Mandibular third molars and postretention crowding

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The role of mandibular third molars in the relapse of lower anterior crowding following the cessation of retention in orthodontically treated cases has provoked much speculation in the dental literature over the past 115 years. In 1859 Robinson[1] wrote: ". . . the dens sapientiae . . . is . . . frequently the immediate cause of irregularity of the teeth by the pressure exerted towards the anterior part of the mouth." As recently as 1971, in a survey of more than 600 orthodontists and 700 oral surgeons, Laskin[2] found that 65 per cent were of the opinion that third molars sometimes produce crowding of the mandibular anterior teeth. At present there is no unanimity of opinion as to the possible effect of third molars on mandibular incisor stability.

The purpose of this study was to investigate whether mandibular third molars have a significant influence on posttreatment changes in the mandibular dental arch and specifically on anterior crowding relapse. The abbreviation M3 will be used for mandibular third molars throughout the text.

Review of the literature

Postretention mandibular anterior crowding has been attributed to innumerable causes, one of which is pressure from erupting M3s. Dewey[3] cited the two opposing schools of thought: in some cases the M3 became impacted because of lack of space behind the second molar, while in others it provided room for its eruption by causing the anterior teeth to crowd.

Broadbent,[4] on the basis of the cephalometric evidence collected by the Bolton study, indicated that M3 impaction was not the cause of mandibular crowding but that both were the result of inadequate mandibular growth. According to Nance,[5] the coincident occurrence of M3 eruption with cessation of retention

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was the reason for the indictment of the M3 in the relapse of mandibular crowding. Moore[6] acquitted the M3 and considered that continued forward growth of the mandible after completion of maxillary growth caused the maxillary denture to restrain the mandibular anterior teeth with resultant crowding. Hixon[7] believed that continued reduction of arch length and anterior crowding after the age of 15 years was related to adolescent "development of the chin" rather than to M3 eruption. Björk and Skieller,[8] studying facial development and tooth eruption in subjects during the circumpubertal period, could find no clear evidence that secondary crowding was due to the eruption of M3.

Bergström and Jensen[9] studied sixty dental students with unilateral M3 aplasia and found greater crowding in the quadrants with M3s present than those where M3s were missing. A longitudinal investigation of sixty-five cases from the Bolton study was carried out by Vego.[10] Patients with both M3s present had a significantly greater decrease in arch perimeter (0.8 mm.) than persons with bilateral M3 agenesis. Vego concluded that the erupting M3 can exert a force on approximating teeth. Shanley[11] did a cross-sectional study on untreated patients. Fourteen had bilaterally impacted M3s, fourteen had bilaterally erupted M3s, and sixteen had bilateral M3 aplasia. He found no significant difference between the three groups and concluded that M3s were not important etiologic factors in crowding or protrusion of lower anterior teeth. In a longitudinal study of twenty-nine untreated patients, Stemm[12] found that the presence or absence of M3s was not a significant factor in the changes in arch width, arch length, or rotations that occurred in the mandibular dentition during the period of observation. Sheneman[13] investigated forty-nine patients who had completed orthodontic treatment an average of 66 months before final records were taken. Eleven patients had M3s in occlusion bilaterally, thirty-one had bilaterally impacted M3s, and seven had bilateral M3 agenesis. He found that the cases in which M3s were congenitally missing were relatively more stable in the lower anterior segment than those in which M3s were present. Schwarze[14] has reported that fifty-six orthodontically treated patients who had M3s removed prophylactically were more resistant to late anterior crowding than forty-nine former orthodontic patients with erupted M3s.

Material

The research material consisted of pretreatment, posttreatment, and postretention study models and lateral cephalometric radiographs of seventy-five orthodontically treated Caucasian patients. The records were obtained from the Department of Orthodontics, University of Washington School of Dentistry, and from the private practices of five orthodontists.

The cases were selected on the basis of meeting the requirements of one of the following three groups relative to the mandibular third molars (M3):

Group M3E. Both third molars erupted to the occlusal plane, in good alignment buccolingually, and of normal size and form. This group consisted of thirty cases.

Group M3I. Bilaterally impacted third molars. This group consisted of twenty cases. In the present study, impaction was defined as incomplete eruption of M3 because of its inclined position relative to the second

Table I. The sample

	M3 erupted	*M3 Impacted*	*M3 Agenesis*	*Totals*
Angle classification				
Class I	14	9	10	33
Class II, Division 1	13	11	12	36
Class II, Division 2	3	—	3	6
Females:				
Extraction	18	5	9	32
Nonextraction	—	6	10	16
Total	18	11	19	48
Males:				
Extraction	10	3	2	15
Nonextraction	2	6	4	12
Total	12	9	6	27
Totals	30	20	25	75

molar or the ascending ramus, or a vertical position whereby eruption is impeded by lack of space. All patients were candidates for surgical removal of M3 on the basis of postretention periapical radiographs.

Group M3A. Bilateral third molar agenesis. This group contained twenty-five cases. The diagnosis of M3 agenesis was based on examination of all radiographs taken throughout the treatment period and at the postretention examination and a negative history of previous permanent molar extractions.

The sample is summarized in Table I. Thirty-three patients had Angle Class I malocclusions; thirty-six had Class II, Division 1; and six had Class II, Division 2. There were twenty-eight nonextraction and forty-seven extraction cases, the latter having two lower premolars extracted as part of treatment. All patients had otherwise intact lower dental arches at the postretention examination. Of the nonextraction cases, the lower arch was not fully banded in seven cases; the majority of these had a lower lingual arch. All extraction cases were treated with a multibanded edgewise technique, except for one case in which serial extractions were performed with no subsequent active therapy. The minimum postretention period in this study was 4 years, with a mean of 9.3 years. The minimum postretention age was 20.9 years for females and 21.2 years for males, with a mean age of 26.6 years for the total sample.

For brevity, the following abbreviations will be used in the text to designate the different times: pretreatment, T1; end of active treatment, T2; and postretention, T3. Treatment change refers to T2-T1, posttreatment T3-T2, and over-all T3-T1.

Method

Model analysis. By means of Helios calipers, measuring to 0.10 mm., the following variables were measured on the T1, T2, and T3 study models for each case:

1. *Arch length*—the sum of the right and left measurements from the

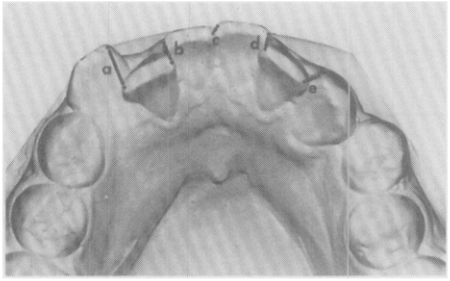

Fig. 1. Lower anterior crowding quantified as the sum of the contact displacements **a, b, c, d,** and **e.**

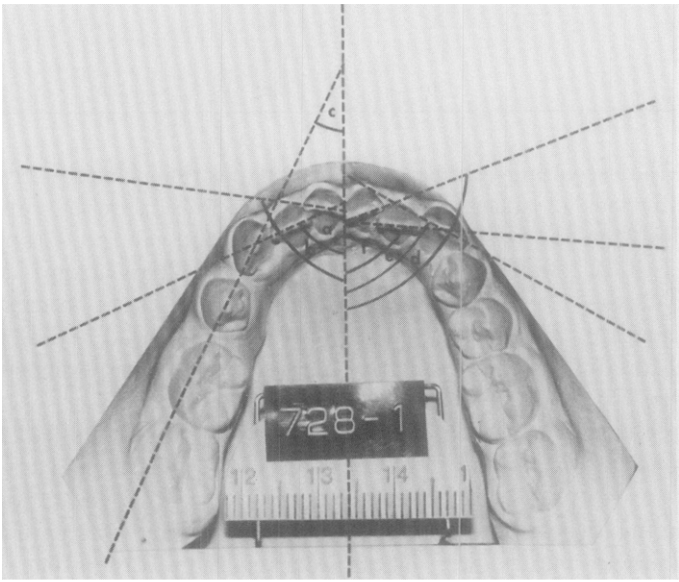

Fig. 2. Lower anterior rotations quantified as the mean absolute change in angles **a, b. c, d, e** and **f** between any two times **(T1, T2, T3).**

buccal grove of the first permanent molar, where it crosses onto the occlusal surface, to the midpoint between the contacts of the lower central incisors.

2. *Intermolar width*—measured from the buccal groove of the first permanent molar where it crosses onto the occlusal surface to that on the opposite side.

3. *Intercanine width*—the distance between the cusp tips of the mandibular canines.

4. *Lower anterior crowding (Fig. 1)* was quantified by the method devised by Little.[15] This consists of measuring the displacement of adjacent contact points at the five interproximal areas of the six anterior teeth. The sum of these measurements represents the degree of lower anterior crowding. Perfect alignment from the mesial aspect of the canine

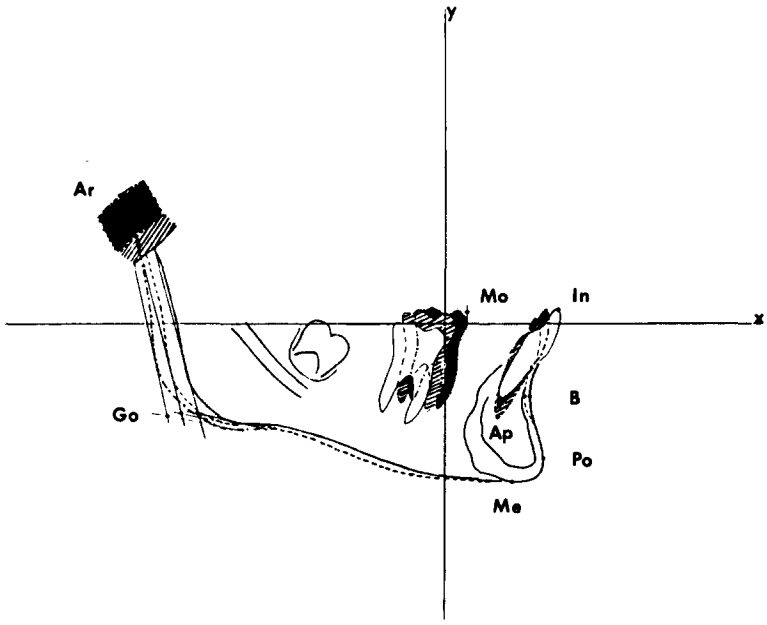

Fig. 3. Mandibular composite tracing. Eight landmarks digitized at each time were: **Mo,** Midpoint of the mesial surfaces of the lower first permanent molars; **In,** incisal edge; **Ap,** incisal apex; **B,** point B; **Po,** pogonion; **Me,** menton; **Go,** gonion; **Ar,** articulare.

to that on the contralateral side would be zero. Any spaces between adjacent teeth were scored as zero, but where a space between two anterior teeth coexisted with a contact displacement between two other teeth, the space was measured and offset against the amount of overlap.

In thirteen cases one or both canines were unerupted at T1, so that there were only sixty-two observations for intercanine width and lower anterior crowding at T1.

5. *Lower anterior rotations (Fig. 2)* were measured from standardized photographs of the study models.[16] The six angles formed between a line joining the mesial and distal contact points of each of the six anterior teeth and the midsagittal plane (transferred from the maxillary to mandibular models) were measured to the nearest degree.

Cephalometric analysis. Mandibular tracings (from the T1, T2, and T3 cephalometric radiographs) were superimposed according to the method described by Björk.[17] On each radiograph, eight cephalometric landmarks were located and indicated by points (Fig. 3). By means of a Benson-Lehner digitizer (Larr-M), the x, y coordinates of each of the twenty-four points were transferred onto magnetic tape. The following variables were derived from these digitized data at T1, T2, and T3:

1. Angle of lower incisor to mandibular plane.
2. Anteroposterior position of the lower incisor along the x axis.
3. Anteroposterior position of the lower first molar along the x axis.
4. Mandibular length—articulare to pogonion.

Two cases (Nos. 811 and 918) were missing one head film each, and were

Table II. Posttreatment changes (all cases)

Variable	Group M3E			Group M3I			Group M3A			F value*
	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	
Arch length (mm.)	-2.50	1.57	30	-2.39	1.83	20	-2.20	1.55	25	0.231
Intermolar width (mm.)	-1.16	1.13	30	-0.52	1.19	20	-0.58	1.16	25	2.487
Intercanine width (mm.)	-1.38	1.19	30	-1.49	1.24	20	-1.94	1.27	25	1.515
Lower anterior crowding (mm.)	3.00	2.15	30	2.20	1.16	20	1.99	1.76	25	2.403
Lower anterior rotations (degrees)	3.40	1.60	30	3.35	2.20	20	2.82	1.69	25	0.806
IMPA (degrees)	2.94	5.55	30	3.83	4.02	19	0.54	3.51	24	2.976
Lower incisor × coordinate (mm.)	1.11	1.80	30	0.86	1.20	19	0.17	1.42	24	2.514
Lower molar × coordinate (mm.)	1.73	1.26	30	1.29	1.43	19	1.29	1.21	24	1.096

*None of the F values were significant at the 0.05 level of confidence.

excluded from the cephalometric part of the study. As a result, group M3I had only nineteen observations and group M3A and twenty-four observations for the cephalometric variables.

Error of the method

The standard error of the measure, determined by replicate measurements from eighteen randomly selected models, was 0.23 mm.

One case (No. 807) was randomly selected for determination of the error of the measurements from the photographs and from the cephalometric radiographs. All measurements were repeated on three separate occasions. The mean ranges of error were as follows:

1. Angular photographic measurements, ± 1.35 degrees.
2. Linear cephalometric measurements, ± 0.24 mm.
3. Angular cephalometric measurements, ± 0.42 degree.

Parallax error in the photographic technique due to inaccurate leveling was determined by photographing a randomly selected model (No. 730, T1) with a 10 degree tilt forward, backward and to each side. The mean range of error was ± 1.33 degrees.

Statistical analysis

The sample was statistically examined in the following groups:

1. All cases.
2. All extraction and nonextraction cases.

Table III. Posttreatment changes (extraction cases)

Variable	Group M3E			Group M3I			Group M3A			F value*
	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	
Arch length (mm.)	-2.45	1.53	28	-1.59	1.13	8	-1.43	1.00	11	2.783
Intermolar width (mm.)	-1.21	1.15	28	-0.40	0.74	8	-0.40	1.46	11	2.685
Intercanine width (mm.)	-1.36	1.18	28	-1.55	1.53	8	-2.03	1.48	11	1.028
Lower anterior crowding (mm.)	3.10	2.18	28	2.28	1.28	8	1.68	1.67	11	2.243
Lower anterior rotations (degrees)	3.53	1.57	28	3.26	2.78	8	3.35	2.31	11	0.145
IMPA (degrees)	3.44	5.25	28	3.73	4.58	8	1.36	3.48	11	0.854
Lower incisor × coordinate (mm.)	1.28	1.71	28	0.74	0.98	8	0.27	1.26	11	1.839
Lower molar × coordinate (mm.)	1.78	1.29	28	0.89	0.85	8	1.23	0.71	11	2.388

*None of the F values were significant at the 0.05 level of confidence.

3. All females and males.
4. All M3E, M3I, and M3A cases.
5. The following subgroups in the M3E, M3I, and M3A groups were examined: extraction cases, females, males, female extraction cases.

Nonextraction cases and male extraction cases in the M3 subgroups were not examined statistically because of the relatively small numbers in some cells. The means and standard deviations of the changes for each of the nine variables and the absolute values of all the variables (except anterior tooth rotations and lower incisor and lower molar position along the x axis) were computed for the above groups and subgroups. Comparison of three group means was performed by means of a one-way analysis of variance. The null hypothesis was rejected where $p < 0.05$.

Findings

Statistical analysis of the posttreatment changes for the three M3 groups is summarized in Tables II and III.

Arch length decreased in all groups and subgroups for the three time periods, except in the nonextraction group where a mean increase of 0.23 mm. (3.58*) occurred during treatment. This was significantly different ($p < 0.01$) from the extraction group which exhibited a mean decrease of 9.50 mm. (3.38). During treatment, group M3E demonstrated significantly more arch length re-

*Standard deviation.

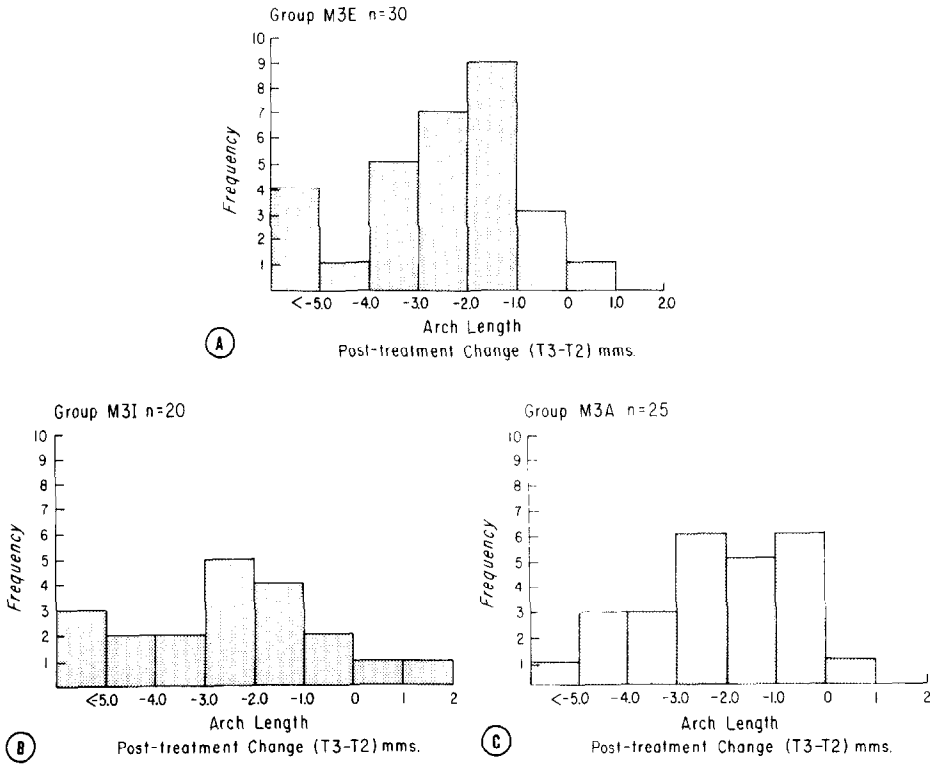

Fig. 4. Frequency distributions of the posttreatment change in arch length in groups M3E, M3I, and M3A.

duction ($p < 0.01$) than groups M3I and M3A, but when only extraction cases in the M3 groups were compared, no statistically significant difference was apparent.

After treatment, arch length decreased slightly more on the average in the nonextraction group (–2.88 mm., 1.83) than in the extraction group (–2.06 mm., 1.42, $p < 0.05$). However, the mean posttreatment decrease was not significantly different between the M3 groups and subgroups. Fig. 4 illustrates the frequency distribution of the posttreatment changes in arch length in the M3 groups.

Intermolar width decreased in the extraction group but increased in the nonextraction group during treatment. The difference, 2.01 mm., was statistically significant at the 1 per cent level.

All groups and subgroups demonstrated a reduction in intermolar width after treatment. For the total sample this was 0.80 mm. (1.18). No significant difference was evident between the extraction and nonextraction groups for the posttreatment change. Over-all, there was a net reduction for all groups and subgroups except the nonextraction group, where half of the treatment expansion (0.56 mm., 1.90) was maintained, while in the extraction group intermolar width decreased by more than double the treatment decrease (–1.72 mm., 1.63, $p < 0.01$).

No statistically significant differences were found in the treatment and post-

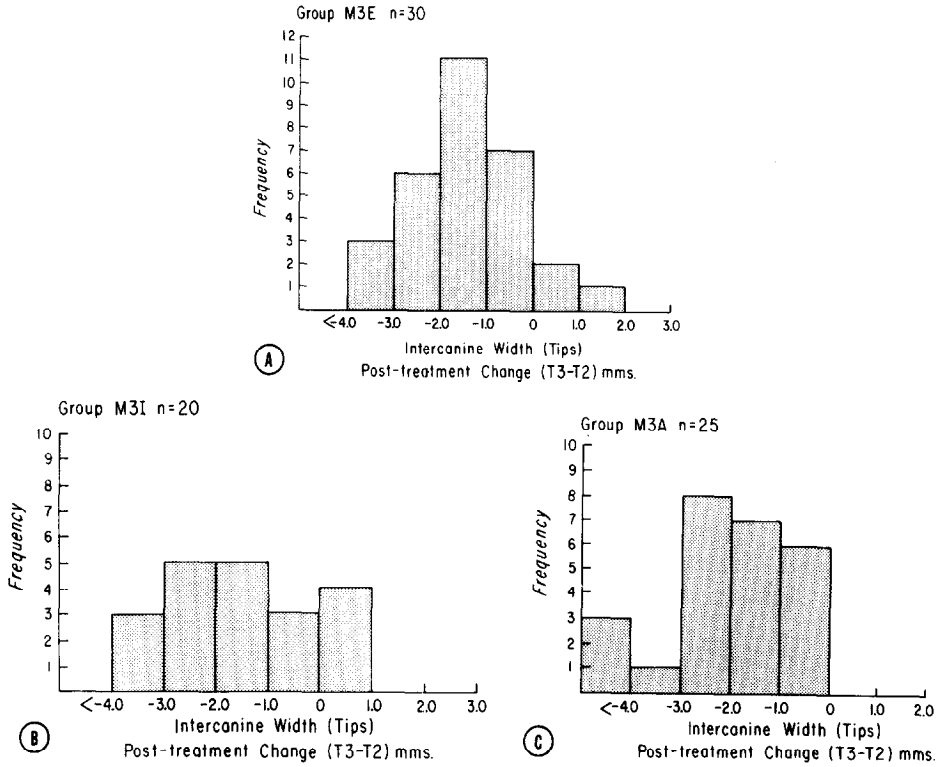

Fig. 5. Frequency distributions of the posttreatment change in intercanine width in groups M3E, M3I, and M3A.

treatment changes in intermolar width between M3 groups and subgroups.

Intercanine width exhibited a mean increase in all groups and subgroups during treatment. The average treatment expansion for the sixty-two cases with both canines erupted at T1 was 1.13 mm. (1.80). No statistically significant differences were found between nonextraction and extraction groups or between M3 groups and subgroups.

The total sample demonstrated a mean 1.59 mm. (1.24) posttreatment decrease in intercanine width. A fairly consistent mean decrease in intercanine width occurred posttreatment throughout the M3 groups and subgroups and no significant differences were evident. Fig. 5 depicts the frequency distribution of the posttreatment changes in intercanine width in the M3 groups.

Lower anterior crowding decreased during treatment an average of 3.90 mm. (3.62) for the sixty-two cases with both canines erupted at T1, and a mean posttreatment relapse of 2.45 mm. (1.84) occurred in the total sample. An overall improvement of 1.43 mm. (3.43) was achieved in the sixty-two cases.

During treatment the extraction group exhibited more than double the decrease in lower anterior crowding (–4.83 mm., 3.78) compared to the nonextraction group (–1.94 mm., 2.30). This was highly significant ($p < 0.01$) and was expected as the extraction cases had significantly ($p < 0.01$) more crowding than the nonextraction cases at T1.

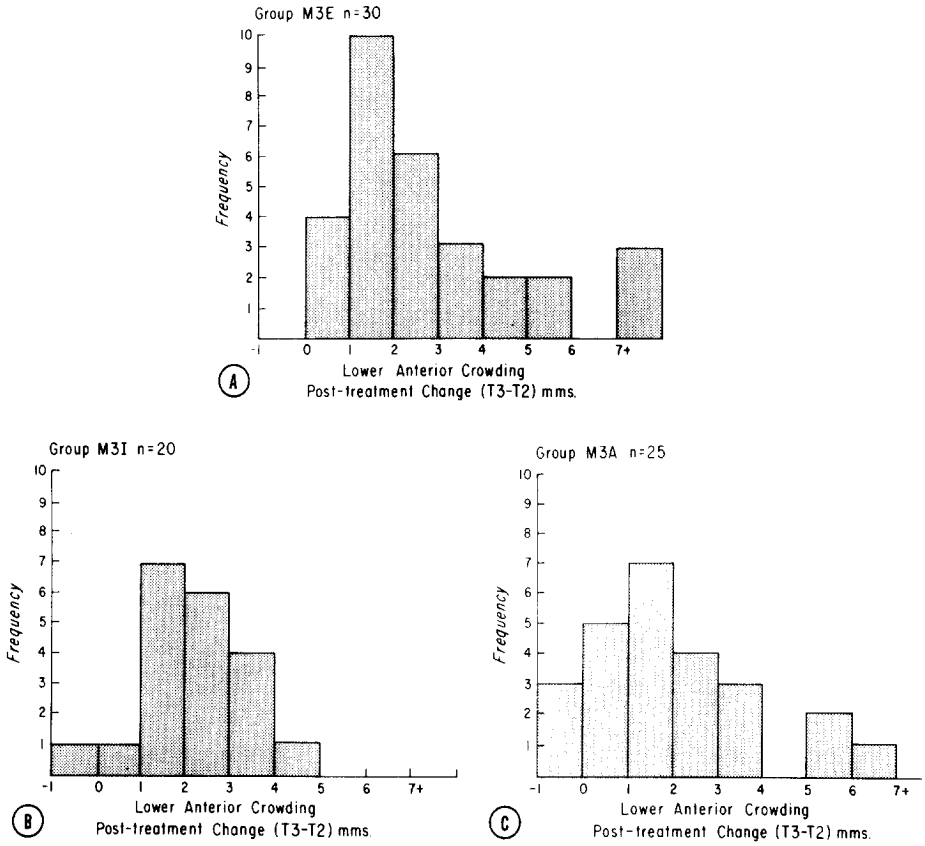

Fig. 6. Frequency distributions of the posttreatment change in lower anterior crowding in groups M3E, M3I, and M3A.

On the average, all groups and subgroups displayed some degree of relapse, but no significant differences were evident between the M3 groups and subgroups. In Fig. 6 are histograms of the posttreatment change in lower anterior crowding that occurred in the M3 groups.

All groups demonstrated a mean over-all improvement in lower anterior crowding, except the nonextraction group which exhibited a return of slightly more crowding than initially (0.40 mm., 1.92), while the extraction group had on the average a relapse of only half the amount of crowding that existed initially (–2.30 mm., 3.65, $p < 0.05$). It should be emphasized that a wide range of over-all change occurred, from 14.1 mm. reduction in crowding to 3.2 mm. increase.

The crowding scores at T1 were plotted against those at T3 for each of the M3 groups. A linear relationship could not be demonstrated.

Lower anterior rotations were assessed as the average absolute angular change for each case over each time period. The mean changes in the angles of rotation were not significantly different between the M3 groups and subgroups for the three time periods.

Lower incisor—mandibular plane angle and lower incisor position along x axis. For the total sample, treatment produced a mean 2.41 degree (6.35) uprighting of the lower incisor with retraction of the incisal edge by an average of 1.81 mm. (2.33). The mean posttreatment change was a 2.37 degree (4.72) proclination, while the incisal edge moved forward an average of 0.72 mm. (1.54).

The extraction group demonstrated a 3.98 degree (6.50) retroclination during treatment, while nonextraction cases proclined 0.42 degree (5.06, $p < 0.01$). During the posttreatment period the lower incisor proclined 3 degrees (4.78) in the extraction group, while nonextraction cases exhibited a further 1.36 degree (4.42) proclination, but the difference was not statistically significant. The M3 groups and subgroups did not reveal significant differences in the mean changes in IMPA produced during treatment and posttreatment.

Treatment changes of the lower incisor along the x axis showed that the extraction group exhibited a mean 2.87 mm. (1.92) retraction while the nonextraction group hardly changed (0.11 mm., 1.72, $p < 0.01$).

Following treatment, some degree of forward movement occurred for both extraction and nonextraction cases, but the difference was not significant.

The M3 groups and subgroups did not reveal statistically significant differences in the mean posttreatment change in the position of the lower incisor along the x axis.

Lower molar position along x axis. All groups and subgroups demonstrated, on the average, mesial movement of the lower first molar for the three time periods. Treatment produced a statistically significant ($p < 0.01$) difference between the extraction (3.68 mm., 1.67) and nonextraction (1.21 mm., 1.13) groups, but posttreatment mesial eruption was the same in the two groups.

Group M3E demonstrated significantly more mesial molar movement than the M3I and M3A groups during treatment, but no significant difference was found during the posttreatment period. An examination of extraction cases in the M3 groups did not reveal significant differences between the mean mesial molar movement for the three time periods.

Mandibular length. Male and female patients demonstrated a significant difference in the increase in mandibular length that occurred for the three time periods. Over-all, females showed an average increase of 7.21 mm. (4.81) and males showed an increase of 14.94 mm. (5.08, $p < 0.01$). Comparison of over-all mandibular growth of females in the three M3 groups revealed no significant difference, as did examination of males in the three groups. Females in the three groups did not demonstrate significant differences in absolute mandibular length for the three times. The same was found for males.

Discussion

The results relative to mandibular arch dimensional changes are in agreement with previous studies when the sample is viewed as a whole and when extraction and nonextraction groups are compared. From the end of active treatment to final records, mandibular arch length demonstrated the typical reduction that occurs with age in both treated[18] and untreated[19-21] subjects. Nonextraction cases exhibited a fractional mean increase in arch length during treatment,

but this can be explained by the fact that posttreatment study models were taken, in some cases, immediately after band removal prior to closure of band spaces. This limited amount of band spacing was masked in the extraction group, which demonstrated a large decrease in arch length during treatment. Group M3E exhibited approximately 5 mm. greater arch length reduction than the other two M3 groups during treatment. This was a function of the higher ratio of extraction to nonextraction cases in that group and is confirmed by the fact that no significant differences in the mean treatment changes in arch length occurred between the extraction cases in the M3 groups. No significant differences in posttreatment arch length reduction were revealed between the M3 groups or subgroups.

In order to determine from which direction arch-length reduction occurred, examination of the lower incisor and lower first molar in terms of their x coordinates reveals that for the total sample the lower incisor was retracted 1.81 mm. while the lower molar moved 2.80 mm. mesially during treatment. This observation is influenced in the main by the extraction group, which exhibited 2.87 mm. incisor retraction and 3.68 mm. mesial molar movement. In the nonextraction group, the lower incisor hardly changed, while the lower molar moved 1.21 mm. mesially during this period. The fact that lower incisors were retracted to such an extent in the extraction cases reflects the influence of Tweed mechanics, which was in vogue when some of the cases comprising this sample were treated.

In spite of the greater number of extraction cases compared to nonextraction cases in group M3E, no significant differences in lower incisor anteroposterior change were evident between the M3 groups during treatment. The lower molar moved mesially significantly more in the extraction group, and this was reflected in the M3E group where the amount of mesial molar movement was greater than in the other two M3 groups. This was a consequence of the higher ratio of extraction to nonextraction cases in this group. Examination of the extraction cases did not reveal significant differences between the M3 groups in the amount that the molar moved mesially during treatment.

It is of interest that during the posttreatment period the lower incisor demonstrated labial movement which was fairly uniform in all the groups. No significant differences were observed between the M3 groups and subgroups. This tendency for the lower incisor to move toward its original position has been documented by Mills.[22] In some cases this labial incisor movement can be explained as it related to postretention crowding—one lower incisor being crowded labially (Fig. 12, *C*, Case 920-3).

During the posttreatment period, the lower first molar demonstrated a fairly uniform mesial movement in all the groups, and no significant differences were observed between the M3 groups and subgroups. This finding suggests that it is unlikely that M3 exerts pressure on the teeth mesial to them.

The possibility that erupting M3s could affect intermolar width was not substantiated in this study. In the extraction group intermolar width decreased 0.83 mm. during treatment, while the nonextraction cases exhibited 1.18 mm. expansion. Posttreatment, the nonextraction cases tended to return to their pre-

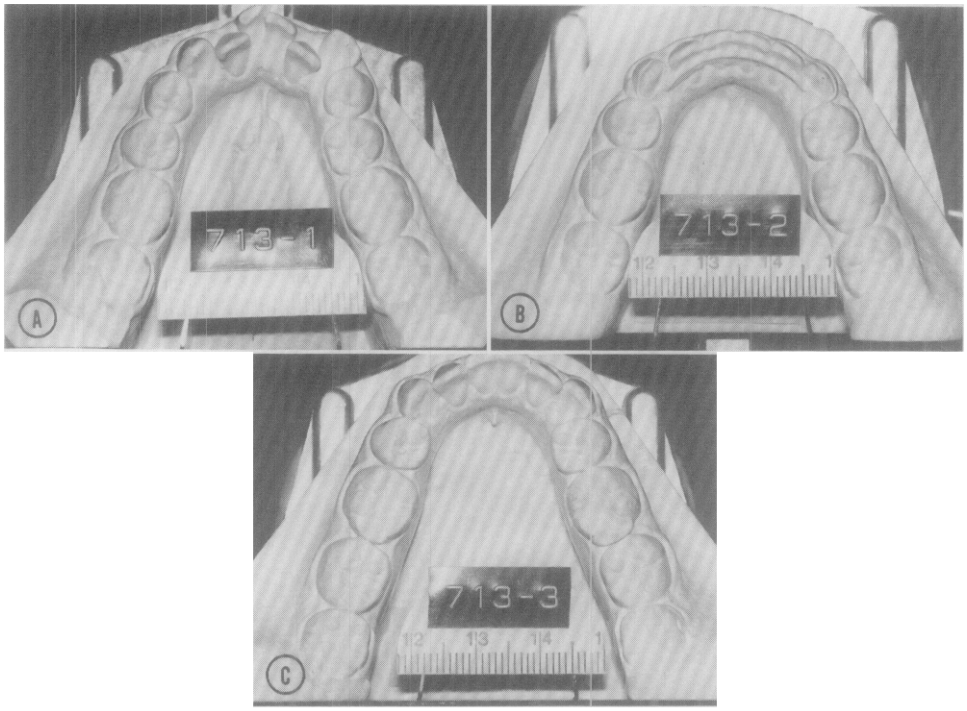

Fig. 7. Case 713, third molars erupted. **A,** Pretreatment—12.06 years, 13.6 mm. crowding. **B,** Posttreatment—15.00 years, 0 mm. crowding; **C,** Postretention (9.06 years)—26.03 years, 2.3 mm. crowding.

treatment intermolar width by decreasing 0.64 mm. but maintained half their treatment expansion. The extraction cases continued to decrease during this period, with the result that at the postretention stage they had decreased by twice their treatment decrease. These findings are in full accord with those of Amott,[23] Welch,[24] and Shapiro.[18] The M3 groups did not exhibit any significant differences in intermolar width changes during treatment or posttreatment.

Intercanine width measurements produced results in conformity with those of Shapiro.[18] The amount of treatment expansion (approximately 1 mm.) was not significantly different between the extraction and nonextraction groups; nor was the posttreatment relapse (approximately 1.5 mm.) significantly different. The net effect was for intercanine width to decrease below the original dimension: –0.42 mm. for extraction cases and –0.82 mm. for nonextraction cases. These values are in close agreement with Shapiro's figures of –0.3 mm. and –0.7 mm., respectively.

The posttreatment change in intercanine width was a mean decrease for all groups, and no significant differences between M3 groups and subgroups were demonstrated. It is therefore apparent that the presence of M3 does not have any effect on intercanine width relapse during the posttreatment period.

Crowding of lower incisors has been demonstrated in many studies to increase with age in a nonorthodontically treated population.[25-27] While no study

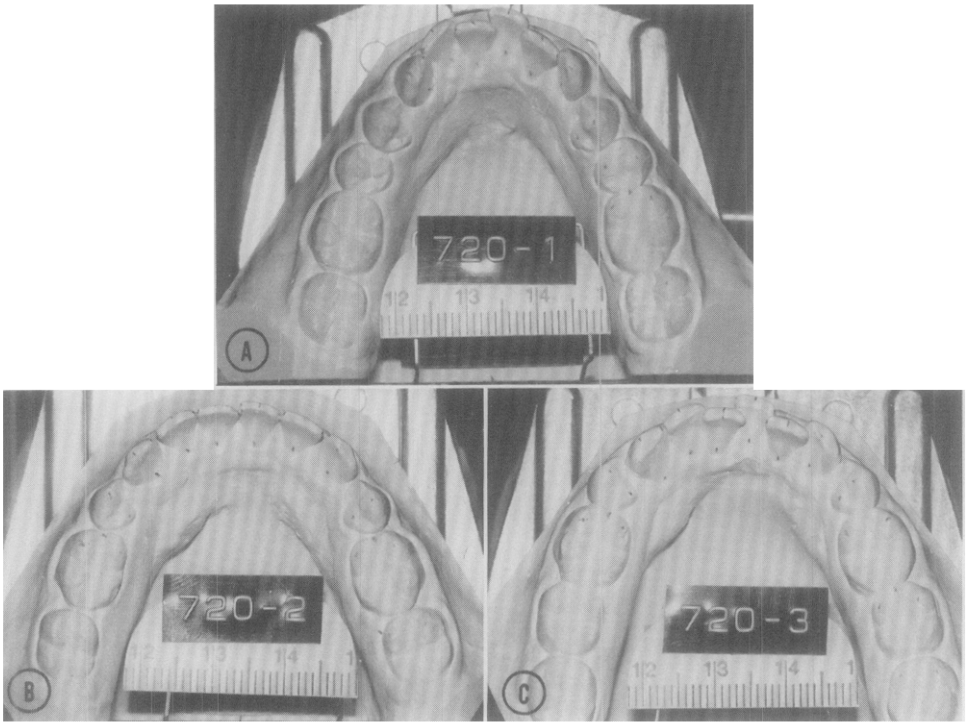

Fig. 8. Case 720, third molars erupted. **A,** Pretreatment—13.08 years, 6.4 mm. crowding. **B,** Posttreatment—15.10 years, 0 mm. crowding. **C,** Postretention (11.06 years)—31.03 years, 8.1 mm. crowding.

of long-term postretention crowding has been carried out previously, it is a well-known clinical fact that crowding relapse is a potential hazard to the integrity of the treated mandibular dental arch. The possibility that lower anterior crowding relapse is related to the amount of crowding present prior to treatment could not be substantiated statistically. Approximately two thirds of all cases had less postretention crowding compared to the pretreatment crowding. Extraction cases underwent more than twice the improvement shown by nonextraction cases during treatment. This is due to the fact that extraction cases had more crowding at T1. During the postretention period no significant difference in the amount of relapse was evident between extraction and nonextraction groups.

Examination of the M3 groups and subgroups revealed a consistent lack of significant differences between the mean changes in lower anterior crowding during the three time periods. Two cases from each M3 group have been illustrated in order to show different relapse patterns within the M3 groups and similar relapse patterns between the M3 groups (Figs. 7 to 12). Three cases in group M3A exhibited considerable crowding relapse and could conceivably have weighted the results. On the average, this study indicates that cases with M3s present do not exhibit more lower anterior crowding relapse than cases with M3 agenesis. This parallels the findings of Shanley[11] but is in conflict with Shene-

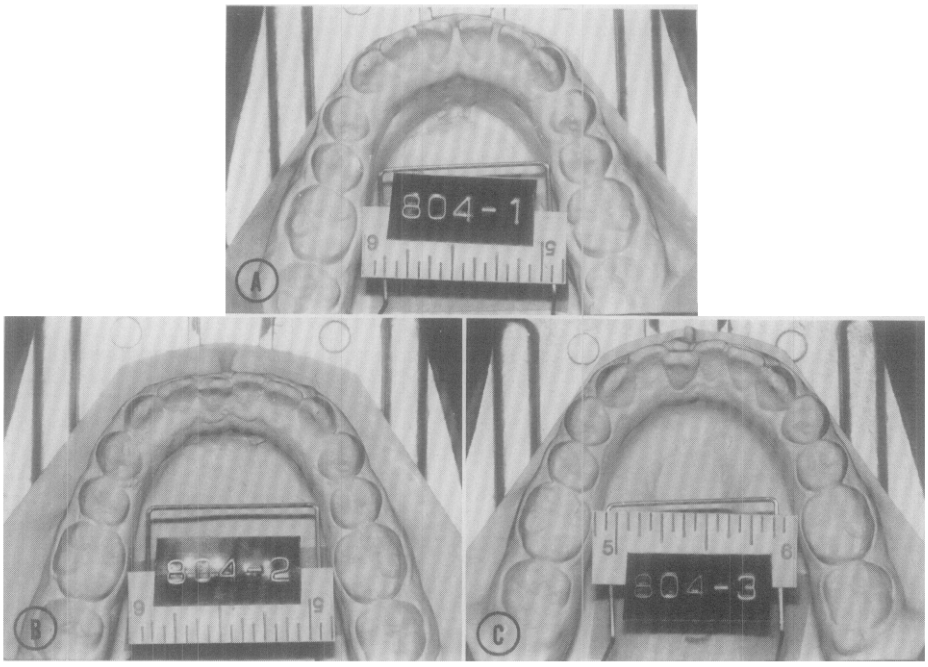

Fig. 9. Case 804, third molars impacted. **A,** Pretreatment—13.00 years, 0 mm. crowding. **B,** Posttreatment—16.02 years, 1.0 mm. crowding. **C,** Postretention (5.09 years)—22.00 years, 3.2 mm. crowding.

man's[13] conclusion that cases with M3 agenesis were more stable than cases in which M3 were present. However, it should be pointed out that Sheneman studied a smaller sample with dissimilar-sized groups and with a younger age range and a shorter mean postretention period. Furthermore, his statistical analysis is open to question since he utilized "t" tests to compare three group means.

Comparison of crowding between cases with M3s present and those with M3 agenesis introduces a question which needs elucidation. Keene[28] has found that the mandibular arch is less frequently crowded when there is M3 agenesis. In this study it was not evident that less crowding existed in Group M3A than in the groups with M3s present prior to treatment. It must be kept in mind that this was a biased sample of patients who had sought orthodontic treatment and in all likelihood had more crowding than the population mean of cases with M3 agenesis.

Rotational relapse is a great postretention problem.[29] In this study, a fairly uniform rotational relapse occurred throughout all groups. No significant differences in posttreatment rotational change were demonstrable between the M3 groups and subgroups. The idea that M3 pressure would crowd teeth in the arch and produce significantly more rotations than cases with M3 agenesis was not substantiated in this study.

The suggestion[11] that pressure exerted by M3s might tip mandibular incisors labially without crowding them was not confirmed in this study. The total sam-

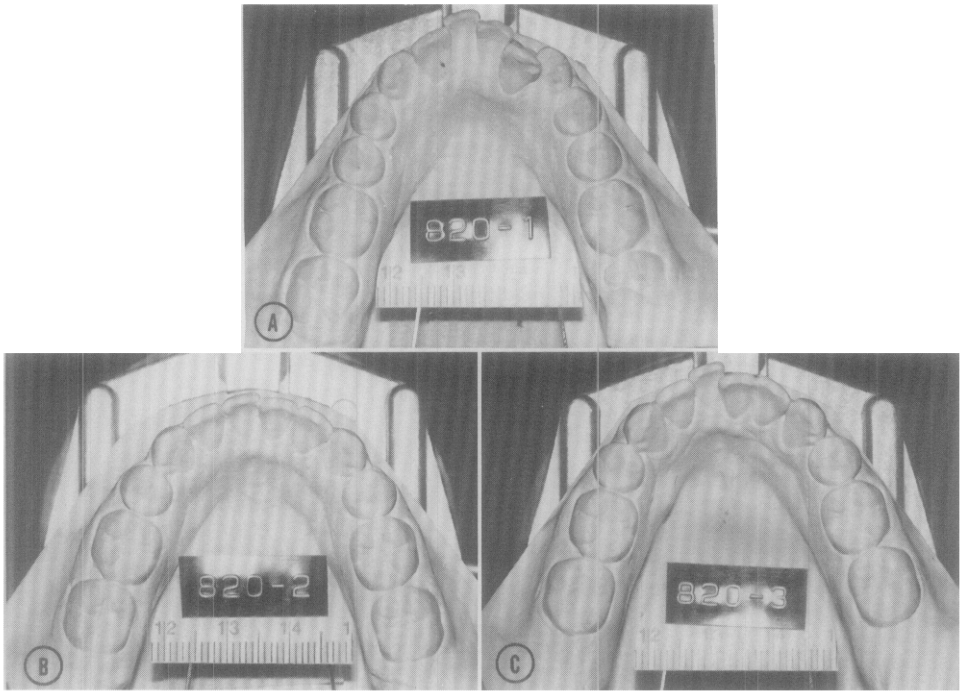

Fig. 10. Case 820, third molars impacted. **A,** Pretreatment—13.02 years, 10.3 mm. crowding. **B,** Posttreatment—16.03 years, 1.0 mm. crowding. **C,** Postretention (13.00 years)—30.01 years, 3.9 mm. crowding.

ple exhibited uprighting of the lower incisor during treatment, and posttreatment the lower incisor proclined approximately the same amount, so that the mean over-all result was a return to approximately the original axial inclination. This corroborates the research of Litowitz[30] and Mills.[22]

The extraction group exhibited incisor retroclination during treatment, while nonextraction cases demonstrated slight proclination. During the postreatment period the lower incisor proclined in both extraction and nonextraction groups, the difference not being statistically significant. Examination of the M3 groups and subgroups did not reveal significant differences in the change in IMPA during treatment and posttreatment. Furthermore, the posttreatment change in lower incisor position along the x axis did not reveal that the lower incisor protruded more in the groups with M3s present. It is therefore concluded that during the posttreatment period the presence of M3s did not affect the changes in IMPA.

The finding that no significant difference in mandibular growth occurred between female patients in the three M3 groups and between male patients in the three M3 groups tends to rule out the possibility that the lack of significant differences in crowding relapse could be atrributable to growth differences between the three groups.

It must be emphasized that the sample was not randomly selected, as post-

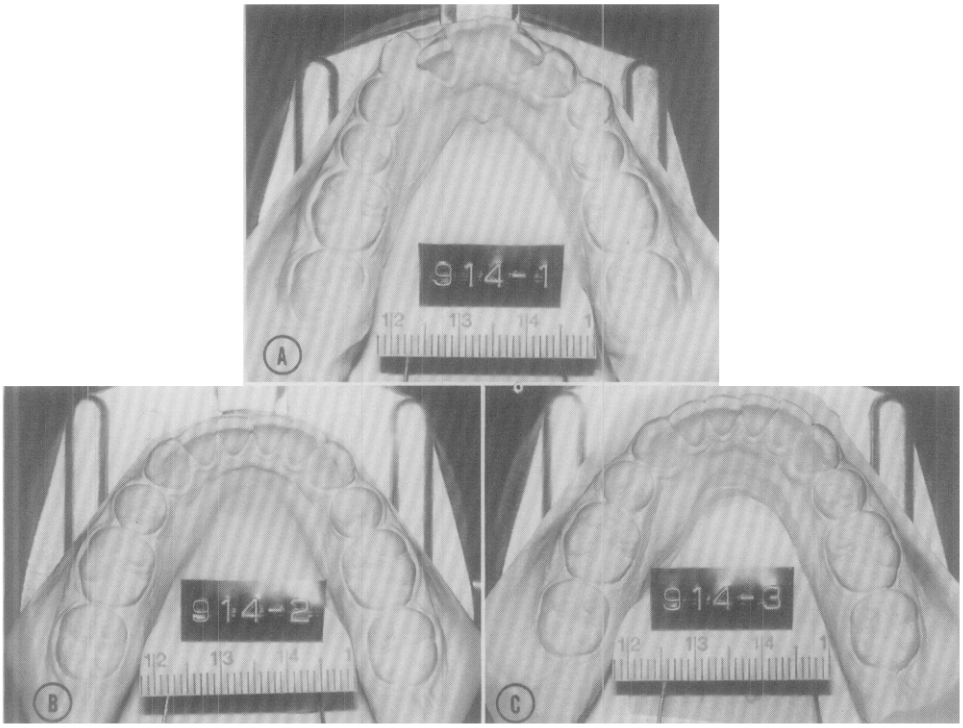

Fig. 11. Case 914, third molars congenitally missing. **A,** Pretreatment—13.04 years, 8.5 mm. crowding. **B,** Posttreatment—15.02 years, 0.8 mm. crowding. **C,** Postretention (6.08 years)—23.01 years, 1.5 mm. crowding.

retention cases are not easily collected. However, since most of the postretention changes conform with other studies, it is suggested that the sample, in fact, is representative of the underlying orthodontic population.

The failure to reject the null hypothesis, while indicating that M3s are not significant factors in lower incisor crowding relapse on the average, does not rule out the possibility that in isolated cases M3 might be a factor. This study tends to emphasize the multifactorial nature of lower crowding relapse. The many unkowns in the question of crowding relapse stress the need for further study of the problem.

Summary and conclusions

A sample of seventy-five orthodontically treated Caucasian patients an average of 9.3 years out of retention, with a mean postretention age of 26.6 years, was collected. Thirty patients had bilaterally erupted mandibular third molars, twenty had bilaterally impacted third molars, and twenty-five had bilateral third molar agenesis.

The purpose of this study was to compare the three groups and subgroups of extraction cases, females, female extraction cases, and males. Changes in mandibular arch dimensions and crowding and rotations of lower anterior teeth were

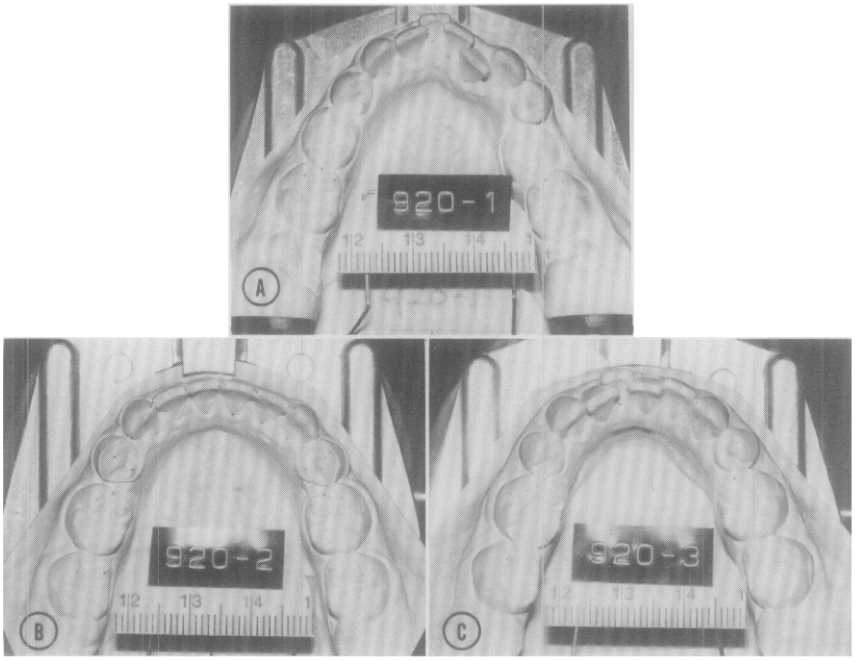

Fig. 12. Case 920, third molars and second premolars congenitally missing. **A,** Pretreatment—13.03 years, 8.8 mm. crowding. **B,** Posttreatment—15.03 years, 0 mm. crowding. **C,** Postretention (17.00 years)—36.03 years, 6.2 mm. crowding.

studied by examining pretreatment, end-of-active-treatment, and postretention dental casts.

Cephalometric investigation evaluated changes in the lower incisor and lower first molar positions and mandibular growth. The data were analyzed statistically, utilizing the F test for a comparison of three group means.

On the basis of the findings of the study, the following conclusions are made:

1. During the posttreatment period no significant differences were apparent in the changes in arch length, lower molar position, lower incisor position, or lower incisor axial inclination between the three third molar groups.

2. It does not appear that the presence of lower third molars has any significant influence on posttreatment changes in arch length, lower molar position, lower incisor position, or lower incisor axial inclination.

3. Significant differences were not demonstrated in the posttreatment changes in intermolar and intercanine width between the three M3 groups.

4. It does not appear that the presence of third molars has any effect on dimensional changes in intercanine width and intermolar width.

5. Some degree of lower anterior crowding relapse occurred in the majority of cases, but this was not significantly different between the third molar groups.

6. These data indicate that the presence of third molars does not appear to produce a greater degree of lower anterior crowding and rotational relapse after the cessation of retention than that which occurs in patients with third molar

agenesis. The theory that third molars exert pressure on the teeth mesial to them could not be substantiated in this study.

7. Further investigation of the factors involved in lower anterior crowding relapse in postorthodontic patients is definitely indicated.

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We are almost daily called upon to combat the erroneous beliefs of men engaged in the practice of dentistry and medicine, to say nothing of the uneducated laity, with reference to the proper time for treating maloccluded teeth. I believe the fallacious teaching that this treatment should be deferred until the permanent dentition is completed can only be promulgated by those who study the subject superficially, if indeed they have had the advantage of preparation for, or any considerable experience in, the practice of orthodontia. (Gray, B. Frank: Discussion of paper by D. Willard Flint entitled "Early Treatment in the Correction of Malocclusion of the Teeth." Transactions of the Seventh Annual Meeting of the American Society of Orthodontists, Detroit, Oct. 2 to 4, 1907.)