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# Effectiveness of digital OPG in ruling out the unpredictable behaviour of third molar eruption/impaction on basis of retromolar space analysis

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**Abstract**
**Background:** Shortage of eruption space between lower second molar and the ramus has long been identified as a major factor in the etiology of lower third molar impaction. The purpose of the present investigation was to evaluate the validity of a particular linear measurement made on digital panoramic imaging to be used as a reference for early prediction of lower third molar eruption or impaction.
**Materials & Methods:** A retrospective study was conducted by taking panoramic images of selective clinically examined patients. A total of 200patients were screened out of which 75 patients were found to be eligible for this study. The subjects were divided into three groups [Gr-A(13-14yrs), Gr-B(15-16yrs) and Gr-C(17-18yrs)] according to their age. The distance from 'Xi' to the distal aspect of mandibular second molar (DS-Xi) of both right and left side were measured (in mm.) for all panoramic images.
**Results:** Comparing the values of DS-Xi of left and right sides between the groups (irrespective of gender), statistically insignificant ($P>0.05$) results obtained. But while comparing the values of DS-Xi of left and right sides of all the males, females and in total (irrespective of groups); statistically significant ($P<0.05$) results were obtained.
**Conclusion:** The DS-Xi value has a diagnostic value in prediction of mandibular third molar eruption. Further parameters should be considered while assessing and more studies with larger sample size are recommended.

**Keywords:** distal aspect of mandibular third molars, panoramic images, Xi point

## Introduction
Radiographic analysis of the presence, position, and level of third molar formation plays pivotal piece of vital dental treatment planning. The impaction rate is higher for the third molars than for some other tooth in the cutting edge human populace. The deficiency of space between the second permanent molar and the mandibular ramus has been distinguished as a central point in the etiology of lower third molar impaction [1].
Between 9% and 20% of humans mandibular third molars do not develop as an inherited feature. This lack of inheritance is more frequent in men than women [2].
The mandibular third molar exhibits the highest rate of impaction. The rates, as reported by author [3-6].

- Hellman 9.5 %
- Bjork 25 %
- Ricketts 50 %
- Richardson 35 %

The etiology of mandibular third molar impaction has many sources which depend upon:

- Multifactorial elements
- Genetic factors
- Lack of space
- Retarded growth process
- Growth direction
- Eruption direction
- Influence of the external oblique line and buccinators

The eruption space for the mandibular third molar is also affected by the direction of tooth eruption during the functional phase of eruption [1].

While trying to foresee the likelihood of third molar eruption, many studies have been done; the greater part of them were utilizing dissected skulls or lateral cephalic radiographs. In view of image superimposition, it is not exceptionally exact when attempting to quantify the third molar's position and its possibility of eruption. In the wake of having led a watchful review and bibliographic audit, panoramic radiographs was chosen to make the expectation. This allowed one to envision both sides of the dental arch and measure the structures with minimal measure of superimposition [2].

Rickett's 'Xi' point represents the centre of the ramus.

## Materials and Methods

Subjects with complement of teeth, Class I Occlusal relationship, and with no history of orthodontic treatment were enrolled in this study. Digital panoramic imaging (Planmeca Proline Panoramic X-ray unit, Helsinki, Finland) was performed at 60 kVp, 5mA, using a 15-second exposure time. The study subjects were selected from the patients. The subjects were clinically examined and the panoramic images of the selected study subjects were taken. The sample consisted of 75 patients (irrespective of their sex) having developed or developing but unerupted lower third molars bilaterally. Prior consent has been taken from all the participants. The present study was conducted after approval by local ethical committee. Individuals with abnormal lower third molar morphology or absence of lower third molar or extracted lower first and/or second molars were excluded from the study.

The subjects were divided into the following 4 groups (Table 1):

1. Group A: 13-14 years
2. Group B: 15-16 years
3. Group C: 17-18 years
4. Control group: 17-21 years (Fully Erupted)

The following two points were determined and the linear distance between them were measured directly on the computer screen alter image standardization. The software used was Dimaxis Pro Version 4.1.4 (Planmeca Oy, Helsinki, Finland). The points were 'Xi' point (Center of the ramus) and the distal face of the second molar (DS-Xi).

DS-Xi represents the lower eruption space that measured by a line drawn from the distal surface of the lower second molar to Rickett's 'Xi' point (Center of the ramus). The Xi point was constructed by a rectangle of four planes. The rectangle can be made by four points i.e. R1 (the deepest point present at the curve of the anterior border of ramus) R2 (point just opposite to R1 present at posterior border of ramus), R3 (the most centered and inferior point at sigmoid notch) and R4 (a point right below R3 at lower border of mandible). Two horizontal planes pass through the points R3 and R4 and two perpendicular planes from Frankfort horizontal plane passing through R1 and R2; make the rectangle. Xi point is the centre of this rectangle.

## Statistical Analysis

Two-way Annova was used to compare between groups and T-test was used to compare among the values of left and right sides of DS-Xi among males and females. A P-value less than 0.05 were considered statistically significant.

## Results

The mean values of DS-Xi with ±SD (Standard Deviation) of left and right sides in males of group 'A' (Figure1) were 30.56±4.56 and 32.19±3.97 respectively and the mean of the total was 31.37±4.26. The mean values of DS-Xi with ±SD of left and right sides in females of group 'A' (Figure 2) were 30.32±2.61 and 32.09±3.72 and the mean of the total was31.2±3.16. In group 'B' the mean values of DS-Xi with ±SD of left and right sides in males were 31.7±3.39 and 34.59±4.64 respectively and the mean of the total was 33.14±4.01 and in the females were 27.82±3.42 and 30.32±4.36 respectively and the mean of the total was 29.07±3.89. Whereas in group 'C' the mean values of DS-Xi with ±SD of left and right sides in males were 28.96±4.93 and 33.88±3.85 respectively and the mean of the total was 31.42±4.39 and the values in the females were 27.26±4.23 and 31.92±3.82 respectively and the mean of the total was 29.59±4.02. The mean values of DS-Xi with ±SD of left and right sides of all the males, irrespective of groups were 30.42±4.29and 33.46±4.15 respectively and the mean of the total was 31.94±4.22 and in all the females the mean values of DS-Xi with ±SD of left and right sides, irrespective of groups were 28.29±3.42 and 31.39±3.96 respectively and the mean of the total was 29.84±3.69 (Table 2). The mean values of control group were explained in Table 3.

The mean value of all the males, irrespective of sides was 31.94±4.22 and of the females was 29.84±3.69. The mean value of DS-Xi in all the subjects, irrespective of gender; of the left and right sides were 29.35±3.85 and 32.42±4.05 and the mean of their total was 30.88±3.95 (Table 4).

While comparing the DS-Xi values of left and right sides among group 'A' v/s 'B'; we got statistically insignificant ($P>0.05$) results. While the same type of comparisons were carried out among group 'A' v/s 'C' and group 'B' v/s 'C', again we got statistically insignificant ($P>0.05$) results (Table 5).

But when we compared the DS-Xi values of left and right sides of all the males (i.e. Total 42 in number), we got statistically highly significant ($P<0.05$) result. The same statistically highly significant results were also seen in case of comparisons of the DS-Xi values of left and right sides of all the females (i.e. total 33 in number) and in total number of subjects (i.e. Total 75 in number) ( Table 6).

We had compared A+B+C against Control group in various combinations. The comparison of DS-Xi values of males and females we find highly significant difference among both right and left sides. The comparison again came highly significant when we compared the left and right side values of A+B+C against the Control group. Among comparing the total male and female population of A+B+C against the Control group yielded highly significant results (Table 7).

## Discussion

Several studies have demonstrated that panoramic radiology can give reliable measurements as can lateral skull radiographs. However, the right and left side' can be measured separately in panoramic radiographs and without any superimposition and this is not possible with traditional cephalograms. Digital technology further offers accurate viewing with numerous image adjustment capabilities that can be used to enhance the radiographic image. Direct linear and angular measurements are possible given a fiducial to calibrate for magnification [7-10].

Rickett's point (Xi) represents the center of the ramus and is considered as a physiologic center of occlusion that can be

accurately determined. Moreover, it is a stable point during mandibular growth [11-12].

For these reasons we suggest its superiority for lower eruption space analysis over that measured from the anterior border of the ramus, since the anterior border of the ramus could be resorbed during mandibular growth as one mechanism for retromolar space development [13].

Turley (1974) quoted by Schulh of (1976) [14] evaluated several methods of measuring the available space. He concluded that the most useful was the distance from "Xi", (center of the ramus) to the distal face of the second molar. The average distances proposed by Turley were 21 mm. for the impacted molars, 25 mm, for the erupted molars but out of position and 30 mm. for molars in occlusion. He thinks that the prediction could be performed from the age 8 or 9 years of age with 90% precision. According to Turley in 1974, this was corroborated by Rickets, 1976 [2].

Rickets (1976) [6] measured the distance from "Xi" to the distal surface that corresponds to the second molar on the occlusal plane, seen in a lateral cephalometric radiograph. We infer, taking this information into account, that a distance of 30 mm is enough for the eruption of the third molar to occur, and a distance of 20 mm, or less, is not enough.

In our study, we have taken the minimum age of the study sample as 13 years and the maximum age 18years because, according to data given by Wheeler's [15]; the crown formation of mandibular third molars start at an age of 13 years and completion occurs at around 16 years and the eruption age is about 17-21 years. Also the root formation starts from 15 years [16]. Thus we had divided the age groups as, starting and continuation of only crown formation of mandibular third molars (Group A: 13-14yrs), continuation and completion of crown formation and initiation of root formation of mandibular third molars (Group B: 15-16yrs) and completely formed crown with root development > 3/4$^{th}$ of total root length and on the verge of eruption/ impacted.

(Group C: 17-18yrs). So we had incorporated the minimum age of mandibular third molar crown formation and also the minimum age of eruption for early prediction of mandibular third molar impaction and /or eruption (Table 1).

The mean values of DS-Xi at right side are found to be more than that of the left side. This may be due to the growth rate of mandible is slightly higher in the right side as stated by Mota R *et al* (2010) [17] ( Table 2).

Irrespective of groups and of gender, the mean value of DS-Xi we got was 30.88±3.95 (Table 3). It was significant according to the average distances from 'Xi' to distal face of mandibular second molar proposed by Turley in 1974 [5]. According to the values given by him the chances of mandibular third molar eruption in our study population were high.

In our study population, there was no statistically differences present in the DS-Xi values among the three groups while comparing the left and right side (irrespective of gender) i.e. P>0.05. This signifies that with advancement of age the DS-Xi distance do not change i.e. the DS-Xi values of a 13yrs old does not differ much with the DS-Xi values of a 18yrs old (Table 4).

According to table 5, in right side more space is available for mandibular third molar eruption than left side. But no documented report/study is present of stating the chances of eruption of right mandibular third molar is more that of the left side. Since eruption of third molars depend upon various other criteria like; MDW, LES-R, α-angle, β-angle etc. So DS-Xi distance is not the only criteria to predict the eruption chances of mandibular third molar.


**Fig 1:** The DS-Xi value of left side of a male subject of Gr-A

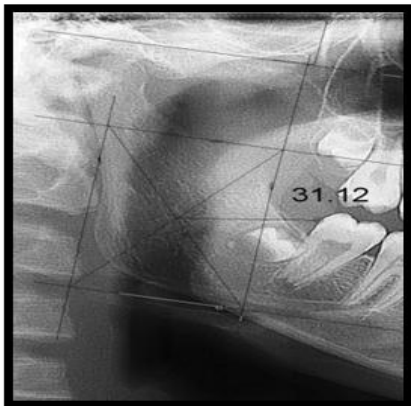


**Fig 2:** The DS-Xi value of right side of a female subject of Gr-A

**Table 1:** Age Wise Distribution of Study Sample among the Age Groups.

| Groups | Gender | | Total |
|---|---|---|---|
| | Male | Female | |
| A(13-14yrs) | 16 | 9 | 25 |
| B(15-16yrs) | 13 | 12 | 25 |
| C(17-18yrs) | 13 | 12 | 25 |
| Control (17-21yrs) | 12 | 13 | 25 |
| Total | 54 | 46 | 100 |

**Table 2:** Mean Values of Ds-Xi of Males and Females in Each Study Group

| Groups | Males (in mm.) | | Total |
|---|---|---|---|
| | Left | Right | |
| A | 30.56±4.56 | 32.19±3.97 | 31.37±4.26 |
| B | 31.7±3.39 | 34.59±4.64 | 33.14±4.01 |
| C | 28.96±4.93 | 33.88±3.85 | 31.42±4.39 |
| Total Mean Value | 30.42±4.29 | 33.46±4.15 | 31.94±4.22 |
| Groups | Females (in mm.) | | Total |
| | Left | Right | |
| A | 30.32±2.61 | 32.09±3.72 | 31.2±3.16 |
| B | 27.82±3.42 | 30.32±4.36 | 29.07±3.89 |
| C | 27.26±4.23 | 31.92±3.82 | 29.59±4.02 |
| Total Mean Value | 28.29±3.42 | 31.39±3.96 | 29.84±3.69 |

**Table 3:** Mean Values of DS-Xi of Control Group

| Control group | N | Left | Right | Total |
|---|---|---|---|---|
| Male | 12 | 33.74 ±2.73 | 35.76 ±3.19 | 34.75 ±2.96 |
| Female | 13 | 31.39 ±2.85 | 34.66 ±2.33 | 33.02 ±2.59 |
| Total | 25 | 32.52 ±2.96 | 35.19 ±2.77 | 33.85 ±2.87 |

**Table 4:** Mean Values of Ds-Xi (Irrespective Of Groups) Of Males and Females

| Gender | Left (in mm.) | Right (in mm.) | Total (L+R) |
|---|---|---|---|
| M | 30.42±4.29 | 33.46±4.15 | 31.94±4.22 |
| F | 28.29±3.42 | 31.39±3.96 | 29.84±3.69 |
| Total (M+F) | 29.35±3.85 | 32.42±4.05 | 30.88±3.95 |

**Table 5:** Comparison of Left and Right Side between the Groups.

| | Group A v/s B | | Group A v/s C | | Group B v/s C | |
|---|---|---|---|---|---|---|
| | L | R | L | R | L | R |
| F-value | 0.672 | 2.062 | 1.292 | 1.295 | 0.215 | 2.111 |
| P-value | 0.518 (N.S.*) | 0.145 (N.S.) | 0.286 (N.S.) | 0.285 (N.S.) | 0.807 (N.S.) | 0.129 (N.S.) |

*(Note:- N.S.= Not Significant)

**Table 6:** Comparison of Mean Ds-Xi between Left and Right Sides of Males and Females

| Gender | Sides | Mean±S.D. | T-test | P-value |
|---|---|---|---|---|
| Male | L | 30.42±4.29 | 3.249 | **0.002 (H.S.*)** |
| | R | 33.46±4.15 | | |
| Female | L | 28.29±3.42 | 3.283 | **0.002 (H.S.)** |
| | R | 31.39±3.96 | | |
| Total | L | 29.48±4.20 | 4.469 | **0.000 (H.S.)** |
| | R | 32.55±4.19 | | |

*(Note: - H.S.= Highly Significant)

**Table 7:** comparison of p-values between all the groups together against control group

| (A+B+C) v/s Control | | | |
|---|---|---|---|
| | | t-value | P-value |
| Male | Left | 2.528 | **0.007* (H.S.)** |
| | Right | 1.771 | **0.041* (H.S.)** |
| Female | Left | 2.891 | **0.003* (H.S.)** |
| | Right | 2.781 | **0.004* (H.S.)** |
| Left | | 3.758 | **0.000*(H.S.)** |
| Right | | 3.175 | **0.001*(H.S.)** |
| Male | | 3.987 | **0.000*(H.S.)** |
| Female | | 3.081 | **0.001*(H.S.)** |

*(Note: - H.S.= Highly Significant)

## Conclusion

Although various parameters are available to predict impaction/eruption of mandibular third molars, among them measurement of 'DS-Xi' distance is the easiest of method to predict the chances of eruption/impaction of mandibular third molars. But other parameters are also to be considered to predict accurately the eruption chances of mandibular third molars. Hence more studies are needed to assess all parameters and especially of DS-Xi to determine which parameter leads us to more accurate prediction. Future studies should recruit larger sample with various other types of parameters in different geographical areas and populations.

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