

Original research

Radiological prediction of the retention of the lower third molars



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ABSTRACT

Objective: To evaluate the validity of the radiological retention coefficient based on linear measurements performed using digital panoramic radiographs as an early prediction index of mandibular third molar eruption/retention status.

Methods: This study consists of the analysis by a single operator (S.S.H.) of digital drawings on panoramic radiographs. A total of 328 third lower molars recorded on diagnostic digital orthopantomograms, were used to analyze retromolar space, mesiodistal crown width, and space/width ratio. The radiological retention coefficient was then calculated with these linear measurements.

Results: The average age of patients was 23.49 years old for men and 23.89 for women. The frequency of lack of space for the lower third molar eruption was 58%. The frequency of retention of the lower third molar in men is 51%, while in women it reaches 64%. In men the probability of the molar being retained is 95% if the radiological retention coefficient lies between 0.69 and 0.78. In women such probability is 95% if the radiological retention coefficient lies between 0.63 and 0.71. In men the probability of eruption is 95% if the radiological retention coefficient lies between 1.08 and 1.22. In women the probability of eruption is 95% if the radiological retention coefficient lies between 1.06 and 1.19.

Conclusions: The radiological retention coefficient is a method with a very high probability of success, for evaluating whether the third lower molar will erupt or be retained. (Rev Port Estomatol Med Dent Cir Maxilofac. 2018;59(3):140-144)

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Previsão radiológica da retenção de terceiros molares inferiores

R E S U M O

Palavras-chave:

Valor preditivo dos testes
Radiografia, panorâmica
Terceiro molar
Extração, dente

Objetivo: Avaliar a validade do coeficiente de retenção radiológica com base em medidas lineares em radiografias panorâmicas digitais como um índice de predição precoce do estado de erupção/ não erupção do terceiro molar inferior.

Métodos: O estudo consistiu na análise de radiografias panorâmicas digitais por uma única operadora (S.S.H.). Um total de 328 terceiros molares inferiores foram registrados para analisar o espaço retromolar, a largura da coroa mesiodistal e a relação espaço / largura. O coeficiente de retenção radiológica foi calculado com essas medidas lineares.

Resultados: A idade média foi de 23,49 anos para os homens e de 23,89 para as mulheres. A frequência de falta de espaço para a erupção do terceiro molar inferior estudado foi de 58%. A frequência de retenção do terceiro molar inferior nos homens é de 51%, enquanto nas mulheres chega a 64%. Nos homens, a probabilidade de retenção será de 95% se seu coeficiente de retenção radiológica estiver entre 0,69 e 0,78. Nas mulheres, a probabilidade de retenção será de 95% se seu coeficiente de retenção radiológica estiver entre 0,63 e 0,71. Nos homens, a probabilidade de erupção será de 95% se o seu coeficiente de retenção radiológica estiver entre 1,08 e 1,22. Nas mulheres, a probabilidade de erupção será de 95% se o seu coeficiente de retenção radiológica estiver entre 1,06 e 1,19.

Conclusões: O coeficiente de retenção radiológica é um método válido para avaliar, com uma probabilidade muito alta de sucesso, se o terceiro molar inferior entrará em erupção ou não. (Rev Port Estomatol Med Dent Cir Maxilofac. 2018;59(3):140-144)

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Introduction

The lower third molar presents great variation in terms of its age at eruption, size, radicular form and direction of eruption.¹ A panoramic radiograph provides us with the information needed to diagnose any retention. Moreover, this simple and routine radiological technique is used in dental clinics for diagnosis of anomalies or pathologies in dentition and jaws. We can measure the position of the retained lower third molar in relation to the second molar and its height up to the mandibular bone crest if the retention is vertical.^{2,3} Literature data indicate that, about 45% of third molars could be retained.¹ Retention rates differ according to the populations studied,^{4,5} and range from 0% in Nigerians⁶ to 39% in Finns. Other authors, such as Carter,⁷ consider that the average retention varies between 3% and 57%. Bishara⁸ states that the lower third molars have a retention prevalence of 17.5% in impacted teeth. Hattab¹ states that mandibular third molar impaction varies considerably from 9.5% to 39% in the different populations studied. Radiological examination through a panoramic radiograph is an essential diagnostic method for evaluating retention of the mandibular third molar, and permits visualisation of the size, shape, position, morphology, bone densities, and location of the retained tooth.⁹⁻¹¹

Although precise prediction of third molar eruption or retention is not possible before the age of 20, differences observed in linear measurements on panoramic radiographs with erupted or retained lower third molars may be used as a

predictive indicator of eruption or retention of such molars. The lack of space in the retromolar area of the jaw is considered to be the main cause of retention of the lower third molar.⁸ Therefore, the objective of this study was to evaluate the possibility of the lower third molar eruption based on linear measurements, for its posterior input into a more complex eruption prediction model. The definition of the eruption space of the retained third molar through measurements performed on a panoramic radiograph provides us with the necessary data to evaluate the possibility of predicting whether the mandibular third molar will erupt or be retained.

This study was conducted to evaluate the validity of the radiological retention coefficient (RRC) based on linear measurements made on digital panoramic radiographs, for preparing an early prediction index of mandibular third molar eruption/ retention status.

Material and methods

The study was performed using diagnostic digital panoramic radiographs of Caucasian patients of both sexes, aged 18 to 27, and taken from the archive of the Radiological Center during year 2017. Only subjects with no previous history of orthodontic treatment, orthognathic surgery, dental extractions or dental absences were included in the study. Individuals with developmental anomalies, dentofacial deformities, or severe facial asymmetries were excluded from the study. Poor quali-

ty digital panoramic radiographs were also excluded from the study. Subjects were only included in the study after obtaining the informed consent of patients and the approval of the Clinical Research Ethics Committee.

A total of 328 third lower molars from 184 individuals from the Galician population were used in the study. All subjects were at least 18 years of age and had full dental arches with radiographically confirmed lower third molars. Participants were divided into two groups according to their eruption status of the third lower molar (retained R/erupted E). The lower third molars were considered erupted if they had reached the occlusal plane drawn on the orthopantomogram; otherwise, they were considered as retained¹² This study focused only on unerupted mesioangular third molars, whether or not they were impacted against the adjacent second molars. All radiographs were taken using a standardized technique (70Kvp, 15mA, analog position patient and 10 seg.) by means of a CS 8100 device (SN EBXG197, Carestream Health Inc., France, 2016). A single operator (S.H.S.) traced and marked all the radiographs using the Dental Studio 3D software (VERSION 3//BASE DE DATOS 3.14 Digital imaging) shown in Figure 1. The following linear measurements were recorded:

- TLM: Third lower molar
- DTLM: Diameter crown third lower molar
- D2°MBR: Distance between the distal border of the second molar crown and the anterior border of the ramus.

This observational study is non experimental and included retrospective monitoring. The aim was to compare the radiological status of mandibular third molars in subjects participating in the study. The study group was comprised of patients that regularly visited dental clinics for treatment, had taken a panoramic x-ray and consented to participate in the study. Patient's evolution was not monitored. Only patient's panoramic radiographs taken earlier for other dental problems were selected following the criteria mentioned above.

Figure 1 shows the distance between the distal border of the second molar crown and the anterior border of the ramus measured in an occlusal plane (retromolar space), as well as the crown diameter of the third lower molar (D2°MBR).

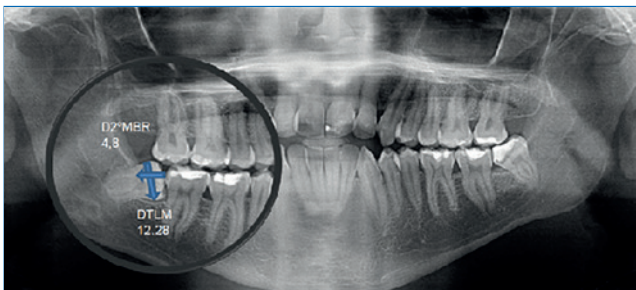


Figure 1. Digital orthopantomogram shows linear measurements realized. DTLM: Diameter crown of the third lower molar. D2°MBR: Distance between the distal border of the second molar crown and the anterior border of the ramus.

The term Radiological Retention Coefficient (RRC) was defined in order to determine the eruption space of the lower third molar and to ascertain the correlation between the linear measurements selected in the study groups. This coefficient is determined by dividing the retromolar space (the distance between the distal border of the second molar crown and the anterior border of the mandibular ramus) by the diameter of the crown of the third molar. The RRC value determines whether the third molar will be retained or be erupted, and this will also allow us to predict the presence or absence of space for eruption.

The distribution of the variables in each group, was analyzed using statistical methods such as mode, mean, median standard deviation, and Student's t-test. The mandibular third molar was analyzed as the statistical unit. Also analyzed was the frequency of occurrence of the R and E groups, which were related to the RRC in order to learn about the type of statistical distribution they have.

Results

Of the total of 328 mandibular third molars studied in the 184 subjects, 212 teeth were observed to be retained and 116 teeth were observed to be erupted. 45.24% of the participants were men and 54.76% were women. The total average age of the subjects was $23.03 \pm SD 2.68$, and their age ranged from 18 to 27 years. The average age for Group E was $24.13 \pm SD 2.36$ years and the average age for Group R was $22.43 \pm SD 2.66$ years.

In Group E, the mean distance between the second lower molar and the ramus (D2°MBR) was found to be $18.6 \pm SD 2.74$ mm, whereas in Group R (D2°MBR) it was $12.1 \pm SD 2.49$ mm, showing a significant difference ($p < 0.001$) between the groups (Tables 1 e 2). In Group E, the mean crown diameter of the lower third molar (DTLM) was $13.7 \pm SD 0.98$ mm and in Group R (DTLM) was $14.4 \pm SD 1.03$ mm, showing a significant difference ($p < 0.001$) between the groups (Figure 2 and Table 1). There was a lack of space for eruption of the lower third molar in 58% of the cases. The frequency of retention of the lower third molar in men is 51%, while it is 64% in women (Figure 3).

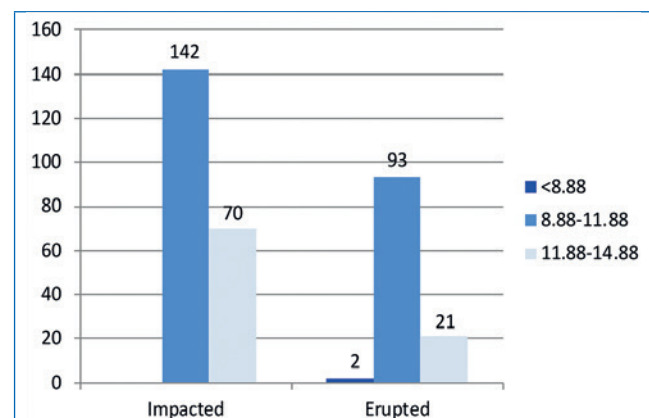


Figure 2. Distribution of lower third molars in groups according to their diameter

Table 1. Descriptive statistics of Group R and Group E

	Group R		
	Minimum	Maximum	Mean+SD
DTLM (mm)	12.1	15.1	14.4+1.03
D2°MBR (mm)	11.6	14.6	12.1+2.49
	Group E		
	Minimum	Maximum	Mean+SD
DTLM (mm)	11.9	14.7	13.7+0.98
D2°MBR (mm)	14.8	21.1	18.6+2.74

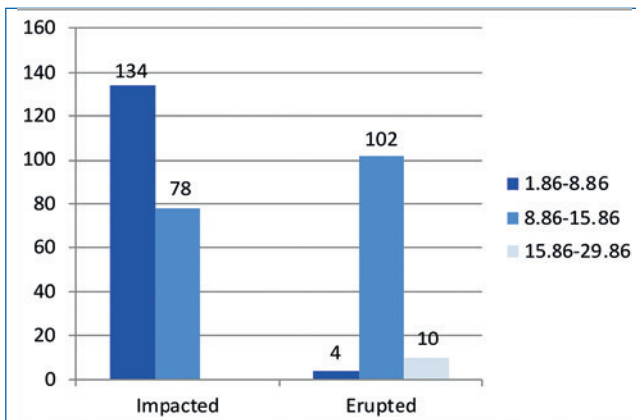


Figure 3. Distribution of mandibular third molar in groups according to retromolar space available

Table 2. Comparison and differences in measured variables for Group R and Group E

	Group R (mean)	Group E (mean)	Difference in means	P value
DTLM (mm)	11.44	11.00	0.44	< 0.00
D2°MBR (mm)	7.91	12.48	4.57	< 0.00

The probability of retention in men is 95% if the RRC lies between 0.69 and 0.78. While in women, the probability of retention is 95% if the RRC lies between 0.63 and 0.71. The probability of eruption in men is 95% if the RRC lies between 1.08 and 1.22. While in women, the probability of eruption is 95% if the RRC lies between 1.06 and 1.19.

Discussion

The lower third molar is the tooth with the highest prevalence of retention.¹ The frequency of lack of space for the eruption of the lower third molar in the population studied was 58%. That incidence varies from 22% to 66% depending on the population studied.¹³ The latter suggested

that factors influencing third molar impaction are facial growth pattern, direction of tooth eruption and root configuration. It has been previously reported that the retromolar space is the most important factor for the eruption of third molars.¹⁴

Although the retromolar space is big enough, the eruption of the lower third molar can not be guaranteed since other factors influence the skeletal growth pattern, the direction of eruption of the dentition, the dental extractions performed, the morphology of the root and the maturation stage of the third molars. However, the existing space in the retromolar region to be a determining factor.¹ This is why our research focused on the linear measurement of the existing retromolar space for the eruption of the lower third molar (D2°MBR) and the measurement of the mesiodistal crown widths (DTLM).

Most studies state that the impaction of the third molar is predictable and that the use of panoramic radiographs for its study is a valid method. After the analysis and study of panoramic radiographs, the authors determined that evaluations performed at an early age have little predictive value. Therefore, these should be performed only after the age of 16 in order to make a decision on whether or not the third molar should be extracted, when the crown is fully formed or only when the third part of the root of the third lower molar is formed.¹⁵

Based on the available evidence at the time, others studies concluded that there is a forward movement of the first lower molars between the ages of 13 and 18, several factors contribute to the development of the eruption space of the lower third molar, the space available for the eruption of the third molar increases by an average of 4 mm between the ages of 13 and 18 years.¹⁴

This is why the population range chosen in our study was 18 to 27 years, where the total average age is 23.03 ± SD 2.68 years. The frequency of retention of the lower third molar in men in our study is observed to be 51%, whereas in women this frequency reaches 64%. The higher frequency observed in females could be explained due to the differences between jaw growth in males and females. Female jaws usually stop growing when the third molars begin to erupt, whereas in males, jaws continue to grow during eruption of third molars, thereby creating more space for third molar eruption.⁸

In our study, the mean retromolar space (D2°MBR) for Group E was 18.6 ± SD 2.74 mm, while that for Group R was 12.1 ± SD 2.49 mm. A significant difference was observed between the two groups. Ganss¹⁶ report that the probability of eruption is 70% when the retromolar space is 13.9 mm in women. Ventä¹³ likewise stated that if the retromolar space is at least 16.5 mm, the probability of eruption is 100%. The minimum retromolar space required for the eruption of the lower third molar measured in our study was 14.8 mm.

The crown diameter of third lower molars (DTLM) was 13.7 ± 0.98 mm in Group E and 14.4 ± 1.03 mm in Group R. Other authors such as Hattab et al. confirmed that third molars were larger in the retained group than in the erupted group, but in their population the difference was insignificant.

It is important to find a reliable and efficient predictive method. This study analysed the proportionality between the mesiodistal diameter of the lower and the retromolar space. This proportionality provided by the RRC will enable us to obtain a very high predictive value to indicate whether or not the lower third molar will erupt.

This study is an approach towards the development of a model to predict the eruption of the lower third molar by taking only linear measurements into account. It would be interesting to complete the model with angular measurements of the inclination of the lower third molars as an attempt at determining a possible eruptive trajectory and make the model more reliable.

Conclusions

The minimum retromolar space required for the eruption of the lower third molar, in the population studied was 14.8 mm.

The radiological retention coefficient (RRC) is a valid method for evaluating whether the third molar will be retained or erupted, with a very high results of success.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Conflict of interest

The authors have no conflicts of interest to declare.

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