The Value of Light Intermittent Force In the Treatment of Malocclusions *

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In any branch of human endeavor, there are men who rise above their contemporaries and lead or direct their thoughts and actions in such a way that succeeding generations, looking back on the history of that period, see them in relation to the group, and if men are thoughtful and discerning they can evaluate their contribution to society. In the field of science, if a man's observations are accurate, if his conclusions are correct, and if his application of the principles evolved is logical, his contribution to the body of knowledge of the science may be great. His knowledge and conclusions may be employed by followers who lack his intellectual powers and insight. In the development of orthodontia as an art and a science, Edward H. Angle was an outstanding example of a man who gave us profound truths and sound principles to follow. Another was Albin Oppenheim. To the great number of orthodontists whom they influenced, they are teachers and guides who spur us to greater efforts to increase our knowledge and perfect our skill.

The purpose of my paper is to emphasize certain principles stated by these men, to show the results of my efforts to apply principles in the treatment of different types and degrees of malocclusion, and to evaluate their effectiveness in clinical practice.

In the Appendix to the 7th Edition, Dr. Angle wrote:

"In moving a tooth the best result is obtainable by applying only that degree of force necessary to bring about physiological changes in the tissues. The practice of applying great force at irregular intervals serves only to defeat the desired object, for it induces pathological instead of physiological changes in the tissues, exciting inflammation, and causing unnecessary pain. In no instance should the pressure be greater than to cause a snug feeling, which is perhaps the best indication of the degree of force. The wise and skilful orthodontist may and will avoid causing pain."

After years of study of the results of various amounts, directions, and durations of force employed in tooth movement, based on microscopic studies of human material, Oppenheim concluded and stated in 1935 that the application of light intermittent forces produced the optimum results while inflicting a minimum of tissue damage. To quote from his revolutionary work, "Biologic Orthodontic Therapy and Reality," *"Only the weakest elastic forces intermittently applied and interrupted by longer or shorter intervals of rest, are now permissible in practice."* In discussing the measurement of force to be used, he states that patients differ widely in their tissue tolerance. Quoting from the same source: *"The conviction of the author that there are not general rules and figures, either for the active time of treatment or for the retention period, based until now on practical experience, received scientific confirmation by the deductions derived from this human material. This shows that there can only be*

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individual judgment in treatment. Painlessness and firmness of the teeth are the sole criteria for judging that no severe damages are being effected. The clinical evidence of tissue damage is expressed in pain and in loosening of the teeth."

A follower of these men, wishing to accomplish tooth movements effectively with the least tissue damage, would be led to employ light intermittent force wherever applicable to the problem. Occipital or other extraoral anchorage offers an alternative to intermaxillary anchorage that appeals to one who wishes to avoid displacement or other undesirable results on teeth used for anchorage. Dr. Oppenheim brought this old, but long neglected device back into clinical practice. Some orthodontists seem to look upon Dr. Oppenheim's most recent contribution as merely a revival of the headcap, losing sight of the tremendous importance of his emphasis on the efficacy of weak elastic forces intermittently applied.

The reports of Dr. Oppenheim's success in the use of the headcap for the application of light pressure nightly for distal movement of maxillary teeth led me to try that method as early as 1936. It was not until after meeting Dr. Oppenheim and hearing his lectures at the University of Illinois early in 1945 that the full importance and value of his conclusions impressed me enough to alter my office procedure greatly. Since that time, in the treatment planning of each new case, consideration has been given to the possibility of using intermittent force. The results of treatment of some of these patients will be shown.

The appliance technique will not be described in detail, as it can be found in orthodontic literature, and I have nothing original to offer. Details of headcap and appliance have been changed as new ideas have been presented to me. In general, where second deciduous molars have sufficient roots they are banded, rather than the permanent molars, as it is found that the latter are influenced just about as well as if the application of force is directly upon them. Most of the cases shown were begun with an arch of 0.045 stainless steel to which hooks were soldered. Steel hooks connected the soldered hooks to the headcap. Later Dr. Bercu Fischer's method of joining the dental arch to a facial bow at the midline was adapted to the appliance, and the two steel hooks were eliminated. An appliance all in one piece has obvious advantages.

In all cases the arch is kept clear of the incisors. When lingual pressure is applied to the incisors, rubber dam elastics are used, either intramaxillary, or stretched from the right to left canine area on the arch from small soldered hooks.

The patient is instructed to wear the appliance 10 hours out of 24, and every effort is made to secure his understanding, confidence and cooperation. It is fully explained that the appliance must be adjusted so that no pain is felt, but that a slightly snug feeling is necessary. As different patients tolerate different degrees of force, the maximum amount is determined for each individual by trial, always aiming to begin with a minimum of force and working up to the threshold. Commercial elastics are used to connect the ends of the facial bow with dress hooks sewn on the cap. Adjustment in the amount of force is made by increasing or decreasing the size of the elastics or by moving the dress hooks forward or backward on the headcap. In the clinical material shown, only intermittent force was used with two exceptions which will be noted when the cases are shown.

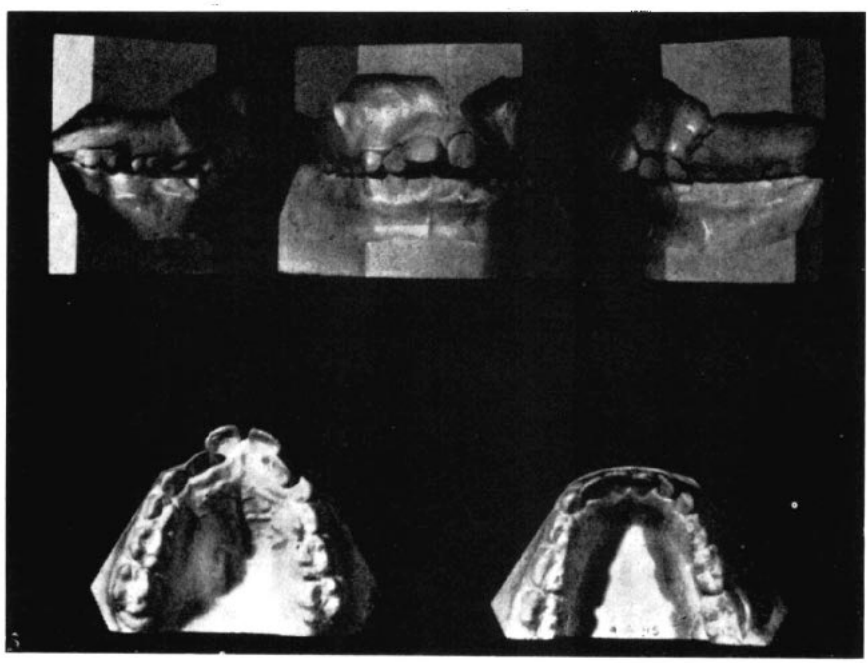

Fig. 1. Models of Case I before treatment.

Case I is a boy eight years of age with a Class II Div. 1 malocclusion. Fig. 1 shows the models before treatment. Light intermittent force was applied in a distal direction on the upper denture through bands on the permanent molars, using occipital anchorage ten hours nightly. After seven months, because of spaces opening between the second deciduous and first permanent molars, the bands were removed from the permanent molars and the appliance was altered to use the second deciduous molars. Bands with small distally pointed spurs were cemented to the upper central incisors and a rubber dam elastic was attached to these spurs to draw the incisors into contact. These light elastics, like the arch and headcap, were worn only ten hours nightly until contact was established, which required about two months. For two months after this, the elastics were worn on alternate nights, then discontinued entirely. After about ten months of treatment, bands were cemented to the upper deciduous canines. At night when the headgear was attached, the patient stretched a rubber dam elastic from molar tube to the bracket on the canine band. Two rubber dam elastics were linked to make a longer band, and this was stretched from one canine bracket, across the incisors to the opposite canine bracket. Thus a series of elastics was attached from second deciduous molar around the arch to the opposite molar. The distal pressure of the appliance with its occipital anchorage kept the molars from coming forward while lingual pressure was exerted nightly on the incisors.

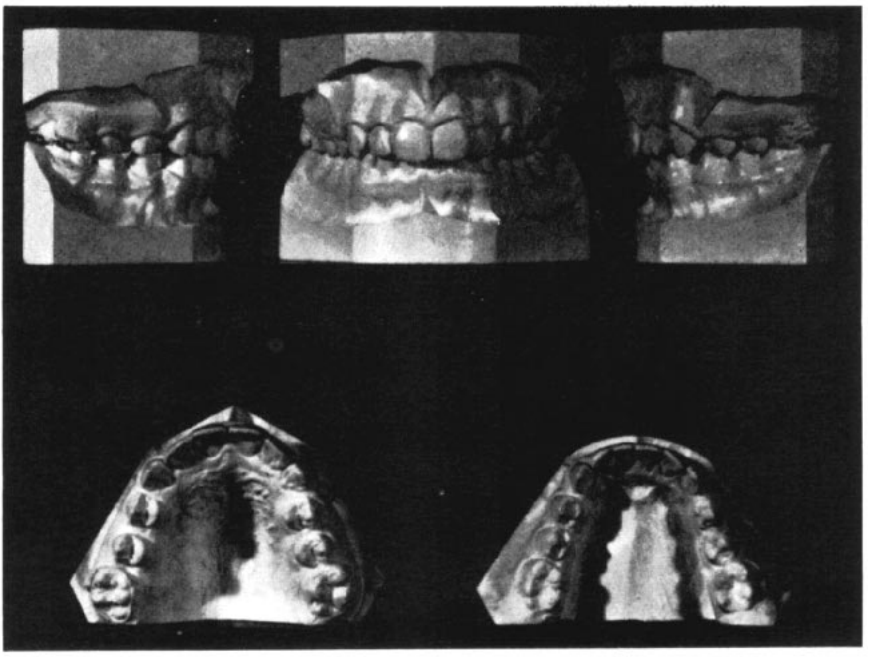

Fig. 2. Models of Case I after treatment.

The second models, Fig. 2, were made after three years and nine months of treatment, following transition from mixed to permanent dentition. The molars and bicuspids are in satisfactory Class I relation. The mesial inclination of the canines has yet to be corrected. As finger pressure was not sufficient, intramaxillary elastics from canine to molar, in conjunction with the night appliance and headgear are now being used. To prevent unfavorable rotation of the canine, a tiny lingual spur, mesially directed, is soldered to the canine band. A rubber dam elastic from the distolingual of the canine to the buccal of the molar establishes the proper contact between bicuspid and canine.

Fig. 3 shows photographs of the patient before treatment, Fig. 4, after eighteen months of treatment, Fig. 5, four years after the first photograph, at the age of 12 years.

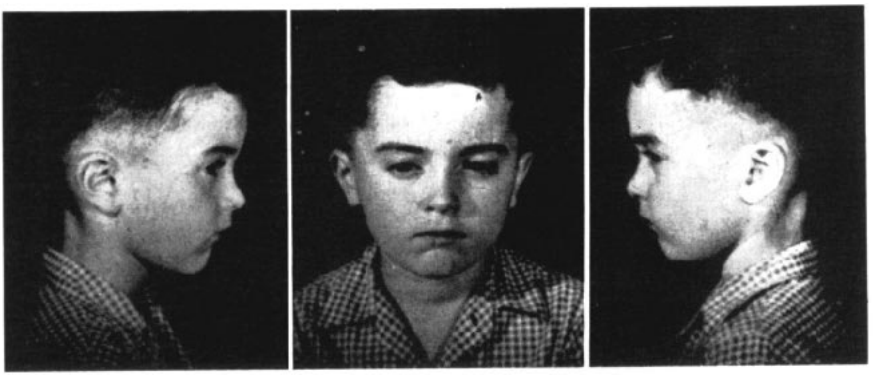

Fig. 3. Case I, photographs before treatment.

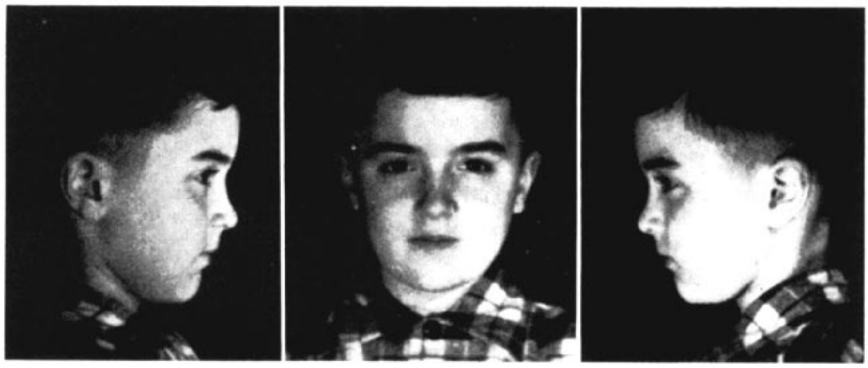

Fig. 4. Case I, photographs after 18 months of treatment.

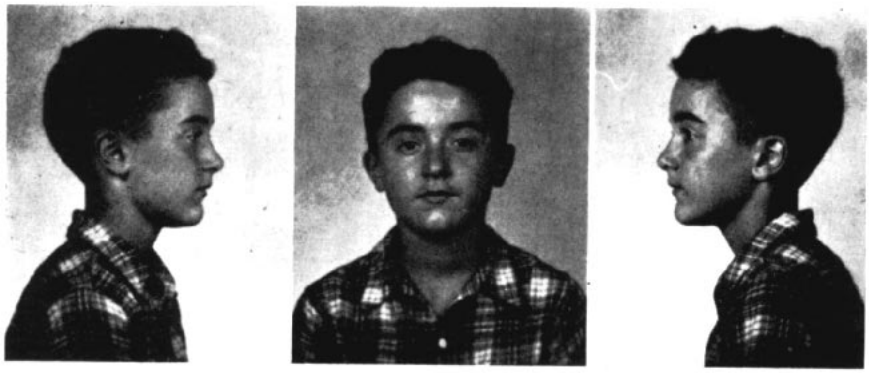

Fig. 5. Case I, photographs after treatment, age 12 years.

This case was treated entirely with light intermittent force and occipital anchorage. There has been no pain and no loosening of teeth, except when the second deciduous molars were shed. At that time the first permanent molars were again banded and the distal force was applied to these teeth while the second bicuspids erupted. No appliance was used on the lower teeth with the following exceptions. At the beginning of treatment a simple unilateral space maintainer was placed following the extraction of the left first deciduous molar until the eruption of the first bicuspid. At the time the lower second deciduous molars were lost, bands with .045 buccal tubes were cemented to the lower first molars, and light distal force was applied to these teeth via the headcap while the second bicuspids were erupting. Masseter temporal exercises and the general tonic exercise described by Dr. Alfred P. Rogers were used.

Case II is a boy five and a half years of age with a Class II Div. 1 malocclusion. Fig. 6 shows the models before treatment. Records were sent to Dr. Oppenheim and treatment was begun under his direction. Bands were placed on the lower second deciduous molars and a removable lingual arch was formed. An arch of 0.040 round gold and platinum wire was

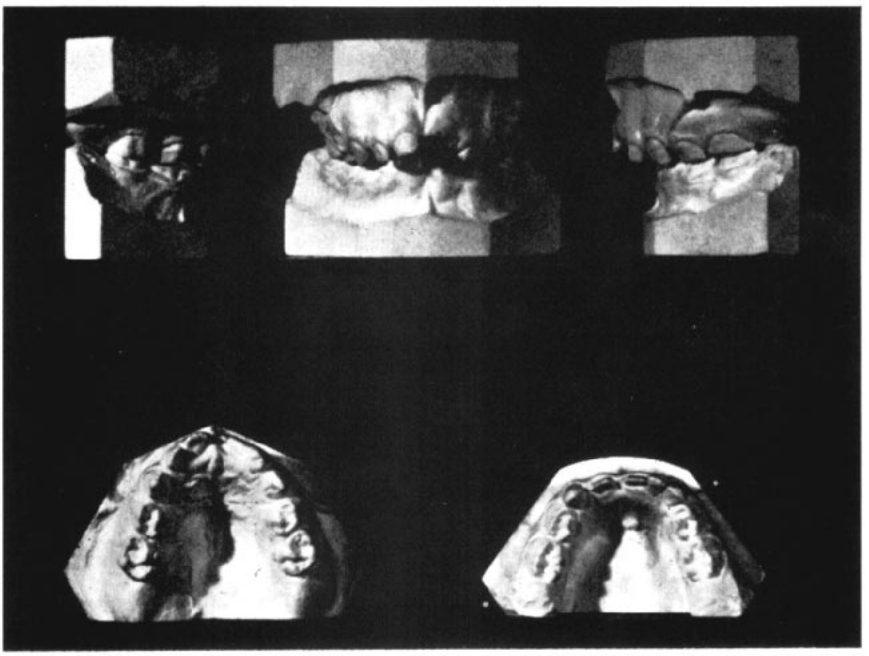

Fig. 6. Case II, models before treatment.

adapted to the upper teeth in contact with the incisors. Stops were soldered on the arch mesial to the buccal tubes on the second deciduous molars, and anterior hooks for rubber dam intermaxillary elastics which were used at night only, attached to hooks on the buccal surface of the lower molar bands. After four months the loss of the one remaining upper central incisor indicated a change in appliance. The upper arch was advanced to clear the incisors and occipital anchorage was substituted for intermaxillary. After seven months of light intermittent distal force on the upper second deciduous molars, the upper left was shed and it was necessary to discontinue treatment until the permanent molar erupted. Three months later, the upper left first molar was banded and a new steel arch was formed to exert force on that tooth and the upper right second deciduous molar. Intramaxillary rubber dam elastics were used as described in the previous case, to keep the canines back with the buccal teeth, and to reduce the protrusion of the incisors. The lingual elastic force on the incisors was discontinued for a time after the patient fell and struck these teeth while sledding.

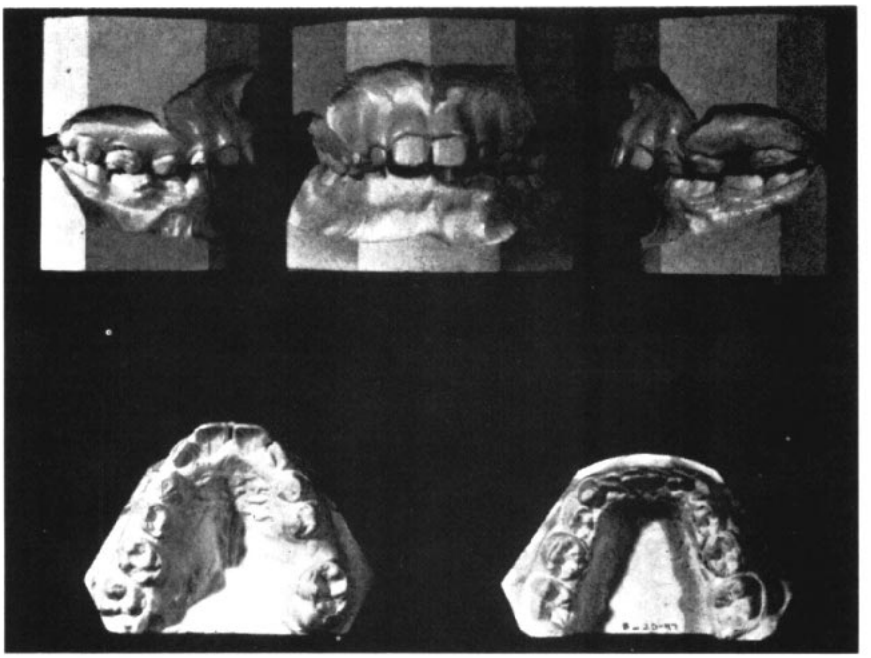

Fig. 7. Case II after two years of treatment.

Fig. 7 shows models after two years of treatment. The upper right first permanent molar had erupted into a Class I relation without having been banded. The upper left permanent molar had erupted into a Class II relation. Meanwhile the lower lingual arch was left on with minor adjustments. Finger springs of 0.016 gold wire were used for moderate expansion. The upper appliance was continued with a minimum of pressure on the right side where the Class I condition existed, and slightly more pressure on the left, though never enough to produce discomfort. After we were satisfied the upper incisors had recovered from the accident and had matured sufficiently to take the pressure, all four upper incisors were banded and lingual pressure exerted by rubber dam elastics attached to hooks on the dental arch. An attempt was made to combine a depressing effect with the lingual force by adjusting the arch so that the elastic band, when passive, was gingival to the incisors, bringing it incisally to hook into the slot of the bracket. We have never been successful in depressing teeth by this method. With this boy we have used an acrylic palate thickened to open the bite slightly, and having an extension over the incisal edge, covering about 1 mm. of the labial surface. The patient is wearing this palate now, and his permanent bicuspids and canines are erupting.

Fig. 8. Case II, models after four years of treatment.

Fig. 8 shows models after four years of treatment. Fig. 9 shows photographs at the beginning of treatment, age 5½ years; Fig. 10, after four years of treatment, age 9½ years.

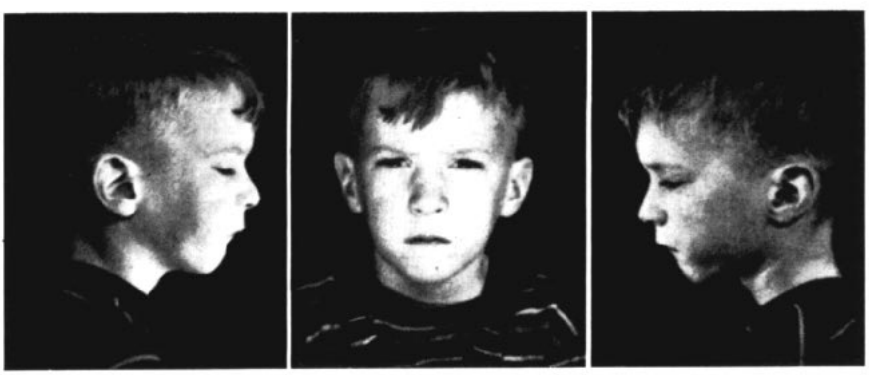

Fig. 9. Photographs of Case II before treatment.

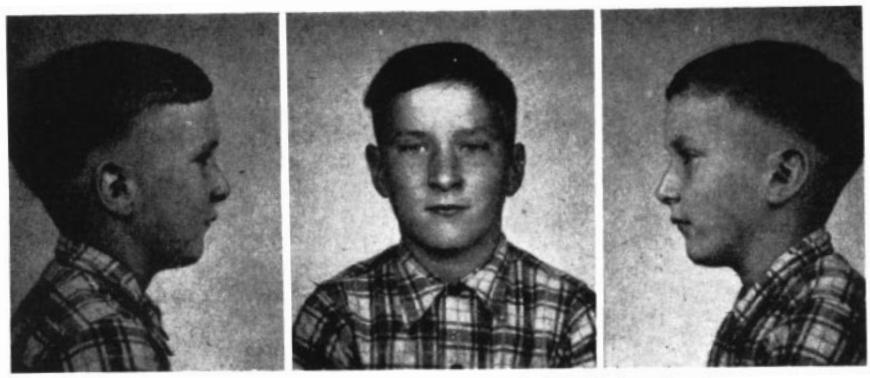

Fig. 10. Photographs of Case II after four years of treatment.

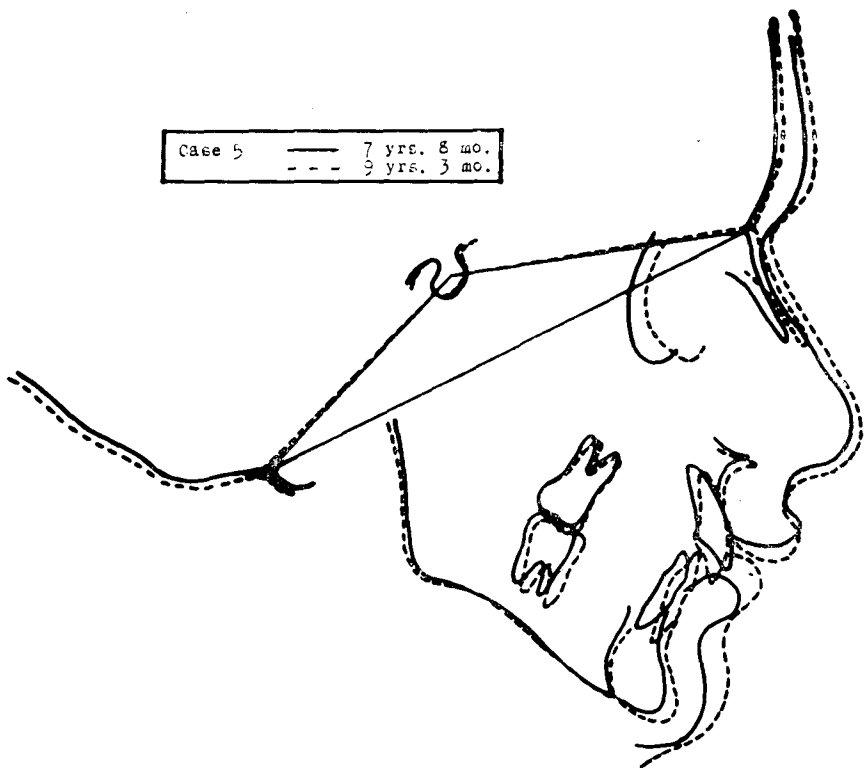

Fig. 11. Superimposed tracings of lateral cephalometric x-rays of Case II during treatment, age 7 years 8 months, and 9 years 3 months.

Fig. 11 shows superimposed tracings of lateral cephalometric x-rays made during treatment at the age of 7 years 8 months, and again one year seven months later, when the patient was 9 years 3 months of age. It indicates that the upper molars have not moved forward in growth at the same rate as the lower molars, with the result that the occlusion has changed from Class II to Class I. We assume this to be due to the influence of the light intermittent distal force on the upper molars. The lower molars and incisors have moved forward bodily in the growth of the mandible without any appreciable change of inclination. There has been a slight tipping of the upper molars which I do not consider desirable. The apices of the upper incisors have moved forward to about the same degree as the anterior nasal spine, but the crowns have tipped downward and backward, closing the bite as the teeth assumed a more vertical inclination.

Class III is a girl nine years and nine months of age with a Class II Div. 1 malocclusion. Fig. 12 shows models of this case when treatment was started. Light intermittent distal pressure was applied to the maxillary

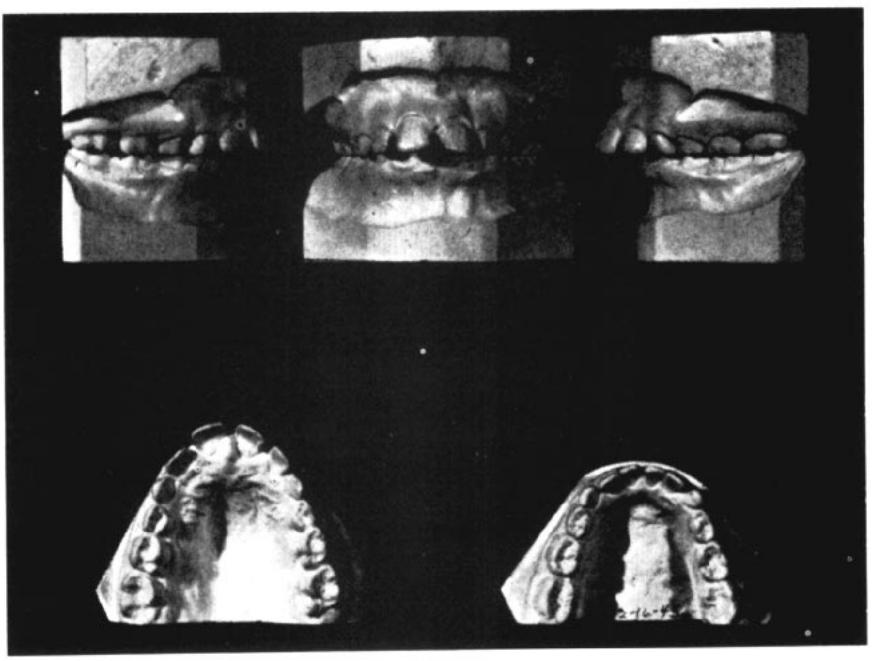

Fig. 12. Models of Case III before treatment.

denture through the first permanent molars. After six months of treatment, intramaxillary rubber dam elastics were applied around the entire arch from first molar to first molar in conjunction with the headcap and the 0.045 arch. After about two years of treatment, we made an acrylic palate extending over the incisal edge and about 1½ mm. of the labial surface of the upper incisors, thickened to open the bite about 1 mm. The

distal pressure was continued on the upper denture through the upper permanent molars. The palate was worn about nine months and then discontinued. The deciduous canines having been replaced by the permanent, these teeth were banded, the central incisors banded, and intramaxillary rubber dam elastics used from canine to molar to close spaces between canine and first bicuspid. Lingual pressure was again exerted on the incisors from rubber dam elastics stretched across the arch from hooks soldered to the canine area of the dental arch. This device serves a purpose similar to that of allowing the steel arch to rest against the incisors. The lingual elastic pull seems to me preferable to the direct pressure of the metal arch.

Intermittent force was employed on this case for two years and eight months. It was always so gentle as to avoid pain or anything more than a slight tenderness in the teeth for the first hour after removal of the appliance. No treatment was given to the lower arch. When the patient was twelve and a half years old and the transition to upper permanent dentition had been completed, edgewise bracket bands were cemented to the upper bicuspids and lateral incisors and a 0.016 round steel arch was tied back to elevate and retract the incisors further and close spaces. After four months this appliance was removed and intermittent force was again applied nightly as retention. Fig. 13 shows the models after four years and three months of treatment. The photographs, Fig. 14 before, and Fig. 15 after eighteen months of treatment, show little improvement in facial balance. We have been disappointed in our hope that treatment would help this girl's appearance.

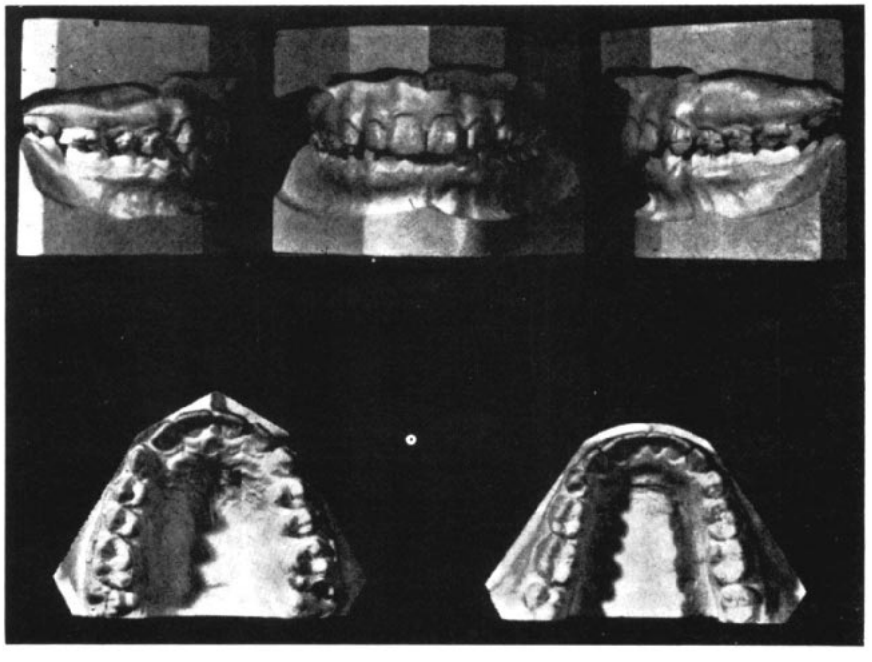

Fig. 13. Models of Case III after four years three months treatment.

Fig. 14. Photographs of Case III before treatment.

Fig. 15. Photographs of Case III after 18 months of treatment.

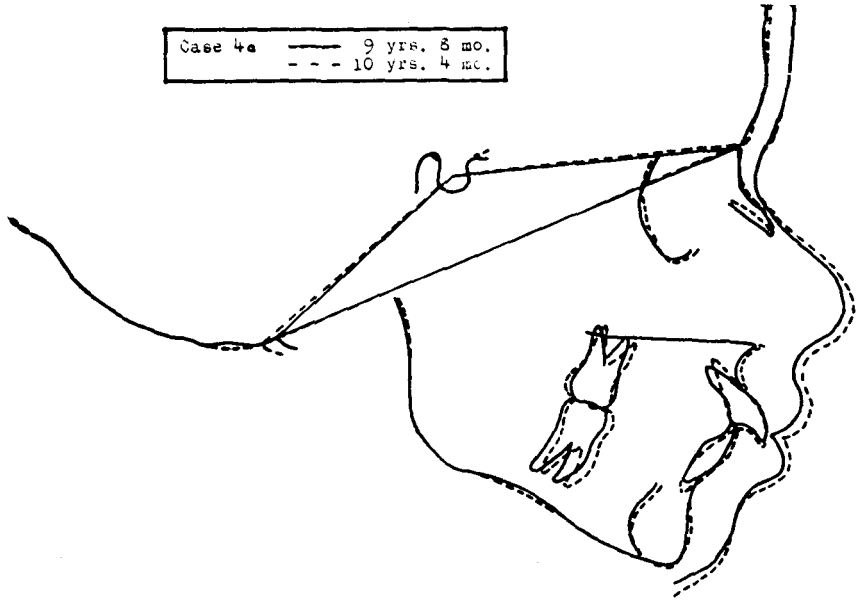

Fig. 16. Superimposed tracings of lateral cephalometric x-rays of Case III before and after 8 months of treatment.

A study of cephalometric x-rays (Fig. 16) of this case shows that in eight months the upper molar crown was tipped distally while the roots came mesially. At the same time the lower molar and incisor moved forward. The upper central incisor root came forward and the crown moved lingually. Fig. 17 is a superimposition of tracings of cephalometric x-rays

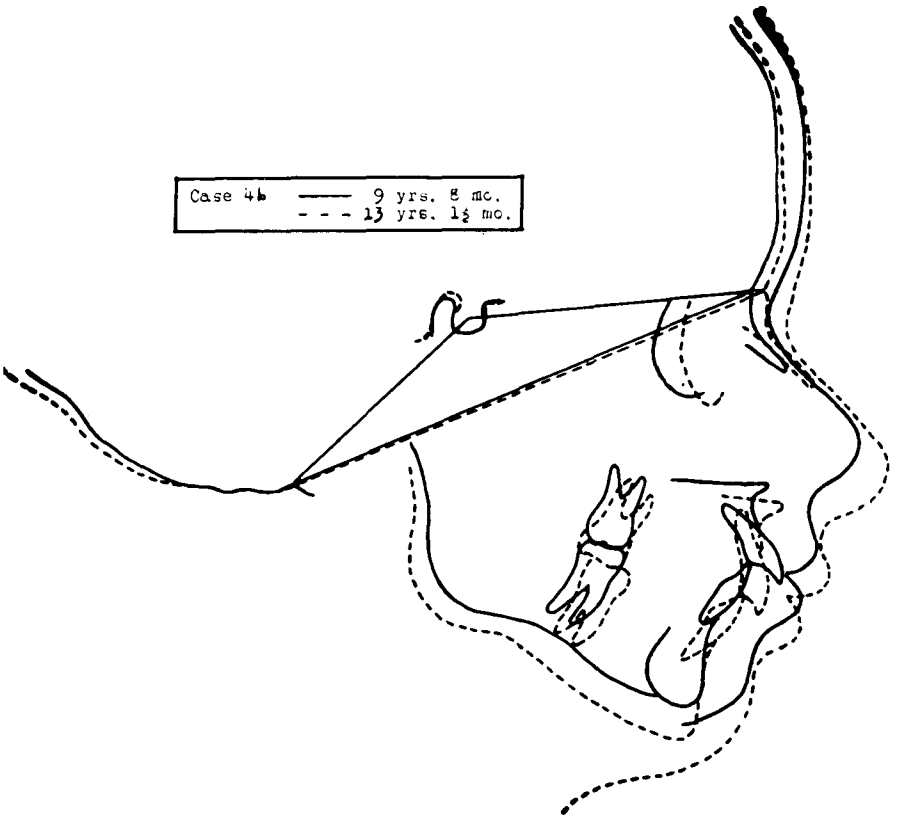

Fig. 17. Superimposed tracings of lateral cephalometric x-rays of Case III before and after 3 years 5½ months of treatment.

before treatment and after 3 years 5½ months of treatment, and shows that the upper molar has grown downward, but very little forward. The lower molar has grown both downward and forward, while the mandible as a whole has grown downward, but not appreciably forward. The lower incisor has come downward and forward, and the upper incisor has tipped downward and backward.

An appraisal of the skeletal pattern gives a clue to the lack of improvement in facial balance. The facial angle was below normal limits and decreased one degree during the time she was under treatment. The angle of convexity was above normal limits, and it increased by four degrees during treatment. The mandibular plane angle was near the upper limit of the normal range, and it did not change. The Y axis decreased one degree during treatment, indicating that growth has not proceeded in a favorable direction.

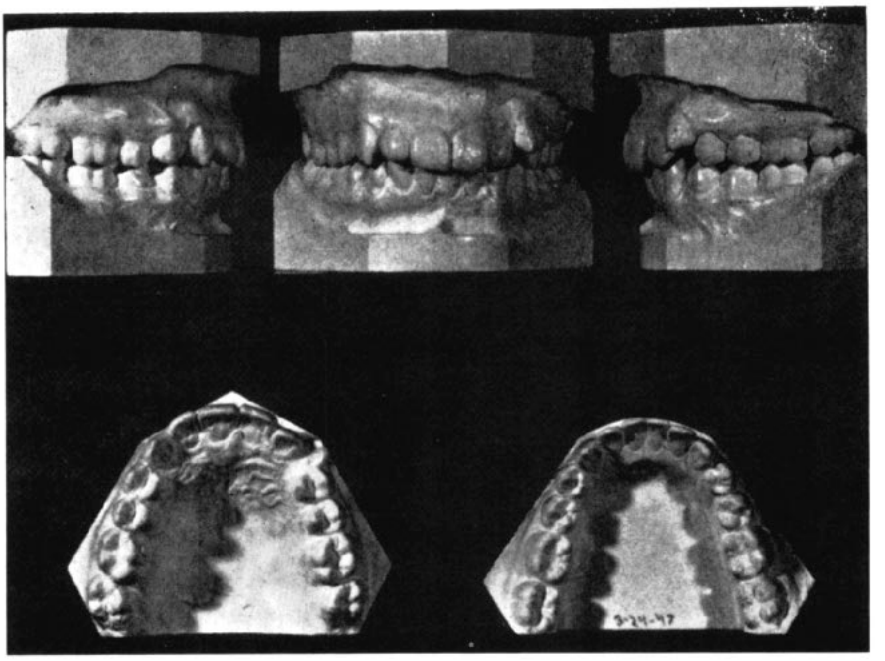

Fig. 18. Models of Case IV before treatment.

Case IV, Fig. 18, is a girl fourteen years of age when treatment was started. This malocclusion was classified Class I with mesial drift of both upper buccal segments, blocking out the upper left canine. The right and left maxillary incisors had moved to the left, encroaching on the space for the left canine. Although a critical appraisal of the lower arch indicates that there has been some forward movement of the lower teeth and that they are not in ideal relation to basal bone, it was decided to give the lower arch no treatment if a fairly satisfactory occlusal relation could be obtained and if space could be provided for the upper canine.

Light intermittent distal force applied through the upper first molars by means of occipital anchorage ten hours nightly for one year resulted in the occlusion shown in Fig. 19. The only teeth banded were the upper Intramaxillary elastics of rubber dam were used to bring the right canine back into contact with the bicuspid after space opened. The same type of first molars, the upper right canine and the upper left first bicuspid. force was used to move the left first bicuspid distally when a space opened between it and the second bicuspid. The patient used finger pressure on the left canine, and of course the normal musculature helped in bringing the tooth into position. Dr. Alfred Rogers' "general tonic" and masseter temporal exercises were used when the inclined planes of the buccal teeth approximated normal relationships. The force was light and intermittently applied, approximately ten hours nightly. Fig. 20 shows the photographs before and after treatment.

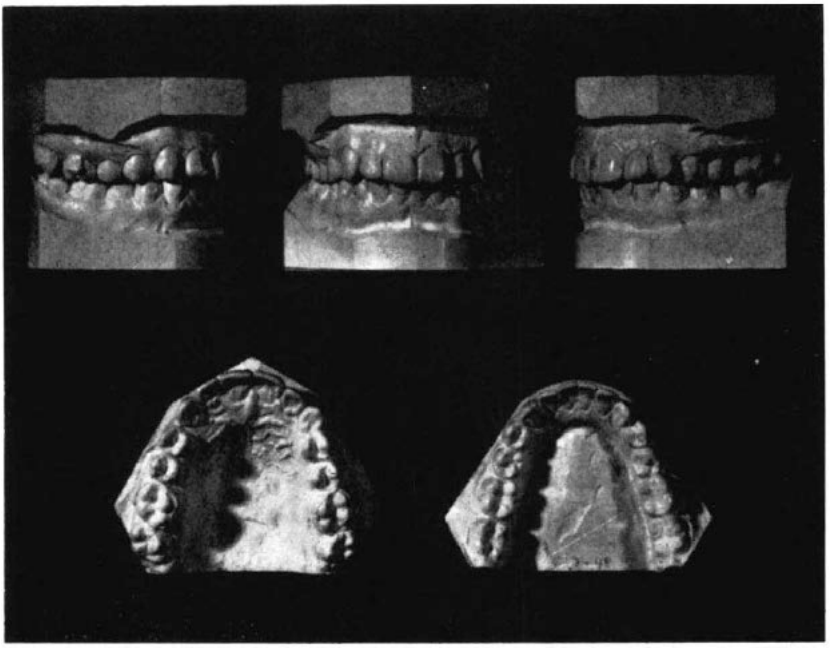

Fig. 19. Models of Case IV after one year of treatment.

Fig. 20. Photographs of Case IV, above, before treatment; below, after treatment.

It may have been wrong to leave the lower arch untreated because there is some forward inclination of the lower incisors and they have longer clinical crowns than I like to see in a teen-age girl. The alternative, in my opinion, would have been the extraction of bicuspids and closing spaces, involving full edgewise treatment, and I wonder whether the health of the tissues would have been better than it is now, had that course been followed.

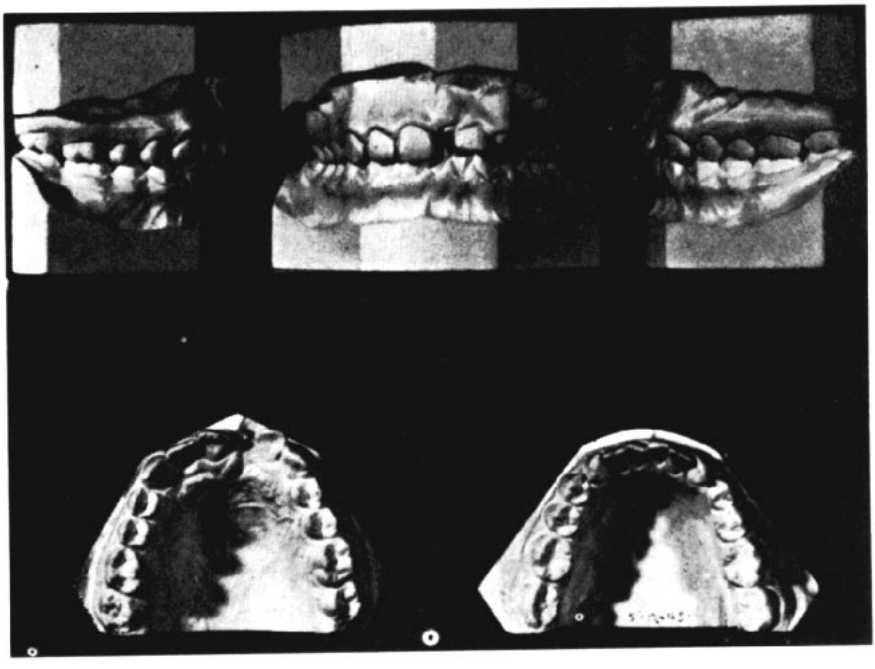

Fig. 11. Models of Case V before treatment.

Case V is a patient thirteen years of age with a Class I malocclusion with insufficient space for an unerupted upper left central incisor. Fig. 21 shows models before treatment. Light intermittent distal force was applied to the upper denture through bands on the first molars, using an 0.045 round steel arch worn ten hours nightly with occipital anchorage. After three months the supernumerary upper incisor was removed and the upper left central incisor crown was exposed by an oral surgeon. As we could devise no feasible method of using intermittent force on the incisor, which had to be brought several millimeters mesially and incisally, we tied in a heavy round gold and platinum upper arch provided with hooks for the application of occipital anchorage with distal force at night only. Molar stops kept the arch advanced so that it was never in contact with the incisors. One end of a coil spring of 0.016 gold wire was attached to the incisor with copper cement, and the free end was tied to a spur in the

midline of the arch. The tension of the coil spring was renewed three times in the next eleven weeks, after which the gold arch was removed and the patient returned to the heavy steel arch inserted nightly and worn ten hours with distal pressure on the molars from occipital anchorage.

To prevent opening of contacts between upper canines and bicuspids, bands were cemented to the canines with spurs for the attachment of interdental rubber dam elastics from the first molars, worn only at night while the appliance was worn. Later the right central incisor was banded with a spur for the attachment of another elastic to move it distally and create more room for the left central incisor. At the end of a year of treatment the buccal teeth were in as good or better occlusion than at the start, the left lateral incisor had spontaneously assumed a more normal position, and the space for the left central incisor had increased from 4 mm. to 5½ mm. A casting was made for this tooth, simply as a means of attachment because the lingual surface was insufficiently exposed to form a band. When the night appliance was worn, a rubber dam elastic was stretched from a distally pointed spur on the casting to a hook on the arch to guide the erupting tooth mesially. This elastic force was applied nightly for ten and a half weeks, then discontinued to give the tissues rest for twelve weeks. The distal pressure on the molars was continued, together with elastic pull to the distal on the canines and upper right central incisor. Then the mesial pull on the left central was resumed nightly for three months, after which a continuous elastic band was used from molar to canine across incisors to the opposite canine and back to the molar. Two years and two months after the beginning of treatment, there was sufficient room (9 mm.) for the left central incisor, but it was not in contact with the right central and the distal surface was rotated labially. Bands were cemented to the left central and lateral incisors; the right central, the canines and the first molars were already banded. A round steel arch 0.021″ in diameter was tied in to correct the rotation and move the left central incisor mesially. This arch was removed after seven weeks, and the patient returned to the heavy steel arch nightly with the headcap. For a few months interdental rubber dam elastics were worn nightly around the arch from molar to molar to retain the left central in its correct position and contact. The distal pressure on the molars was continued nightly, then tapered off until she was wearing it only one night a week. All bands were removed three years and five months after the beginning of treatment. A fixed arch was used for eleven weeks during the first year of treatment, and again for seven weeks during the third year.

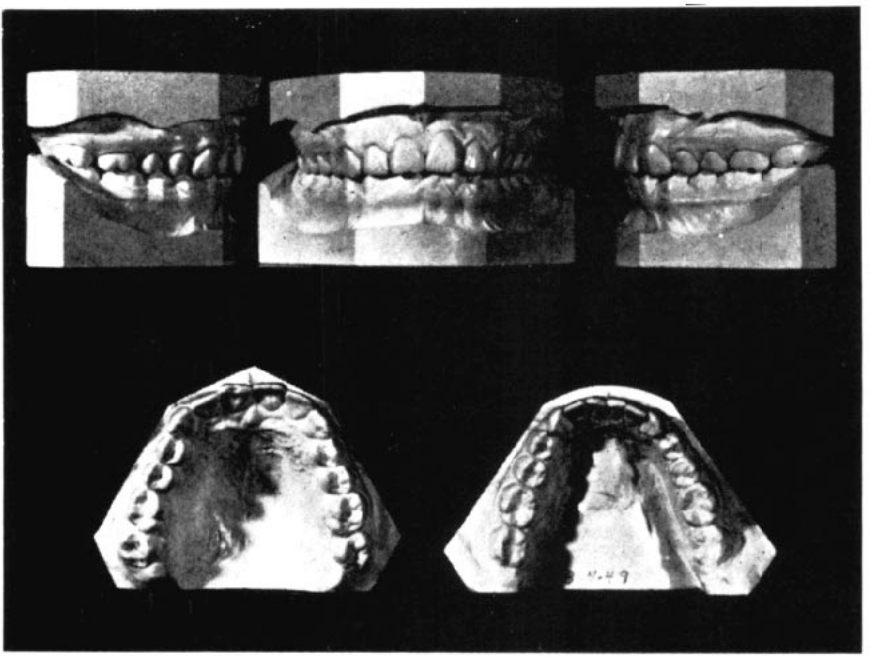

Fig. 22. Models of Case V three months after retention was discontinued.

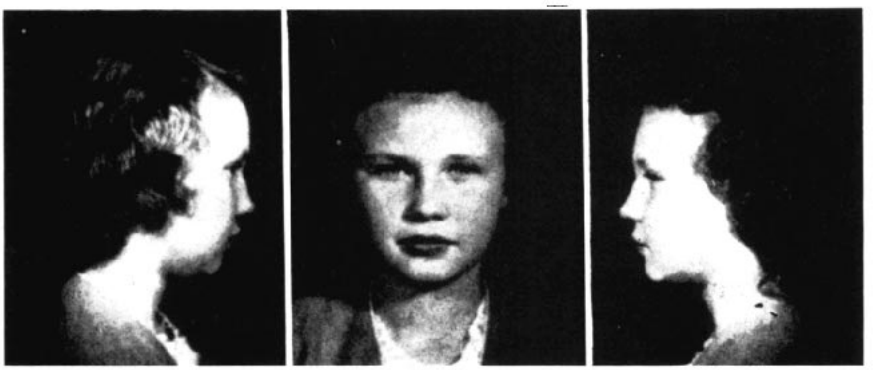

Fig. 23. Photographs of Case V before treatment.

Fig. 24. Photographs of Case V after treatment.

The force was intermittent at all other times during treatment. The models, Fig. 22, show the case three months after all retention was discontinued. Fig. 23 shows photographs before, and Fig. 24, after treatment.

Dr. Oppenheim reported, and I have found also that the method does not invariably move the teeth as desired. He told his patients that six months trial would enable him to say whether or not the method would be successful. Sometimes the teeth will move on one side of the mouth and not on the other, in patients who unquestionably are cooperating. Dr. Oppenheim reported this phenomenon, but gave no explanation for it. In my experience, however, the incidence of failure with intermittent force is no greater than in the use of a fixed appliance delivering constant force, and I humbly admit that I occasionally fail.

We have not been successful in correcting an overbite with intermittent force. While this method can be used to increase upper arch length where there has been mesial drift blocking out teeth, it will not eliminate the necessity for extraction when there has been insufficient bone growth to accommodate a full complement of teeth. Furthermore, with a few exceptions, I have been unable to complete closure of spaces in extraction cases by this method, although it has been found useful in beginning the closure, especially when there are high, blocked out canines.

Obviously the method has the disadvantage of being slow. Those who use light intermittent force must cultivate patience as a virtue. They must have enthusiasm and a firm conviction that the method will move teeth, and they must communicate this enthusiasm and confidence to the children they treat, and to their parents in order that cooperation may be secured.

Thirteen years of experience using light intermittent force leads me to the following conclusions:

(1) It is an effective, practically painless method of moving teeth.

(2) A minimum of banding and appliance can be used because the gradual movement of the banded teeth carries the neighboring unbanded teeth in the desired direction.

(3) The problem of retention is diminished by tapering off the wearing of the appliance. When, all during treatment, teeth are free to relapse 14 hours out of every 24, we need not be too concerned about relapse following discontinuance of the appliance, provided normal function has been established.

(4) Clinically the soft tissues of the mouth look healthy and free of inflammation.

(5) There is no x-ray evidence of damage to the roots or alveolar bone.

An orthodontist with a keen tissue sense, who is troubled by the thought of the possible injuries his treatment may inflict upon his patients, may find comfort in the knowledge that by using light intermittent force he is moving teeth slowly but surely, while reducing the risk of tissue damage to a minimum.

715 Lake Street.

Announcement

Strang Study Group No. 2

Copley-Plaza Hotel
Boston, Mass.

Sunday, March 5th, 1950

10:00 Modified Mechanical Plaster Mixer .. Dr. Earl Rogers, Canton, Ohio
Discussion

10:30 Case Reports ..... Dr. Joseph Herbstman, Newark, New Jersey
Discussion

11:00 Mandibular Arch Wire in its Final
Stages ..... Dr. Walter Mosmann, Hackensack, New Jersey

12:30 Business Meeting
Lunch

2:00 "Anchorage During Treatment and Retention Following Treatment" — A Thesis presented to A. B. O. .. Dr. Eldridge P. Smith, Rockville Centre, New York

3:00 Report of Extraction Case . Dr. Francis A. Haugh, Stamford, Conn.

3:30 Court of Errors

Presiding
Dr. Bernard Lloyd
Dr. Oscar Jacobson
Dr. Bernard Schambam

Each member is to bring models, photographs, x-rays of a failure or a problem case. If problem case, bring progress models.