Correlation between developmental stages of mandibular third molar and retromolar space

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Abstract

Background: The degree of formation of third molar, its presence and position is associated with the development of this tooth. A decrease eruption space between lower second molar and ramus has been identified as an etiology of lower third molar impaction.

Aims and objectives: To assess the association between developmental stages of the mandibular third molars and space distal to the permanent molars (retromolar space).

Materials and method: The study included pre-treatment lateral cephalographs and orthopantomograms of 200 orthodontic patients (136 females and 64 males) of age group from 8 and 18 years old. The molar formation stages were assessed by the method of Nolla's. The retromolar distance was measured from the most concave point of the anterior border of the ramus to the distal surface of the first molar. Statistical analysis included analyses of variance for group differences and pearson product moment for assessing associations among variables.

Results: High correlation between developmental stage of third molar and retromolar space (r=0.726) was observed. The formation stage advanced with age, but wide standard deviations were noted. The retromolar distance increased with age and was greatest between 9 and 12 years. An increment of 5 mm of retromolar space corresponds to a 2.4 stage in tooth maturation.

Conclusions: The developmental formation of mandibular third molar is associated with the available retromolar space. An increase in retromolar distance suggests a higher chance of eruption, an advanced stage of development of the mandibular third molar might be an additional indicator of future eruption.

Keywords: Third molar; Dental age; Root formation; Development; Retromolar space

Introduction

The impaction of tooth is a pathological condition in which it fails to erupt to the normal functional position within the expected time; due to lack of available space to erupt, or physical barriers.[1]

It may be caused by inadequate space, limited skeletal growth, distally erupting dentition, vertical direction of condylar growth, increased crown size of impacted teeth, and the late or retarded maturation of the third molars.[2] The average age for eruption of the third molar is considered 20 years old by Garcia and Chauncey (1989), the time of the eruption shows considerable variations among populations ranging from 14 to 24 years old.[3,4]

An important variable to predict eruption of third molars is the space between the distal surface of the second molar to the ascending ramus of the mandible i.e. the mesiodistal space.[5] Some authors reported that the probability of eruption of third molar is approximately 70% if the mesiodistal space is larger than the mesiodistal width of the third molar crown. However third molar eruption cannot be guaranteed despite adequate space available in the jaw.[6]

Prediction of impaction during growth could be of help in planning future dental treatments (orthodontic, prosthesis or surgical exodontia).[7] The developmental stage of the mandibular third molar has been associated with chronologic and skeletal ages.[8] The environment of the third molar, particularly mandibular anatomic restrictions by the ramus, creates an inherent association between crowding of the third molar and tooth impaction.[9]

It is hypothesized that a positive correlation exists between the developmental stages of the mandibular third molars and the retromolar space.[9] The aim of our study was to evaluate the association between developmental stages of the mandibular third molars and retromolar space (distal to the first molar).

Materials and Methods

The study was conducted in the Department of Oral Medicine and Radiology of Al Badar Dental College and Hospital, Gulbarga, after approval by the Research Ethics Committee. The subjects who agreed to participate in the study after informed consultation and signed a written informed consent.

The sample consisted of pretreatment lateral cephalometric and panoramic radiographs from 200 subjects between the ages of 8 and 18 years who fulfilled the specific inclusion and exclusion conditions.

Inclusion criteria: The inclusion criteria were, a full complement of mandibular permanent teeth(erupted or unerupted); physically healthy and well-nourished subjects; non-syndromic childrens; subjects with normal growth and development; no history of surgical or medical diseases that could affect the presence and development of mandibular permanent teeth; and radiographs of diagnostic quality.

Exclusion criteria: Exclusion conditions were congenital malformations, disturbance in dental development absence of mandibular third molars, history of previous orthodontic treatment, existing pathology, prior surgery (as a result of trauma), and age older than 18 years.

Methodology

All the cephalometric and panoramic radiographs of the study subjects were taken with Kodak 8000C Digital Panoramic and Cephalometric machine operating at 60-90 kvp, with exposure time of 8-18 seconds at 2-15 mA in a standardized manner with an inbuilt magnification factor as specified by the manufacturers. OPG images were viewed on a flat screen Compaq TFT-LCD monitor with a resolution of 2906 × 2304 pixels. Mandibular measurements were made on each Digital Lateral Cephalogram using Trophy Dicom Software.

For orthopantomograms the developmental stages of mandibular third molar were recorded by comparing the stages given by Nolla's method[10] as shown below. The degree of calcification of each was recorded.

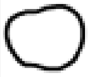
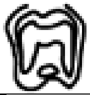
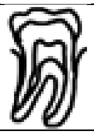
Stages of calcification of third molar by Nolla's method	Radiographic appearance	Description
Stage 0		Absence of crypt
Stage 1		Presence of crypt
Stage 2		Initial calcification
Stage 3		1/3rd of crown completed
Stage 4		2/3rd of crown completed
Stage 5		Crown almost completed
Stage 6		Crown completed
Stage 7		1/3rd of root completed
Stage 8		2/3rd of root completed
Stage 9		Root almost completed with open apex
Stage 10		Completed root apex

Fig. 1: Stages of dental development according to Nolla

For lateral cephalogram the retromolar space was measured using DICOM software. A horizontal reference line was used, the Frankfort horizontal (FH). A line perpendicular to the horizontal line passing through the most concave point of the anterior border of the mandibular ramus was traced. The mandibular first molar was traced, and the shortest distances from the distal surface of the first molar to the vertical line passing through the ramus was calculated by the software (in millimeters).

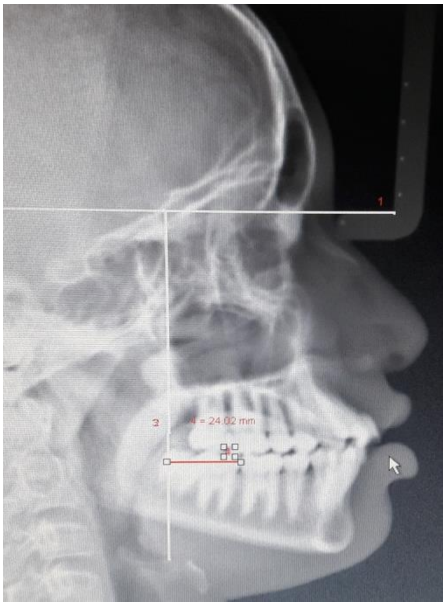


Fig. 2: Red horizontal line denotes measurement of retromolar distance i.e. distance between most distal point of distal surface of the permanent first molar and a vertical drawn perpendicular to the Frankfort horizontal plane

A total of 40 images were re-evaluated after 6 months by the same examiner to check the error of digitalisation. All the values were recorded tabulated and subjected to statistical analysis.

Statistics

All calculations were done by SPSS software version 16.0. The differences between age and gender groups were analyzed with t-tests. The Pearson product moment was employed to evaluate associations among variables. Intraexaminer reliability was evaluated using intraclass correlation coefficient.

Results

A total of 200 subjects (136 girls and 64 boys) in the age group of eight to eighteen years were enrolled in the study.

The intraclass correlation coefficients were r=0.985 for the first molar to ramus distance and r= 0.978 for developmental stage, indicating high intraexaminer reliability. The averages of age, retromolar distance, and dental formation stage for boys and girls are shown in Table 1.

The overall mean age of the subjects was 14.25±2.57 years. The overall mean age of males was 14.46±2.53 years, whereas, the overall mean age of females was 13.82±2.19 years.

Table 1: Mean and standard deviation of age, retromolar distance & stage of dental formation

Sex/Factors	Males	Females	Total	P-value & significance
No. of cases	64(32%)	136(68%)	200(100%)	--
Age in years Mean± SD	14.46±2.53	13.82±2.19	14.25±2.57	P=0.45, NS
Retromolar Distance in mm Mean±SD	15.56±4.36	14.41±4.77	15.26±4.64	P=0.036, S
Stage Mean±SD	6.10±1.89	5.17±2.16	5.75±2.06	P=0.043, S

Table 2: Average mean value of retromolar molar distance in different age groups

Age group	Developmental stages of third molar	Retromolar distance
9	2.25±1.08	5.56±0.36
10	3.12±1.54	9.26±3.42
11	4.43±1.50	9.71±2.86
12	4.5±1.7	13.11±4.11
13	5.1±1.35	14.52±3.03
14	5.3±1.53	15.31±2.76
15	6.41±1.07	16.96±3.40
16	6.43±1.05	18.39±3.39
17	7.35±1.49	18.44±3.49
18	8.0±1.56	18.52±3.98

The retromolar distance was statistically significantly different between genders with P value 0.036.The developmental stage was also statistically significant between gender and developmental stage increased with age, but wide standard deviations were noted in each group (Fig. 3).

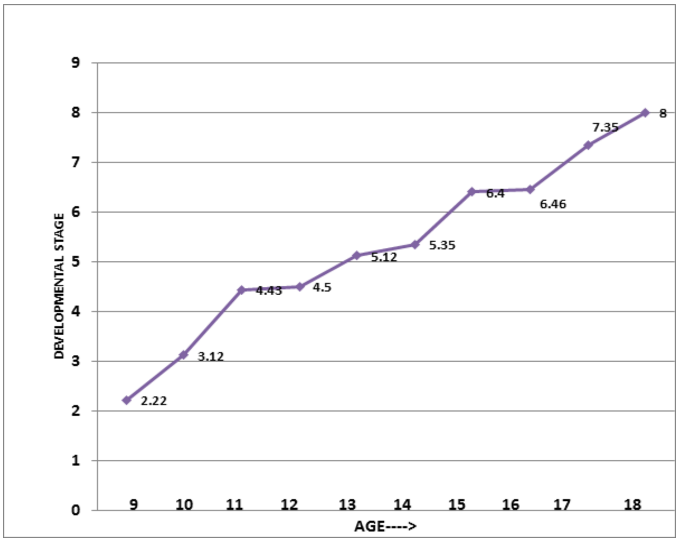


Fig. 3: Diagram of the relationship between third molar developmental stage and age

Similarly, the distance between first molar and ramus increased with age and was greatest between 9 and 12 years (Fig. 4).

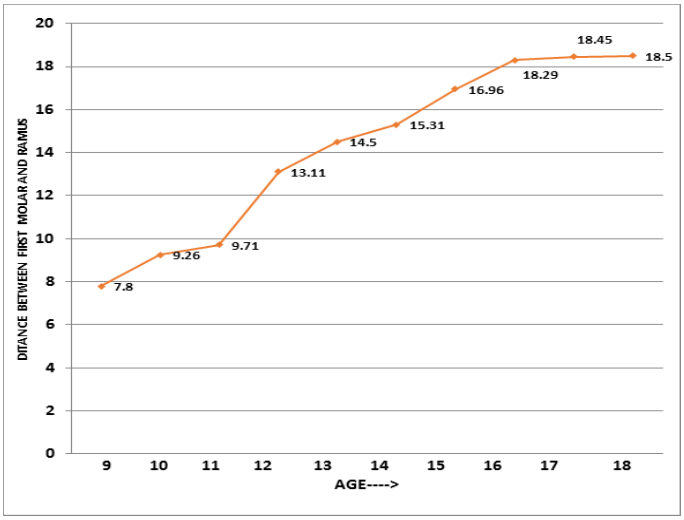


Fig. 4: Diagram of relationship between age and distance between first molar and ramus showing acceleration in development between the ages of 9 and 12 years

High and statistically significant correlations were observed between age and retromolar distance (r=0.723; P, .0001), between age and stage of development (r=0.749; P, 0.0001), and between stage of development and retromolar distance (r=0.726; P, 0.0001; Fig. 5).

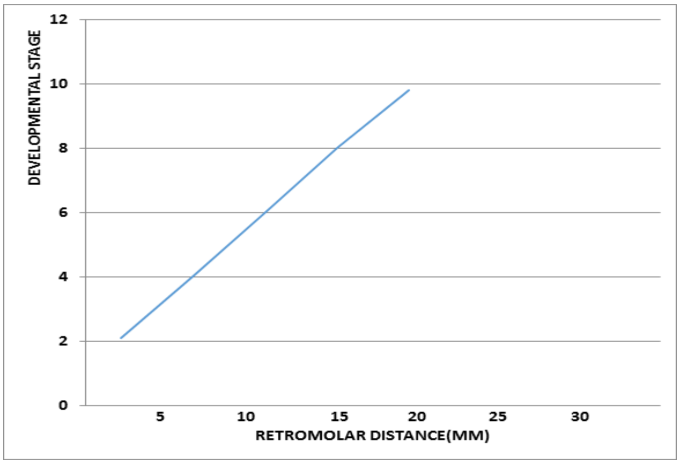


Fig. 5: Diagram of the relationship between retromolar distance and stage of dental development showing variation of first molar to ramus distance with stage

Discussion

Radiographic diagnosis of the presence, position, and degree of third molar formation is a crucial part of integral dental treatment planning. The impaction rate is higher for the third molars than for any other tooth in the modern human population. The shortage of space between the second permanent molar and the mandibular ramus has been identified as a major factor in the etiology of lower third molar impaction. The eruption space for the mandibular third molar is also affected by the direction of tooth eruption during the functional phase of eruption. The more anteriorly the posterior teeth erupt, the more the retromolar space will increase in dimension.[11]

Previous studies have attempted to predict the probability of third molar eruption by using dissected skulls or lateral cephalometric radiographs. Recently, Niedzielska et al measured the retromolar space and lower third molar crown width ratio (Gnass ratio), the angle formed between the third and second molar teeth, and the molar plus third molar angulation to the lower border of the mandible.[11]

Similar study was done by Ghougassian et al[9] where only the retromolar distance was statistically significant between the genders with P value 0.005. In our study mandibular retromolar space was highly correlated with the stage of development of the third molar (r=0.726) and P value 0.036 and also there was a statistically significant difference of developmental stages of mandibular third molar between the genders.

In Table 2 the average mean value of developmental stages of mandibular third molar and retromolar distance is given in different age groups. Maximum increase in retromolar distance was seen between the ages 9 to 10 and 11 to 12, which signifies maximum linear growth of mandible at this age group. Minimum increase in retromolar distance was seen after the age of 16 which signifies that the growth ceases after puberty. In a study done by Bjork et al[12] the retromolar distance was measured from anterior edge of the ramus and the distal surface of second molar. In our study the retromolar distance was measured from distal surface of first molar since the second molar was not erupted in younger age groups. The study conducted by Quiros et al[13] the retromolar distance in fully erupted third molar was found to range from 14 to 17 mm. In our study this distance ranged from 15 to 18 mm.

The Fig. 3 shows the relationship between age and developmental stages of third molar. The developmental stages increased with age but wide deviation was noted among the groups due individual variation in development. Acceleration in development was seen between ages 9 to 12 years (Fig. 4).

Thus the space availability for eruption of mandibular third molar is directly related to difference between available space and the mesiodistal diameter of the third molar. The dental maturation may be related to available space: slower development occurs with less space, and faster development occurs with more space.[9] Our study revealed that these variables indicated that an increment of 5 mm in retromolar space corresponds to about 2.4 stages in tooth development (Fig. 5).

In our study high correlation between developmental stages of mandibular third molar and retromolar distance implies that the mineralization of mandibular third molars is an indicator of the space availability in the mandibular arch. From this perspective, mineralization would represent the association between dental formation and mandibular skeletal growth.

Conclusions

The developmental formation of the mandibular third molars is associated with the available retromolar space. An increase in retromolar space a higher chance of eruption, an advanced stage of development of the mandibular third molar might be an additional predictor of future eruption.

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