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Chapter 8

Wisdom Teeth (Third Molars) and Orthodontics — A State-of-the-Art Analysis and Prediction of Eruption

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1. Introduction

The association of lower incisor crowding with wisdom teeth eruption has been a contentious and mythical concept in orthodontics. As the crowding of the lower incisors occurs coincidentally at the same chronological age that third molars erupt, a causal relationship seems intuitive, and prophylactic third molar extraction should be a logical preventive measure.

A longitudinal study by Bjork et al. [1] reported late mandibular growth with uprighting of the mandibular incisors, resulting in crowding. Nevertheless, researchers continue to blame the eruption of the third molars or lack of the patient retainer wearing for the appearance of lower incisor crowding.. There is a need for more conclusive evidence based on rigorous scientific research and its integration in clinical practice to prove whether there is any association between lower incisor crowding and wisdom teeth eruption, and the present chapter is intended to address that need.

Specifically, this chapter aims to give a comprehensive account of third molar extractions research, with a particular reference to evidence-based decision-making process, and to evaluate the prognosis of upper and lower third molar evolution according to a study conducted at Casablanca Dental School [2]. We studied the prognosis of evolution of wisdom teeth according to simple radiographic criteria. We also considered the variation of space retromolar after referred orthodontic extractions.

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2. Third molars (M3) and mandibular incisor relapse

Increasing lower dental arch crowding with age is a recognized clinical problem, and the role of the lower third molars in the lower incisor crowding has been extensively studied but remains controversial since late incisor crowding is frequently observed concomitantly to the eruption of the third molars.

The justification often stated for **M3** extraction is prevention of mandibular incisor relapse and irregularity [3]. However, there is no reliable research evidence to support the prophylactic removal of disease-free impacted third molars. Indeed, numerous studies found no correlation between lower third molars and lower incisor crowding considering subjects with unerupted, absent, or extracted third molars.

A Cochrane systematic review issued in 2005 [4] found no evidence for accepting or refuting prophylactic extraction of third molars in adults and adolescents to prevent later incisor crowding. Other factors besides **M3** eruption have been associated with lower incisor crowding and relapse (anterior growth, mesial migration of posterior teeth, lack of attrition anterior occlusal forces, poor periodontal status, the soft tissue pressure, the position of the opposite teeth, etc.) [5,6,7]. Thus, orthodontic retention may be more effective and cost-efficient than extraction of wisdom teeth, at least in the short to medium term [8].

This finding was supported by another systematic review published in 2014 [9]. The authors argued that definitive conclusions on the role of the third molars in the development of anterior tooth crowding could not be drawn. They found a high risk of bias in most of the trials, but studies have not supported a cause-and-effect relationship.

In addition, Pirttiniemi et al. concluded in their study [10] that the extraction of an impacted third molar allows at least the second molar drift posteriorly and laterally, but it has the smallest effect on the anterior area of the dental arch.

However, despite the absence of a clear relationship between the mandibular incisor crowding and third molar's presence, extraction of those teeth is still a common practice among orthodontists to prevent abnormal orthodontic condition [11]. In this respect, orthodontists should not indicate M3 removal; otherwise its responsibility will be engaged.

In the light of the current evidence, the presence of third molars has no significant effect, and extraction to prevent anterior tooth crowding or post-orthodontic relapse is not supported.

3. Study conducted at Casablanca Dental School

3.1. Patients and method

This study involved 78 patients. The inclusion criteria were age over eight years and germs of wisdom teeth present and visible radiographically, with or without extractions of the premolars or the first molars. Exclusion criteria included wisdom teeth in the arch, invisible tooth

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germs on the panoramic radiograph (by agenesis, extraction, etc.), and patients with lip and palatal cleft.

The analysis parameters were taken from clinical examination, dental casts, panoramic radiographs, and radiograph profiles. Radiographs of the first consultation (T1) were renewed two years later (T2). The measurements were made on a layer attached to the film. A single operator has made cephalometric tracings possible.

Measurements on the panoramic radiograph were (fig 1.):

1. The occlusal plane (OP): Line joining the top of the uppermost of the first premolar cusp (in the absence of the second premolar) and the summit of the mesial cusp of the second molar (M2);
2. A vertical line (VL) perpendicular to the OP and tangent to the distal surface of M2;
3. The retro-molar space (RMS): Distance between the intersection OP-VL and the point of intersection OP and anterior border of the ramus;
4. The mesio-distal diameter of the coronary M3 (M3Ø);
5. The ratio: Retro-molar space/coronary diameter (RMS/M3Ø);
6. The angle "axis M3-OP" (M3i axis is the line joining the center of the crown and root bifurcation of M3) (fig. 1).



Figure 1. Measurements on dental panoramic.

On the lateral cephalometric radiograph, the right profile was studied, the Frankfurt plane must be horizontaly oriented (fig. 2). For bilateral structures, only structures left less distorted were retained. The measures were:

1. At mandible, the retro-molar space available for M3: Distance between Xi (central ramus) and the most distal point of the crown of lower M2 (Xi-M2i);
2. At maxilla, the distance (M1-PTV) between the most distal point of the first molar (M1) and the pterygoid vertical plane (vertical line tangent to the posterior edge of the pterygomaxillary slot) (fig. 2).

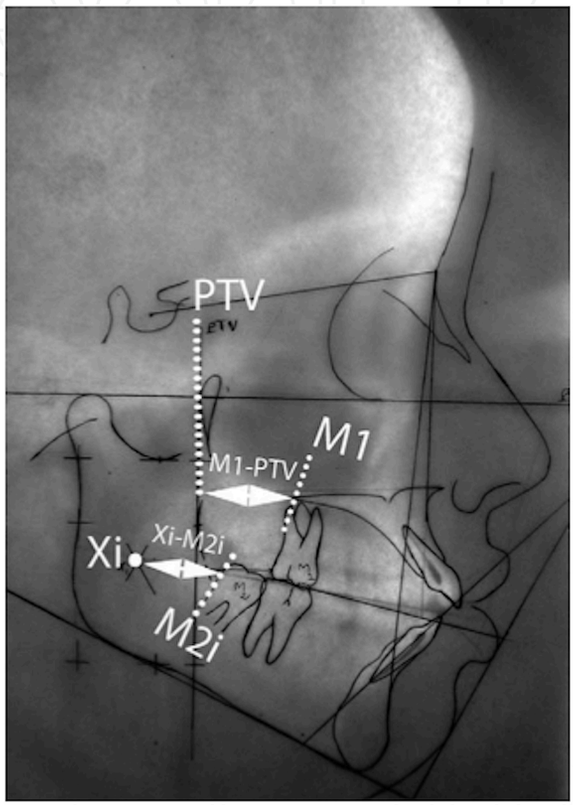


Figure 2. Measurements on lateral cephalogram.

The expansion of dental panoramic was calculated by comparing the mesio-distal diameter of M1 or M2i on casts to that measured on the panoramic. All these measures undertaken between T1 and T2 were compared: Qualitative variables were analysed with the McNemar test and quantitative variables (paired data) with the Student test (t).The SPSS 10.0.5 software treated the data.

3.2. Results

57.7% of the patients were female, aged from 8 to 27 years.

23.1% of the patients (18 cases) were treated without extractions and 76.9% (60 cases) with extractions (PM1 56 cases M1 in four cases). Regardless of extractions, between T1 and T2, the ERM has increased by an average of 5 to 7 mm ($p < 0.001$) in the maxilla, and 5 to 8 mm ($p < 0.001$) in the mandible, with no difference between right and left sides (Table I).

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	T	N	Mean	Differences mean	t	Df	p
Right maxilla							
Non-extraction	T1	15	4,24	1,24 (± 2,9)	1,652	14	0?121 (NS)
	T2	15	5,48				
PM1 extraction	T1	54	5,24	2,03 (± 3,31)	4,510	53	0.000
	T2	54	7,27				
M1 extraction	T1	3	5,46	6,8 (± 1,11)	10,577	2	0.009
	T2	3	12,26				
Left maxilla							
Non-extraction	T1	18	5,21	1,77 (± 2,66)	2,831	17	0.012
	T2	18	6,98				
PM1 extraction	T1	48	5,58	2,26 (± 2,87)	5,439	47	0.000
	T2	48	7,84				
M1 extraction	T1	3	6,53	4,8 (± 1,25)	6,635	2	0.022
	T2	3	11,33				
Right mandible							
Non-extraction	T1	20	4,55	4,58 (± 14,24)	1,438	19	0.167 (NS)
	T2	20	9,13				
PM1 extraction	T1	47	5,35	2,27 (± 2,68)	5,792	46	0.000
	T2	47	7,61				
M1 extraction	T1	4	8,57	4,55 (± 3,8)	2,360	3	0.099 (NS)
	T2	4	13,12				
Left mandible							
Non-extraction	T1	20	5,21	2,2 (± 2,49)	3,944	19	0.001
	T2	20	7,41				
PM1 extraction	T1	48	5,48	2,68 (± 2,76)	6,734	47	0.000
	T2	48	8,16				
M1 extraction	T1	4	8,75	5,42 (± 4,01)	2,702	3	0.074 (NS)
	T2	4	14,17				

T: time; **n**: number; **t**: value of Student test; **df**: degree of freedom; **p**: significance level; **NS**: nonsignificant.

Table 1. Retromolar space (RMS) variation in maxillary and mandibular arches with and without extraction of PM and M_1, depending on time (T_1 and T_2)

Maxillary right ERM increased on average 4.2 mm to 5.4 mm, if there is no extraction ($p = 0.12$), 5.2 mm to 7.2 mm after extraction of PM1 ($p < 0.001$), and 5.4 mm to 12.2 mm after extraction of M1 ($p < 0.009$).

For each hemi-arch, the gain of the MRA was 1.2 to 2.2 mm if there was no extraction, from 2 to 2.7 mm after extraction of PM, and from 4.5 to 6.8 mm after extraction M1 (fig. 3). Between T1 and T2, the ERM/ØM3 ratio increased from 0.6 to 0.8 in the maxilla and from 0.5 to 0.8 in the mandible ($p = 0.01$)

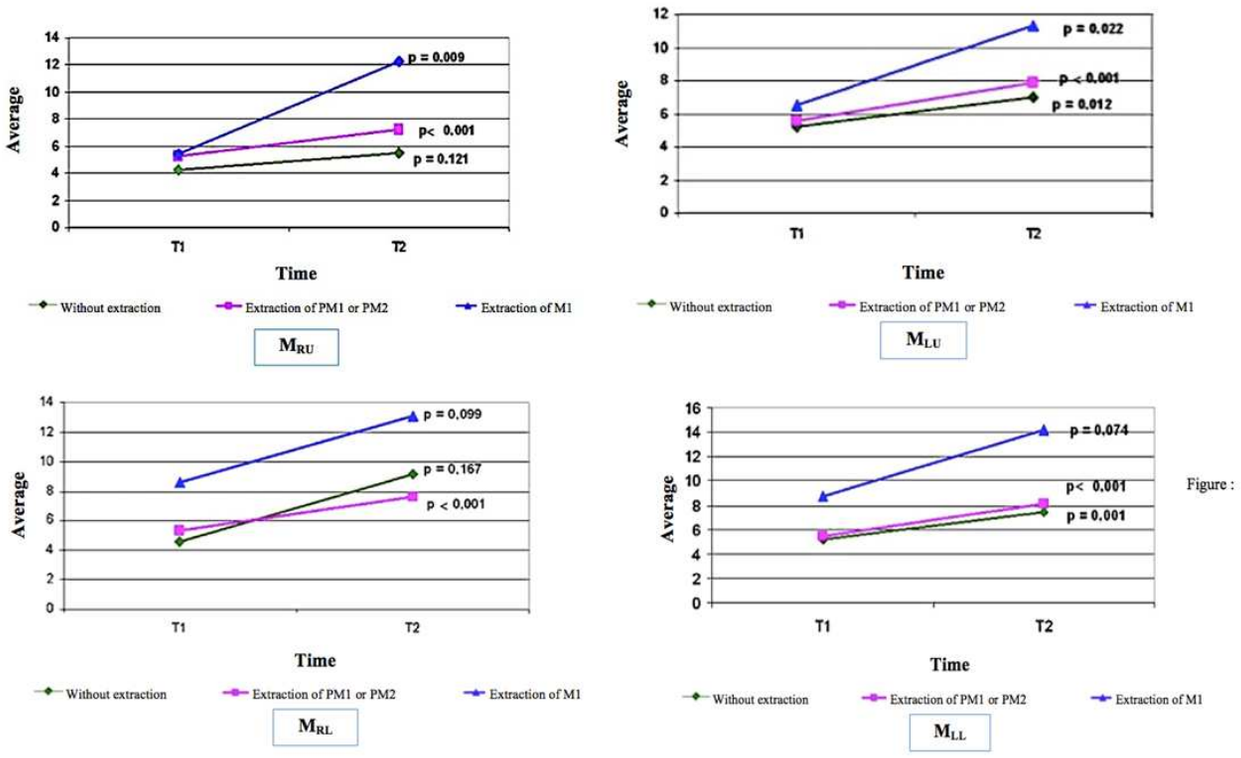


Figure :

Figure 3. Retromolar space variation for each hemi-arch in case of non-extraction and of PM or M_1 extraction. (M_{RU}: *upper right first molar*, M_{LU}: *upper left first molar*, M_{RL}: *lower right first molar*, M_{LL}: *lower left first molar*)

When this initial ratio was greater than 1, it increased in T2, and when it was less than 1, it decreased in T2 (Table II).

			Upper right M3 (T2)			Total	Significance level (p)
			Missing	**< 1**	**≥ 1**		
Upper right M3 (T1)	**Missing**	Number	7	2	1	10	p = 0.019
		% (T2)	87,5	4,2	4,5	12,8	
	< 1	Number	1	43	12	56	
		% (T2)	12,5	89,6	54,5	71,8	
	≥ 1	Number	-	3	9	12	
		% (T2)	-	6,3	40,9	15,4	
	Total	Number	8	48	22 100	78	
		% (T2)	100	100		100	
Upper left M3 (T1)	**Missing**	Number	10	2	1	13	p < 0.001
		% (T_2)	90,9	5,1	3,6	16,7	
	< 1	Number	1	36	18	55	
		% (T_2)	9,1	92,3	64,3	70,5	
	≥ 1	Number	-	1	9	10	

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			Upper right M3 (T2)			Total	Significance level (p)
			Missing	< 1	≥ 1		
		% (T_2)	-	2,6	32,1	12,8	
	Total	Number	11	39	28	78	
		% (T_2)	100	100	100	100	
Lower right M3 (T1)	**Missing**	Number	6	2	-	8	p = 0.05
		% (T_2)	66,7	3,9	-	10,3	
	< 1	Number	2	46	14	62	
		% (T_2)	22,2	90,2	77,8	79,5	
	≥ 1	Number	1	3	4	8	
		% (T_2)	11,1	5,9	22,2	10,3	
	Total	Number	9	51	18	78	
		% (T_2)	100	100	100	100	
Lower left M3 (T1)	**Missing**	Number	5	2	-	7	p = 0.008
		% (T_2)	71,4	4,2	-	9	
	< 1	Number	2	45	13	60	
		% (T_2)	28,6	93,8	56,5	76,9	
	≥ 1	Number	-	1	10	11	
		% (T_2)	-	2,1	43,5	14,1	
	Total	Number	7	48	23	78	
		% (T_2)	100	100	100	100	

Table 2. Comparison of "RMS/M_3 diameter" values between T_1 and T_2, for each M_3 (McNemar test)

The M3 whose RMS/M3Ø ratio was greater than or equal to 1 were more in significant eruption than those with a ratio less than 1 (Table III).

	T1 RMS/M3 diameter	T2 Eruption (%)	Retention (%)
Right maxilla	≥ 1	42	58
	< 1	5,5	94,5
Left maxilla	≥ 1	33,3	66,7
	< 1	2	98
Right mandible	≥ 1	28,6	71,4
	< 1	10	90
Left mandible	≥ 1	50	50
	< 1	11,9	78,1

Table 3. M_3 evolution between T_1 and T_2 in each hemi-arch depending on "RMS/M3 diameter" value

In the maxilla, the distance (PTV-M1) increased from 17.1 to 19.9 mm between T1 and T2 ($p < 0.001$). It was observed that 2.6% of distances (PTV-M1) were greater than or equal to 25 mm at T1, and 12.8% at T2.

In the mandible, the distance (Xi-M2i) increased from 18.5 to 22.4 mm between T1 and T2. This distance was greater than or equal to 25 mm in 10.3% of cases at T1 and in 26.9% at T2. Xi-M2i ratio was less than 25 mm in 87.2% of cases at T1 and in 61.5% at T2 (Table IV).

PTV-M_1 distance	**T_1**		**T_2**	
	Number	**%**	**Number**	**%**
Missing	3	3,8	14	17,9
< 25 mm	73	93,6	54	69,2
≥25 mm	2	2,6	10	12,8
Total	78	100	78	100
Xi-Mi2 distance	**T_1**		**T_2**	
	Number	**%**	**Number**	**%**
Missing	2	2,6	9	11,5
< 25 mm	68	87,2	48	61,5
≥25 mm	8	10,3	21	26,9
Total	78	100	78	100

Table 4. Comparison of (PTV-M1) and (Xi- Xi-Mi2) between T1 and T2

All M3 with PTV-M1 distance greater than or equal to 25 mm at T1 remained included at T2. When PTV-M1 was less than 25 mm at T1, 6.4% erupted after two years.

In the mandible at T1, 3.8% of M3 with a distance (Xi-M2i) greater than or equal to 25 mm have erupted and 6.4% of those whose distance (Xi-M2i) was less than 25 mm.

The average value of the "a" angle increased between T1 and T2, from 54.8° to 60.68° for the right side and from 54.78° to 63.38° for the left unerupted. On the right, all M3 having an angle "a" of less than 40.8° and 84% of those with an angle greater than or equal to 40.8 remained included at T2. On the left, all M3 with an angle "a" less than or equal to 40.8° and 76% of those with an angle greater than or equal to 40.8° have not been erupted.

3.3. Discussion

The extraction of premolars has a little effect on the modification of the retro-molar space while the extraction of the first molar leads to its increase. An RMS/ ØM3 ratio greater or equal to 1 increased the probability of eruption of M3; the distance (PTV-M1) or (XI-Mi2) greater than or equal to 25 mm did not guarantee the eruption of M3. An angle "a" less than 40.8° was not a good prognosis for the evolution of M3, whereas the reverse was not true.

Ricketts [12] estimated that the prediction of mandibular growth and space available to tooth eruption should not receive orthodontic treatment, although it may have an impact on the evolution of M3. He evaluated the proportion of the volume of coronary lower M3 in front of the intersection of the external oblique line of the mandible bone and the occlusal plane. For

Schulhof [13], the two predictive measurements are distances Xi-Mi2 for lower M3 and M1-PTV for upper M3 (fig. 1).

Kim et al. [14] confirmed that premolar extraction is associated with a mesial molar movement, increasing the space to the eruption of M3. He suggested that the extraction of premolars to reduce the risk of M3 inclusion. This risk is reduced by 63% for Behbehani et al. [15].

For William, the only significant factor was the choice of the site of extraction [16]: The percentage of M3 eruption was almost identical with and without premolar extractions (54% versus 52%). It was 90% after extraction of M1. Bayram et al. in the present study support this finding [17].

For Gaumond [18], after germectomie of M2i, the extraction space is naturally firm by the migration of M3i.

Like Hattab and Ganss, we showed the importance of the ERM/M3Ø report in the prognosis inclusion M3 [19,20].

The first technical prediction of M3i eruption is based on the distance (Xi-M2i). The critical value is 25 mm [21,22]. An increase of 1mm Xi-M2i reduces the risk of including M3 by 30% [15].

Many authors have noted the correlation between Xi-Mi2 and prognosis Blowout M3i [12,13, 18]. In our study, we found no correlation between the prognoses of eruption of the maxillary M3 and distance (PTV-M1) less than 25 mm. Other factors contribute to the risk of including M3i as: The initial angulation of the tooth relative to the mandibular plane [23,24], the distance M3- anterior edge of ramus [24] and the slope of M2 versus M3 [25].

In our study, all M3 with less than 40.8° angle were brought against 20% of those with an angle greater than or equal to 40.8°. Staggers et al. [26] showed no change in the angle of extraction after M3 premolars. For Badawi et al. [27], the sagittal inclination of the maxillary M3 was a predictive sign of eruption. The more the mesial inclination, the more the chance of eruption of M3.

In the light of the current evidence, the presence of third molars has no significant effect, and extraction to prevent anterior tooth crowding or post-orthodontic relapse is not supported.

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