

**INFLUENCE OF THE PREMOLAR EXTRACTION ON PREDICTING  
ERUPTION OF THIRD MOLAR****Ines Dallel<sup>1</sup>, Dhekra Hammouda<sup>2</sup>, Sana Hannachi<sup>1</sup>, Moncef Ommezine<sup>3</sup>, Samir Tobji<sup>1</sup>,  
Adel Ben Amor<sup>1</sup>****<sup>1</sup>Professors, PHD- University of Monastir, Faculty of Dental Medicine, Dento-Facial  
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Orofacial Rehabilitation, LR12ES11, 5000 Monastir, Tunisia;****<sup>2</sup>Doctors(DDS) University of Monastir, Faculty of Dental Medicine, 5000 Monastir,  
Tunisia;****<sup>3</sup>Professor University of Monastir, Faculty of Dental Medicine, Laboratory of Oral Health  
and Orofacial Rehabilitation, LR12ES11, 5000 Monastir, Tunisia;****Received: 10-02-2021 / Revised: 13-03-2021 / Accepted: 11-05-2021****Corresponding author: Dr Dallel Ines****Conflict of interest: Nil****Abstract****Objective:** The aim of this work was to evaluate predictive factors for wisdom teeth impaction in the upper and lower jaw and to establish two predictive models.**Materials and methods:** This study was performed on 90 patients who had been treated with and without premolars extraction. Lateral cephalograms of pretreatment and post-treatment were evaluated. Logistic regression analyses were performed in order to extract two predictive formulas.**Results:** The maxillary formula documented that premolar extraction enhances the chance of eruption by more than ten times, 1mm increase in PTM-M increases the risk of impaction by 68%. The mandibular formula revealed that premolar extraction enhances the chance of third molar eruption by more than 4 times, 1mm increase in posterior space decreases the risk of impaction by 54%.**Conclusion:** Prediction of third molar impaction can be executed before orthodontic therapy based on the retro-molar space and the extraction decision.**Keywords:** Orthodontic, prediction, impaction, premolar extraction, wisdom teeth

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## Introduction

Impaction of the third molars is a subject of controversy that continues to interest the dental profession. Impaction is more probably to appear because of insufficient space. Although, an abnormal path of eruption was associated with impaction. However, most authors believed that the crucial cause is the lack of space<sup>1-5</sup>. Maxillary retro-molar space is influenced by tuberosity growth, alveolar growth and the mesial molars movement<sup>6</sup>.

In the mandible, it is influenced by anterior border of the ramus resorption and the path of eruption during the functional phase<sup>7</sup>

First, mandibular third molar develops with a mesial inclination in the ramal region<sup>8</sup>. To assume physiological eruption, it should undergo an up-righting movement which become possible only with sufficient jaw growth<sup>9</sup>. In the upper jaw, the molar germs develop with a distal occlusal inclination. When maxillary growth was sufficient, it change its position<sup>9,10,11</sup>

Besides, wisdom teeth is associated with various pathologies<sup>7,11</sup>. Moreover, it was demonstrated that molars impaction influence orthodontic treatment stability by causing secondary crowding<sup>12</sup>.

The early prediction of third molar eruption has a great benefit to the orthodontist. It will help him plan the treatment and also optimize the time of surgical intervention if it's

necessary.

Attempts have been made to predict third molar impaction<sup>3,5,13-18</sup>. However, the aims of these studies were to give a prognosis for mandibular third molar situation in cases treated without orthodontic treatment. Hence, their findings do not take into consideration the influence of orthodontic therapy especially with premolar extraction.

The aims of this work were to develop two formulas for wisdom teeth impaction, and to identify predictive factors.

### Materials and methods:

The present retrospective study was performed in the orthodontics department. It has reviewed 90 records of orthodontic patients. The sample is comprised of 69 females and 21 males with mean ages 15.8[SD 1,8], classified in two groups; 46 patients of non-extraction therapy (51.1%) and 44 patients of extraction therapy (48.9%) (23 subjects treated with first premolar extraction and 21 subjects treated with second premolar extraction). Exclusion criteria were as follows: patients with erupted third molar at T1, dento-facial malformation, syndrome, missing or supernumerary teeth.

Lateral cephalograms, study models were analyzed. The following variables were noted; **(Figure 1-2)**

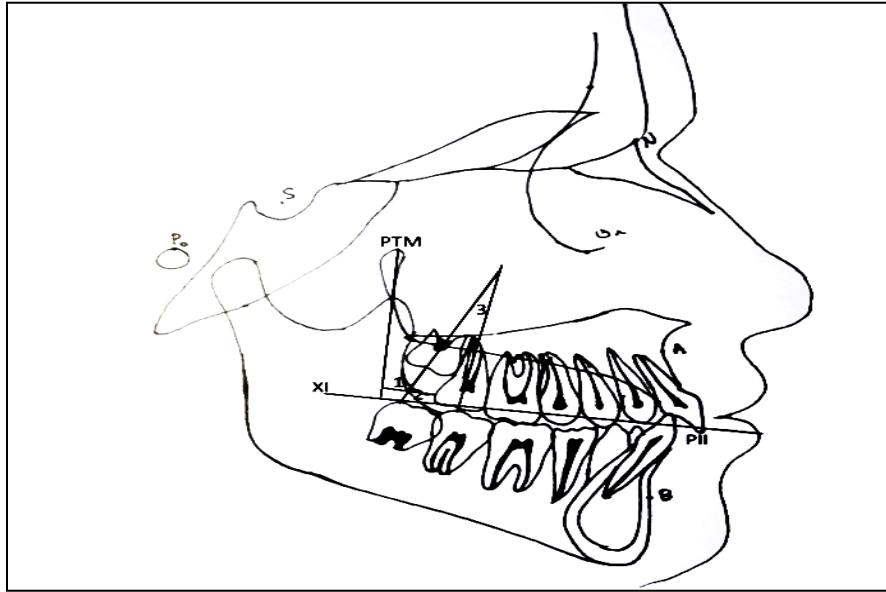


Figure 1

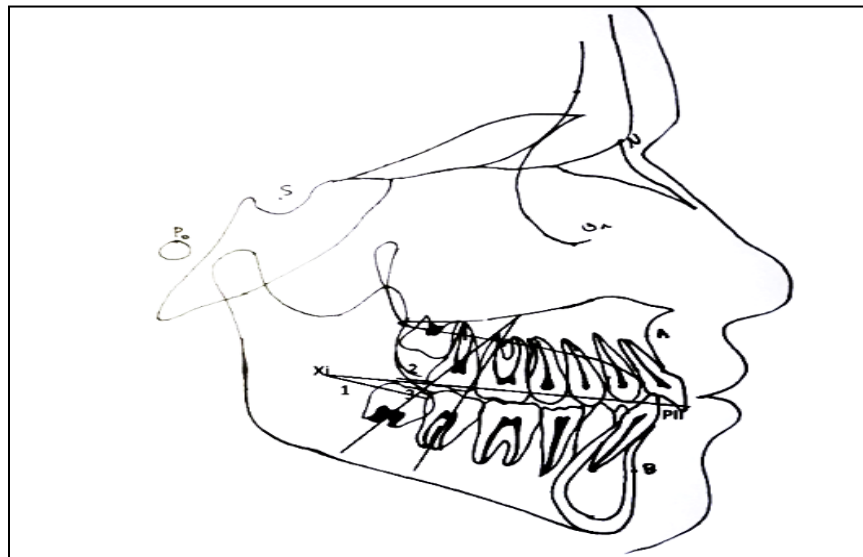


Figure 2

- Axial inclination of third molar: two angles were analyzed;

\* The angle in relation to the longitudinal axis of third and second molar (angle M2M3(3)),

\* The angle in relation to the longitudinal axis of third molar and a constructive plane,

that was defined from Ricketts Xi point to the inter-incisor point (angle M3(2)).

- Retro-molar maxillary space (1) taken from point ptm to the distal point of the second molar (Ptm-M).

- Retromolar mandible space taken from EP point and the distal point of the second molar (PS)(1).

- XI-M: is space between XI point and the distal surface of the second mandibular molar. The measurements were performed out by another examiner to determine the reliability of our examination.

In order to create a predictive model for third molar eruption, each wisdom tooth was classified on lateral post-treatment cephalogram:

Favorable eruption conditions for the mandibular molar:

- 1-  $Xi-M \geq 25mm$ <sup>19</sup>
- 2- The angle between the second and third molar is between 0 and 15 % eruption
- 3- The posterior space  $\geq 12$  mm for an 11mm tooth
- 4- The angle% at the occlusal plane is between 60 ° and 90 °

Favorable eruption conditions for the maxillary molar:

- 1- The posterior space  $PTMM \geq 12$  for a tooth with a diameter of 11mm<sup>21</sup>
- 2- The angle between the second and third molar is between 0 and 15 °<sup>18,20</sup>
- 3- The angle% occlusal plane is between 60 ° and 90 ° favorable position<sup>22,23</sup>

Each wisdom tooth is judged to be in a favorable eruption situation when it satisfies all the conditions mentioned and it will be coded "1", otherwise if one of these conditions is absent it will be coded "0".

#### Statistical analysis:

The data were studied using SPSS program for window (version 20.0). Chi-square test was used on qualitative variables and Student test was used on quantitative variables to identify predictors. The candidate variables for the model must have a significance  $\leq 0.2$ .

Logistic regression analyses were used to establish predictive formula. First, correlation between variables and impaction were examined with univariate logistic regression.

#### Results:

##### For the third maxillary molar

The logistic regression analyses reported that premolar extraction reduce the risk of impaction by ten times, 1mm increase in PTM-M increases the risk of impaction by 68%. Dento-maxillary disharmony (DMD) was found to be a marginal risk factor in the previous logistic regression which increases the risk of impaction by 11% (tables 1-2).

**Table 1: Predictors identification for the maxillary model**

Qualitative variables tested by chi-square test	Signification
FMA group	<b>0.101*</b>
CS group	<b>0.121*</b>
Treatment	<b>0.000*</b>
Quantitative variables tested by student 't test	Signification
DMD	<b>0.000*</b>
PTM-M(T1)	<b>0.000*</b>

**Table 2: The variables included in the final prediction maxillary model according to forward stepwise logistic regression**

	A	E.S.	Wald	ddl	Sig.	Exp(B)	CI pour Exp(B) 95%	
							inferior	Superior
<b>PTMMax</b>	0.523	0.154	11.565	1	0.001	1.688	1.248	2.282
<b>Extraction</b>	2.380	0.722	10.870	1	0.001	10.807	2.625	44.488
<b>Cst</b>	-5.912	1.250	22.371	1	0.000	0.003		

The probability of maxillary wisdom teeth impaction could be predicted based on:

$$\text{Extraction} \times 2.380 + \text{PTM-M} \times 0.523 - 5.912$$

### Mandibular molar

Logistic regressions analyses proved that premolar extraction improves the chance of eruption by plus than 4 times, 1mm increase in posterior space reduces the risk of impaction by 54%. Facial divergence was found as marginal risk factor ( $p > 0.06$ ); an augmentation of  $1^\circ$  in GoGn/Sn increase the risk by 14.5%.

The probability of mandibular third molar impaction could be predicted based on (tables 3-4)

**Table 3: Predictors identification for the mandibular model**

Qualitative variables tested by chi-square test	Signification
Treatment	0.085*
ANB group	0.059*
CS group	0.119*

Quantitative variables tested by Student's t test	Signification
Age	0.144*
DMD	0.019*
GoGn/SN	0.082*
m3 (T1)	0.162*
PS (T1)	0.000*
Xi-M (T1)	0.003*

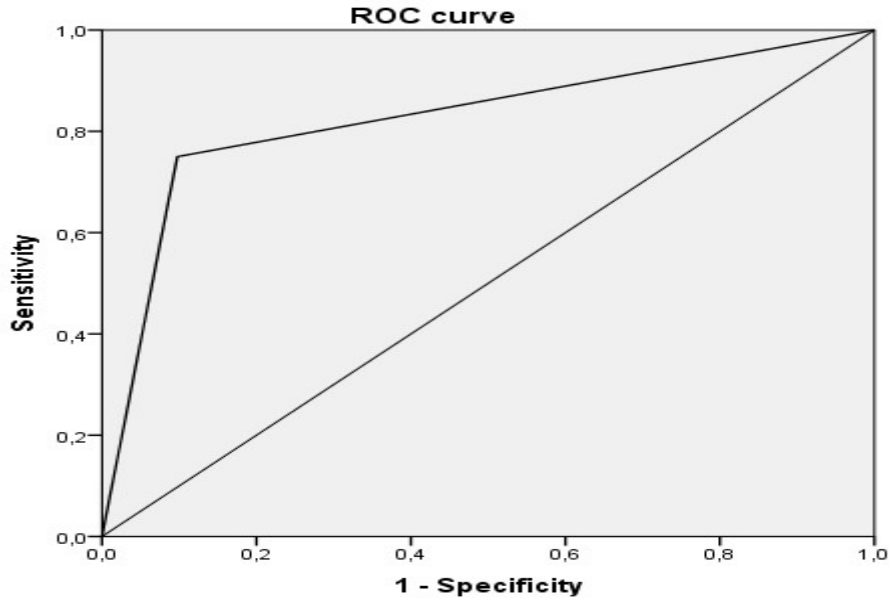
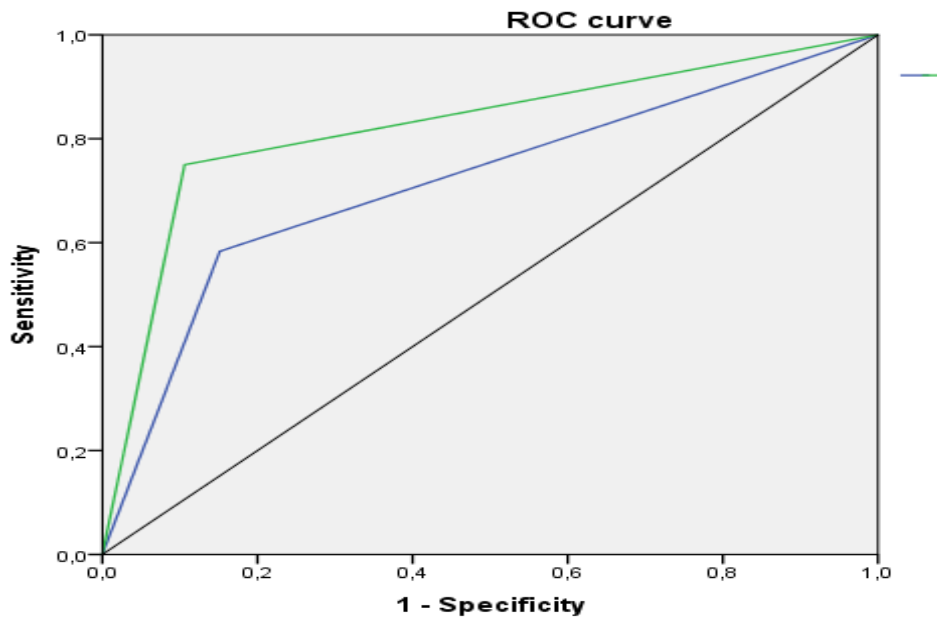
\* All candidate variables for the model must have a significance  $\leq 0.2$

**Table 4: The variables included in the final prediction mandibular model according to forward stepwise logistic regression**

	A	E.S.	Wald	ddl	Sig.	Exp(B)	CI pour Exp(B) 95%	
							inferior	Superior
<b>Extraction</b>	1.507	0.788	3.661	1	0.056	4.514	0.964	21.139
<b>PS</b>	0.437	0.114	14.724	1	0.000	1.548	1.238	1.935
<b>Cst</b>	-5.299	1.145	21.400	1	0.000	0.005		

**Extraction x 1.507 + Posterior space x 0.523 - 5.299**

The Roc curves obtained (**figure 3 and 4**) are between two extremes 100% and 45% while approaching the upper left corner of the graph (100%) and present a curved appearance; this means that the variables have an important diagnostic value. Air under the Roc curve is equal to 82.2% and 82.6% for in the upper and lower jaw respectively.

**Figure 3****Figure 4**

**Discussion:**

The results obtained support previous suggestions that premolar extraction improves the eruption chance of third molars thanks to the expansion of available space concomitant with molar movement during space closure. However, there is an individual variation in this effect. Our finding proved that initial retro-molar space has the most predictive value for third molar eruption.

Niedzielski<sup>15</sup> established a predictive equation by following 64 patients. In their theory, retro-molar space/ crown width ratio and the angle between the third and second molar (A) and to the lower border of the mandible (B) were conclusive factors of wisdom teeth development;

Uthman A.<sup>16</sup> (2007) conducted a study on 50 patients by observing panoramic radiographs. They concluded that for lower third molar eruption five conditions must be satisfied; posterior space should be higher than 11mm and 12mm for females and males respectively. Second, the distance XI-M needs to be superior to 27mm and 29mm for females and males respectively. Then, third molar angle must be 40° at least. Finally, space ratio (R) has to be greater than 0.88 and 0.85 for females and males each and space ratio (Xi) should be more than 2. He claimed that third molar angle, gonial angle and eruption space are the variables funded in the model prediction.

Begtrup A.<sup>17</sup> combined mandibular length with the second molar width to create a predictive method of mandibular third molar eruption. He claimed that the odds ratio for mandibular length was 1.34 and 1.16 in the left and the right side each. However, the length of mandible was taken from a marginal alveolar point that could exhibit several

variations due to resorption, also, the sample was limited.

Verma<sup>24</sup> found predictive equation that included retro-molar space and the angle between third molar and mandibular plan with positive correlation for both factors. In addition, the angle between third and second molar showed a strong negative influence. However, the imaging method employed reduced the accuracy of prediction.

Haavikko<sup>25</sup> stated that third molar initial angulation is the most determinant variable. Third molar could equally remain at the same angle or develop a smaller or larger angle from 10° to 20°. While favorable eruption was noted if initial angulation was lower than 10°. Wolft<sup>26</sup> stated that deformation created by external forces influence external bone tissue. He claimed that the increase in retro-molar space was concomitant with bone expansion and ramal resorption in case of appropriate initial angle.

Schulhof<sup>27</sup> reclaimed that if posterior space related to Xi was lower than 25mm, there is high probability of impaction. Alternatively, maxillary third molar had a high chance of impaction if maxillary posterior space was less than 18mm. However, the data of Kim and al<sup>21</sup> questioned the validity of this finding. He found 20% of impaction despite a distance of 18mm or more and 60% of eruption despite a distance of Xi-M below 23mm.

The purposes of these studies were to give a prognosis for ultimate mandibular third molar situation in cases treated without orthodontic treatment in order to decide whether there is a necessity of their extraction. Hence, their findings do not consider the influence of orthodontic treatment. In fact, the type of treatment executed influence wisdom teeth evolution. In the cases with severe DMD, anterior teeth alignment could supply all the

extraction space. In other cases, retro-molar space increases due to mesial molar movement during space closure. Moreover, previous observations proved that orthodontic treatment is a risk factor for impaction<sup>28-31</sup>. Silling<sup>28</sup> indicated that non-extraction therapy by holding back or tipping molars increases impaction risk; rotational movement did not occur until forward migration of molars take place. Hence, orthodontic treatment presents a crucial factor to predict the developmental course of third molars.

In contrast, we are trying to predict maxillary and mandibular third molar eruption in orthodontic patients treated with and without premolar extraction. We concluded that the probability of third molar eruption improves with an increase in retro-molar space. Hence, according to the initial retro-molar space and the choice of orthodontic treatment, the probability of impaction can be predicted:

**Extraction x 2 .380 + PTM-M x 0.523 - 5.912 for maxillary third molar**

**Extraction x 1.507 + Posterior space x 0.523 - 5.299 for mandibular third molar**

We support recommendation to choose non-extraction treatment in border line cases to avoid the loss of maxillary and mandibular teeth. Alternatively, Artun and Behbahani<sup>2,32</sup> followed 123 orthodontic patients to distinguish predictors of wisdom teeth impaction. They found that the probability of maxillary and mandibular impaction decrease by 76% and 63% respectively if premolars extraction therapy was performed and by 13% and 30% respectively with every millimeter increase in posterior space. They also conducted two formulas for pretreatment and post treatment

prediction. The odds of impaction of maxillary third molars was according to Artun Pretreatment exp [3.91 - 0.26(M1/PTV) - 0.42(MM T1/T2)].

Post-treatment exp [10.48 + 4.21(M3/OP <0) + 1.59(M3/OP >30) - 0.34(M1/PTV) - 0.20(MP/SN)]. The probability of mandibular wisdom teeth impaction was according to Behbahani;

Pre-treatment expo (30.45 - 1.83 [gender] - 0.69 [M2/Xi] - 0.19 [gonial angle]).

Post-treatment expo (- 6.05 - 0.27 [M2/Xi] - 0.13 [M3/OP] - 0.30 [beta angle]).

The unusual finding in the pretreatment mandibular formula was that gender was the most significant factor with six-fold increase because of the over-presented number of females among the excluded patients. Hence, this formula wasn't specific. However, variables included in our equation were different from the previous study, this can be explained by the difference between methods, and on the other hand, by the difference between the ethnic characteristics of the two samples (North Africa and Middle East) with variations between cephalometric standards and aesthetic criteria of the two countries.

Our multivariate analyses also suggest a marginal association between facial divergence and mandibular third molar impaction by 14.5% with 1° in GoGn/Sn increase. In this context, Kaplan<sup>8</sup> examined 1500 cases of orthodontic patients, he found that the mandibular jaw morphology associated with a large jaw angle was significantly associated with higher risk of impaction. In contrast, other studies<sup>2,3,5,20,21</sup> reported that mandibular third molar is associated with small jaw angle. Bjork et al.<sup>5</sup> believed that a large jaw angle is

associated with a large posterior space, as the condylar growth would be sagittal and therefore mandibular length increases. He found also that an anterior rotated growth type influence retro-molar space due to limited resorption of the anterior border of the ramus. Despite the high rate of maxillary third molar impaction, only few studies have interested in their development.

Indeed, our study brought a scientific value of predicting the evolution of wisdom teeth thus providing a therapeutic guide of choice to help the orthodontist in his treatment plan. This formula also requires a clinical check after the complete eruption of third molars which is the result of a prospective 10-year follow-up study.

### Conclusion:

In borderline cases, we note the following recommendations;

- Treatment with premolar extraction will improve the chances of eruption if a sufficient molar mesial movement during extraction-site closure would take place,
- To avoid additional extraction of the four teeth, the clinical implication is to choose a treatment without extraction of premolars in cases with high risk of impaction.
- For cases at high risk of impaction, the therapy of choice is the prophylactic enucleation of wisdom teeth (germ) before the start of its pre-eruptive movements.

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