138. Only patients with no previous orthodontic treatment and no missing permanent teeth in the mandible were included. All the teeth in the mandibule were at the occlusal level and the root structure of the lower third molar was at least 2/3. The minimum accepted age was 17 years old. The cases with the mandibular third molar not visible on the panoramic X-ray (by agenesis, extraction, or others) and labio-alveolo-palatal clefts cases were excluded.

The X-rays have been classified into 2 groups:

- Group 0: with the 3rd lower molar included.
- Group 1: having advanced lower 3rd molar in functional position (the occlusal face of the 3rd lower molar is on the occlusal plane and no part of the crown is included in the ramus).

Measurements made on dental panoramic: (Figure 1)

- X° (**LM3/LM2 Angle**): angle formed between the axis of the 3rd and the 2nd mandibular molars. The axes were drawn between the central point of the occlusal face and the point of the root bifurcation.
- Y° (**LM3/mandibular edge Angle**): angle formed between the axis of the 3rd lower molar and the tangent of the lower mandibular edge.
- RMS (mm): The retro molar space between the most distal point of the distal face of the 2nd lower molar and the point of intersection between the occlusal plane and the anterior border of the ramus. The occlusion plane is the line joining the apex of the uppermost cusp of the 2nd lower premolar and that of the mesial cusp of the 2nd lower molar. Its layout is done by hemi arcade.
- LM3d (mm): largest mesio-distal coronal diameter of the 3rd lower molar
- RMS/LM3d Ratio: retromolar space / the 3rd molar mesio-distal diameter.

Figure 1: Measurements made on dental panoramic.
RMS (mm): retro-molar space
LM3d (mm): third lower molar mesio distal diameter
X°: angle between LM2 and LM3
Y°: angle between LM3 and mandibular edge

Measurements made on lateral teleradiographs (Figure 2)

The following cephalometric markswere located:

- Sella (S): the midpoint of the sella turcica (pituitary fossa);
- Nasion (N): the most anterior point on the frontonasal suture in the midline;
- Gnathion (Gn): the most anterior and inferior point on the bony chin;
- Gonion (Go): the most posterior and inferior point on the angle of the mandible;
- Point A (subspinale): the deepest point on the curved profile of the maxilla between the anterior nasal spine and alveolar crest;
- Point B (supramentale): the deepest point on the curved profile of the mandible between the chin and alveolar crest.

Then the ANB (angle between line NA and line NB) and GoGnSN (angle between line GoGn and line SN) angles were measured. The sagittal skeletal classification was finally defined according to ANB (°) value.
ANB<0°: Class III, 0° ≤ ANB ≤ 4°: Class I and 4°<ANB: Class II.

Figure 2: Measurements made on lateral teleradiographs.
ANB (°): angle between line NA and line NB.
GoGnSN (°): angle between line GoGn and line SN.

Statistical analysis

The results were expressed as the mean ± standard deviation or as the median [Interquartiles] for the quantitative variables, and as counts and percentages for the qualitative variables. All measurements were compared between the two groups with the chi-square test for qualitative variables (gender and sagittal skeletal class) and Student's T test and Mann-Whitney test for quantitative variables. Logistic regression analyzes were used to identify predictors of the 3rd lower molar eruption. Initially, univariate logistic regression was used to test associations between the estimated variables and the rash. After that, multiple logistic regression was used to develop a prediction model. The variables were successively entered into the model if their p was significant or close to significance (p <0.25). Data were entered and analyzed by Jamovi software. The difference was considered statistically significant for p-value< 0.05.

Results

In our sample (71 patients), 72.5 % were women and 27.5 % were men. Mean average age was 23.79 ± 5.6 years old [17- 45]; 67.4% of patients had Class I maxillo-mandibular relationship. **Table 1** showed the mean values of each variable regardless of the eruption.

Table 1 : Description of clinical parameters and cephalometric data.

Variables	Characteristics
Age (years old)	23.79 ± 5.6
ANB (°)	3.99 ± 2.4
GoGnSN (°)	36.0 ± 6.24
Retro-molar space RMS (mm)	11.98 ± 3.49
3rd molar mesio-distal diameter LM3d (mm)	13 ± 1.38
RMS/LM3d ratio	1± 0.26
X° LM3/LM2 angle (°)	5.50 [-3 ; 23.25]
Y° LM3/mandibular edge angle (°)	83.23±19.47
Gender	
-Male	19 (27.50%)
-Female	52 (72.50%)
Sagittal skeletal class:	
-class I	93 (67.40%)
- class II	22 (15.90%)
-class III	23 (16.70%)

No statistically significant relationship was found between the inclusion of the mandibular 3rd lower molar and gender, sagittal skeletal class, ANB and GoGnSN angles (p> 0.05). (**Table 2**)

However, the retro molar space, the 3rd lower molar mesio-distal diameter, the RMS/LM3d ratio, the LM3/LM2 angle and the angle LM3/mandibular edge were significantly associated with the eruption of the 3rd lower molar (p <0.05). (**Table 2**)

Table 2: Association between the variables studied and mandibular third molar eruption.

	Eruption N (%)		p
	Yes	No	
Gender :			0.39
- Male	10 (14.08%)	9 (12.7%)	
- Female	23 (32.4%)	29 (40.84%)	
Sagittal skeletal class:			0.29
- Class I	48(51.6%)	45(48.4%)	
- Class II	9(40.9%)	13(59.1%)	
- Class III	15(65.2%)	8(34.8%)	
ANB (°)	3.55 ± 2.74	4.26 ± 2.1	0.21
GoGnSN (°)	36.82 ± 6.8	35.42 ± 5.59	0.35
RMS (mm)	14.36 ± 2.31	9.37 ± 2.58	<0.001
LM3d (mm)	13 ± 1.59	14 ± 1.08	0.045
RMS/ M3d ratio	1.1 ± 0.12	0.7 ± 0.2	<0.001
LM3/LM2 angle (°)	3[-3 - 9.75]	19[-4.25 – 38.25]	<0.001
LM3/mandibular edge angle (°)	89.22 ± 11.15	76.71 ± 24.09	<0.001

A univariate and multivariate logistic regression was performed to determine the impact of "gender, sagittal skeletal class, GoGnSN angle, retro-molar space, RMS/LM3d ratio and LM3/LM2 angle" on the probability of mandibular 3rd molar eruption.

In univariate analysis, except for the gender, ANB and GoGnSN angles, all the variables tested (RMS, RMS/LM3d ratio, LM3/LM2 angle) had a statistically significant influence on the eruption phenomenon of the 3rd lower molar. (Table 3). In multivariate analysis, among the six predictor variables, only the RMS/LM3d ratio and the LM3/LM2 angle were statistically significant (p <0.05). (**Table 3**)

In fact, for each increase of 0,1 in the RMS/LM3d ratio, the probability of eruption of the 3rd lower molar increases by 19% (OR = 0.81; 95% CI [0.73; 0.92] p <0.05), while increasing the LM3/ LM2 angle by 1° increases the inclusion risk by 1.09 (0R = 1.09; 95% CI [1.032; 1.161] p <0.05).

The probabilities of 3rd lower molar eruption could be predicted by the following equation:

Logit P (eruption = 1 / gender, ANB, GoGnSN, RMS, RMS/LM3d ratio, LM3/LM2 angle) = 1.54 gender + 0.84 ANB + 1.11 GoGnSN + 0.90 RMS + 0.81 RMS/LM3d ratio + 1.09 LM3/LM2 angle.

Gender, ANB, and GoGnSN angle showed no statistically significant relationship with eruption in this sample.

Table 3: Predictors of mandibular third molar eruption.

	Univariate analysis			Multivariate Analysis		
	Exp B	IC 95%	p	Exp B	IC 95%	P
RMS	0.401	0.293 ; 0.548	**<0.001**	0.907	0.46 ; 1.788	0.77
RMS/M3d ratio	0.821	0.759 ; 0.888	**<0.001**	0.818	0.73 ; 0.92	**0.001**
Angle M3/M2	1.04	1.019 ; 1.061	**<0.001**	1.094	1.032 ; 1.161	**0.003**
Gender						
-Female	1.00		**0.4**			0.67
-Male	0.72	0.34 ; 1.54		1.54	0.2 ; 11.72	
ANB	0.90	0.79 ; 1.04	**0.17**	0.84	0.6 ; 1.17	0.3
GoGnSN	1.04	0.99 ; 1.10	**0.10**	1.11	0.97 ; 1.28	0.12

Discussion

Mandibular 3rd molar impaction can be accompanied by various pathologies such as recurrent pericoronitis, periodontal disease, decays, second molar resorption, periodontal cysts and benign and malignant odontogenic tumors [3]. In addition, some authors have suggested an association between the eruption of the third molar and increased incisor crowding, or even its recurrence in patients who had already received orthodontic treatment [4]. However, the risk of the occurrence of these complications remains negligible [6] and does not justify the systematic extraction of third molars.

To determine the predictive factors of the eruption of mandibular third molars in the Moroccan population, we performed a retrospective study using lateral teleradiographs and panoramic radiographs of 71 patients. The average age of the patients was 23 years [17- 45], they were all in a non-growth period; 27.50% of patients were men while 72.50% were women, this percentage is explained by the larger amount of consultations by women compared to men. The distribution of patients according gender was homogeneous in the two groups.

Regarding the sagittal skeletal class and the ANB angle, no statistically significant association was found. However, we noted a higher average of patients with class I and class III in the eruption group compared to the inclusion group where classes II were more frequent. This could seem logical especially at the level of class II by mandibular retrognathia where the arch length may be insufficient for the complete eruption of the entire dentition while at the level of class III by mandibular macrognathia, there is often an excess space on the lower arch. This result agrees with Alexandar Jokovljevic et al. (2015) [7] and Jason et al. series [8]. However, Abu Alhaija et al. [9] reported a higher average of impaction in patients with skeletal class III compared to class I and II. These opposing results may be explained by the hereditary character and variability in facial growth pattern, jaw development, and tooth size between populations and races.

Regarding the GoGnSN angle, the general mean was 36.0° ± 6.24 with a mean of 36.82° ± 6.8 at the eruption group and 35.42° ± 5.59 at the inclusion group. The difference between the two groups was statistically insignificant ($p = 0.17$). However, several authors have associated vertical condylar growth with a high risk of impaction due to the resulting reduction in retro-molar space. A study by Breik and Grubor [10] reported a statistically significant difference between the brachyfacial and dolichofacial sample with a greater eruption rate in the brachyfacial group.

The comparison of the 2 groups of eruption and inclusion in relation to the retro-molar space, the diameter of the third lower molar, the RMS/LM3d ratio and the LM3/LM2 angle and the LM3/mandibular edge angle showed a statistically significant difference ($p < 0.05$).

Our univariate analysis identified the retro-molar space (RMS), the RMS/LM3d ratio, and the LM3/LM2 angle as factors influencing the eruption of mandibular third molar. However, only the RMS/LM3d ratio and the LM3/LM2 angle factors remained statistically significant after the application of multivariate logistic regression. This result matches those reported by Niedzielska et al [11]. Indeed, even if the RMS is an important factor in the eruption of the LM3, reported by several authors as a determining factor of the eruption or the inclusion of the LM3 (Molloaglou et al. [12], Behbehani et al. [13]), it remains insufficient to determine the prognosis of eruption of the LM3, especially when the initial angulation of the molar is unfavorable for a complete eruption of the tooth on the arch. This explains the cases of eruption failure reported by Türköz C et al. in the presence of an adequate RMS [14].

Thus, the eruption process of the LM3 depends on several factors at the same time. An adequate retro-molar space, an appropriate diameter allowing to have a RMS/LM3d ratio greater than or equal to 1

and a vertical trajectory of the germ favor the complete eruption of the third lower molar. It is therefore recommended to take all those parameters into consideration to define the prognosis of its development in a precise and correct manner.

Study limitations:

Our study presents some limitations namely: the cross-sectional design, the heterogeneous distribution in terms of age ranging from 17 to 45 years old and the female gender prominence which could be a source of bias. Thus, a large longitudinal and national study is needed to assess national recommendations.

Conclusion

The present study allowed us to assess the validity of several clinical and radiographic parameters, to provide predictive factors for the evolution of the lower wisdom tooth and its prognosis. The RSM/LM3d ratio and the LM3/LM2 angle are predictive indicators in the assessment of the eruption or inclusion of the lower third molar. The combination of a sufficient RMS, a RMS/LM3d ratio equal to or greater than 1, and a vertical eruption path guided by the adjacent tooth (the 2nd lower molar) would be favorable for a complete eruption and correct positioning of the 3rd lower tooth on the arch.

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