Cervical Anchorage in Class II, Division I Treatment, A Cephalometric Appraisal

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This investigation is concerned with Class II, Division 1 malocclusions in the late mixed and adult dentitions in which extraoral force, a neck strap, has been the primary source of anchorage. In addition to reporting just what happened in terms of dental and skeletal changes through growth and treatment, the findings have been organized to relate time of starting and duration of treatment to the amount of change. These considerations may provide further material for speculation on "when to" and "how long" to treat.

Much has been written in regard to headgears and neckbands in Class II treatment and a number of the observations of others are pertinent in regard to this study.

Kloehn (1947) urged early treatment to guide alveolar growth for better facial balance by holding back the maxillary denture as the face grew forward. Epstein (1948) reported on molar relationships in twelve cases treated by means of headcap. He concluded that in some cases the maxillary first molars were held back in relation to the general forward growth of the face; in others the molars were moved backward in relationship to the maxilla by tipping. Hedges, (1948) employing a cephalometric roentgenographic method, showed that in Class II treatment mandibular growth provided most of the change in molar relationship.

Brodie, Downs, Goldstein and Meyer (1938) in cephalometric appraisal of orthodontic results observed that growth and development accounts for much of the change that occurs and that tooth movement was not as great as it would seem on clinical examination. The Class II cases in their study were treated with intermaxillary elastics. Under this treatment the posterior movement of the maxillary molars was negligible. The occlusal plane tipped and the mandibular molars came forward. They also noted that the best results were obtained when growth was most active. Tovstein (1955) confirmed in detail the occlusal plane changes observed in the aforementioned work.

Since this present study included some observations regarding the bony profile, it is pertinent to note the changes observed by Bjork (1947). In his longitudinal cephalometric study on Swedish males at twelve and twenty years of age, he observed that the prognathism of both jaws increased with age, with the increase in the mandible greater than in the maxilla. Pelton and Elsasser (1955) in a cross-sectional study based on soft tissue measurements observed just the opposite; namely, that maxillary prognathism rather than mandibular prognathism appeared to increase more with age.

Kendrick (1955) noted downward and forward growth at menton in almost equal amounts in appraising treated Class I and Class II cases.

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MATERIAL AND METHOD

The material upon which this study was made consisted of cephalometric

roentgenograms of fifty individuals before and after orthodontic treatment. All of these had clinically diagnosed Class II, Division 1 malocclusions. The sample consisted of twenty-seven males and twenty-three females. The youngest individual in the group was 9 years, 5 months at the start of treatment and the oldest 18 years, 9 months. The longest elapsed time between the first and second roentgenograms was fifty-four months. In each individual the Class II condition was corrected by means of cervical anchorage. In nearly all cases full or partial edgewise appliances were used to correct other malrelationships and to retract the maxillary anterior segment.

The before treatment roentgenograms were taken approximately 2 to 3 weeks prior to beginning appliance therapy. Most of the posttreatment roentgenograms were taken immediately on completion of treatment. However, a few in the sample were taken as long as two years following treatment.

Each film was traced and certain landmarks located in order to study the dental and skeletal changes. No attempt was made to correct for projection of the x-ray as the differences in absolute size of the individual faces and teeth were much greater than the errors in technique. For example, the number of millimeters of change necessary to correct a Class II condition is far more significant where the mesio-distal width of a bicuspid is seven mm. than where it is five mm..

Following the tracing of the first film, the SN and Frankfort planes were constructed. On tracing the second film the SN plane was superimposed, with S registered, and the Frankfort plane located identically with the first. The points to be measured were then projected perpendicular to the Frankfort plane.

The antero-posterior measurements

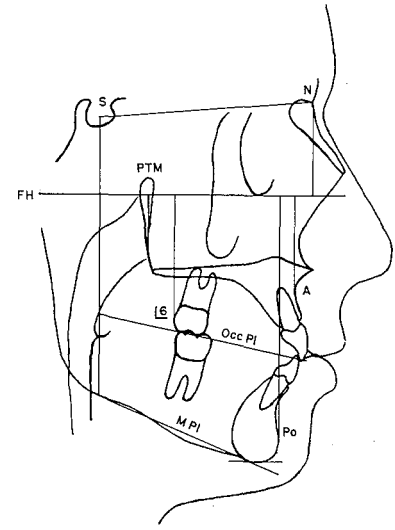

Fig. 1

(Fig. 1) were read between projections representing sella turcica and nasion (S-N), sella turcica and point A (S-A), pterygomaxillary fissure and left maxillary first molar (Ptm-6) and between sella turcica and pogonion (S-Po).

A vertical measurement was made between Frankfort plane and menton (FH-M).

Angular measurements were made between the maxillary first molar and the Frankfort plane (6-FH), between the occlusal plane and Frankfort plane (OccPl-FH), and between the mandibular plane and Frankfort plane (MPl-FH).

For certain observations the cases were grouped according to sex and as to whether or not teeth were removed in accomplishing treatment.

Findings

To determine what change occurred in the maxillary anterior denture base area, point A was selected. Measurement of the change in the antero-posterior position of point A related to *nasion* yielded the following results.

The first was a group of fourteen males with an average age for starting treatment of 11 years, 6 months, and a range of 10 to 14 years. The net change in the antero-posterior position of point A related to nasion was a posterior change of 3.2 mm.

The greatest change was 6.0 mm. for a case started at 11 years, 3 months, and the least was zero, for another started at 11 years, 4 months. The former was treated for 19 months, the latter for 22.

In females, measurements of the same landmarks yielded the following. The average starting age for the group of fifteen cases was 11 years, 5 months. The youngest was 10, the oldest 15 years, 1 month. The net change in the position of point A related to nasion was posteriorly 1.7 mm. The greatest change of 3.5 mm. occurred in two cases started at 10 years and 10 years, 4 months. The former was treated for 39 months, the latter 18 months. The least was zero in cases started at 10 years, 5 months, and 15 years, 1 month. These were treated for 25 and 15 months respectively.

In the group of fourteen males in which biscuspids were extracted, the average age was 13. The youngest in the group was 9 years, 11 months, the oldest 18 years, 9 months. The same measurements yielded a posteriorly directed change for point A of 3.1 mm. The greatest change was 6.5 mm. in a case started at 9 years, 11 months. The least change of 0.5 mm. was in a boy started at 13 years, 4 months.

For a group of eight females in which bicuspids were extracted the average age was 10 years, 11 months, with a range of 9 years, 8 months to 12 years, 2 months. The average net change was 2.8 mm. The greatest change was 5.5 mm. for a case started at 11 years, 3 months and treated 25 months. The least was no change in two which were started at 10 years, 5 months, and 11 years, and treated 20 and 16 months respectively.

Figure two shows a scatter diagram of the amount of change at point A in relation to starting age. The X axis (abscissa) is the age in years and the Y axis (ordinate) is the amount of change in millimeters.

Figure three is a scatter diagram of the change in terms of treatment time. The X axis is the number of months of treatment and the Y axis is again expressed in millimeters.

The antero-posterior changes recorded at pogonion were as follows. For the males growth carried pogonion forward 2.5 mm. For the male extraction cases it was —.5 mm. For the fe-

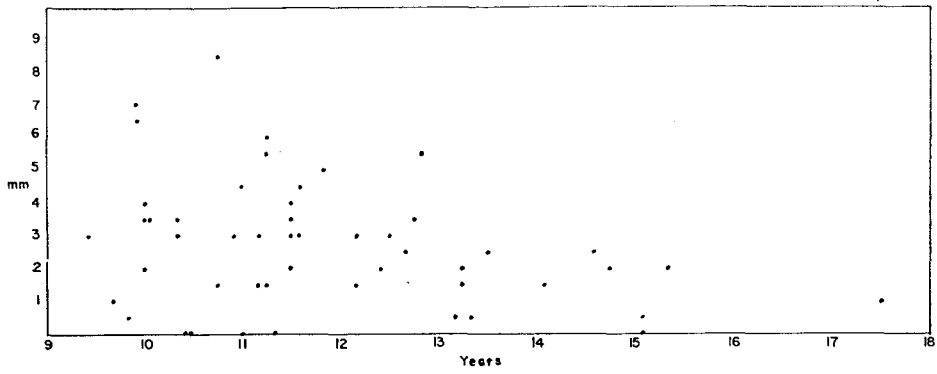

Fig. 2

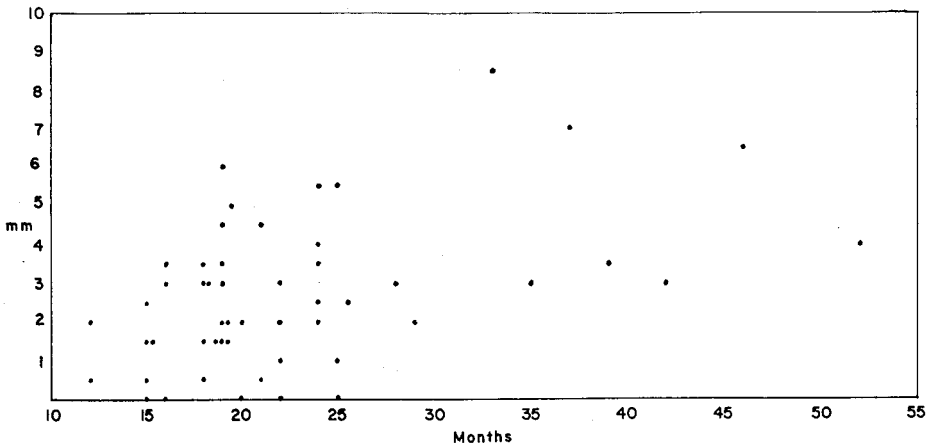

Fig. 3

males it was .5 mm. and for the female extraction cases 1.2 mm.

The above findings were felt to be the most significant in terms of profile change. However, a number of other measurements were taken. Figures four and five record those data.

forward growth of the first molar and the maxillary denture area. The changes noted at point A would indicate that the upper face was growing forward more than the maxillary denture area and that some remodelling of the bone at point A was occurring.

	AGE	S–N	S–A	Ptm–6	∠6–FH	S–Po	FH–M	Occ Pl	M Pl
MALES	11–6	2.9	–3.2	0.9	1.9	2.5	9.7	1.5	2.5
MALES EXT	13–0	2.1	–3.1	1.8	1.4	–0.5	7.5	3.0	1.8

Fig. 4

Discussion

The findings relating to the changes at point A and the maxillary first molar tend to confirm the observations of Kloehn and Epstein, namely, that the extraoral anchorage does hold back the

The relative stability of pterygomaxillary fissure was established by Brodie (1941). Measurements from this point to the maxillary first molar indicated that this tooth grew forward less than either nasion or pogonion and we may

	AGE	S–N	S–A	Ptm–6	∠6–FH	S–Po	FH–M	Occ Pl	M Pl
FEMALES	11–5	1.6	–1.7	0.5	0.8	0.5	6.8	1.0	0.8
FEMALES EXT	10–11	1.9	–2.8	3.3	–1.7	1.2	5.6	0.6	1.7

Fig. 5

assume that it was held back by the extraoral force. A limited amount of posterior movement of the maxillary first molars occurred in some cases but the amount was not significant. In fact, in each group the mean revealed some forward growth of the maxillary first molar related to Ptm.

In the extraction group of females the maxillary first molar moved forward 1.4 mm. in excess of the forward growth expressed at nasion. The findings confirmed Hedges' observations that some of the improvement in the occlusion occurred through mandibular growth. However, these changes were significant only in the non-extraction group of males. In the other groups the maxillary molars were held back to a lesser degree and the mandible grew forward little, if at all.

In the extraction cases it would seem that the maxillary buccal segments and the mandibular anterior segment moved the least, while the maxillary anterior segment moved posteriorly and the mandibular buccal segments moved forward.

Angular measurements for the maxillary first molar were recorded, and even where posterior movement of this tooth was noted, the degree of tipping was not great. It appeared that the tipping did not appreciably affect the measurements at the first molar. It was felt that the tipping was controlled largely by a full or partial maxillary appliance that was in place during part or all of the time each case was under treatment.

In each group the vertical growth exceeded the forward growth of the face. This does not coincide with the expected change on the basis of the findings of Bjork, or Pelton and Elsasser. Also, Kendrick reported downward and forward growth in about equal amounts for treated cases.

Three factors may be responsible for the excess of downward growth over forward growth observed in this study. First, because of the method of registering and superimposing, some of the antero-posterior growth of the mandible was lost in the method of measurement because the mandibular condyle is carried down and backward in growth (Brodie 1944). Second, the entire vertical growth of the face below nasion is expressed as downward displacement of menton. Third, the bite opening tendency of the orthodontic appliance would tend to displace pogonion downward and backward. The last apparently happened in those cases that grew little or none at all. Generally, those cases that exhibited the greatest increase in height also had the greatest increase in the mandibular plane angle and the least favorable response at pogonion. These, too, were among the few cases which had some degree of Class II treatment with intermaxillary elastics in order to finish in a reasonable amount of time.

Changes in the occlusal plane as well as the mandibular plane were smaller than those reported by Tovstein on cases that had been treated with Class II elastics. This would tend to confirm the conclusion that Class II elastics disturb the occlusal plane.

The scatter diagrams were not prepared from a sufficiently large sample to draw any valid conclusions. Also, they lump the four groups presented above into one. Even so, there is an obvious tendency expressed in each. Figure two indicated the degree of change at point A related to nasion in terms of starting age. The greatest change occurred in the younger individuals and gradually the indicated change decreased, as the age for starting treatment increased. This confirms the observations of others, among them Brodie, Downs, Goldstein and Meyer, that the best results are obtained when growth is more active. It appeared that

it was important to start girls younger than boys.

An arrangement of the female cases, in sequence according to starting age beginning with the youngest, indicated that the best response occurred in those started before eleven years. In the male group, notable changes occurred in the relationship of point A to nasion up to a starting age of thirteen, and even beyond this age, changes were elicited which did not occur in the female group after eleven years of age.

Relating the amount of change to the duration of treatment (Figure 3) indicated, as we would expect, that the longer the time over which the neckband operated, the more the change. This would tend to refute the advocates of very rapid treatment techniques. Rather, it would appear that treatment should progress hand in hand with growth or, as Kloehn has so very aptly expressed it, with guiding growth.

The material presented here tends to confirm an observation of Brodie, Downs, Goldstein and Meyer that tooth movement was not as great as it would appear clinically. Growth, it seems, is the prime ingredient for successful treatment.

Summary

Fifty cases in the late mixed and adult dentition treated with neckband have been studied by means of cephalometric roentgenograms taken before and after treatment. Of these, twenty-seven were males and twenty-three females. The cases were grouped according to sex and whether or not extractions were performed in accomplishing treatment. Additional correlations were made with the entire sample, relating age for starting and duration of treatment to the amount of change.

Conclusions

1. A posteriorly directed change in the position of point A related to *nasion* was elicited in each group with the greatest change occurring in the non-extraction group of males.

2. The forward growth of pogonion was disappointing except in the non-extraction group of males.

3. The maxillary first molar appeared to be held back as the face grew forward.

4. Nearly all faces exhibited downward growth in excess of forward growth.

5. Changes in both the occlusal plane and the mandibular plane generally were small.

6. There appeared to be a relationship between starting age and the amount of change at point A, with the most change occurring in the younger individuals.

7. The duration of treatment showed a definite relationship to the degree of change, with those treated the longest time achieving the greatest change at point A.

8. Because of the notably different responses of various cases pertaining to both growth and treatment, it seems appropriate here to state that we must provide ourselves with more knowledge of the mechanism of growth in the age groups that we treat and the effect of treatment upon growth. This will provide a better means for treatment planning and permit a more valid prognosis for each case.

The material in this study was treated in terms of means or averages. The statisticians admonish us that the average is a very lonely place to be. Unfortunately this was only too true.

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