A Clinical Study on Closing Edentulous Spaces in the Mandible

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Orthodontists are often confronted with young adults and adult patients who have large edentulous spaces in the posterior of the mandibular arch. Frequently this is because of the loss of lower first molars. To date no clinical study has been reported regarding closing large edentulous spaces in the posterior of the mandible.

The purpose of this study is to investigate changes in the edentulous ridge and adjacent teeth before and after closure of first molar spaces in the mandible. The following were noted before and after space closure: 1) mandibular ridge width and height, 2) crestal bone height, 3) root resorption, 4) total space closure and 5) mesial migration, uprighting, and eruption of the second molar.

MATERIALS AND METHODS

The 16 edentulous spaces selected include treated cases from three orthodontic offices. All were fully treated with upper and lower edgewise appliances. Included are 8 young adult and 8 adult cases. The young adult cases ranged from 11 to 17 years of age, the adult cases from 23 to 46 years of age.

The sample is divided into two groups, Group A are the young adults, mean age 13.6 years old and Group B the adult cases with a mean age of 31.5 years. The average treatment time for Group A was 27.8 months and for Group B 32.3 months.

The cases used in this clinical study showed complete closure of the edentulous space in all but five of the spaces. All five unclosed spaces were in Group B, the adults.

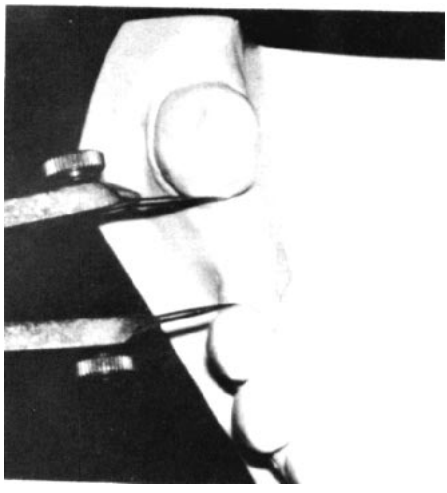


Fig. 1

All patients showed some buccolingual constriction of the cortical plate of the alveolar bone; no evidence of the residual socket was seen on periapical radiographs. The purpose was to obtain cases that had completed bony remodeling in the area of the lost first molar.

The before and after treatment records were: lower jaw casts, lateral headplates, panoramic radiographs or full mouth radiographs of the teeth. The before records are prior to any orthodontic treatment, the after records are following the removal of the orthodontic appliance.

The before and after casts were measured for the mesial-distal length of the edentulous space. Measurements were made from contact point to contact point of the teeth adjacent to the edentulous space (Fig. 1).

The buccolingual width of the al-

Read at the May 1978 meeting of the Northern California Component of the Angle Society.

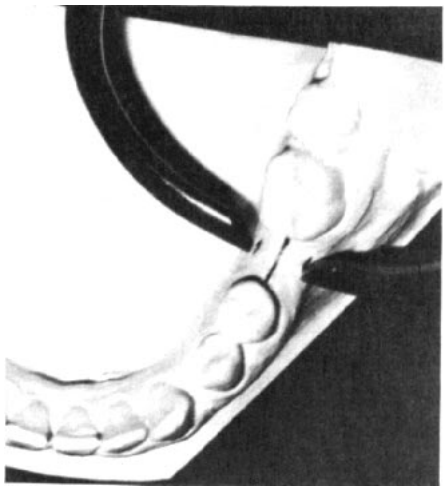


Fig. 2

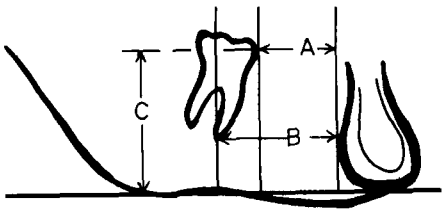


Fig. 3

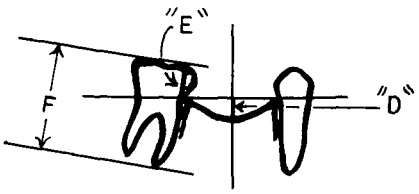


Fig. 4

veolar ridge of the edentulous space was measured in the following manner. A point was located by inspection at the middle of each edentulous ridge mesiodistally and buccolingually. From this center point, two points 4 mm down the slope of the alveolar ridge, one buccally and one lingually, were used to measure the width of the alveolar ridge of the edentulous space. A caliper was used to make this width measurement (Fig. 2).

From the lateral cephalometric head plate were traced the right or left molar, the distal border of the ramus and inferior border of the body of the mandible and the mandibular symphysis (Fig. 3). From panoramic or periapical radiographs of the teeth, the right or left second molar, right or left second premolar and the outline of the alveolar ridge in edentulous space were obtained (Fig. 4).

The following points were used in this study: gonion, menton, the most posterior point on the mandibular symphysis, most mesial point of the crown of the lower second molar, most superior points of the alveolar bone distal to the second premolar and mesial to the second molar, and the most inferior point on the mesial root of the lower second molar.

The planes drawn were (Figs. 3 and 4) mandibular (Go Me), interproximal bone height plane (line connecting the crests of the interproximal bone between molar and premolar) and second molar occlusal plane (connecting the tips of the occlusal cusps).

The following perpendicular lines were erected: symphysis, from the mandibular plane through the distal of the symphysis; second molar crown, from the mandibular plane through the mesial contact point of the molar; second molar root, from the mandibular plane through the tip of the mesial root of the molar; and interproximal bone, the perpendicular bisecting the line from crest to crest of interproximal bone in the edentulous space (Fig. 4, line "D").

The following millimetric measurements were made before and after treatment: (Figs. 3 and 4) A, distance between the second molar crown perpendicular and the symphysis per-

pendicular; B, between the molar root perpendicular and the symphysis perpendicular; C, from the mandibular plane to the mesial contact point of the molar; D, the interproximal bone height plane to the lowest point on the crest of the alveolar ridge; E, the distance from the second molar occlusal plane to the crest of the interproximal bone mesial to the tooth; and F, from the molar occlusal plane to the tip of the mesial root of the molar.

Each edentulous space was studied individually. First the model measurements for each edentulous space were recorded on the data sheet. The tracings for each edentulous space were then made from the lateral cephalogram and periapical films, lines were drawn, and the measurements recorded. This procedure was followed using before and after records.

Discussion

Table I denotes changes in the width of the alveolar ridge. Group A showed no overlap with Group B in the size of the ridge before or after treatment. Two distinct groups exist, separated by age.

Half the adult patients (Group B) in this clinical study resisted forming any new bone during space closure. The other half developed only small amounts of new bone. Group A, 18 years younger, added four times more bone to the width of the alveolar ridge during space closure than Group B.

Table II studied the height of the alveolar ridge by recording the "D" measurement. As teeth are moved through the edentulous ridge, the interproximal bone does seem to rise as the mean figures show in both Groups A and B. This is a false reading, as will be shown in discussing Table III.

TABLE I

Changes in the Width of Alveolar Ridge

	Before (mm)	*After (mm)*	*Change (mm)*
	Group A (mean age 13.6)		
Range	7 to 9	8 to 11	-11 to 17
Mean	7.5	9.9	2.4
	Group B (mean age 31.5)		
Range	4 to 6	5 to 7	0 to 2
Mean	5	5.9	.62

TABLE II

Changes in the Height of the Alveolar Ridge "D" Measurement

	Before (mm)	*After (mm)*	*Change (mm)*
	Group A		
Range	−2 to +2	0 to 0	−2 to +2
Mean	−.9	0	+.9
	Group B		
Range	−4 to 0	−2 to +1	−1 to +2
Mean	−1.4	−.62	+.8

TABLE III

Changes in Crestal Bone Height on the Mesial of the Molar Tooth "E" Measurement

	Before (mm)	*After (mm)*	*Change (mm)*
	Group A		
Range	6 to 10	6 to 10	−4 to 0
Mean	7.1	8.3	−1.1
	Group B		
Range	7 to 10	8 to 12	−3 to −1
Mean	8.1	10	−2

The changes in the height of crestal bone measurement "E" are in Table III. Bone height loss is seen in both groups but is more evident in Group B.

In comparing Table II and Table III, one can see that with the increase of measurement "E" that measurement "D" would equally be reduced, so a false reading is being recorded in Table II. Measurement "D" was not being reduced; only the crestal bone was being reduced and no height was being added to the alveolar ridge.

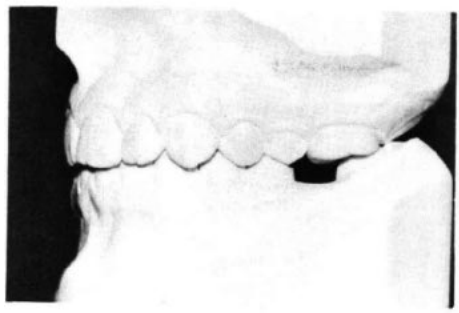


Fig. 5 Subject R. G. Group A. The lower left first molar space closed. Before and after views. The lower right first molar was removed in treatment. Now waiting for the eruption of the lower third molars.

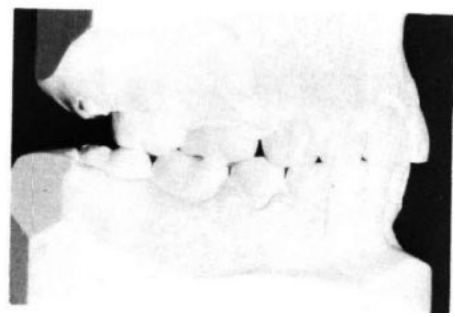


Fig. 6 Subject L. I. Group A. The lower first molars as well as lower first premolar spaces closed. The upper right first premolar was missing, and the upper right second premolar was removed in treatment. The lower third molars have erupted and the upper third molars are erupting.

Group A showed some loss of crestal bone when teeth were moved into edentulous spaces but Group B showed twice as much crestal bone lost. Gingival recession as seen clinically is not a part of this study but is evident in Figures 5, 6, 7 and 8.

One young adult in Group A showed the greatest amount of crestal bone loss, 4 mm. Three patients in Group B had 3 mm bone loss.

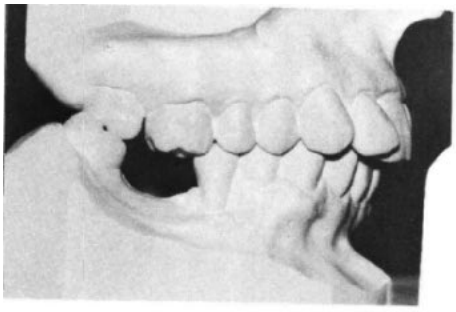
Root resorption is always a concern when moving teeth. In Table IV the "F" measurement was studied. In Group A there was actually additional root length being added because of growth. In Group B no change in root length was noticed in six out of eight patients, resorption in two patients.

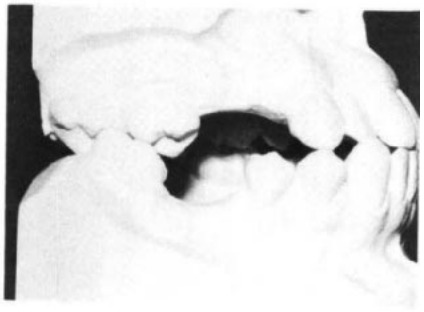
Of the sixteen spaces studied eleven had panoramic radiographs and five periapical radiographs. Whichever was available for each edentulous space was used to make the tracings of Figure 4. Panoramic radiographs can reduce the amount of root foreshortening or elongation that can occur using periapical radiographs. The method used in this study to study

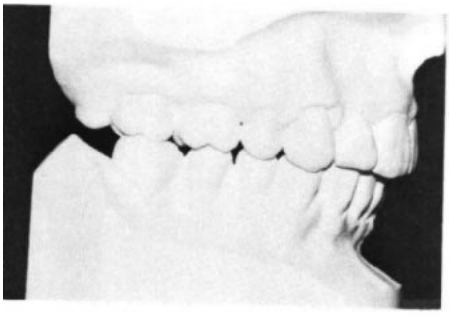
TABLE IV

Changes in Mesial Root Length of Molar "F" Measurement

	Before (mm)	*After (mm)*	*Change (mm)*
	Group A		
Range	18 to 23	18 to 23	0 to 3
Mean	20.3	21.5	+1.3
	Group B		
Range	19 to 25	19 to 24	−2 to 0
Mean	22.2	21.8	−.38







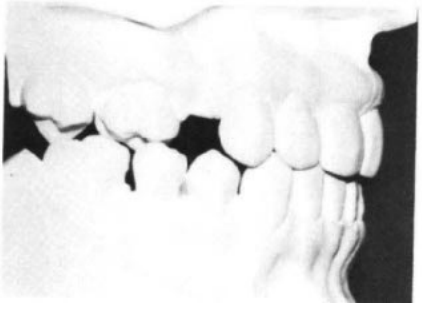


Fig. 7 Subject M. L. Group B. The lower right first and second molars and lower left first molar spaces closed. Before and after views. The upper first premolars were removed in treatment.

Fig. 8 Subject T. L. Group B. The lower right first and second molars and lower left first molar spaces were closed then opened slightly. The upper right first and second premolar spaces were only closed partially.

root resorption has some limitations because of the use of periapical radiographs.

In Table V the before and after measurements of the edentulous space were studied. Five adult spaces in Group B did not complete space closure, yet there was still a significant amount of closing. All spaces in the young adult Group A closed and have remained closed (Figs. 5, 6, 7 and 8).

In all the patients the mechanics of space closure was done with rectangular wire Bull loop retraction in an .022 slot.

In Table VI mesial crown movement was studied. Group A exhibited much more mesial crown movement than Group B. In Group B there is actually a measurement where a molar moved distally (Subject T.L.). This occurred with the uprighting of a molar and space closure without any loss of anchorage.

In comparing the overall space closed with the amount of mesial crown movement in Table VII, it is demonstrated that molar teeth can be moved forward through edentulous areas.

The same Group B patient (T.L.) whose crown moved distally showed a ten mm distal movement of the anteriors (Table VII) to complete a space closure. This type of movement is difficult and possibly a reason for the 42 month treatment time of this case.

Tracing the right or left molar tooth from the cephalometric headplate is difficult. To be successful requires the use of study casts, periapical films, plus bright illumination of

TABLE V

Model Measurement of the Edentulous Spaces

	Before (mm)	*After (mm)*	*Change (mm)*
	Group A		
Range	5 to 9	0 to 0	−9 to −5
Mean	7.4	0	−7.4
	Group B		
Range	3 to 12.5	0 to 2	−11 to −3
Mean	7.4	.9	−6.6

TABLE VI

"A" Crown Movement Measurement

	Before (mm)	*After (mm)*	*Change (mm)*
	Group A		
Range	17.5 to 28	8 to 25	−10 to −2
Mean	21.8	15.8	−6.1
	Group B		
Range	11 to 30	10 to 25	−9 to +1
Mean	23.4	19.9	−3.7

TABLE VII

Comparison of Tables V and VI

	Space Closed On Model Table V (mm)	*Mesial Crown Movement Table VI (mm)*	*Space Left To Close (mm)*
	Group A		
Range	5 to 9	2 to 10	−2 to 5
Mean	7.4	6.1	2.5
	Group B		
Range	3 to 11	.5 to 9	−1 to 10
Mean	6.6	3.7	3.3

TABLE VIII

"B" Root Movement Measurement

	Before (mm)	*After (mm)*	*Change (mm)*
	Group A		
Range	22 to 33	12 to 23	−14 to −5
Mean	27.9	17.8	−10.1
	Group B		
Range	24 to 37	17.5 to 28	−15 to −5
Mean	30.9	21.3	−9.6

TABLE IX

Comparison of Table VI and Table VIII

	Mesial Crown Movement Table VI (mm)	*Mesial Root Movement Table VIII (mm)*	*Difference (mm)*
	Group A		
Range	2 to 10	5 to 14	0 to 7
Mean	6.1	10.1	4.1
	Group B		
Range	−1 to 9	5 to 15	0 to 15
Mean	3.7	9.6	6.2

TABLE X

"C" Eruption Measurement

	Before (mm)	*After (mm)*	*Change (mm)*
	Group A		
Range	22 to 25	24 to 35	3.5 to 10
Mean	24.1	28.7	+4.6
	Group B		
Range	21 to 33	27 to 34	−1 to +8
Mean	28.3	30.8	+2.5

the headplate being traced. By studying the restorations on the panoramic films and the anatomy of the individual teeth, accurate tracings from headplates can be made of the right or the left mandibular molar teeth.

The mesial movement of the root was tabulated in Table VIII. Groups A and B seem about even on root movement measured to the "B" measurement. The mean measurement for Group A was −10.1, and the mean measurement for Group B −9.6 mm.

In Table IX, Tables VI and VIII are compared. The crown movement measured to the symphysis perpendicular is compared to the root movement measured to the symphysis perpendicular. In every case there was either uprighting or bodily movement. No tipping was seen.

In Table X eruption of the second molar is tabulated. Before treatment the "C" measurement was recorded and again after treatment. There was more eruption in Group A, some of which could be attributed to growth. One factor that must be considered

is that when a tooth is uprighted the mesial contact point will move upward and can give a false eruption reading; therefore this study has its limitation in this measurement. Some eruption does seem to occur with moving molars into edentulous space.

Summary and Conclusions

All the cases used in this clinical study were fully banded cases. Success was accomplished in completely closing edentulous spaces in the posterior of the mandible in all but five of the sixteen spaces studied, all adult cases.

It is this author's opinion that such spaces can enjoy better than moderate success if cases are fully banded. Many orthodontists have attempted to upright lower molars by placing only a lower appliance, and many of these attempts have failed. Greater success is attained if both arches receive appliances.

This clinical study showed:

1. That the width of the alveolar bone can be changed by orthodontic treatment. Alveolar bone does follow a tooth as it is moved into an edentulous space that is smaller buccolingually than the tooth. This is seen more readily in the young. The older patients seem to resist the apposition of new alveolar bone.

2. The height of the crestal alveolar bone before and after moving teeth into edentulous spaces showed a definite loss of bone. The adult patient showed more loss than the younger.

3. Root resorption of a lower second molar that is moved into an edentulous space was not seen in the young. The adults did show resorption on an individual basis.

4. Spaces of ten mm or more in the posterior of the mandible can be closed in young adults as well as adults. This study demonstrated that molar teeth can be moved forward and that edentulous areas should not be relied on as areas of substantial anchorage.

5. Uprighting of teeth into edentulous areas in the posterior of the mandible was shown not only to be possible but actually easy to accomplish. It also demonstrated that closing of large mandibular spaces is possible without tipping teeth.

6. Closed spaces are difficult to maintain in the adult patient. In the younger patient spaces remained closed.

7. Some eruption was noted for molars being moved into edentulous spaces. Possibly eruption is more a function of the mechanics used rather than the act of moving teeth into edentulous spaces.

The significance of this clinical study points to the two groups studied, the young adults and the adults, and the comparison of the effect treatment had on the bony tissues. When closing first molar spaces in the mandible the young adult generated more alveolar bone in the edentulous space and lost less crestal bone than adult patients.

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