Extra-oral anchorage in the treatment of class II, division 1 malocclusions - its possibilities and limitations*

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A most important consideration of treatment planning is the choice of anchorage to be used for tooth movement. This is particularly important if the malocclusion is a Class II, Division 1. Influenced by the work of William B. Downs,[1] John R. Thompson, Wendell L. Wylie, Bercu Fischer, Ashley Howes and others, orthodontists have been led to differentiate among the wide variations found in the group Edward H. Angle called Class II, Division 1. Consideration of the possibility of posterior displacement of the mandible, recognition of the degree of divergence of the lower face from the cranium, study of the relation of the mandibular base to the maxillary base, evaluation of the relation between the total tooth mass and the bone able to support it—all these should be part of the diagnosis of a Class II, Division 1 malocclusion. Whatever the differential diagnosis reached, treatment involves either distal movement of upper teeth or a change in the relation of lower to upper teeth by allowing the mandible to reposition itself forward.

Until the principle of mesiodistal intermaxillary anchorage was introduced in 1893, occipital anchorage had been the usual means of moving teeth distally in Class III malocclusions and in Class II or Class I cases with protruding upper incisors. It is easy to understand why the headcap was discarded by most orthodontists after the introduction of intermaxillary elastic traction, rightly hailed as a great step forward in the development of appliance therapy. For forty years or more, occipital anchorage was seldom used, until Albin Oppenheim[2 3 4] revived it in the 1930s. He used extra-oral force, applied from a headcap, to exert distal pressure on two upper molars of an actress, who could not carry on her professional duties if she wore a full orthodontic appliance, to correct her Class II, Division 1 malocclusion. The marked improvement in tooth relationship and facial appearance resulting from the use of this simple appliance, worn at night only, led Dr. Oppenheim to apply the method to other patients. He attributed the success of the treatment to its application of light intermittent force, which his research findings had shown to be not only the most effective means of tooth movement, but also the means resulting in the least damage to the root and its investing bone and peridental membrane.

The value and wide range of possibilities offered by this simple method of exerting gentle intermittent force from extraoral anchorage were not immediately recognized by the orthodontic profession. Many used too much pressure. Almost invariably the effectiveness of delicate force is underestimated by those inexperienced in the use of the method. Even after fifteen years of its use, the changes resulting from almost

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imperceptible intermittent pressure often amaze me.

The orthodontic profession in general, the members of this group in particular owe a profound debt to Dr. Charles H. Tweed for pointing out and emphasizing the importance of maintaining or establishing the correct position of the lower teeth, particularly the lower incisors, in relation to basal bone. He has called attention to the all-too-frequently unfavorable result of Class II intermaxillary elastics—labial tipping of the lower incisors, or a sliding forward of the entire lower denture on the body of the mandible. He has also recommended extra-oral anchorage on the upper teeth to help keep them from moving forward while Class III elastics are worn to prepare lower anchorage.

It is the purpose of this paper to show the value of extra-oral anchorage as the sole means of changing the relationship of upper to lower teeth in Class II, Division 1 cases without incurring the risk of disturbing the relation of lower teeth to basal bone. An example from each of three types of Class II, Division 1 will be shown to illustrate the use of extra-oral instead of intermaxillary anchorage in treatment.

Figure 1 shows models of a patient eight years, eight months of age. The lower arch has good form and sufficient length; the first bicuspids have begun to erupt; and the incisors are not badly inclined labially. The upper arch shows protruding incisors and carious deciduous molars. In occlusion the molars are in Class II relation, and the distobuccal cusp of the upper right molar occludes in the central groove of the lower molar. There is excessive incisal overbite and overjet. A functional analysis of the occlusion was not made, and it is possible the mandible followed an upward and backward path to occlusion from physiological rest, for the facial photographs (upper group, Figure 2) show a face not badly unbalanced, but with lips pursed, an overactive mentalis bringing the lower lip up to cover the protruding upper incisors. It is doubtful that the profile photographs were taken with the teeth in the relation shown in the occluded plaster models.

Fig. 1 Models of Case 1 before treatment.

Fig. 2 Case 1, above, before treatment; below, after treatment.

Figure 3 shows the most significant anatomic points of the cephalometric x-ray. The tracing on the left shows the condition before treatment. The figures of the Downs analysis all fall within normal range for the skeletal pattern. The upper and lower denture bases are in good relation. Although they are not shown in the tracing, all four developing third molars appear in the head-

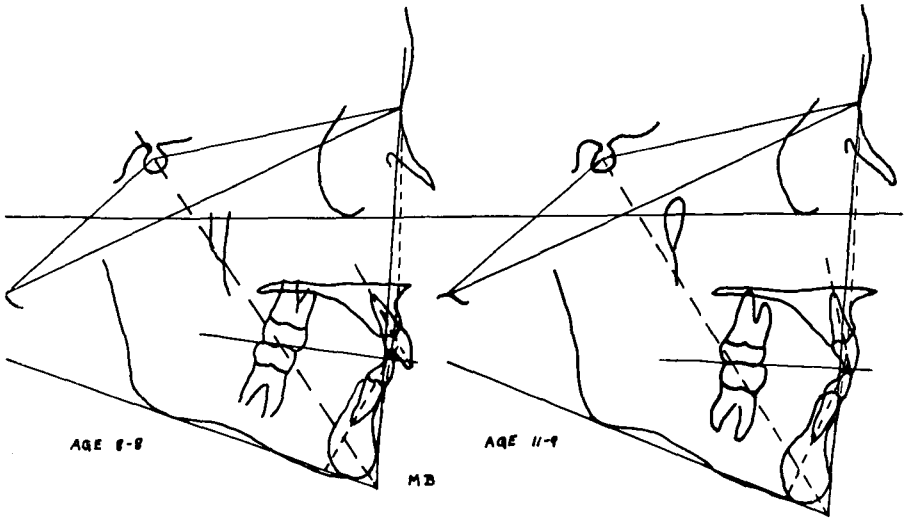

Fig. 3 Tracing of Case 1. Left, before treatment; right, after treatment.

M B

	8 yrs. 8 mos.	*11 yrs. 9 mos.*
Facial Angle	86	85.5
Angle of Convexity	+5.5	+ 6
A-B Plane	—6	— 6
FH - Mandibular Plane	19	22
Y Axis	56	58
Occlusal Plane - FH	6.5	6
$\overline{1}$ to $\underline{1}$	123	140
$\overline{1}$ to occlusal plane	22	18.5
$\overline{1}$ to mandibular plane	+8.5	+ 3
$\overline{1}$ to AP plane	+6 mm.	+ 3 mm.

plates. The case does not seem to be difficult, for the skeletal pattern is good. The only departure from normal is in tooth relationship and this should respond to treatment. The low mandibular plane angle (19°) makes the +8.5° lower incisor angle less unfavorable. A treatment plan which would leave the lower arch undisturbed is desirable. *Treatment* was begun when the patient was eight years and nine months of age with bands on the upper first permanent molars with buccal tubes to receive the appliance to bring light intermittent distal pressure on these teeth. An arch of 0.045″ steel was attached with solder in the midline to a facial bow with the ends turned under to afford attachment for elastics from the appliance to hooks on a headcap. Molar stops were soldered to the arch to clear the incisors. Expansion was placed in the arch to correct the right molar crossbite. The patient inserted the appliance at night and wore it for at least ten hours out of twenty-four. A passive lower lingual arch was placed and the second deciduous molars were removed to allow room for the crowded first bicuspids. This arch was removed after ten and a half months, when the lower teeth had erupted into satisfactory alignment. No retention and no other appliance was used on the lower teeth.

As soon as possible after their eruption, the upper canines were banded and gentle distal pull was exerted by latex elastics stretched from the molar tubes to small mesially pointed spurs soldered to the disto-lingual surface of the canine bands. These elastics were used only while the occipital appliance was worn. At the end of thirteen and a half months of light intermittent distal

force on the upper molars, the buccal teeth were in normal relation and treatment was discontinued for two and a half months. During this rest period, the buccal teeth held their normal relationship. To correct the overbite and close the spaces in the anteriors, the upper incisors were banded and a round arch was tied back to the molars. The appliance, which included only the molars and six anterior teeth, was removed after four months and the patient returned to the simple appliance giving light distal pressure on the upper molars nightly for the purpose of retention. Figure 4 shows the models at this time.

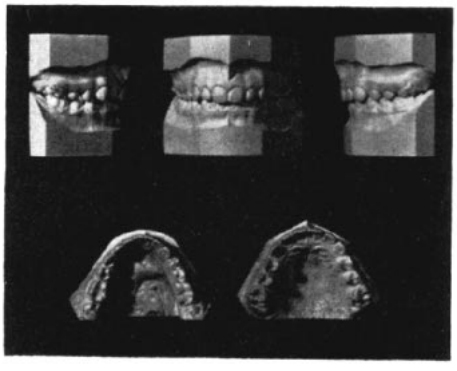

Fig. 4 Case 1 after two years treatment.

Because we were dissatisfied with the incisal overbite which had not been fully corrected, eight months after the upper appliance was removed the anterior bands were recemented, both rectangular and round tubes were soldered to the molar bands and another round arch was tied back to the molar tubes to complete the treatment. In addition, the patient inserted the simple appliance into the round tubes on the molars and wore it nightly attached to the headcap. Four months later the entire appliance was removed and the case was retained with an acrylic palate with a biteplane and wires between laterals and canines for the attachment if latex elastics to retain the lingual position of the incisors.

Results

Figure 5 shows the models at this time. The treatment time of the upper arch was as follows: thirteen and a half months of intermittent force with extra-oral anchorage; two and a half months complete rest; four months continuous force with an arch tied in; eight months intermittent force; four months continuous force with an arch tied in, augmented by extra-oral anchorage. The bicuspids were never banded. The case was retained with a palate when the patient was eleven years, five months of age, two years and eight months after treatment was initiated. There was no treatment of the lower teeth except a passive lingual arch used for ten and a half months during the transition from mixed to permanent dentition.

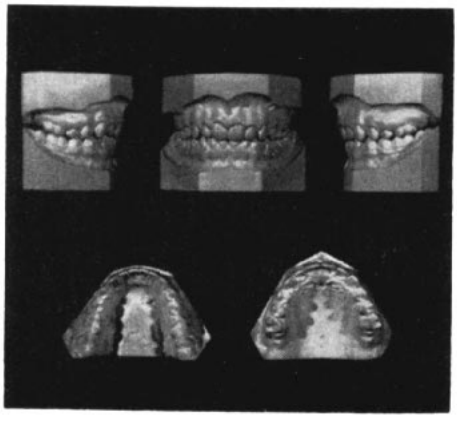

Fig. 5 Case 1 at the time of retention.

A cephalometric x-ray was made four and a half months after the case was retained. Figure 3 shows a tracing of the second x-ray at the right of the first. The figures of the Downs analysis show little change in the readings of the angles of the skeletal pattern. The

mandibular plane angle is 22° instead of 19° before treatment, indicating that the ramus height has not increased in proportion to the height at the symphysis. The increase from 56° to 58° in the Y axis indicates the mandible has not grown forward as much as downward. These figures are all within normal limits, however, and the changes cannot be considered of great significance. The figures relating the denture to the skeletal pattern indicate the treatment has brought the picture within normal range. The relation of upper to lower incisors has improved; the angle formed by the lower incisor and the occlusal plane has decreased; the lower incisor is less procumbent,—its angle with the mandibular plane is now +3° indicating an uprighting of 5.5°. This may be attributed to growth and to the influence of the upper incisors. The facial photographs after treatment for twenty-two months were made before the final stage of treatment, which decreased the overbite, but changed the facial lines very little. The plump cheeks reduce the appearance of lip prominence, and the mentalis muscle mass makes the lips look almost sunken in. Because the denture is in balance with the cranium and facial bones, we hope and trust the facial beauty will be enhanced as the child matures.

A second type of Class II Division 1 chosen for treatment with extra-oral anchorage is a double protrusion. The models, Figure 6, when the patient was seven years, five months of age, show a lower arch of good width and length, the incisors excessively tipped labially. The upper arch is slightly narrowed and lengthened, the incisors spaced. The occluded models show a full Class II molar relation, greatly protruded upper incisors and an open bite. An examination with the mandible in physiological rest showed a much better

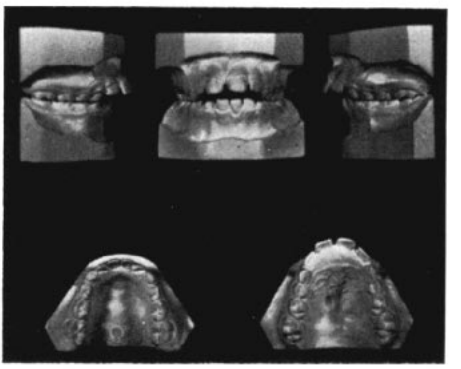

Fig. 6 Case 2 prior to treatment.

molar relation than when the teeth were in occlusion. The facial photographs (upper group, Figure 7) probably caught the patient in physiological rest. They show a marked double protrusion. In the tracing of the cephalometric x-ray (left side, Figure 9) the Downs analysis shows a facial angle of 83°, near the lower limit of normal; the angle of convexity is +19°, 9° above the upper limit of normal. The AB reading of −12° indicates the lower base is distal to normal in relation to upper. The mandible has good size and form, and the angle between its lower border and Frankfort, 26°, offers a fair prognosis. The departure from normal limits is even more marked in the relation of denture to skeleton. The long axes of upper and lower incisors meet at a 99° angle, far below the lower limit of normal. The long axis of the lower incisor forms a 32.5° angle with the occlusal plane and a +17° angle with the mandibular plane, both high readings indicating pronounced labial inclination. The tip of the upper incisor lies 10mm. anterior to the AP plane, 5mm. in excess of the upper limit of normal. Although not shown in the tracing, all four developing third molars appear in the x-ray.

The child was healthy, distinctly on the heavy side without giving the impression of being in glandular imbal-

Fig. 7 Case 2, above, before treatment; below, after two years treatment.

ance. A finger sucking habit of long standing was still operating on the denture, and although the parents seemed unconcerned about the habit or the condition of the child's teeth, her aunt, with their consent, undertook the responsibility of treatment because it seemed imperative that corrective steps be taken without further delay. The prognosis was considered only fair, and we discussed the possibility that extraction of teeth mightbe recommended at a later date if the best in facial esthetics were to be attained.

The patient was seven years and six months of age when treatment was begun by exerting light intermittent distal force on the upper second deciduous molars through an appliance inserted by the patient nightly into buccal tubes on the molar bands, attached for extra-oral anchorage to a headcap and worn at least ten hours out of twenty-four. This intermittent pressure was continued for eleven months until one of the molars was shed. At this time the permanent molars had been corrected to an end to end relation. For some time before the beginning of treatment, and at every appointment during treatment, we had been trying to help the patient cease the persistent habit of finger sucking, but with little success. Instead of banding the permanent molars immediately after the deciduous molar was shed, we told the patient we would discontinue treatment until she had made some progress toward correcting the habit, and she was kept under observation without any appliance for the following four months. By the end of that time she had begun to win the battle against finger sucking. Bands were then cemented to the upper first permanent molars and an appliance similar to the first one was used to give light intermittent distal pressure on these teeth. Three months later, when the patient assured me that she had not sucked her fingers for a month, hooks were soldered to the canine areas of the arch-wire for the attachment of latex elastics to exert light lingual pressure on the incisors while the appliance was worn. Bracket bands had been cemented to the upper incisors so that the elastics could be prevented from slipping gingivally or incisally by engaging them in the slot of the bracket.

The models (Figure 8) show the progress of the case after ten months of the second period of treatment. Lingual

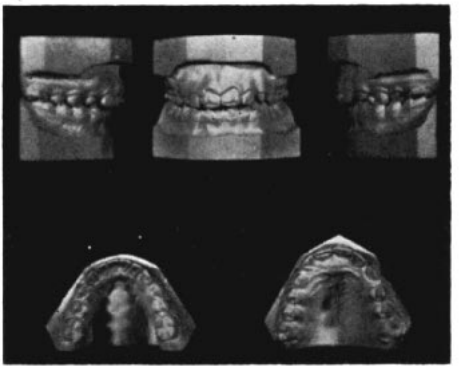

Fig. 8 Case after two years of treatment.

pressure had been exerted on the incisors for seven months. The patient had been performing the upper lip and orbicularis oris exercises described by Dr. Alfred P. Rogers.[5 6 7] After they have erupted sufficiently, the upper canines will be banded, and rectangular tubes soldered occlusal to the round tubes on the buccal of the upper molar bands. A round arch will be tied back to close the remaining spaces and level the occlusion. The position of the upper molars must be maintained by continuing distal pressure from the headgear. Neglect of this precaution might result in a relapse of the molar correction while the incisors are being retracted.

Figure 9 (right side) shows a tracing of the cephalometric x-ray taken two years after the beginning of treatment,

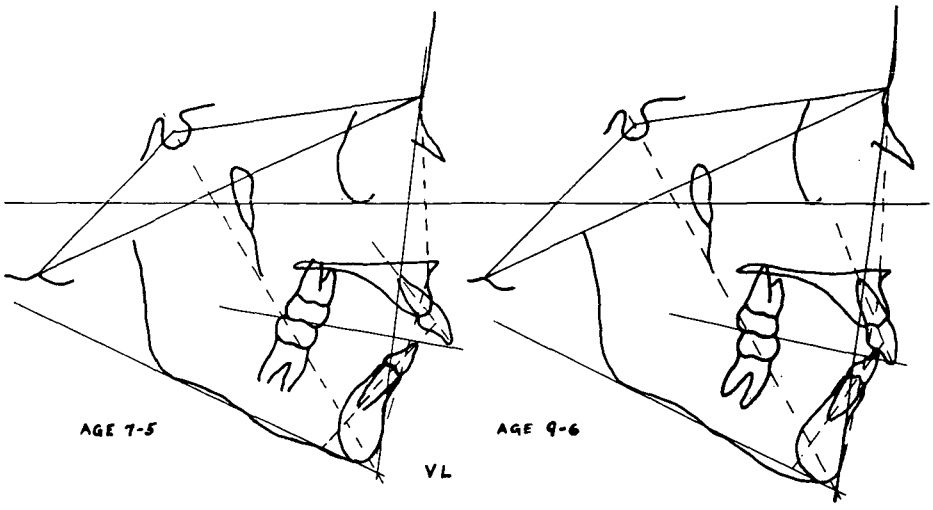

Fig. 9 Case 2, left, before treatment; right, after two years treatment.

V L

	7 yrs. 5 mos.	*9 yrs. 6 mos.*
Facial Angle	83	83
Angle of Convexity	+19	+10
A-B Plane	—12	— 6
FH - Mandibular Plane	25	26
Y Axis	59	60.5
Occlusal Plane FH	10	12
$\overline{1}$ to $\underline{1}$	99	122
$\overline{1}$ to occlusal plane	32.5	24
$\overline{1}$ to mandibular plane	+17	+10
$\overline{1}$ to AP plane	+10 mm.	+ 8 mm.

eleven months on the deciduous molars, nine and a half months on the permanent molars; during six and a half months of the latter period, intermittent lingual pressure from light elastics was exerted on the incisors. The Downs analysis indicates a reduction in the convexity of the face and a reduction in the discrepancy between upper and lower denture bases. The relation of upper to lower incisors has improved, due to the removal of the labial finger pressure and to the lingual pressure of the elastics. The swinging back of the upper incisors has closed the bite. The protrusion of the lower incisors has been reduced without a lower appliance, due, we think, to a combination of growth and the cessation of the finger habit.

Figure 10, the superposition of the two tracings on Frankfort, shows more forward growth of the mandible than of the maxilla. A perpendicular from Frankfort through the most distal point on the upper first molar shows distal bodily movement of the tooth in the two year period.

Figure 7, lower group, the photographs after two years of treatment, show improvement in the face. The lips, though less protrusive, are still too prominent, and the facial lines are not altogether pleasing. The child is young, however, only nine and a half, and in my opinion she is entitled to a chance for further growth before a decision on extraction is made. This is a case in which Class II elastics from a lower appliance might easily have aggravated the labial inclination of the lower incisors. Nature was allowed to improve conditions in the lower denture while extra-oral anchorage and light intermittent force carried the upper denture back into better relation with the lower.

The third case to be shown is also a progress report. It illustrates another type of Class II, Division 1 maloc-

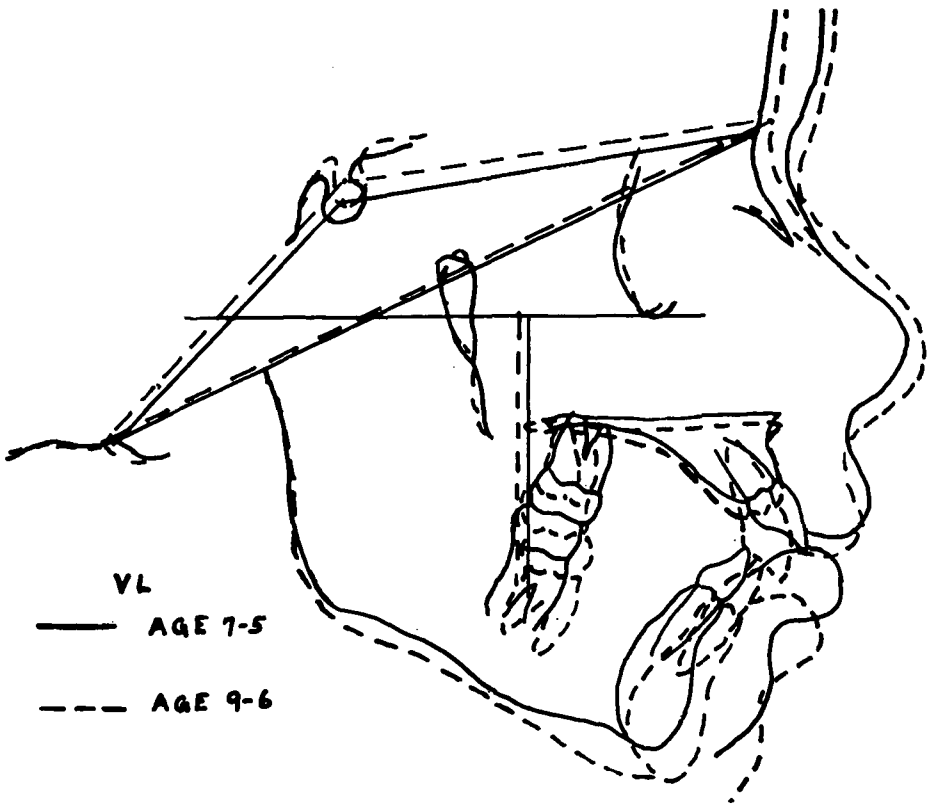

Fig. 10 Superposed tracings of Case 2 before and after two years treatment.

clusion quite unlike the preceding two.

The models, Figure 11, when the patient was eleven years, seven months of age, show a narrow lower arch with incisors in supra-occlusion, all six anteriors inclined forward, the second molars and second bicuspids still unerupted. The upper arch is long and narrow with generalized spacing in the buccal segments and markedly protrusive incisors. The second molars are rotated. The upper first molars are missing, the family dentist having advised their early removal "to make room for the remaining teeth." The occluded models show an end-to-end relation of the lower first to upper second molars, an extreme incisal overjet and overbite. The photographs, (Figure 12, upper group) show a convex, backward divergent face with lax lip musculature. The cephalometric x-ray is traced in Figure 13, and the Downs analysis shows that the only measurements falling within the range of normal are the angles formed by the long axis of the lower incisor with the occlusal plane, 19°, and with the mandibular plane, +1°. As these two planes are excessively steep, the occlusal plane 23°, and the mandibular plane 41.5°, this lessens the significance of the incisal angles as related to these abnormally inclined planes. The ramus is short and the chin point is far posterior, as shown by the facial angle of 75°. The facial convexity is high, +18°, and the lower to upper denture base relation is distal to normal,—the angle —13°. The Y axis indicating the growth prognosis is 75°,

Fig. 11 Models of Case 3 before treatment.

Fig. 12 Case 3, above, prior to treatment; below, after thirteen months.

showing the direction more downward than forward. The four developing third molars show in the x-ray.

The health history reveals little to show cause for this arrest in the growth of the facial bones. The mother says she saw nothing wrong with the deciduous occlusion. The child is delicate looking, slender almost to the point of emaciation, and lacks animation. On the whole, we have dim hopes for a good result in tooth and jaw relationship or improvement in facial esthetics. Our objectives are to establish as good occlusion as possible, attempting to occlude the upper second molars with lower first molars, to establish arch integrity and correct contacts in so far as possible, and to develop as normal a muscular environment for this denture as possible.

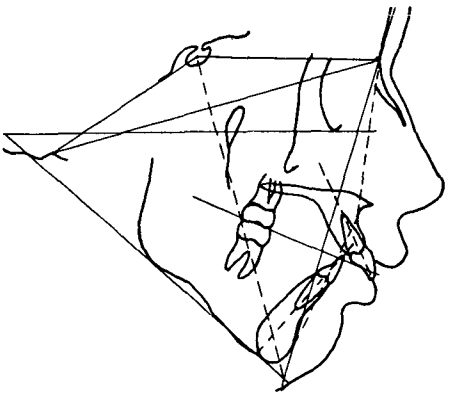

Fig. 13 Case 3 before treatment.

G A

	11 yrs. 5 mos.
Facial Angle	75
Angles of Convexity	+18
A-B Plane	—13
FH - Mandibular Plane	41.5
Y Axis	75
Occlusal Plane - FH	23
$\overline{1}$ to $\underline{1}$	114
$\overline{1}$ to occlusal plane	19
$\overline{1}$ to mandibular plane	+1
$\overline{1}$ to AP plane	+15 mm.

Treatment

Bands were cemented on the upper second molars with 0.045″ round buccal tubes to receive the appliance for intermittent distal pressure from extra-oral anchorage. Bands were cemented to the upper first bicuspids with hooks for the attachment of latex elastics for intramaxillary pull to the molars while the extra-oral force was acting. The upper lip and orbicularis oris exercises recommended by Rogers were prescribed and the patient has been kept on these exercises consistently during treatment. The

extra-oral anchorage was continued for three months, and by that time the upper second bicuspids had erupted sufficiently to receive bands. Sectional arches were tied in the buccal segments to move the bicuspids back and close the spaces. Extra-oral anchorage was not used during this stage of treatment, but our practice now would be to solder two tubes to the molar bands and continue extra-oral force on the molars while we use them to move the buccal teeth back into contact. After treatment for six months with sectional arches, edgewise bracket bands were cemented on the anterior teeth and a round upper arch with vertical loops between the laterals and canines was tied in to retract the anteriors. Hooks from a headcap were attached to the vertical loops. The patient cheerfully cooperated in wearing this appliance many hours daily. This force was continued for nine and a half months, until the spaces were closed and the upper teeth were in fair, though not ideal occlusion with the lowers. The upper appliance was removed, except for the molar bands, and the occipital appliance was resumed, exerting distal pressure on the upper second molars. The upper was retained with an acrylic palate with a bite plane and vertical wires between laterals and canines for the engagement of latex elastics to hold the incisors lingually. This retainer was placed nineteen months after the beginning of treatment.

Meanwhile a passive lower lingual arch had been made to hold the first molars back during the transition from deciduous molars to second bicuspids. A year after the beginning of treatment, the lower lingual arch was removed, the lower teeth were banded and a levelling arch was tied in with tip back bends for the first molars and slight expansion for the first bicuspids. After less than four months treatment of the lower arch, it was clear that the attempt to correct the rotations and level off the occlusal plane was displacing the incisors labially. The discrepancy of lower to upper denture base relationship, $-13°$, contra-indicates lower bicuspid extractions. Instead, the lower right first molar, which had an incomplete and unsatisfactory root canal filling, was extracted. The space is to be closed by combined distal movement of the right bicuspids and mesial movement and uprighting of the second molar which is now erupting.

Fig. 14 Case 3 after nineteen months of treatment.

Figure 14 shows the models when the upper was retained. Figure 12, lower group, shows the facial photographs after treatment for thirteen months. This incompleted case is presented to show correction in arch relationship without the use of the lower teeth as anchorage, the extreme maxillary protrusion contraindicating Class III mechanics for lower anchorage preparation. Consideration was given to taking this step after the retraction of the maxillary teeth. The marked discrepancy in the antero-posterior relation of the denture bases, however, demands the exercise of care lest the lower incisors be set back far enough to require severe retrusion of the upper incisors to meet the lowers. When this mistake is made it is difficult to avoid

a deep incisal overbite. Since we know ideal results cannot be achieved in this case, it seems prudent to temper idealism with realism, and conclude treatment without resorting to inter-maxillary traction at all, using the minimum mechanical treatment necessary to secure a reasonably functional result.

The subject assigned to me calls for a discussion of the limitation of extra-oral anchorage in the treatment of Class II, Division 1. It has limitations and disadvantages, but they are outweighed by the possibilities and advantages.

Using extra-oral anchorage makes treatment extend over a longer span of months than intraoral anchorage, though the hours and degree of force are less for extra-oral anchorage than for intermaxillary traction.

For some unaccountable reason, we occasionally encounter cases in which the teeth do not move, even though the patient cooperates. Dr. Oppenheim spoke and wrote more than once of this failure to achieve the desired result, and was at a loss to explain it. Sometimes the failure is unilateral,—the teeth move on one side, but not the other. He told his patients he could not predict, until after a trial of six months, whether the method would be successful.

Difficulty in securing cooperation is a problem with a few patients, but my experience has been that most children whose confidence you have won will do anything within reason that you ask. If a patient fails to wear a headcap or cervical strap, he probably would not wear intermaxillary elastics either. The orthodontist himself must be convinced of the value of extra-oral anchorage, and of its suitability for the case to be treated, before he can "sell" the parent and the patient on the idea. The appliance can be made comfortable, and it is becoming common enough now that in most communities it is not considered a freakish gadget.

A realistic orthodontist no longer looks for stationary anchorage in the mouth. He does not delude himself into thinking he can use a group of teeth as anchorage to move other teeth without exerting a reactionary force on the anchor teeth. If he wishes to use reciprocal force, intraoral anchorage is indicated, but if he desires truly stationary anchorage, he will employ extra-oral force.

Teeth can be held or moved distally with extra-oral anchorage and correction of mesiodistal relationships of teeth can be made. Extra-oral anchorage permits the use of light intermittent force, of a simple appliance with a minimum of banding, which seems to influence teeth to grow into their normal positions by exerting pressure for ten or twelve hours and allowing rest and repair during the remaining hours of the day. This gentle force is effective and inflicts a minimum of pain to the patient and damage to the tissues.

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