Mandibular growth and third molar impaction in extraction cases

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The incomplete eruption of third molars remains a serious problem in dentistry, primarily because of its high incidence and clinical consequences. Even in the absence of clinical symptoms, impacted third molars may be associated with pathologic processes ranging from simple caries and pericoronitis to cysts and neoplastic lesions. Ironically called "wisdom teeth," third molars are commonly blamed for a variety of complications even though responsibility has not necessarily been established. Their role as an etiologic agent of mandibular incisor crowding following orthodontic treatment is thus controversial. Any recommendation for removal of third molars to prevent future complications, without determining the frequency of complications, should be questioned. The decision to extract third molars should be made according to well-defined criteria.

When planning treatment, orthodontists should take into account the presence or absence of third molars, particularly those in the mandible. Consideration should be given to: 1) the possibility of eruption or impaction when distal movements of first or second molars are required during treatment; 2) the repercussion of the extraction of premolars or other permanent teeth in their positioning; 3) the timing of the orthodontic treatment, its conclusion coinciding with the final stages of dentition development.

Mandibular growth is associated with the provision of space for correct positioning of the third molars, as well as with the unfavorable inclination of the crown in the ascending ramus ...all related to the etiology of impaction.

The purpose of this study was to relate the impaction of third molars to individual patterns of facial growth as well as to the inclination of third molar crowns. The sample consisted of people who had received orthodontic treatment following the extraction of first premolars. Results were compared with similar studies found in the literature.

Abstract

The position of mandibular third molars was studied in 60 patients from the pedodontic and orthodontic departments at the Federal University of Rio de Janeiro. All individuals received orthodontic treatment with an edgewise appliance following the extraction of first premolars.

Examination of superimposed pretreatment and posttreatment cephalometric radiographs led to the observation that mandibular growth is directly related to the positioning of mandibular third molars. Third molar impactions were more likely to occur in cases with a predominance of vertical growth. The larger ascending ramus, the dimunition in total length of the mandible and the larger mesial inclination of the crowns also seem to be indicative of third molar impaction.

This manuscript was submitted October 1989. It was revised and accepted for publication October 1990.

Key Words

Third molar • Impaction • Mandibular growth • Premolar extraction

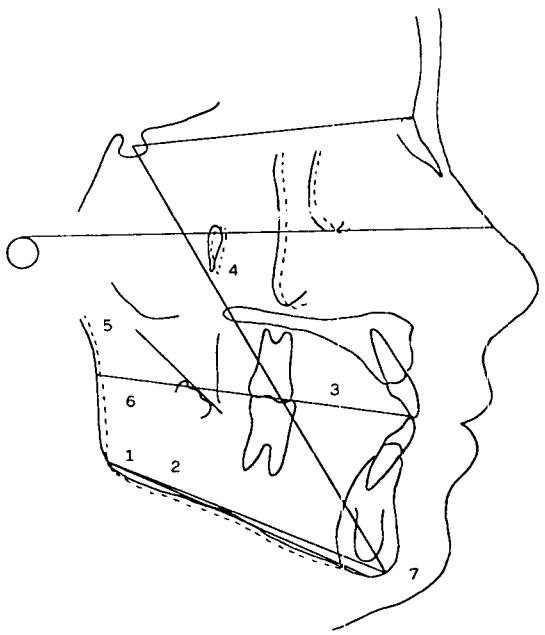

Figure 1

The development and eruption of the mandibular third molars have long been studied by odontological researchers. The high incidence of impaction of these teeth[1,5] has given rise to many studies in which factors that could be considered responsible for or associated with the etiology of this malocclusion are correlated.

If retention of the mandibular third molars in the bone were related to the development of specific pathologies,[1,2] according to Broadbent,[6] the facial dimensions of people with impacted third molars would grow less than those of people whose third molars are occluded. The regular extraction of these teeth does not seem to be so valid a conduct.[2,3,4,7,8]

Several studies[3,4,9,10] have advanced a hypothesis favoring extraction of mandibular third molars in cases that require distal movement of the first and second molars.

The eruption or impaction of mandibular third molars has been related to genetic factors,[11] and even attributed to consequences of eating habits in civilized man.[12] But facial growth and development proved to be factors directly associated with the position of mandibular third molars.[2,5-7,13-20]

Other authors[3,4,7,9,13,21-25] have attempted to correlate the extraction of teeth adjacent to the third molars and the latter's eruption.

According to Steiner[26] and Fernandes,[27] orthodontic therapy requiring the extraction of first premolars would allow mesial movement of the permanent molars. In view of this, some authors[7,9,10,13,19,20,22,23] have concluded that orthodontic treatment including extraction of premolars would make eruption of mandibular third molars easier and reduce the incidence of impaction in these teeth. However, this idea has been opposed by other researchers[8,28] who do not see a correlation between treatment including extraction of premolars and eruption of the third molars. Even so, many authors[21,24] have presented studies suggesting that, in cases where extractions are required in the orthodontic plan, the choice should be the second molars, instead of the premolars, so as to make eruption of the adjacent third molars easier. The drawback to this extraction decision is the requirement for additional treatment to align the third molars following eruption.[21,24]

The study material consisted of 120 cephalometric radiographs taken in the initial stage of orthodontic treatment and just after the removal of fixed appliances in 60 patients. The sample was selected by the following criteria: 1) patients had undergone orthodontic treatment with complete fixed appliances, edgewise technique, and extraction of four first premolars; 2) radiographic records from the initial and concluding stages of the orthodontic treatment, consisting of lateral cephalometric X-rays of the head (taken from the left side at 90°) and periapical X-rays of all teeth were available; 3) all patients had mandibular third molars.

Incomplete eruption was the criteria used to verify third molar impaction. Lack of eruption was usually due to an inclined position in relation to the second molar or a lack of free space, according to Kaplan.[13] Twenty-seven patients were selected because their mandibular third molars were not bilaterally impacted (group 1). The 11 males and 16 females had an average age of 11 years 3 months at the beginning of active orthodontic treatment and 16 years 4 months at the end of treatment.

The remaining 33 patients (group 2) had bilaterally impacted mandibular third molars at the end of active orthodontic treatment. In this group, 17 males and 16 females were studied with an average age of 11 years 7 months at the beginning of orthodontic treatment and 16 years 7 months at the end of treatment.

The method consisted of comparing the measurements obtained from initial and final radiographs, as well as all standard values from the literature.

Angular and linear measurements (illustrated in Figure 1) were obtained, as follows:

1. Mandibular plane angle (GoGnSN)
2. Mandibular plane angle (GoMeFrankfort)
3. Occlusal plane angle (Occl.SN)
4. Axis Y angle (Axis Y)

Table 1
Arithmetic means of measurements before and after treatment in groups 1 and 2.

Measurement	Period	Group	Mean	Standard Deviation	"t" Test	Significance
GoGn-SN	Before	1	33.66±1.87	4.96	3.58	p < .01*
		2	38.03±1.47	4.32		
Go-Gn-SN	After	1	32.96±1.99	5.28	4.27	p < .01*
		2	38.60±1.65	4.86		
Go-Me-F	Before	1	27.88±1.47	3.90	3.39	p < .01*
		2	31.75±1.68	4.94		
Go-Me-F	After	1	27.85±1.36	3.61	3.86	p < .01*
		2	32.33±1.82	5.35		
Occl.SN	Before	1	18.88±1.55	4.12	2.83	p < .01*
		2	21.97±1.48	4.34		
Occl.SN	After	1	16.26±1.64	4.35	5.22	p < .01*
		2	22.42±1.62	4.76		
Axis Y	Before	1	60.96±1.28	3.40	1.63	p > .05
		2	62.51±1.35	3.98		
Axis Y	After	1	61.22±1.40	3.73	2.17	p > .05
		2	63.48±1.48	4.36		
Incl.38	Before	1	41.63±2.88	7.64	5.88	p < .01*
		2	52.69±2.32	6.81		
Incl.38	After	1	33.62±2.58	6.84	9.20	p < .01*
		2	51.94±2.95	8.64		
Ramus width	Before	1	34.92±1.26	3.36	-1.50	p > .05
		2	33.69±1.00	2.93		
Ramus width	After	1	34.59±1.23	3.28	.42	p > .05
		2	34.94±1.07	3.13		
Total length	Before	1	74.26±1.75	4.66	-1.69	p > .05
		2	72.36±1.37	4.04		
Total length	After	1	80.81±2.03	5.39	-2.56	p < .05**
		2	77.66±1.32	3.87		

*significant at 1% **significant at 5%

5. Inclination of angle of the crown of 38°, formed by the intersection of the tangent to the occlusal face of the left mandibular third molar and SN plane.

6. Linear width of the ascending ramus of the mandible — measurement in millimeters of the ascending ramus, from frontal to back edge, through extension of occlusal plane.

7. Total linear length of the mandible — measurement in millimeters on a line from Gonion to Pogonion.

Results

The mean values of measurements in groups 1 and 2 before and after orthodontic treatment were submitted to a Student's *t* test (Tables 1, 2 & 3).

In Table 4, the arithmetic means of measurements before and after orthodontic treatment in the group without impacted mandibular third molars are compared to standard values in the literature. A similar comparison is shown in

Table 2
Arithmetic means of measurements before and after treatment in group 1.

Measurement	Period	Mean	Standard Deviation Dif. (A-B)	"t" Value	p Value
GoGn-SN	Before After	33.66 32.96	2.52	1.44	> .05
GoMe-F	Before After	27.88 27.85	2.40	.06	> .05
Occl.SN	Before After	18.88 16.26	3.31	4.10	< .01*
Axis Y	Before After	60.96 61.22	1.76	-.76	> .05
Incl.38	Before After	41.63 33.62	10.17	4.08	< .01*
Ramus width	Before After	34.94 34.59	3.18	.53	> .05
Total length	Before After	74.26 80.81	2.81	-12.09	< .01*

*significant at 1%

Table 3
Arithmetic means of measurements before and after treatment in group 2.

Measurement	Period	Mean	Standard Deviation	"t" Value	p Value
GoGn-SN	Before After	38.03 38.60	1.78	-1.83	> .05
GoMe-F	Before After	31.75 32.33	2.47	-1.34	> .05
Occl.SN	Before After	21.97 22.42	2.91	- .88	> .05
Axis Y	Before After	62.51 63.48	1.59	-3.50	< .01*
Incl.38	Before After	52.69 51.94	6.88	.62	> .05
Ramus width	Before After	33.69 34.94	1.27	-5.64	< .01*
Total length	Before After	72.36 77.66	3.20	-9.50	< .01*

*significant at 1%

Table 5 for the group of patients with impacted third molars.

Discussion

In a sample of 60 patients who underwent orthodontic treatment following extraction of first premolars, mandibular third molars erupted in 27 patients and became impacted in the remaining 33 patients. An attempt was made to correlate factors positively or negatively influencing the eruption of these teeth.

As shown in Table 1, the angular values GoGn-SN, Go-Me and Occl-SN are higher for the group with impacted third molars than for the other group. The results follow the findings of other studies,[5,7,16-18] which relate the impaction of mandibular third molars to a predominantly vertical growth component.

Not significantly, different means were obtained for both periods as well as for both groups (impacted and erupted molars), when pre- and posttreatment mandibular planes were compared. However, when compared to standard values in the literature[26,29] (Tables 4 and 5), the mandibular plane measurements had higher than normal values for the group with impacted third molars; the same measurements were close to standard values for the group with erupted third molars.

The Y axis, which, according to Downs[30] indicates the direction of facial growth, were not significantly different before and after treatment in the group with erupted third molars; for the group with impacted third molars, however, means were higher after treatment than before treatment (Tables 2 and 3). This indicates a pattern of growth more vertical than horizontal in the second group.[30]

The inclination of the mandibular third molar crown was measured in relation to the SN plane.[16,17,22,24,26] As the study used measurements obtained both before and after orthodontic treatment, the occlusal plane was not considered an appropriate reference, since it could be altered by treatment and mask the positioning of the third molars. A similar objection may be raised regarding the mandibular plane. Under the hypothesis of a steep mandibular plane angle and a marked inclination of the third molar crown, the latter would not be seen because of the limited angle formed by the tangent to the third molar occlusal face and the mandibular plane. With the same inclination of the third molar crown and a closed angle of the mandibular plane, the angle formed by the tangent to the occlusal face of the lower third molar and the mandibular plane would be large. In view of this, the inclination of the third molar crown

Table 4
Arithmetic means in group 1 and standard values.

Measurement	Period	Mean	Standard Deviation	Standard Values	"t" Value	p Value
GoGn-SN	Before	33.66	4.96	32.0	1.73	> .05
	After	32.96	5.28	32.0	.94	> .05
GoMe-F	Before	27.88	3.90	25.0	3.83	< .01*
	After	27.85	3.61	25.0	4.09	< .01*
Occl.SN	Before	18.88	4.12	14.0	6.14	< .01*
	After	16.26	4.35	14.0	2.69	< .01*
Axis Y	Before	60.96	3.40	59.4	2.38	< .05**
	After	61.22	3.73	59.4	2.53	< .01*

*significant at 1% **significant at 5%

Table 5
Arithmetic means in group 2 and standard values.

Measurement	Period	Mean	Standard Deviation	Standard Values	"t" Value	p Value *
GoGn-SN	Before	38.03	4.32	32.0	8.01	< .01
	After	38.60	4.86	32.0	7.79	< .01
GoMe-F	Before	31.75	4.94	25.0	7.84	< .01
	After	32.33	5.35	25.0	7.86	< .01
Occl.SN	Before	21.97	4.34	14.0	10.54	< .01
	After	22.42	4.76	14.0	10.15	< .01
Axis Y	Before	62.51	3.98	59.4	4.48	< .01
	After	63.48	4.36	59.4	5.37	< .01

*significant at 1%

was measured in relation to the SN plane.

Use of the tangential plane to the occlusal face of the mandibular third molar is in accordance with some studies[9,16,17,24] that have used this plane in the visualization of the third molar crown inclination. At the initiation of orthodontic treatment, the radiographs showed that the rate of third molar root development was insufficient to prevent the drawing of their long axes. The mean of the group of patients with impacted third molars, both at the beginning and the end of the orthodontic treatment, was higher than that of the group with erupted third molars (Table 1). This result was similar to the findings of other researchers[16,17,31] who have considered a higher inclination of the third molars in the ascending ramus an indication of impaction. An average inclination before orthodontic treatment was also found not to differ from the inclination after treatment in the group with impacted third molars (Table 3). In the other group (Table 2), the inclination of the

third molar crown was higher before treatment than after, suggesting a forward root movement that rectified the mesial inclination of the crown and allowed its eruption as described by Salzmann.[32] This change in the position of the third molars seems to be associated with the idea of continuous mandibular growth, which is responsible for enlargement of the retromolar region up to the age of 20. Beyond this age, growth is negligible, but in some cases serves to provide space for a more adequate positioning of the mandibular third molars.[31]

The width of the ascending ramus of the mandible did not change significantly after orthodontic treatment in the group of patients with impacted third molars (Table 2), but turned out to be higher in the other group (Table 3). These findings coincide with the studies[5,7,8,13] of authors who considered a negligible resorption of the anterior edge of the mandibular ramus the reason for impaction of the mandibular third molars. The ascending ramus is normally subjected to resorption of the internal angle, providing space for the teeth and growth on the external edge, shaping a longer mandible.[32] Therefore, according to Leyard,[14] regardless of the existence of other factors involved in the normal eruption of the third molars, they will probably remain impacted when space is insufficient.

When considering total length of the mandible, measurement was made from Gonion point to Pogonion, following the studies by Richardson.[16,17] The means were nearly the same at the beginning of orthodontic treatment, but larger at the end in the group of patients with erupted third molars (Table 1). In a separate comparison of this group (Table 2) and the group with impacted third molars (Table 3), a higher potential mandibular growth was verified in the former, since the total length of the mandible was considerably greater at the end of orthodontic treatment. The results are in agreement with those of some authors.[5,6,16,17,19,31] However, other studies[7,13,22] indicate no correlation between mandibular length and impaction or eruption of the mandibular third molars.

In a recent meeting at the National Institutes of Health, it was recommended that the relationship between third molar eruption and facial growth and development be studied.

The influence of premolar extraction on the eruption of third molars should be carefully analyzed. An interesting study would consist of evaluating the reaction, development, eruption and impaction of the third molars by comparing patients treated with and without extractions. Studies are needed taking these variables into account.

The orthodontist must be cautious in evaluating the position of the third molars when planning treatment, since their final characteristics are late to develop. According to Perlow,[25] it is advisable to alert patients to the importance of third molars. In cases where the orthodontic treatment is concluded before full third molar development, the patient should return when older for radiographic examination and to consider the need for extraction.

Conclusions

1. The impaction of third molars is associated with a vertical component of mandibular growth.
2. Patients with impacted mandibular third molars following orthodontic treatment which includes the extraction of first premolars, have mandibular plane angles higher than reported by Steiner and Tweed.
3. High mesial inclination of the mandibular third molar crown in the ascending ramus is indicative of the tendency for these teeth to be impacted.
4. There is impaction of the mandibular third molars in patients with larger ascending rami.
5. In patients with impacted third molars, the total length of the mandible is less than in patients without impacted teeth.

Acknowledgements

To Dr. Carlos de Souza Telles and Dr. Antonio Carlos Peixoto da Silva, for their help.

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