Some Factors Related to Mandibular Third Molar Impaction

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In a recent study it was shown that the presence of mandibular third molars is not a significant factor in post-retention relapse of lower anterior crowding.[1] Despite this finding, the question of removing third molars because of their propensity to impaction is of frequent clinical importance. Extraction of teeth as part of orthodontic treatment has been shown to increase the probability of third molar eruption.[2] Some extraction cases, nevertheless, develop impacted third molars. The purpose of this study was to investigate in orthodontically treated cases, some factors previously suggested[3] to be significant in providing adequate space for third molars to erupt to the occlusal plane.

Literature Review

The incidence of third molar impaction in the general population has been investigated by Hellman[4] who reported a 9.5% incidence in males and 23% incidence in females. Björk et al.[3] investigating two groups of males found an incidence of 17% in one group and 22% in the other. Haralabakis[5] found an incidence of 17.5% among Greek students, while Dachii and Howell[6] found a similar incidence (with no significant sex difference) in American patients.

On the basis of the serious sequelae that can arise from impacted third molars, Henry[7] advocated "prophylactic odontectomy" of the developing third molar at 9-11 years of age. The problem regarding early removal of third molars is how to determine which teeth will become impacted and which will erupt and become functional members of the dentition. Henry and Morant[8] claimed future third molar impactions could be predicted from the "third molar space index" which expressed the mesiodistal width of the third molar as a percentage of the space between the second molar and the anterior border of the ramus.

By studying lateral jaw radiographs Ledyard[9] found that, after sixteen years of age, further growth in the retromolar area was negligible. He concluded that a comparison of tooth size and bone structure at that age would determine whether sufficient space was available for third molar eruption. Ricketts[10] has suggested that for a 50% favorable prognosis for eruption, the third molar crown must lie 50% ahead of the external oblique ridge.

The study by Björk et al. revealed that, in 90% of cases with impacted third molars, the alveolar arch space between the second molar and the ramus was considerably reduced. Three factors separately influenced this: reduced growth in length of the mandible, a vertical direction of condylar growth, and a distal pattern of eruption of the mandibular denture.

In the orthodontically treated case, the extraction of teeth (specifically premolars) is considered by Ledyard to allow mesial drift of the buccal segments which would provide additional space in the retromolar area for third molar eruption. Fanning[11] found that 75% of 20+ year-old cases had third molars erupted where extraction had been performed compared with 57% in the cases where no teeth had been lost.

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Serial lateral jaw radiographs of forty postorthodontic patients were studied by Faubion[2] who found that, in cases where first premolars had been extracted, 55% of third molars were in a good position for eruption while only 15% of third molars were retained in the nonextraction group.

Ricketts found a 25% increase in the space available for third molars in cases where first premolars were extracted. In 80% of extraction cases, third molars erupted, while in nonextraction cases only 55% erupted.

The usually stable third molar crypts have been shown by Riedel[12] to occasionally migrate downward and forward during orthodontic space closure.

It has recently been shown by Silling[13] that appliance therapy in nonextraction cases, by holding back or distally tipping the lower first or second molars, increases the probability of third molar impaction.

Materials and Method

The material for this investigation consisted of pretreatment, posttreatment, and postretention lateral cephalometric radiographs of fifty orthodontically treated Caucasian patients. The records were obtained from the Department of Orthodontics, University of Washington and from the private practices of five orthodontists.

Thirty cases had both mandibular third molars erupted to the occlusal plane, in good alignment buccolingually and of normal size and form. This group will be designated the "erupted group."

Twenty cases formed the "impacted group." This group consisted of cases where both mandibular third molars were candidates for surgical removal on the basis of postretention periapical radiographs. Impaction was defined as incomplete eruption of the third molar due to its inclined position relative to the second molar or the ascending ramus, or a vertical impaction due to lack of space. The latter cases were included on the basis of the patient's age and closure of the root apices. There were 23 mesioangular, 8 distoangular, 5 horizontal, and 4 vertical impactions.

Of the cases with erupted third molars, eighteen were females and twelve males, of which two were treated nonextraction. Eleven females and nine males had bilateral third molar impactions; of these six females and six males were treated nonextraction. All the remaining cases were treated with extraction of two premolars. At the postretention examination, all cases had otherwise intact lower dental arches.

The mean postretention age in this sample was 26.6 years with a minimum age of 21.5 years for females and 21.2 years for males.

Composite mandibular tracings were obtained from the pretreatment, posttreatment, and postretention cephalometric radiographs. On each composite, 24 points were digitized (8 for each headfilm) utilizing a Bensen-Lehner (LARR-M) digitizer. An additional point was digitized on the initial occlusal plane which represented the x axis. The y axis was a perpendicular constructed at a point midway between the mesial surfaces of right and left lower first molars. These x and y coordinate data were processed by a CDC 6400 computer utilizing a program designed to convert the points into linear and angular measurements. The following variables were derived from these data for each of the three times of examination: 1) Anteroposterior position of the lower first molar along the x axis; 2) angle of tooth eruption, the angle between the mandibular plane and a line from the incisal edge of the lower incisor passing through pogonion. This is a modification of the angle of

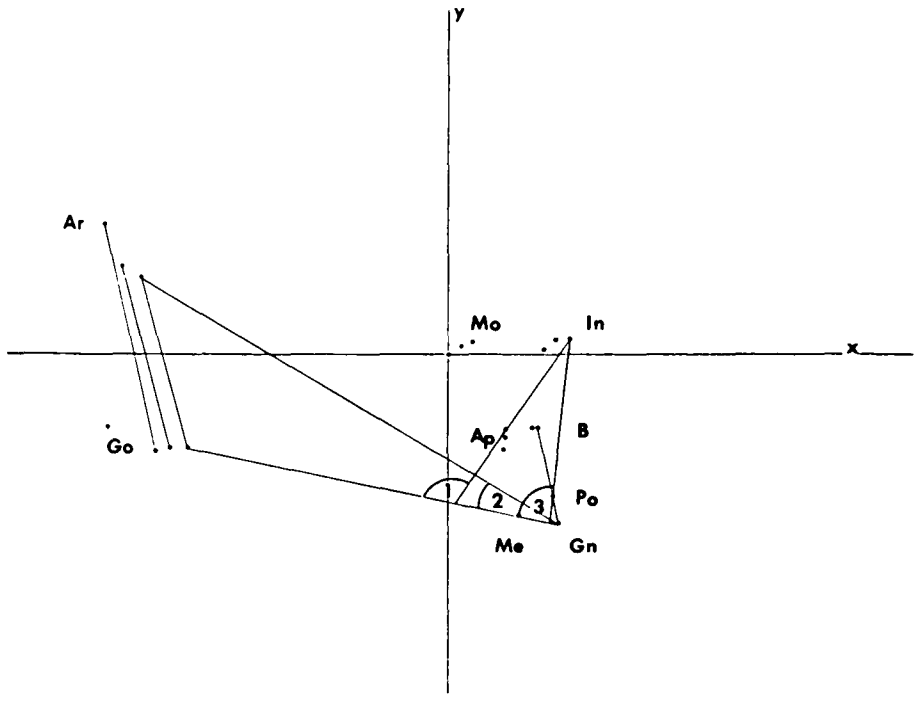

Fig. 1 Digitized cephalometric landmarks on x-y co-ordinate system. Mo—first permanent molar, In—incisal edge of lower incisor, B—point B, Ap—apex of lower incisor, Po—pogonion, Gn—gnathion, Me—menton, and Go—gonion. Angle of mandibular growth—angle 2, Angle of tooth eruption—angle 3, x axis—initial occlusal plane, and y axis—perpendicular to x axis tangent to mesial surface of first molar.

alveolar prognathy[3] and is considered an estimate of the direction of tooth eruption; 3) mandibular length, articulare to pogonion; 4) angle of mandibular growth, the angle between the mandibular plane and a line joining articulare and gnathion. This is a modification of the mandibular base angle[3] and is an indication of the direction of condylar growth relative to the mandibular body. Figure 1 illustrates the points digitized and the angles measured.

The range of error of the method was ±0.24 mm for linear measurements and ±0.42° for angular measurements.

The variables were examined by comparing the mean values in the erupted and impacted groups and also by examining only the extraction cases, females and males in these two groups. Comparison of two group means was performed by applying unpaired "t" tests, $\alpha = .05$.

Results

In the case of the angles of mandibular growth and mandibular length, no significant differences could be shown between the groups with erupted and impacted third molars for the *changes* in these variables during treatment, posttreatment, and overall. This is understandable because patients did not commence or end treatment at similar developmental, skeletal, or chronologic ages, nor did treatment proceed for similar periods of time. Consequently, comparison was made of these variables between the erupted and impacted groups at the final postretention exami-

TABLE I

	Erupted Group			Impacted Group			t Value	Significance
	$\bar{x}$	SD	n	$\bar{x}'$	SD	n		
Angle of Mandibular Growth at T3								
All Cases	20.14°	2.85	30	22.57°	2.56	20	3.076	**
Extraction	19.78°	2.56	28	22.12°	3.51	8	2.098	*
Females	18.98°	2.06	18	21.44°	2.82	11	2.492	*
Males	21.87°	3.07	12	23.95°	1.29	9	2.110†	*
Mandibular length at T3								
Females	108.44 mm	5.23	18	105.76 mm	5.10	11	1.353	ns
Males	117.97 mm	8.76	12	118.26 mm	6.03	9	0.085	ns
Angle of Tooth Eruption: Over-all Change								
All Cases	—3.01°	3.82	30	—1.66°	4.48	19	1.126	ns
Extraction	—2.98°	3.85	28	—4.90°	3.97	8	1.240	ns
Lower Molar (x co-ordinate) Over-all Change								
All Cases	5.41 mm	1.94	30	3.52 mm	1.73	19	3.466	**
Extraction	5.60 mm	1.86	28	4.59 mm	1.50	8	1.214	ns

** Significant at 1% level
* Significant at 5% level
ns Not significant
† Separate variance estimate

nation when all mandibular growth was essentially complete (Table I).

Statistically significant differences in the angle of mandibular growth were found to exist between cases with erupted and impacted third molars when all cases were compared and when extraction cases, females and males, were compared. In each case the impacted group demonstrated a larger angle. Figure 2 is a histogram illustrating the frequency distribution of the angle of mandibular growth in the two groups.

Sexes were segregated when mandibular length was examined because significant differences in mandibular length were found between males and females at all three examinations. At the final examination no significant differences in mandibular length occurred between females with erupted and impacted third molars nor between males.

The direction of tooth eruption and the change in lower first molar position were both intercepted by treatment, but the over-all change showed no significant difference between erupted

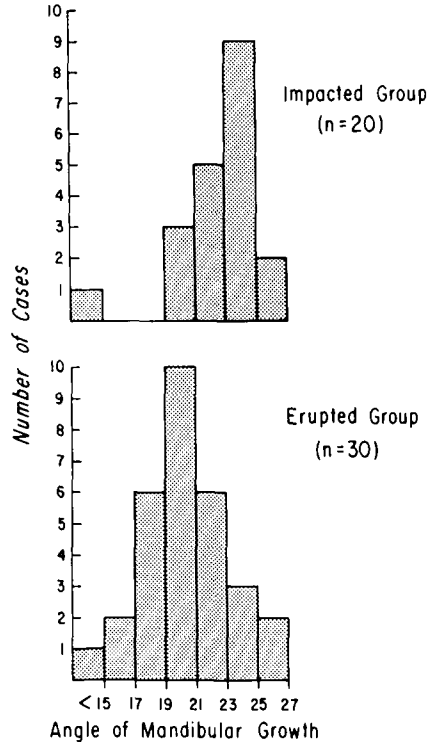

Fig. 2 Frequency distribution of angle of mandibular growth in the impacted and erupted groups.

and impacted cases for the angle of tooth eruption.

The significant difference in the change in the lower first molar position was due to the higher ratio of extraction to nonextraction cases in the erupted group. When only extraction cases were examined no significant difference was evident.

Discussion

It should be pointed out that the orthodontic cases from which this sample was drawn, to a large extent, had had third molars extracted. The most frequent reason was a mesial inclination of the third molar which was interpreted in the teenage patient as an impaction. Richardson[14] has shown that this mesial inclination is a developmental position and should not be considered as an impaction until after 15 years of age.

Nevertheless, out of approximately 1500 cases examined for this study, only two (out of 30) nonextraction cases could be located with both third molars erupted. This observation seemed to confirm the findings of Faubion that premolar extractions increase the probability of third molar eruption. A significant proportion of cases in which third molars were removed during the retention period were extraction cases, and the supposed reason was that third molars produce crowding relapse.

However, even cases where premolars were extracted developed third molar impactions. The findings of this study indicate that the angle of tooth eruption and mesial molar movement were not significantly different between the extracted cases with impacted third molars and those with erupted third molars. It was therefore concluded that the difference might lie in the ramus area. Willis[15] has clearly shown that the significant difference between jaws with and without impaction is the development of alveolar shelves and buccinator grooves. He claims that estimation of the space for eruption of the third molars based on the anterior border of the ramus as viewed from lateral cephalometric headfilms is unreliable.

Surprisingly, no significant difference in mandibular length could be found when females and males were separately compared in the two groups. The angle of mandibular growth did, however, demonstrate significant differences when the impacted group was compared with the erupted group. When all the cases, extraction cases, females and males in each of the groups were compared, the angle of mandibular growth was larger in the impacted group. According to Björk et al., this is associated with insignificant resorption along the anterior border of the ramus and would account for the difference in third molar impaction in cases with premolars extracted as part of orthodontic therapy. Cognizance of this dimension should be taken into consideration when the decision is being made in the teenager whether to retain or remove mandibular third molars.

Conclusions

1) Where premolars have been extracted as part of orthodontic therapy, due to increased mesial molar movement, there is an increased probability of third molar eruption.

2) Where premolars have been extracted but third molar impaction occurs, insignificant resorption along the anterior border of the ramus is probably responsible. This is associated with increased vertical condylar growth. Cases with impacted third molars exhibit a larger angle of mandibular growth compared with cases with erupted third molars. This should be taken into consideration when the decision to remove third molars is made.

3) Cases with impacted third molars did not exhibit shorter mandibular lengths than cases with erupted third molars.

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