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Size of the lower third molar space in relation to age in Serbian population

Zavisnost veličine donjeg retromolarnog prostora od uzrasta u srpskoj populaciji

Ksenija Zelić*, Nenad Nedeljković†

***Clinic of Restorative Dentistry and Endodontics, School of Dentistry, University of Belgrade, Belgrade, Serbia; †Clinic of Orthodontics, School of Dentistry, University of Belgrade, Belgrade, Serbia**

Abstract

Background/Aim. It is considered that the shortage of space is the major cause of the third molar impaction. The aim of this study was to establish the frequency of insufficient lower third molar eruption space in Serbian population, to question the differences in this frequency in the subjects of different age, to determine th of the lower third molar space (retromolar spa third molar eruption, and to investigate a poss lation between the size of gonial angle space/third molar width ratio. **Methods.** Dig pantomograms were taken from 93 patients di two groups: early adult (16–18 years of age) (18–26) patients. Retromolar space, mesiod molar crown width, gonial angle and eruption measured. **Results.** The space/third molar width in early adult subjects was smaller ($p < 0.0001$) and insufficient space was significantly more frequent ($p = 0.0003$) than in adult patients. Considerably more third molars erupted in case of enough space in both age groups ($p < 0.0001$). There was no difference between the means of gonial angle size in relations to the available space. **Conclusions.** The retromolar space/third molar width ratio is more favorable in adult subjects. Gonial angle is not in correlation with the retromolar space/third molar width ratio.

Key words:
molar, third; tooth eruption; tooth impaction; adolescent; adult; serbia.

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Correspondence to:
Ksenija Zeli• •Çlinic of Restorative Dentistry and Endodontics, Rankeova 4, 11000 Belgrade, Serbia.

Apstrakt

Uvod/Cilj. Smatra se da je nedostatak prostora glavni uzrok ukleštenja trećeg kutnjaka. Cilj ove studije bio je da se ustanovi učestalost nedovoljnog prostora za nicanje umnjaka u srpskoj populaciji, da se ispitaju razlike u ovoj učestalosti kod mlađih odraslih i odraslih ispitanika, da se odredi uticaj veličine retro- rostora na nicanje umnjaka, kao i da se ispita pove- đu veličine ugla mandibule i odnosa između veliči- larnog prostora i meziodistalne širine umnjaka. istraživanje su bila uključena 93 ispitanika podelje- rosne kategorije: mlađi odrasli (16–18 godina) i od- godina) ispitanici. Kod svakog pacijenta na digital- ntomogramu mereni su: retromolarni prostor, me- širina umnjaka, nivo izniklosti umnjaka i ugao **Rezultati.** Odnos između veličine retromolarnog prostora i meziodistalne širine umnjaka bio je statistički značajno manji ($p < 0.0001$) kod mlađih ispitanika. Takođe, nedostatak prostora sretao se značajno češće u istoj starosnoj kategoriji ($p = 0.0003$). Prilikom poređenja nivoa izniklosti u obe starosne kategorije nađena je visoka statistička značajnost ($p < 0.0001$) u korist grupe sa dovoljnim prostorom za nicanje umnjaka. **Zaključak.** Značajno više umnjaka ima mesta za pravilno smeštanje u zubni niz nakon 18 godina života što navodi na zaključak da rast retromolarnog prostora nije završen u 16. godini. Ugao mandibule nije u korelaciji sa odnosom retromolarnog prostora i meziodistalnog promera umnjaka.

Ključne reči:
umnjak; zub, nicanje; zub, impakcija; adolescencija; odrasle osobe; srbija.

Introduction

Surgical extraction of impacted third molar is among the most frequently performed oral–surgical procedures [1]. It was reported that the lower third molar is the second most commonly impacted tooth in the human jaw [2–4]. Insufficient jaw development will primarily affect the eruption space of wisdom teeth, as they are the last ones to erupt into the oral cavity. In addition to inappropriate inclination of the lower third molar, the lack of space is considerate as main cause of

Correspondence to: Ksenija Zelić, Clinic of Restorative Dentistry and Endodontics, Rankeova 4, 11000 Belgrade, Serbia.
Phone: +381 63 238 414. E-mail: ksenijazelic@gmail.com

its impaction [5]. Because of this, consideration of these teeth is a part of overall dental examination and treatment plan.

In the lower jaw, the lower third molar space (retromolar space) borders are well defined – the distal surface of the second molar crown and the anterior border of the mandibular ramus. The mesiodistal crown width of the third molar should be smaller than this space if its eruption is to be expected. Ganss et al. [6] claimed that in this case, almost 70% of wisdom teeth would erupt. However, this space is insufficient in a significant number of individuals.

It was considered that the growth of lower retromolar space should not be expected after the age of 16 [5, 7]. On the other hand, Chen et al. [8] reported that there is a significant expansion of this space between the age of 16 and 18. This issue is clinically significant, since possibility to predict impaction of lower third molar in an early stage would favor the decision to remove it easily before the roots are fully formed. However, if such prediction is based on a wrong assumption that retromolar space will not enlarge in the future, some of those surgical procedures would not be justified.

Several researchers also investigated the correlation between the size of gonial angle and the retromolar space width, as both variables are dependent on mandibular growth [9–11]. As the results are conflicting [9, 11, 12], it is interesting to evaluate if size of the gonial angle might be used as a predictor of the lower third molar impaction.

It can be assumed that facial growth, jaw size and tooth size differ among races and populations. Since there have been very few research articles on this issue based on Serbian population [13], it might be interesting to compare some of those variables in our material with results from studies reported for other populations.

Therefore, the aims of this study was to establish the frequency of insufficient space for lower third molar eruption in Serbian population, to determine the influence of this fact on third molar eruption, to investigate whether there are differences in this variable between different age groups and to analyze the relationship between the retromolar space and the gonial angle size.

Methods

A total of 93 subjects (41 males and 52 females) between 16 and 26 years and with no history of previous orthodontic treatment were included in this study. Exclusion criteria were previous extraction or hypodontia of any tooth and some particular angulations of the lower third molar (buccooral position and distal angulations for more than 10 degrees). The study took place at The Clinic of Orthodontics, School of Dentistry, University of Belgrade. The participants were divided into two age groups: the early adult group – subjects from 16 to 18 years of age and the adult group – subjects from 18 to 26 years.

The total sample consisted of 164 lower third molars, 85 on the left and 79 on the right side. The early adult group included 62 third molars (23 from males and 39 from females), and the adult group included 102 third molars (45 from males and 57 from females).

Digital orthopantomograms (Planmeca, Promax; performed at 66–70 kV; 11–14 mA; 6.2 s exposure time; pulse x-ray) were taken and, on acetate paper attached to radiographs, the following planes, lines, and angles were drawn (Figure 1): occlusal plane (OP) – line connecting midpoint of the vertical overlap of the central incisors and the most distal contact point of upper and lower teeth; mesiodistal crown width of the lower third molar (MW) – measured as the greatest diameter of the crown; tangent line (TL) – drawn through the most distal points on the crown and root of the second molar; retromolar space (RS) – measured as a length of the line drawn along the occlusal plane from the point it bisects TL to the point it bisects the anterior border of the ramus; space/third molar width ratio – calculated by dividing RS with MW; gonial angle formed between the tangent line to the posterior border of the mandibular ramus and the tangent line to the lower border of the mandibular corpus; eruption level – measured according to the classification of Pell and Gregory [14]: A level – the occlusal surface of the third molar is leveled or nearly leveled as the occlusal surface of the second molar, B level – the occlusal surface of the third molar is between the occlusal surface of the second molar and its cervical line, C level – the occlusal surface of the third molar is below the cervical line of the second molar.

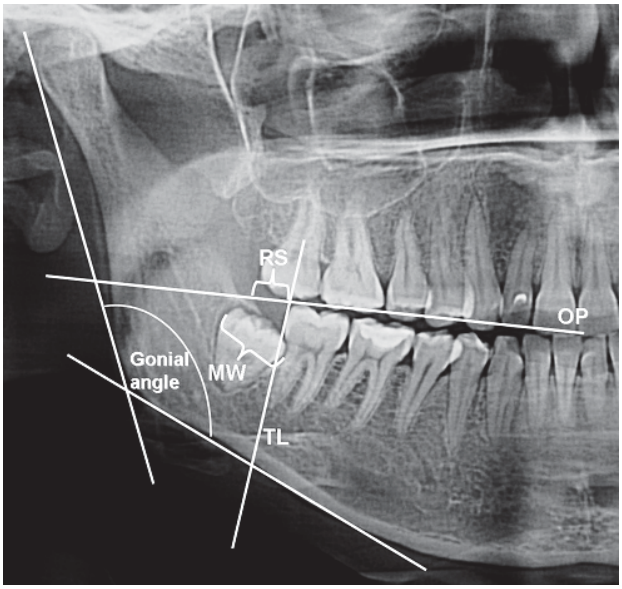

Fig. 1 – Linear and angular measurements on orthopantomogram
RS – retromolar space; MW – mesiodistal width of the third molar; OP – occulasal plane; TL – tangent line.

After calculating space/third molar width ratio, both age groups were divided into two subgroups the ES subgroup with enough space for third molar eruption (space/width ratio ≥ 1), and the NS subgroup with no enough space for third molar eruption (space/width ratio < 1).

All orthopantomograms were interpreted by the same examiner.

The arithmetic mean and standard deviation were calculated for each continuous variable. The frequency and percentages were displayed for categorical variables. Compari-

son of the continuous variables between genders and sides was made using the Student's *t*-test and Mann Whitney's test. Statistical differences between frequencies were tested with Pearson's χ^2 test and Fisher's test. Statistical analyses were performed in R 2.11 statistical software package (R Foundation, Vienna, Austria).

Results

In the early adult group the majority (more than 80%) of investigated third molars did not have enough space for eruption. However, in the adult group, this was the case with about half of the third molars (Table 1).

Table 1
Distribution of lower third molars in two age groups in relation to the available space for eruption

Patients	Subgroups of patients		*p*
	NS n (%)	ES n (%)	(χ^2 test)
Male			
early adult	18 (78.26)	5 (21.74)	0.04
adult	24 (53.33)	21 (46.67)	
Female			
early adult	34 (87.18)	5 (12.82)	0.003
adult	34 (59.65)	23 (40.35)	
Total			
early adult	52 (83.87)	58 (56.86)	0.0003
adult	10 (16.13)	44 (43.13)	

Early adult – subjects aged 16 to 18 years; Adult – subjects older than 18 years; ES – third molars with enough space for their eruption [RM (retromolar space)/MD (mesiodistal crown with) ≥ 1]; NS – third molars without enough space for its eruption (RM/MD < 1).

These differences proved to be statistically significant, both in the whole sample and when data on genders were extrapolated. Comparisons between genders and between the left and right side showed no significant differences. Comparing male and female subjects within the these age groups, the same results were obtained.

In order to confirm these results, mean values of the space/third molar width ratio for early adult and adult subjects were calculated and the differences between them were tested (Table 2). The results showed significantly smaller space/third molar width ratio in younger patients ($p < 0.0001$). Comparing the means of this parameter between males and females, no significant difference was observed.

Table 2
Age dependence of the space/third molar crown width ratio in males and females

Patients	Space/crown ratio ($\bar{x} \pm SD$)	*p* (*t*-test)
Male		
early adult	0.62 ± 0.44	0.0007
adult	1.01 ± 0.43	
Female		
early adult	0.67 ± 0.26	0.006
adult	0.84 ± 0.37	
Total		
early adult	0.64 ± 0.32	< 0.0001
adult	0.92 ± 0.40	

Early adult – subjects aged 16 to 18 years; Adult – subjects older than 18 years; space/crown ratio – RM (retromolar space) divided by MD (mesiodistal crown width).

In the patients from the early adult group, the highest number of third molars was in the C-position, according to the Pell-Gregory classification. This was particularly the case in the third molars with enough space for their eruption in the NS subgroup, in contrast to the third molars with enough space for their eruption in the ES subgroup where more of the third molars were in the A-position (Table 3). On the other hand, in the adult group, the highest number of the third molars was in the A-position, clearly indicating their eruption over time. Despite this, in the NS subgroup more than half of the investigated teeth were in the C position while almost 90% of the third molars reached the occlusal plane in the ES subgroup. Differences between ES and NS subgroups were statistically significant in both age groups.

There were no differences between the mean values of the gonial angle size in relation to the available space (Table 4). The average mandibular angle for the whole group was 124.39 on the left and 123.45 degrees on the right side ($p > 0.05$). There were no significant differences in mean values of this angle between genders and between left and right sides.

Table 3
Third molar eruption level in relation to the available space in the mandible in two age groups

Patients	Level of eruption (the Pells Gregory classification), n (%)			*p*
	A	B	C	(χ^2 test)
Early adult				
NS	8 (15.38)	15 (28.85)	29 (55.77)	0.008
ES	6 (60.00)	1 (10.00)	3 (30.00)	
Adult				
NS	14 (24.14)	10 (17.24)	34 (58.62)	< 0.0001
ES	39 (88.64)	1 (2.27)	4 (9.09)	
Total				
NS	22 (20.00)	25 (22.72)	63 (57.27)	< 0.0001
ES	45 (83.33)	2 (3.70)	7 (12.96)	

Early adult – subjects aged 16 to 18 years; Adult – subjects older than 18 years; ES – third molars with enough space for its eruption [RM (retromolar space)/MD (mesiodistal crown with) < 1]; NS – third molars without enough space for its eruption (RM/MD < 1).

Table 4

Gonial angle size in relation to the available space in the mandible in two age groups

Mandible side	Early adult		Adult	
	($\bar{x}$ ± SD)	p*	($\bar{x}$ ± SD)	p*
Left				
NS	126.4 ± 6.63	0.16	125.4 ± 8.02	0.06
ES	123.2 ± 13.03		121.1 ± 7.90	
Right				
NS	126.4 ± 6.79	0.80	120.8 ± 7.2	0.50
ES	127.8 ± 13.66		122 ± 7.76	

Early adult – subjects aged 16 to 18 years; Adult – subjects older than 18 years; ES – third molars with enough space for its eruption [(RM (retromolar space)/MD (mesiodistal crown with) < 1]; NS – third molars without enough space for its eruption (RM/MD < 1); *Mann-Whitney test .

Discussion

The lack of space in human jaws has been a topic of interest for a long time. The mandibular retromolar space is one of the most investigated parameters for two reasons: the lower third molars are the second most frequently impacted teeth [2–4] and the lack of space is considered to be the major cause of this[9]. Therefore, the analysis of this space should be carefully performed, especially in young patients.

Two main methods have been used for estimation of the available retromolar space: measurement of the distance between the center of the ramus (Xi point) and the distal aspect of the lower second molar [15, 16], and measurement of the distance between the anterior edge of the ramus and the distal surface of the lower second molar [6, 12, 17]. Olive and Basford [17] reported that the use of the first method could not be supported.

Many studies have demonstrated that orthopantomography can give reliable measurements of the skeletal and dental structures as can lateral cephalogram [6, 18–21]. The advantage of the orthopantomogram is evident when measuring right and left side because there is no superimposition, which is present at lateral cephalograms. Furthermore, digital technology gives more clear radiograms and analysis on them is easier. However, possible distortions and magnifications in the molar region can lead to unreliable linear measurements on the orthopantomogram [6, 20, 22]. Therefore, the space/third molar width ratio was used as a parameter for space analyses because these irregularities will affect the retromolar space width as well as the third molar width, but the ratio will remain constant. Moreover, Olive and Basford [17] concluded that the space/width ratio provides reliable assessment of the available retromolar space for the third molar eruption and that orthopantomogram gives the best estimation of the required ratio, while the lateral cephalogram is uncertain. Lerheim and Svanses [20] showed that orthopantomogram does not change the size of the gonial angle and Mattila et al. [21] concluded that it is more obvious choice for determination of the gonial angles than lateral cephalograms.

It is considered that the shortage of space is the major cause of the third molar impaction [11]. Kahl et al. [23] found that the majority (97.40%) of impacted teeth did not have enough space. After 7 years of observation, Ganss et al. [6] concluded that, if the space/third molar width ratio is larger than 1, most of wisdom teeth would ultimately enter the arch (almost 70%). Many authors supported this observation. Bjork et al. [12] reported that the third molar space was reduced in 90% of cases of its impaction. Hattab and Alihaija [9] found that the space/third molar width ratio was significantly larger in the group of teeth that had erupted than in the impacted group. In addition, in the impacted group, in approximately 80% of investigated teeth, this ratio was smaller than 1, whereas in the erupted group, in 69% it was larger than 1 [9]. Olive and Basford [17] concluded that prognosis for the third molar eruption is favorable if the ratio is equal or greater than 1, while Uthman [10] found even smaller minimum values for successful eruption (0.88 for males and 0.83 for females).

Our results showed significantly more erupted third molars in the enough space (ES) subgroups, regardless of patients age (Table 3). In the early adult group, the difference reached the significance of $p = 0.008$ and in the adult group it was even higher ($p < 0.0001$). It is interesting that these differences proved to be statistically significant even in the early adult group, although it is the period of life in which third molars just begin to erupt. Altogether these results are in agreement with previous studies, thus supporting the opinion that the lack of space can delay or disable the third molar eruption and enough space, among other factors, favors its eruption.

One of the aims of this study was to investigate the frequency of insufficient retromolar space in Serbian population as it is considered the main cause of third molar impaction. Although, there are differences between early adult and adult subjects, high prevalence of shortage of retromolar space was evident (Table 1).

The question we also posed was weather the third molar space can be measured in the age of 16 without making wrong assessment about the future outcomes. Ganss et al. [6] reported that the space/width ratio remained almost constant between 16 and 20 years of age in the impacted group and increased insignificantly in the erupted group. The investigation of Bjork [24] showed no increase of posterior dental arch after the age of 14 for girls, and the age of 16 for boys. Ledyard [7] also found no expanding of this area after the age of 16. Niedzielska et al. [5] confirmed this observation and concluded that eruption or non-eruption can be adequately predicted in young adults.

Nevertheless, it was also shown that some significant changes can happen in the size of retromolar space after the age of 16 [8]. It was reported that total increases from 13 to 18 years

of age were 5.12 mm for girls and 5.79 mm for boys. Also, significant annual increase for boys between 16 and 17 years of age (average 1.20 ± 0.02 mm) and for girls between 17 and 18 years of age (1.32 ± 0.04 mm) was found. We found that this increasing is important and we consider that the retromolar space size cannot be adequately assumed in the age of 16.

Our results show that in early adult patients lack of space is significantly more frequent than in adults ($p = 0.04$ in male and $p = 0.009$ in female subjects) (Table 1). Moreover, the means of the space/third molar width ratio were significantly larger in older subjects (Table 2). For such strong statistical significance, we find no other explanation than the fact that retromolar space grows after the age of 16. This growth will, during time, lead to an improvement of the space/third molar width ratio. We tested the differences between means of space/third molar width ratio and frequencies of insufficient space in younger and older subjects, so it could be more obvious that decision concerning third molar removal can be unreliable in early adulthood.

Chen et al. [8] found differences between genders, but this was not observed in our study. However, we divided subjects in 16–18 years of age as the early adult and from 18–26 years of age as the adult group and compared differences between them. Chen et al. [8] analyzed differences between genders annually and found significant retromolar growth for girls at the age 17 and for boys at the age 16. This was not observed in our study as both male and female subjects showed significant growth between the age of 16 and 18 (in our study – early adults).

Average gonial angle in our sample was 123.45 degrees on the right and 124.39 degrees on the left side, whereas in Finish population, it was 128.3 degrees [25]. In Jordanian population, Hattab and Alihaija [9] reported smaller average gonial angle (120.8 degrees). Richardson [11] and Bojrk et al. [12] had reported that smaller gonial angle was more common among subjects with impacted third molars. On the other hand, Hattab and Alihaija [9] concluded that there was no relationship between the size of the gonial angle and impaction of the third molars. If the size of the gonial angle is different in subject with impacted than in those with erupted lower third molars, than the impaction is caused by insufficient space as these two parameters depend on mandibular growth. Therefore, we compared sizes of gonial angle of the NS and ES subgroup, without concerning the eruption status. Our findings show that the size of gonial angle cannot be an indicator of future outcomes of the space/third molar width ratio because there was no relationship between these two parameters (Table 4).

Conclusion

The retromolar space/third molar width ratio differs between subjects aging from 16 to 18 years and subjects older than 18 years. Insufficient space was more frequent in younger group and the mean value of the space/third molar width ratio was significantly smaller in the same group. Therefore, the decision about the removal of the third molar in young adults should be made with caution.

Gonial angle size was not in correlation with the retromolar space/third molar width ratio and the use of this parameter as a predicting factor for future outcomes of this ratio cannot be recommended.

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