COMPARATIVE ANALYSIS REGARDING TWO METHODS FOR PREDICTING LOWER THIRD MOLAR IMPACTION
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ABSTRACT
Third lower molar is a major controversy in dental practice. The purpose of this study is to compare the reliability of two radiographic methods used to predict third lower molar prognosis of eruption or impaction. 109 children, with ages between 12 and 19 years were enrolled in our study. For all subjects we measured the retromolar available space and lower third molar inclination on the orthopantomograms and lateral cephalometric films. The measurement of the retromolar space has similar predictive value on both films, especially for those third molars with 100% chances of impaction or eruption. The correlation analysis for the angle between the long axis of the lower third molar and the mandibular plane measured on orthopantomograms, respectively on lateral cephalometric film showed that $R^2 = 0.439$, which means significantly statistic direct correlation between this two variables.

Key words: third molar; prediction; impaction

INTRODUCTION
The mandibular third molar is a major problem facing the dental profession and it is by far the most frequently impacted tooth. One explanation for the high impaction rate might be insufficient development of the retromolar space. If the remodelling resorbtion at the anterior mandibular ramus is limited, the eruption of the mandibular third molars could be blocked. The variation in resorbtion is correlated with the direction of condylar growth [1]: vertical condylar growth is associated with reduced resorbtion at the anterior aspect of the ramus and forward growth rotation of the mandible, whereas more backward-directed growth at the condyles is associated with increased resorbtion and posterior growth rotation.

Richardson [2] found that another explanation for mandibular third molar impaction might be an unfavourable path of eruption. Although the third molar bud is mesially angulated during the initial stages of calcification and root development, it should upright properly in order to be able to erupt. There are indications that excessive initial mesial angulation and minimal uprighting might increase the likelihood of impaction.

Many attempts have been made to analyse the predictive value of the adolescent eruption space for mandibular third molar impaction. Most of the authors considered that the orthopantomogram is the most useful exam for third molar prediction of eruption [3, 4, 5], while others used the lateral cephalometrics for third lower molars assessment [2, 6]. In our study we used both methods for measuring the available molar space and third molar angulation according to mandibular plane in order to establish if any
correlation exists between linear and angular parameters on orthopantomogram and lateral cephalometrics.

MATERIAL AND METHODS
The study population consisted of 109 subjects (72 girls and 37 boys) seen in the Department of Orthodontics and Dentofacial Orthopedics, University of Medicine and Pharmacy “Gr. T. Popa” - Iasi, Romania and in a private dental office. None of the subjects had received orthodontic treatment before. The mean age of the subjects was 13.52 years (range 12 to 19 years). Orthopantomograms and lateral cephalograms were taken through use of a standardized technique by means of an X-ray device (Strato X, Villa Sistemi Medicali). The magnification of the orthopantomograms is x1.2. All cephalograms were made with a standard focus-to-object distance of 1.5 m. The film cassette was adjustable in a lateral direction and was typically placed as close to the cephalostat as possible. The radiographs were traced on overlying acetate paper and analysed by a single observer. The reproducibility of the measurements was assessed by statistically analyzing the difference between double measurements taken at least 1 week apart on 10 subjects randomly selected.

Dimensional radiographic measurements of the third molar and mandible were carried as follows:

A. On the orthopantomograms (Fig. 1)
1. The retromolar available space was measured as the distance between the distal aspect of the lower second molar and the anterior border of the mandible along the occlusal plane. Considering that most of our subjects are during a growth period and for more accurate results, we considered the expected retromolar space by adding 1.5 mm/year up to 15 years for girls and up to 17 years for boys [7].
2. The mesiodistal diameter of the lower third molar was measured as the distance from the mesial to the distal contact points. We calculated the difference between the expected retromolar space and the lower third molar diameter. Mesioangular inclination of the third molars measured as the angle formed between the long axis of the tooth and the lower border of the mandible (angle β).

Fig. 4. Radiographic measurements for lower third molar on the orthopantomograms

Fig. 5. Radiographic measurements for lower third molar on lateral cephalometrics

B. On the lateral cephalometrics (Fig. 2)
1. Distance between the distal aspect of the lower second molar and point Xi, the geometric center of the mandibular ramus (DXi). According to Ricketts [8] this is the best measurement for the evaluation of the posterior space on lateral cephalometrics. Mesioangular inclination of the lower third molar measured by the angle formed...
between its long axis and the mandibular border (Angle λ).

A statistical analysis was carried out of the relationship between measurement values obtained on orthopantomograms and lateral cephalometrics using ANOVA analysis of variance and Pearson correlation analysis in SPSS software 17.0 for Windows.

RESULTS

The study sample consisted of 109 subjects, 72 girls and 37 boys with ages between 12 and 19 years, mean age 13.52. Most of the children were 12 years old (40 subjects) which is the appropriate age for the beginning of the normal orthodontic treatment. Furthermore, according to Richardson, the crown of the third molar is visible on the X-ray films after the age of 12. The number of the lower third molars taken into study was 185.

The differences between the estimated retromolar space and the mesio-distal diameter of the lower third molar measured on orthopantomograms were divided in 4 groups:

- a) $\Delta L < -2$ mm
- b) $-2 \leq \Delta L < 0$ mm
- c) $0 \leq \Delta L < 2$ mm
- d) $\Delta L > 2$ mm

According to Hattab [3] and Venta [9] the lower third molar has great chances for normal eruption if the retromolar space is more than 16 mm, and the difference is more than 2 mm. Poor prognosis for eruption and great probability of impaction have those molars for which the retromolar space is less than 11 mm, and the difference between the retromolar space and the mesiodistal diameter is less then -2mm.

The distances between the distal aspect of the lower second molar and point Xi, the geometric center of the mandibular ramus (DXi) measured on lateral cephalograms were divided also in 5 groups:

- a) $DXi < 20$ mm
- b) $20 \leq DXi < 23$ mm
- c) $23 \leq DXi < 25$ mm
- d) $25 \leq DXi < 28$ mm
- e) $DXi > 28$ mm

Tulley and Schullhof [10] concluded in their previous studies that for a distance DXi greater than 28mm the lower third molar has good prognosis for eruption, while for DXi less than 19 mm there are 100% chances for impaction.

<table>
<thead>
<tr>
<th>$DXi$</th>
<th>$\Delta L$</th>
<th>Number</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; -2</td>
<td>-2, 0</td>
<td>0-2</td>
</tr>
<tr>
<td>&lt; 20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>18</td>
<td>5</td>
<td>3</td>
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<tr>
<td>%</td>
<td>66.7%</td>
<td>18.5%</td>
<td>11.1%</td>
</tr>
<tr>
<td>[20, 23)</td>
<td>Number</td>
<td>34</td>
<td>16</td>
</tr>
<tr>
<td>%</td>
<td>50.0%</td>
<td>23.5%</td>
<td>10.3%</td>
</tr>
<tr>
<td>[23, 25)</td>
<td>Number</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>%</td>
<td>23.7%</td>
<td>23.7%</td>
<td>21.1%</td>
</tr>
<tr>
<td>[25, 28)</td>
<td>Number</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>%</td>
<td>18.4%</td>
<td>36.8%</td>
<td>13.2%</td>
</tr>
<tr>
<td>$\geq 28$</td>
<td>Number</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>%</td>
<td>14.3%</td>
<td>7.1%</td>
<td>.0%</td>
</tr>
<tr>
<td>Total</td>
<td>Number</td>
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</tr>
<tr>
<td>%</td>
<td>37.8%</td>
<td>24.3%</td>
<td>12.4%</td>
</tr>
</tbody>
</table>

Table 1. Crosstabulation - distance $DXi$ on lateral cephalograms / $\Delta L$ calculated on orthopantomogram
For growing subjects we used in our analysis the estimated Xi value, according to Langlade [11], who found that the Xi point moves in a backwards and downwards direction with 1mm/year up to 15 years for girls and 17 years for boys due to the growth of the mandibular ramus.

Correlation between ∆L, the difference between the expected retromolar space and mesiodistal diameter of lower third molar measured on orthopantomogram and DXi, the distance between the distal aspect of the lower second molar and point Xi, measured on lateral cephalograms (Table 1 and Fig. 3).

Correlation between angle β and angle λ formed by the long axis of the lower third molar and the mandibular plane measured on orthopantomograms and on lateral cephalograms (Table 2).

<table>
<thead>
<tr>
<th>Angle β Pearson Correlation</th>
<th>Angle λ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.662(∗∗)</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>185</td>
</tr>
<tr>
<td>185</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Chi – square test angle β and angle λ

p<0.005 means that there is a direct proportional correlation of low intensity between this two variables. The regression coefficient $R^2 = 0.439$, which means that 43% of the β angle values correlate significantly statistic with λ angle values (Fig. 4).

DISCUSSIONS

The lower third molar remains a current controversy in dental practice. There has been considerable research regarding the more accurate methods for predicting lower third molar eruption or impaction. Some authors, such as Hattab [3], Venta [9], Altonen [6] advocated that orthopantomogram is the most reliable exam for early prediction of lower third molar prognosis of eruption by measuring the retromolar space and mesioangular inclination of the tooth in relation to lower second molar axis, mandibular and oclusal plane. Others, such as Richardson [2], Ricketts [8]) Tulley [10] and Merrifield [7] found that lateral cephalograms are relevant for measuring the available space and third molar angulation.

In our research we studied the relationship between correspondent variables measured separately on orthopantomograms and lateral cephalograms for the same subjects. Hattab [3] found that if the difference between the retromolar space and the mesiodistal width of the lower third molar measured on orthopantomogram is less than – 2 mm there is 100% prognosis for third molar impaction. Similar findings are described by Tulley [10] and Ricketts [8] for a distance DXi less than 20 mm on the lateral cephalometrics. Our results showed in figure 3 that 66,7% of the third molars in which $\Delta L < -2$ mm have DXi.
<20 mm. Furthermore, 78.7% of the third molars with $\Delta L > 0$ mm, which means a good prognosis of eruption, have $\text{DXi} > 28$ mm. There some uncertain results in group $\Delta L = [-2-0)$ mm (low chances for third molar eruption) where 38.6% of the lower third molars have $\text{DXi} = [25-28)$ mm, which means 75% chances for eruption evaluated on lateral cephalograms. These results could be explained by the errors raised during the process of accurate identification of the lower third molars on lateral cephalometric film.

The angle formed by the lower third molar long axis with the mandibular plane measured on orthopantomogram and lateral cephalometric film showed significant similar predictive values, despite the changes in the inclination of the mandibular baseline in the panoramic technique.

**CONCLUSIONS**

The lower third molar prediction remains a subject of research for orthodontists, surgeons and dental practitioners. There are two common available methods for lower third molar prediction, one of them using measurements made on orthopantomogram and the other one using measurements on lateral cephalogram, but none of them can give an accurate prognosis for third molar eruption or impaction. The orthopantomogram is more reliable for the assessment of lower third molar available space and the lateral cephalogram allows for better angular measurements. The major disadvantage of the lateral cephalogram is the superposition of the two lower third molars and the difficulty in the interpretation of the measurements.

Further research is needed in order to develop new techniques and measurements for third lower molar prediction of eruption or impaction.

**REFERENCES**

2. Richardson ME. Late lower arch crowding: the etiology reviewed. Dent Update 2002; 29, 234.