stock smatraju da nakon preparacije treba zadržati debljinu dentina od 200 do 300 μm kako bi se izdržale sile tokom opturacije i sprečila perforacija ili vertikalna fraktura korena. Tokom obrade kanala korena instrumente treba usmeravati prema bočnim i mezijalnim zidovima koji imaju mnogo deblji dentin, a u rizičnoj zoni dentin stanjiti ne više od 0,5 mm [7].

Vesal Feiz Azimi i saradnici navode da je srednja debljina dentina 2 mm ispod furkacije

kod mandibularnih molara od 0,78 do 1,27 mm. Poređenjem debljine dentina došli su do zaključka da postoje razlike u debljini 2 mm ispod furkacije između dugih i kratkih korenova [11]. Najtanji zidovi su izmereni na distalnim zidovima najdužih korenova, pa se preporučuje oprez kod obrade kanala i izbegavanje upotrebe kanalnih instrumenata većeg promera kako bi se izbegle perforacije. Analiza korenske morfologije CBCT-om je neophodna zbog individualnosti morfologije korenskih kanala i genetske uslovljenosti. Danas se zna da etnička pripadnost određuje morfološke karakteristike, što daje okvir za endodontsku terapiju. Endodontski tretman uključuje mehaničku upotrebu instrumenata u kombinaciji sa hemijskim sredstvima. Ukoliko tokom svih ovih faza ne poznajemo morfologiju korena zuba i debljinu dentina, moguća je pojava neželjenih komplikacija – mehaničkih, hemijskih ili termičkih povreda nerva koje mogu uzrokovati neuropatski bol ili anesteziju u svojoj inervaciji zona. Tokom endodontskog tretmana 1% donjih pretkutnjaka pa čak i 10% donjih drugih kutnjaka postoji mogućnost ozlede donjeg alveolarnog živca. Za bolje informisanje kliničara je važno proceniti razlike u obliku korena i kanala među različitim rasnim populacijama i subpopulacijama [12, 13].

Treba imati u vidu da je za prvi i drugi donji kutnjak prevalencija fuzije korenova 0,7%, odnosno 12,6%, što može uticati na debljinu dentina u opasnoj zoni odnosno krivini mezijalnog korena prvog i drugog donjeg molara [14].

Takođe, odontološka istraživanja ukazuju na povećanje raznolikosti u broju i obliku korenskih kanala mandibularnih kutnjaka. Najčešća morfološka varijacija kod donjih molara je prekobrojan koren koji se nalazi ili lingvalno (radix entomolaris) ili bukalno (radix paramolaris) i javlja se s različitom učestalošću kod svih trajnih mandibularnih kutnjaka (kod Evropljana sa manje od 4% učestalosti) [15, 16].

ZAKLJUČAK

Ovo istraživanje je pokazalo da se najmanja debljina zidova dentina rizične zone nalazi na 2 do 3 mm ispod furkacije. Poznavanje ove lokacije navodi na veći oprez i bolji plan tokom endodontske terapije kako bi se izbegle neželjene posledice. Takođe treba obratiti veću pažnju kod mlađih pacijenata, pogotovo ako njihovi zubi imaju duže korenove.