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Mandibular Third Molar Impactions and Retromolar Distance-What Is the Correlation

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Original Research Article

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Abstract: The formation of mandibular third molar and its position depends upon the development. Reduced eruption space between lower second molar and ramus is considered as an important etiological factor for mandibular third molar impaction. Prediction of mandibular third molar impaction by measuring the retromolar distance and its association with developmental stages of the mandibular third molars.The study included pretreatment orthopantomograms and lateral cephalographs of 50 orthodontic patients (33 females and 17 males) of age group between 9 and 18 years old. The mandibular third molar calcification stages were assessed by Nolla's method. The retromolar space was measured from the distal surface of the first molar to the most concave point on the anterior border of the ramus to the mandible. Statistical analyses included t-tests and analyses of variance for group differences and the Pearson product. High correlation between calcification stage of third molar and retromolar space (r=0.726) was observed. The calcification stage increased with age. The retromolar distance increased with age and was greatest between 10 and 15 years. An increase of 5 mm of retromolar space corresponds to a 2.4 stage in tooth maturation. The developmental formation of mandibular third molar 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.

Keywords: Retromolar space, Third molar; Dental age; Root formation.

INTRODUCTION

Impacted permanent tooth is considered as a pathological condition in which there is a failure in its eruption within the expected time to its normal functional position which may be as a result of reduced space, or physical hiderence[1].

This is attributed to variation in the facial growth pattern, the jaws, and the tooth size, which always determine the pattern of eruption [2]. Third molar impaction may be caused by lack of space, distal eruption of the dentition, decreased skeletal growth, condylar growth in vertical direction, crown size of larger dimensions, and retarded maturation of the third molars [3]. According to Garcia and Chauncey *et al*. the average age of eruption of the third molar is 20 years, although the time of the eruption ranges from 14 to 24 years[4,5]. The prediction of third molar eruption is variable. One of the important variable to predict is space between the ascending ramus of the mandible to the distal surface of the second molar (mesiodistal space)[6]. It is reported that there are 70% of chances of eruption if the mesiodistal space is large than the mesiodistal width of the third molar crown [7].

There are many methods for predicting the third molar eruption such as, periapical radiographs, panoramic, bite-wings, lateral radiographs; anterior-posterior radiographs [8-13]. The prediction of third molar during growth helps in orthodontic treatment planning. Because when most dental treatments start, third molars often show a limited amount of calcification and just start to develop. Probably the excessive high rate of asymptomatic third molar extraction is due to a lack of reliable and simple predictive tools. Therefore, it is often difficult to predict whether these teeth will erupt or remain impacted [14].

Third molar impaction is a major problem in modern human without interproximal attrition [15]. Skull materials indicate that third molar impaction was relatively infrequent in primitive populations [6].

Few studies in the scientific literature have been conducted and compared different predictive methods in the prognosis of the third molar eruption [15]. In fact, a high number of third molar eruption prediction methods have been described by various authors but none of these methods predicted the third molar eruption with great accuracy [16]. The developmental stage of the mandibular third molars has been related to chronologic and skeletal ages [17].

However, local morphological and dental factors can affect the stage of development, which may be accelerated or delayed in the presence of anatomical differences among individuals of the same chronologic or skeletal age. Within-mouth variations of up to four stages of maturation have been observed [18], and a given stage of third molar crown formation could develop within a range of 7 to 8 years in different persons [19].

There is fever data reported relating molar impaction and size (mesio-distal width) of the permanent teeth (molars, premolars, canines, and incisors); however, it is logical to assume that larger teeth are likely to be associated with an increased incidence of crowding [20].

There are various studies reported in the literature to predict impaction or eruption of the mandibular third molars and have come to the conclusion that the impaction may be as a result of reduced space available for its eruption [11]. Unlike the study of space availability for all other permanent teeth, 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. Accordingly, investigators have measured the ‘‘retromolar’’ space between the second or first molars and the ramus [20].

Despite remarkable individual variation, findings have emerged that may represent general tendencies. Some observations relate to tooth formation: erupted third molars were at a slightly more advanced stage of development at a younger age [11]; late mineralization and delayed root development were associated with high risk of impaction. A great number of publications relate to available space for eruption: impaction or eruption was correlated with the retromolar space, a higher chance of eruption occurring with an increased space; impaction was more likely to occured with early physical maturation (and corresponding limitation of mandibular growth, and thus a decrease in retromolar space).Other findings relate to the provision of additional space through the extraction of teeth within the arch: third molars in the earlier stages of development at the time of extraction of adjacent second molars are likely to take longer to erupt, and development of the mandibular third molar was accelerated on the side on which the first molar was extracted[20].

It was hypothesized that a positive correlation exists between the developmental stages of the mandibular third molars and the retromolar space [20].

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 and second molars).

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. All the subjects agreed to participate in the study after prior informed consultation and signed a written informed consent.

The sample consisted of pretreatment lateral cephalometric and panoramic radiographs from 50 patients between the ages of 9 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; nonsyndromic childrens; patients 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, absence of one or both mandibular third molars, disturbance in dental development, history of previous orthodontic treatment, existing pathology (eg, cyst), prior surgery (as a result of trauma), and age older than 18 years. With the latter criterion, the assumption was that, on average, normal emergence might occur at the age of 18 years. If at this age the tooth had erupted and/or the root was completely formed, the record was excluded.

METHODOLOGY

The pretreatment cephalometric and panoramic radiographs of all 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. Linear Mandibular diamensional measurements were made on each Digital Lateral Cephalogram using Trophy Dicom Software.

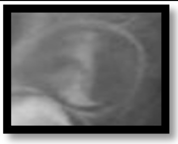
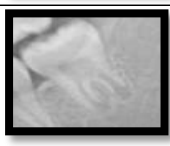
Stage	Description	Radiographic appearance
0	Crypt absent	
1	Crypt present	
2	Initial calcification	
3	1/3rd of crown completed	
4	2/3rd of crown completed	
5	Crown almost completed	
6	Crown completed	
7	1/3rd of root completed	
8	2/3rd of root completed	
9	Completed root with open apex	
10	Apical ends of root completed	

Fig-1: Stages of dental development according to Nolla

For orthopantomograms the developmental stages of mandibular third molar was assessed through the method of Nolla[21]which is based on rating the degree of calcification of each tooth on a described scale of 10 stages of calcification, starting from the absence of a crypt (stage 0). Dental maturation proceeds from the presence of a crypt (stage 1) and includes five stages of crown maturation from calcification to completion (stages 2–6), three stages of calcification of the root scaled in thirds (stages 7–9), and a final stage designated for root completion (stage 10).

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

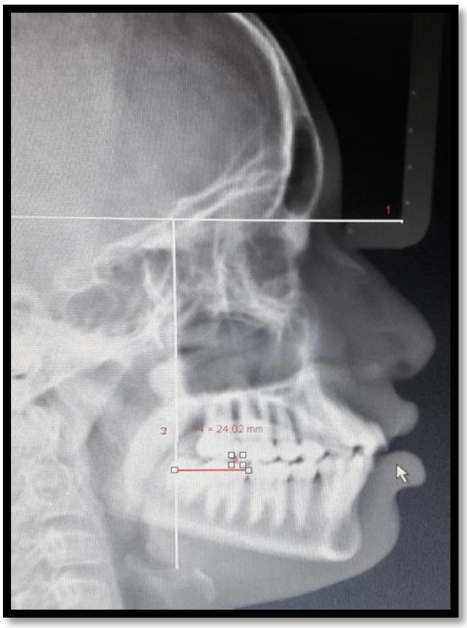


Fig-2: (A) Red horizontal line indicates measurement of retromolar distance between most distal point of distal surface of the permanent first molar and a vertical drawn perpendicular to the Frankfort horizontal plane

STATISTICS

Differences between age and gender groups were analyzed using t-tests. The Pearson product moment was utilised to assess the correlation. A total of 20 subjects were re-evaluated by the same examiner after a period of two months. The intraobserver reliability was done using intraclass coefficient. All statistical computations (all calculations were done by SPSS package 16.0 version software).

RESULTS

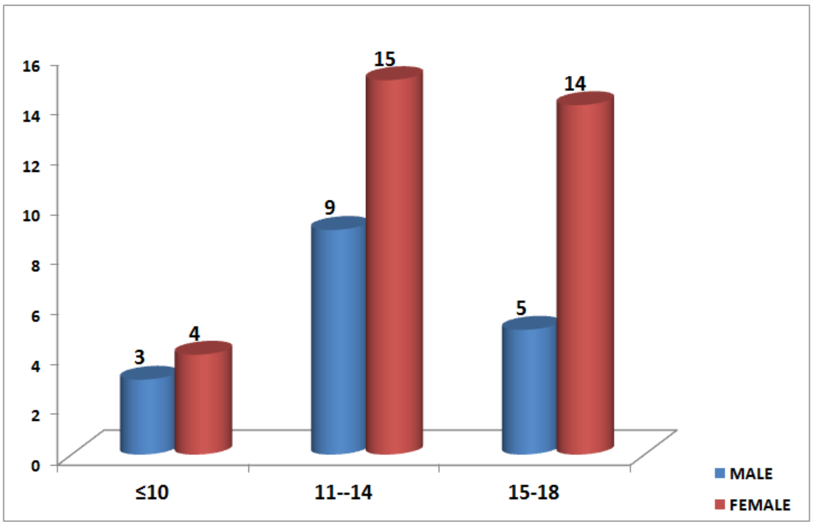
Our study included 50 subjects (33 girls and 17 boys) in the age group of 9 to 18 years who visited the Department of Oral Medicine and Radiology for the purpose of orthodontic treatment at Al-Badar Dental College and Hospital, Gulbarga.

Among the total 50 subjects 7 subjects belonged to the group of ≤10 years of age 3 males and 4 females, followed by 24 subjects belonged to the group of 11-14 years of age with 9 males and 15 females and lastly 19 subjects belonged to the group of 15-18 years of age with 5 males and 14 females. The result showed no statistically significant difference in the distribution of age among males and females group with χ^2=0.85, p>0.05.(Table 1, Graph 1)

Table-1: Age and sex wise distribution of cases

Age	Male No. of cases	Female No. of cases
≤10	3	4
11-14	9	15
15-18	5	14
TOTAL	17	33
Mean±SD	13.0±2.24	13.75±2.58

χ^2=0.85 P>0.05 Not significant



Graph-1: Bar Diagram represents age and sex wise distribution of cases

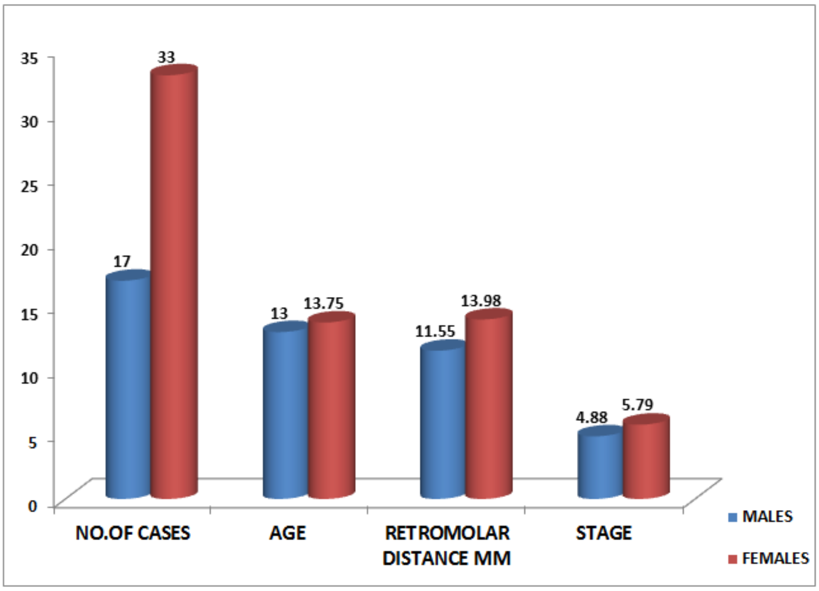
The mean age of the male patients was 13.0±2.24 and the mean age for female patients was 13.75±2.58.The t- value of 1.07 and p >0.05, indicates no statistical significance among the genders in their age distribution.

The mean retromolar distance of the male patients was 11.55±2.01and the mean retromolar distance of female patients was 13.98±3.86. The t-value was t=4.11 and p<0.05 indicates high statistical significance among the genders in their retromolar measurements.

The mean±SD of developmental stages for males was 4.88±2.34 and for females was 5.79±1.94 with t=1.41 and p>0.05 indicates no statistical significance among the genders in their developmental stages (Table 2, Graph 2).

Table-2: Comparision of males and females

Factors	Males	Females	t-Test value and P-value
No.of cases	17	33	50
Age (Mean±SD)	13.0±2.24	13.75±2.58	t=1.07 p>0.05 ,Not Significant
Retromolar distance mm (Mean±SD)	11.55±2.01	13.98±3.86	t=4.11 p<0.05 ,Highly Significant.
Stage (Mean±SD	4.88±2.34	5.79±1.94	t=1.41 p>0.05, Not Significant



Graph-2: Multiple bar diagram represents gender wise distribution of subjects, means age, mean retromolar distance and mean developmental

Correlation between age and retromolar distance

The correlation coefficient was r=0.646 and p<0.01 which indicates a highly significant positive correlation between age and retromolar distance. (Table 3, Graph 3)

Correlation between age and developmental stage

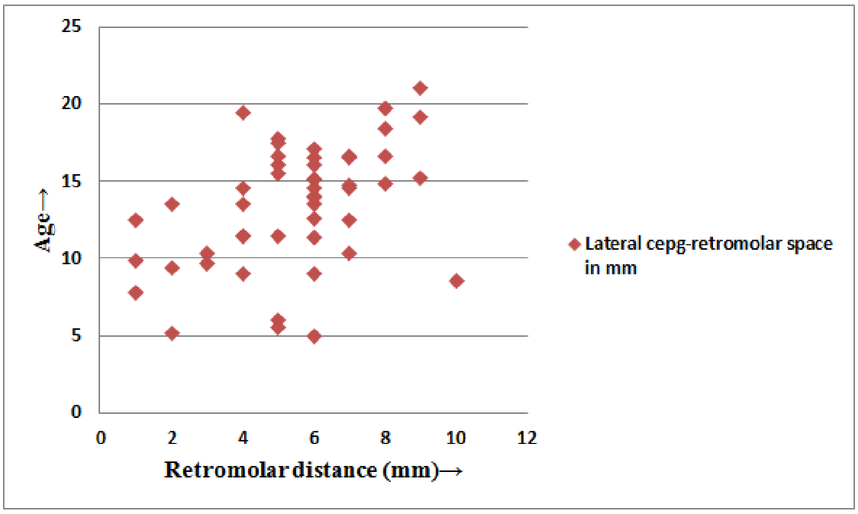
The correlation coefficient was r=0.721and p<0.01 which indicates a highly significant positive correlation between age and developmental stage (Table 3, Graph 4).

Correlation between developmental stage and retromolar distance

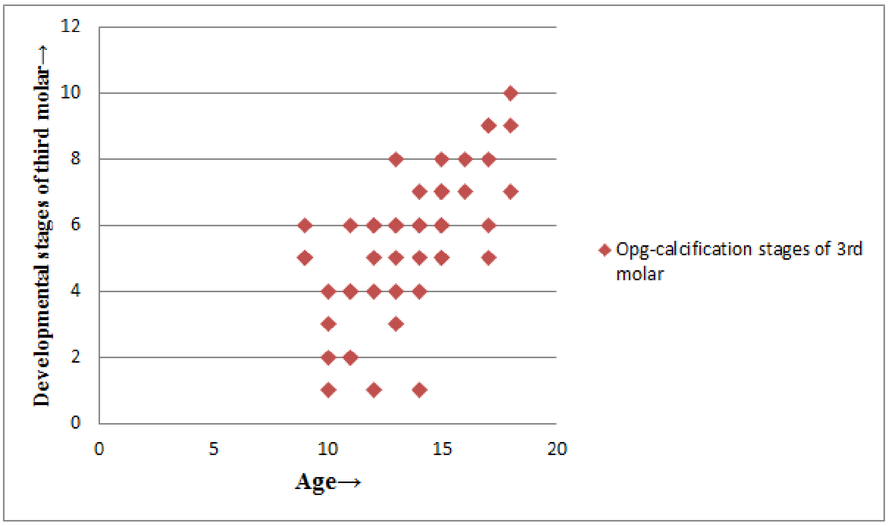
The correlation coefficient was r=0.783 and p<0.01 which indicates a highly significant positive correlation between age and retromolar distance (Table 3, Graph 5).

Table-3: Correlation between various factors

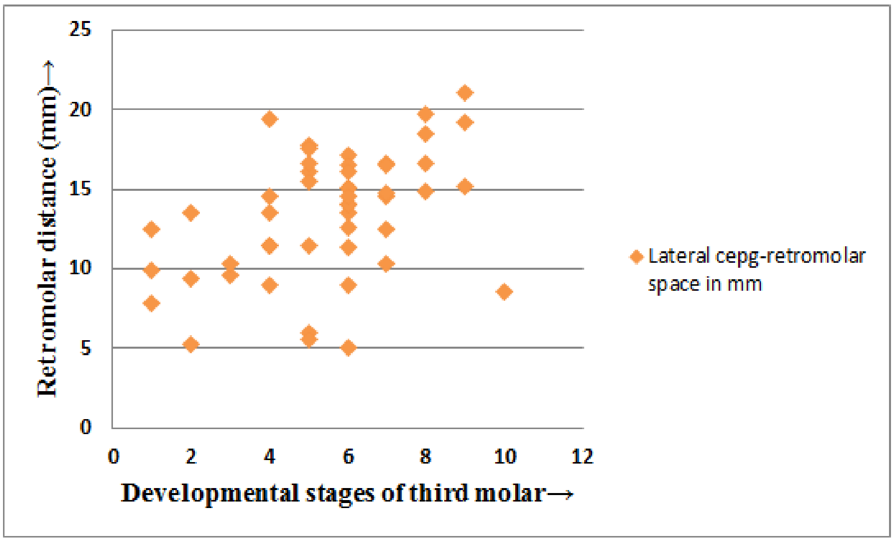
Correlation	Correlation coefficient r value	P-value and significance
Age & retromolar distance (mm)	r=0.646	p<0.01 Highly significant +ve correlation
Age & developmental stage	r=0.721	p<0.01 Highly significant +ve correlation
Developmental stage & retromolar distance (mm)	r=0.783	p<.0.01 Highly significant +ve correlation



Graph-3: Correlation between age & retromolar space in mm



Graph-4: Correlation between age and developmental stages of 3rd molar



Graph-5: Correlation between developmental stages & retromolar space in mm

The intraclass coefficient for the developmental stages was 0.99 and for the first molar to ramus distance was 0.96.

DISCUSSION

Our study comprised of a total of 50 randomly selected subjects (17males and 33 females), with age range from 9 to 20 years and 50 Digital Orthopantomograms and 50 Digital Lateral Cephalograms were utilized for the study. There was no statistically significant difference in the distribution of age among males and females groups. Maximum number of subjects were from age group 11-14 years where as minimum number of subjects were from age ≤10 years. This is due to fact that the radiography was difficult to perform at younger ages and legal and ethical consideration. Also in our study more number of subjects were females which may be due to more number of female subjects seeking orthodontic treatment.

In table 2 the retromolar distance showed a high statistical significance among the genders in their retromolar measurements, which was in consistence with previous study done by Ghougassian *et al*. [20] where only the retromolar distance was was significant.

In the table 3, graph 3 our results showed a highly significant positive correlation age and retromolar distance. Retromolar distance increased with age. An accelerated increase in retromolar distance was seen between 13 to 15 years of age. Previous studies done by Ghougassian *et al* showed an accelerated increase in the retromolar distance between 10 and 12 years.

In the graph 5 an increment of 5 mm in retromolar space corresponds to about 2.0 stages in tooth development where as in the other studies reported it was 1.8 stages.

CONCLUSION

From our study it can be concluded that there is a highly significant positive correlation between the developmental stages of mandibular third molar and the retromolar distance. Further the females showed early increase in the retromolar space than male subjects. An accelerated increase in the retromolar distance was in between 13 to 15 years and an increament of 5mm of retromolar distance corresponds to stage 2.

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