Analysis of Malocclusion From Models And Photographs

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Modern orthodontia came into existence in 1899 when Dr. Edward H. Angle stated that normal occlusion was the basis of the science. Too much emphasis cannot be placed on this concept since it involves the proper spatial relationships of the teeth to each other in both, the same and the opposing arches. The normal establishment of this condition is most important since it is expressed as a combined result of the external forces of the environment and the inherent processes of embryological and postnatal development. It is impossible therefore, for the orthodontist to accomplish his mission successfully, without an understanding of the processes involved and their relative importance in the production of normal occlusion.

Prior to Angle's pronouncement, the major concern of the orthodontist was for esthetics. This being the case, there was little or no regard for, much less an understanding or proper appreciation of, the natural endowment of an individual from the standpoint of the masticatory apparatus. Such a superficial objective coupled with an almost total lack of comprehension of the problems involved, naturally led to failures with which you are all familiar. The date of 1899 carries with it no magic implications. It merely indicates the date of a fundamental observation and the recognition of the biological result toward which nature seemed to strive. This observation provided a basis from which different types of abnormal spatial relationships of teeth could be grouped in an orderly fashion. A natural corollary to Angle's fundamental observation was the development of remedial measures directed toward the elimination of malocclusion and the establishment of harmonious dental relationships.

One significant discovery often leads to another and thus it has been that while normal occlusion was recognized and used as the most important factor in diagnosis, orthodontists have ever since been on the alert for more accurate accessory methods with which to increase their proficiency and advance their professional success.

Differences of opinion arising from individual interpretations of scientific observation together with a tendency to reduce intricate problems to a state of over simplification, have often lead to stagnation and at times, actual retrogression in professional fields. Examples of this in modern orthodontia are to be found in the different *ages* through which the profession has evolved. During the *Mechanical Age* there was a total disregard for fundamental biological principles, with success or failure dependent solely on design and progressive "improvement" of appliances and their manipulation. Similarly, the *Muscle Age* placed major emphasis on the importance of contractile tissue associated with the movement of the masticatory apparatus. More recently the *Age* of *Growth* and *Development* ran its course with the usual overemphasis. Finally, cephalometry made its appearance and blossomed with such vigor that for the past twenty years we have been swinging by our heels from the sella turcica, bumping

our heads against the Frankfort horizontal and flattening our noses against the mandibular plane. At present we are so confused by a multiplicity of attempts to interpret and explain malocclusion that we often find ourselves guilty of placing weird interpretations on findings for which there is no clinical basis or proof.

It is regrettable that such a state of affairs should exist. In view of our acknowledged progress and the attendant controversy and confusion, it seems timely for us to reaffirm our faith in the basic concepts of our profession and to re-evaluate the principles which have been chiefly responsible for placing modern orthodontia in its present respected position among the healing arts.

I am well aware of the importance of a fixed point from which to measure variations or deviations from the normal of any part. I am also familiar with the previous efforts of science to establish such reference points and the fact that up to the present time, no such points have been found that were universally applicable. We must rely on our knowledge of the principles underlying development, growth and function of the component structures which provide the anatomical harmony expressed in normal occlusion. Chief among these principles as described by Angle and listed by Dewey are, (a) normal cell metabolism, (b) muscular pressure, (c) force of the inclined plane, (d) normal proximal contact, and (e) harmony in the size of the arches.

CASE ANALYSIS

1. Teeth
   a. Size
   b. Form
   c. Intra arch relations
   d. Inter arch relations
   e. Axial positions
   f. Symmetry
   g. Alveolar development
   h. X-ray analysis
3. Musculature
   a. Muscles of mastication
      1. Function
      2. Rest position
   b. Lips and cheeks
   c. Tongue
   d. General posture
   e. Habits
2. Facial Form
   a. Analysis of skeletal pattern
   b. Analysis of denture pattern
   c. Symmetry
4. Physical Appraisal
   a. General conduct
   b. Medical examination
      Heart
      Chest
      Blood pressure
      Blood count
      Blood vitamin C
      Blood calcium
      Blood sugar
      Blood phosphorus
      Basal metabolic rate

In the analysis of malocclusion which have become established as a result of the interplay of these factors, the following outline has proved of great value in planning intelligent therapeutic procedures.

From this outline it will be apparent that the author believes that seemingly discredited factors form an indispensable foundation for the planning of proper therapeutic measures. Please note that sections 2 and 3 involve X-ray cephalometry and musculature, respectively. Last but not least, a physician's examination may be necessary to establish whether or not a patient can be expected to respond normally to orthodontic procedures.

From the following case histories it will become increasingly evident that many aids are valuable in the practice of orthodontia. Chief among these are (1) photographs, (2) models, (3) X-ray cephalometry, (4) intraoral roentgenograms, and (5) recognition of the relative importance of

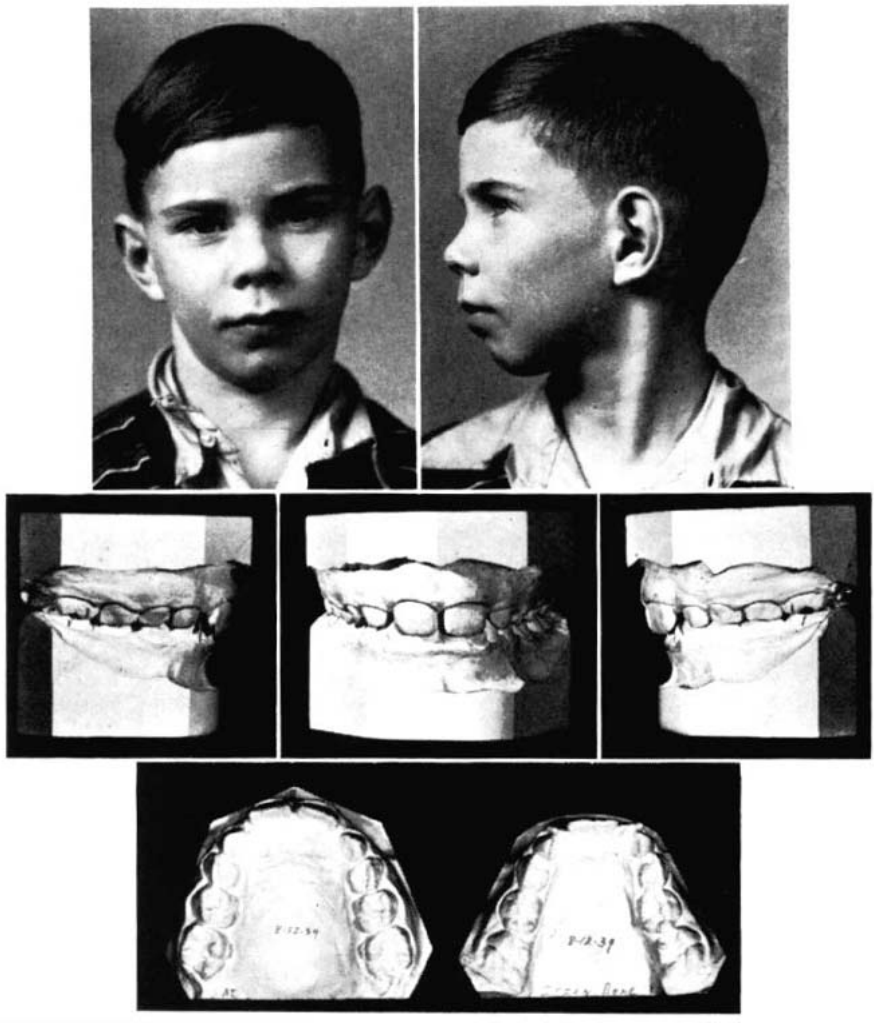

FIG. 1. Casts and photographs of boy, age 7 years, showing a Class II, Division 1 (Angle) relation of the teeth and jaws with bunching of mandibular incisors and insufficient space for lateral incisors. Photographs show upper face development in advance of cranial and mandibular development. A protrusive type.

development, structure, function, mechanical forces and mechanical limitations. No one or two of these can be successfully used alone. All are necessary and each plays its role, important or otherwise.

In Figure 1* are shown the casts and photographs of a boy, 7½ years of age. The teeth and jaws are in a Class II, Division I relationship with bunching of the mandibular incisors and insufficient space for eruption of the maxillary laterals. Skeletal development as judged from examination of the patient and from the photographs, indicates good symmetrical development, but the upper face is protrusive and in advance of cranial and mandibular development. Treatment was delayed and the patient

* Angle's classification and Black's measurements of the teeth are used throughout the present paper.

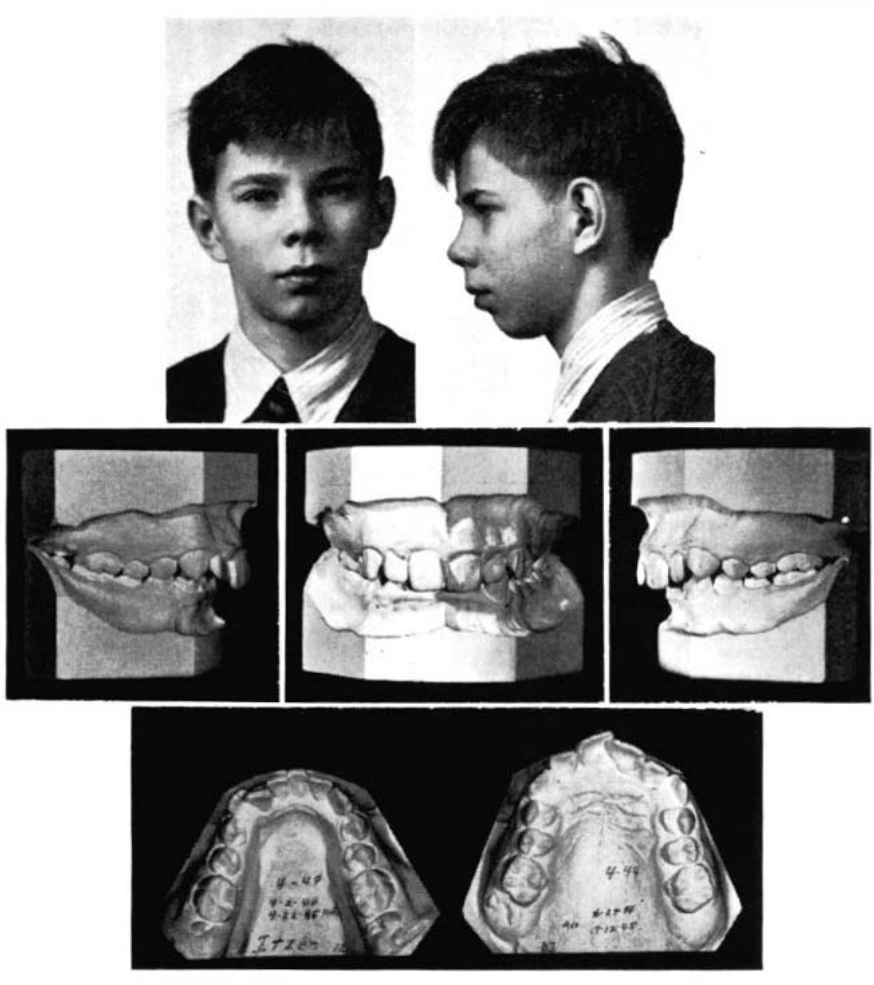

FIG. 2. Casts and photographs of same boy as shown in Fig. 1. Age 12 years at which time orthodontic management was begun.

was examined periodically. Progressive growth changes were checked against the original records. Figure 2 shows the casts and photographs of the same patient at 12 years of age. The Class II relationship of the teeth and jaws are of course still present. Cranial growth, however, seems to have caught up somewhat with the upper face and the upper laterals have been accommodated pretty well in the maxillary arch. In a similar way, the lower incisors have tended to align themselves. To complete the analysis, the teeth are of maximum size with good cusp formation and correspondingly well defined inclined planes. Inter-arch relations as already stated are Class II, Division I. Axial positions are generally good with perhaps a slight mesial crown inclination particularly of the lower molars and bicuspids, indicating that there was little or no drifting and that the teeth are in quite good relation to their respective jaws. There is, as always in these cases, a marked deficiency in vertical development of the alveolar process in the molar and bicuspid areas. X-ray examination of the teeth was negative.

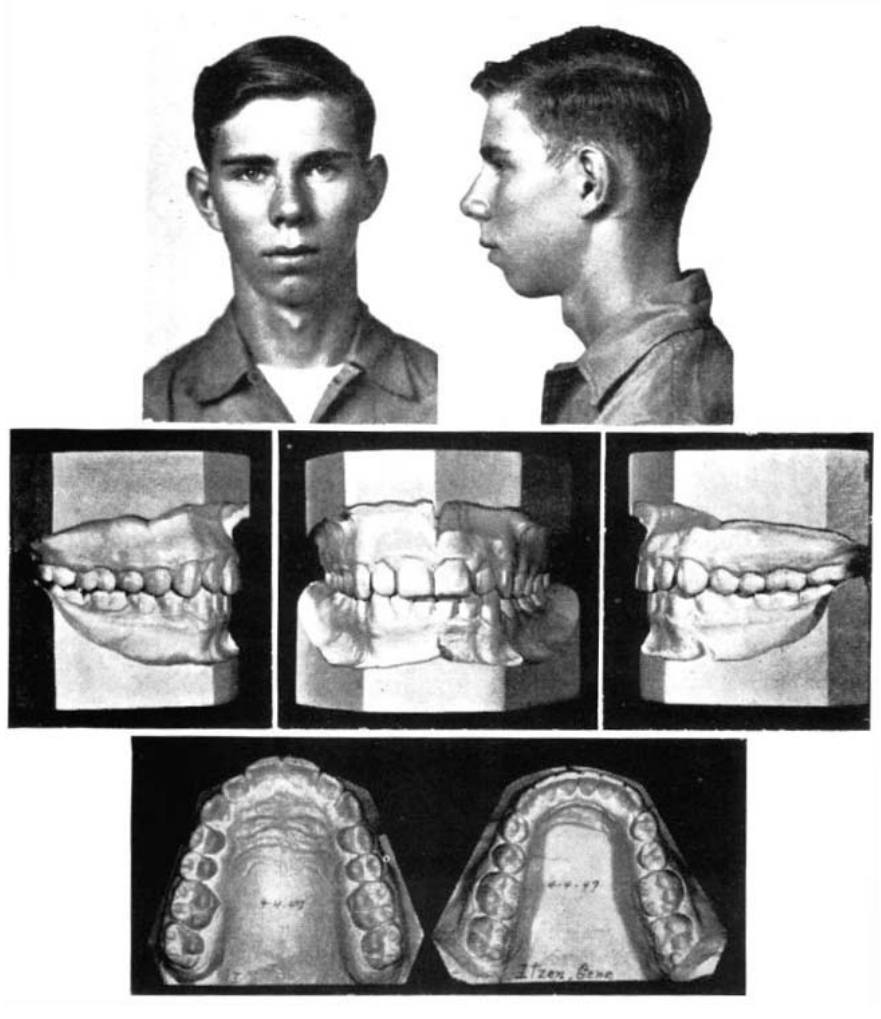

FIG. 3. Casts and photographs of completed case shown in Figs. 1 and 2 at 15 years of age and 1 year after removal of all retention.

The muscles of mastication were in good function, however, from the rest position of the mandibular to full closure, there was a slight distal displacement — the mandible moving upward and backward as compared to the normal upward and forward movement. The lips and cheeks were definitely hypotonic. The tongue was normal in size and position and the general posture was fair to good. There were no habits. The patient's general conduct was poor, he did not get along well with his schoolmates or at home. He had an extremely indifferent attitude. The medical examination was negative.

Summary: A Class II, Division I case with a distal displacement of the mandible in occlusion. Treatment was directed toward correcting the arch forms restoring correct mesio-distal relations in harmony with occlusion and muscular balance of the mandible, and stimulating the vertical alveolar development.

Figure 3 presents casts and photographs of the completed case at the age of 15 years. It is felt that the objectives of treatment concerning occlusion of the teeth and the vertical developmnt of their supporting alveolar process, were accomplished. As for skeletal pattern, there is better balance and harmony in the upper face and cranium, but little if any improvement in the lower face. This is clinical confirmation of cephalometric findings, that orthodontic treatment does not affect skeletal bones beyond the alveolar process as reported by Brodie et al. in the *Angle Orthodontist*, Volume VIII, No. IV, October, 1938. A point in diagnosis that should be emphasized, is that the alignment of the bunched mandibular incisors was effected without their forward movement by (1) uprighting the molars and bicuspids and (2) the vertical development of the alveolar process. This was verified by clinical observation and measurements. Note the vertical development of the teeth and alveolar process as shown by comparison of the models in Figures 2 and 3. Clinical measurements show the overbite and overjet to be 7 and 6 mm respectively in Figure 2. In Figure 3 they have been reduced to 3 and 1 mm respectively.

Figure 4 depicts the casts of a girl, age 11 years, showing a Class II, Division II, subdivision (left) relation of the teeth and jaws with a bunching of the mandibular and maxillary incisors. Original photographs are not available for observation, but clinical examination revealed a well-developed skeletal pattern with good proportion of the face, cranium and mandible. The teeth were of average width and possessed well-developed cusps and correspondingly good inclined planes. Contact relations were good on all posterior teeth but were broken on all six anterior teeth in both arches. A study of interarch relations gave important clues to diagnosis. The right maxillary and mandibular first bicuspids were in a Class I relation but the first molars were in a Class II relation. It is important to note, however, that the maxillary deciduous 2nd molar had been lost. This permitted a normal forward drift of the 1st molar. The mandibular 2nd deciduous molar was still present, thus the 1st molar in this dental arch has not yet moved forward, as had the upper, to the extent of the normal 1.7 mm as described by Nance.[1] Turning to the opposite side, the molars were in the same relative relation as on the right side and under the same circumstances. The 1st bicuspids, however, were in an end-on relation. Examination of the midlines showed that of the mandible to be slightly to the left of the maxillary. This suggested a left distal displacement of the mandible. Mandibular displacement cannot be easily checked clinically in all cases, but in the examination of this patient such displacement was thought to be likely. If present, it would explain the end-on relation of the 1st bicuspids and actually resolve the case into a Class I. In this connection, I should like to express another thought regarding diagnosis. This thought has been provoked by reports of cephalometric and other studies in growth and development and was called to my attention by Dr. Brodie. In the examination of a model it must ever be borne in mind that we are observing a frozen interval of time in the life of an individual. It is a static diagnosis, whereas in fact the forces exerted by the eruption of the teeth and other growth processes about them and at higher levels, plus the action of the musculature together with all of the interplay of forces, make the

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[1] American Journal of Orthodontics and Oral Surgery, Volume XXXIII, No. IV, April, 1947.

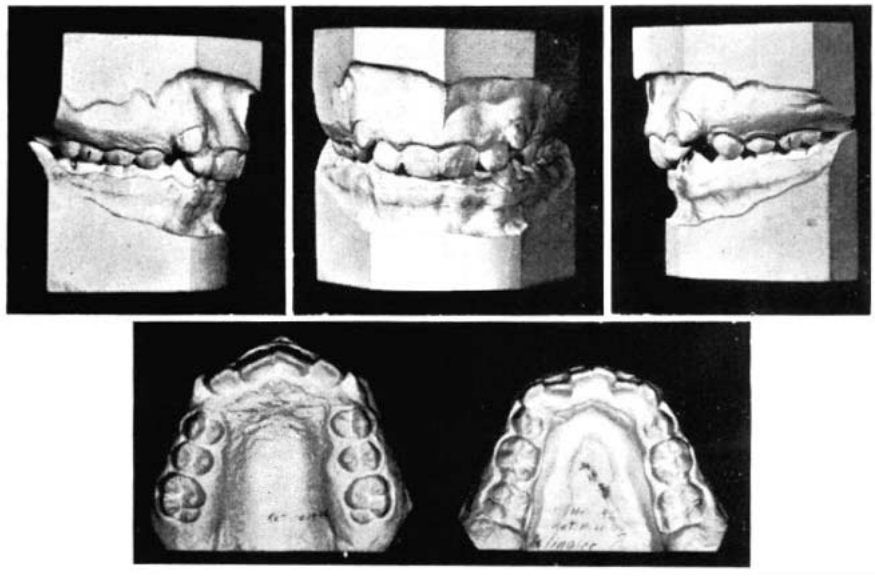

FIG. 4. Casts of a girl age 11 years. Note the Class I relation of the right bicuspids. Explanation of the classification to be found in the text.

denture a dynamic machine; this *must* be projected in one's thinking during diagnosis from models. Please observe that in the case under discussion, it was determined statically as a Class II, but in function it proved to be a Class I. When, during treatment the upper anteriors were depressed and aligned, relieving the occlusal interference their retrusion offered the muscular balance of the mandible was restored. Then the patient functioned in a Class I relation on the left as well as on the right. A further lead to this mandibular displacement was evidenced by an examination of the axial inclinations of the teeth. All posterior teeth were in normal upright positions. The incisors, while inclined distally in relation to the frontal plane, were upright in relation to the sagittal plane. Hence, shifting of the midline was not due to lateral tip or drift of the teeth. The dental arches were symmetrical and there was good alveolar development. As stated above, the skeletal pattern was good, with adequate development of both the maxillae and mandible. The muscles of mastication were good. The lips and cheeks were slightly hypertonic but the tongue was normal. General posture was good with an absence of any habits. General conduct was good and the physical examination was negative. X-ray examination revealed the presence of the lower 2nd bicuspids and all the 2nd molars.

Summary: A Class I case with a left distal displacement of the mandible in occlusion. The regular plan of treatment for this classification was followed with the occlusal and esthetic result shown in Figure 5 at the age of 16 years — two years after the removal of all retention. Esthetically, the face appears in good balance and harmony — the component parts being well proportioned. Measurements of the teeth show that the overbite was decreased 2 mm and the overjet 1 mm. The maxillary arch length was increased 4 mm and the mandibular arch length was increased 4 mm.

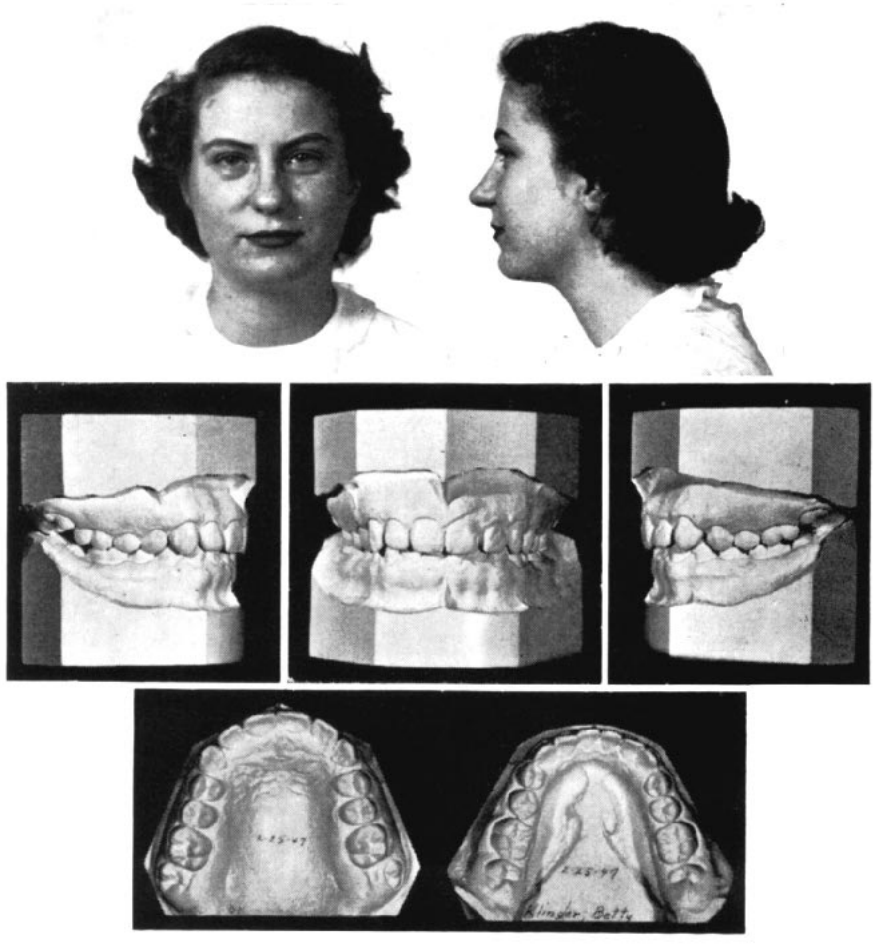

FIG. 5. Casts and photographs of case shown in Fig. 4, at 16 years of age; two years after the removal of all retention. Note the delayed eruption of the 2nd molars.

Figure 6 shows the casts of a boy at 13 years of age. The teeth are of average width and are provided with well-marked cusps and have well-defined inclined planes. All the contacts in the mandibular dental arch are broken except those between the molars and those between the 1st molars and the 2nd bicuspids. Of special note are the rotations of the cuspids, the significance of which will be discussed later. All contacts in the maxillary dental arch are also broken. There is present Class I relation of the cuspids and 1st bicuspids on both sides; the molars are in a Class II relationship. All axial relations are good except those of the maxillary molars which present a mesio-axial crown inclination. Both arches are symmetrical with good alveolar development with the midlines coinciding. The mandible, maxillae and cranium were well developed with the face definitely protrusive but in keeping with the skeletal pattern. The muscles of mastication were in good function and there was no evidence of any mandibular displacement in closure—the mandible traveling upward and forward from

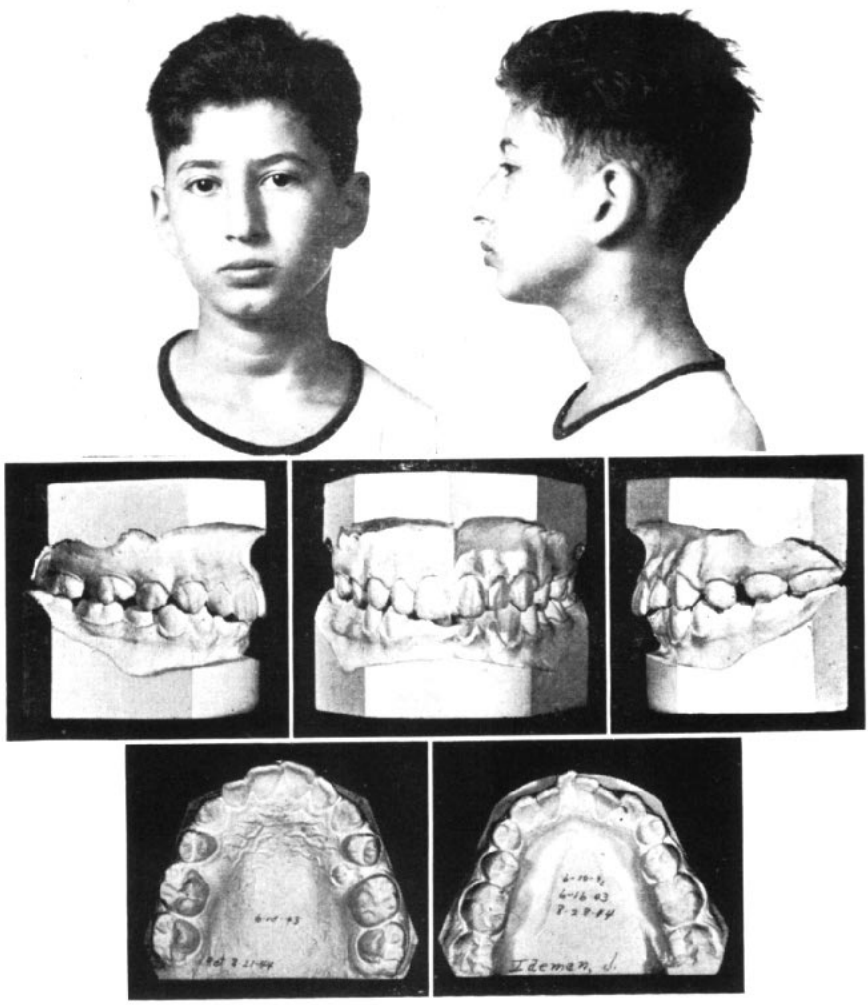

FIG. 6. Casts and photographs of a boy age 13 years. Note the protrusive type and the axial inclination of the maxillary molars.

the rest position to occlusion. Lips and cheeks were hypotonic, the tongue was normal in size and position, the posture was good and there were no habits. General conduct was good and the medical examination negative. X-rays revealed the upper right 2nd bicuspid present.

Summary: A Class I case with forward drift of the upper molars. The keys to the diagnosis in these models are the Class I relation of the cuspids and the axial inclination of the maxillary molars. In treatment, the upper molars were moved distally to a Class I relation thereby opening the space for the 2nd bicuspids. The maxillary incisors were depressed and aligned and the cuspids were rotated mesio-labially. In the mandibular dental arch, the cuspids were rotated mesio-labially opening space for the alignment of the incisors. The laterals were moved forward while the left central was

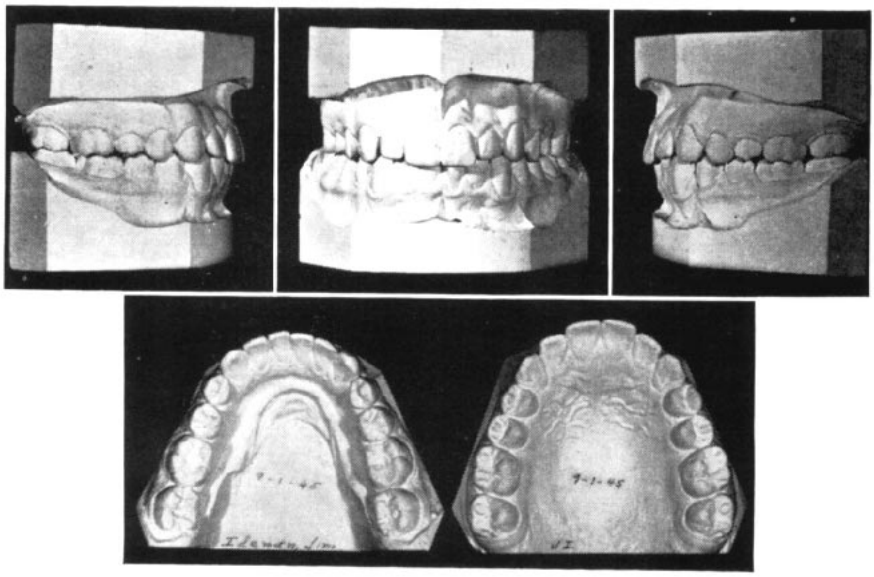

FIG. 7. Casts of patient shown in Fig. 6, six months after all retention was removed.

rotated and moved lingually. The right central maintained its original position. It is realized that those accustomed to the use of X-ray cephalometry would demand proof of these movements. It is believed that clinical observations plus actual measurements taken from the models provide such proof.

Figure 7 represents casts made six months after all retention was removed. A comparison of measurements made from the casts shows an increase in maxillary arch, length of 11 mm effected by distal movement of the molars. In the mandibular arch, the distance from the mesial point of the 1st molar to the most forward point of the right central incisors remained the same. The same measurement on the left side showed a decrease of 1 mm. No change in skeletal pattern could be demonstrated.

Figure 8 shows the casts of a girl at 12 years of age. The teeth are of average size, with average cusp height and corresponding inclined planes. In the mandibular dental arch, contacts of only the six anterior teeth are broken while in the maxillary dental arch only those of the left cuspid are broken, with the teeth in juxtaposition. On the left side the molars and bicuspids present a Class I relation while on the right side the Class I relation includes the cuspids. Axial inclinations of the maxillary teeth are good except that the incisor crowns are bodily distal. The crowns of the mandibular molars and bicuspids may be slightly forward with the right cuspid somewhat more pronounced. The left cuspid and all incisor crowns are definitely inclined to the right. The dental arches are relatively symmetrical, however, the midline of the mandible passes to the left of the midline of the teeth. The alveolar processes were somewhat deficient in the vertical dimension. Here I cannot offer original photographs since this was a transferred case. However, the patient possessed a good skeletal pattern with good proportions of the cranium, maxillae and mandible, none

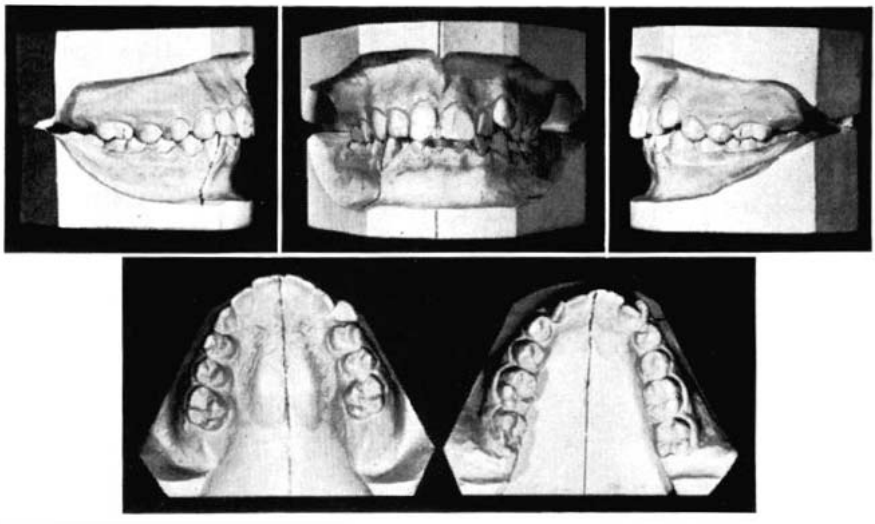

FIG. 8. Casts of a girl age 12. Note the Class I relation of the molars and the shifting of the midline.

of which showed a deficiency in development. Please observe Figure 9 which includes photographs made fol owing treatment. All muscle functions were normal and there were no habits. General posture was excellent. X-ray and medical examinations were negative.

Summary: A Class I case with backward and left drift of the maxillary incisors and backward and right tipping of mandibular incisors. The key to this malocclusion was the tipping of the mandibular incisors and the resultant shift of the midline. There was nothing unusual about the treatment and it progressed rapidly according to plan. There was, however, an interesting development following removal of the treatment appliances. It is my usual custom to remove one of the appliances to permit the teeth to settle into occlusion, before retaining, while the other appliance is left in position for support. Most often the upper appliance is removed first and this was done in the present case. When it became evident that no retention was needed on the upper, the lower appliance was removed but no retention was provided. The usual check made after two weeks revealed that the mandibular right central was moving lingually at an alarming rate. At this time the centrals and left lateral were stripped at the contact points and at the next observation the central was back in position — obviously moved by pressure exerted by the tongue. No retention was ever worn on either dental arch. The casts shown in Figure 9 were made 14 months following removal of the appliance. The photographs show the esthetic result. Measurements of the teeth show a 3.5 mm decrease in overbite and 0.5 mm decrease in overjet. The maxillary arch length was increased only 0.5 mm while the mandibular arch length was increased 3 mm.

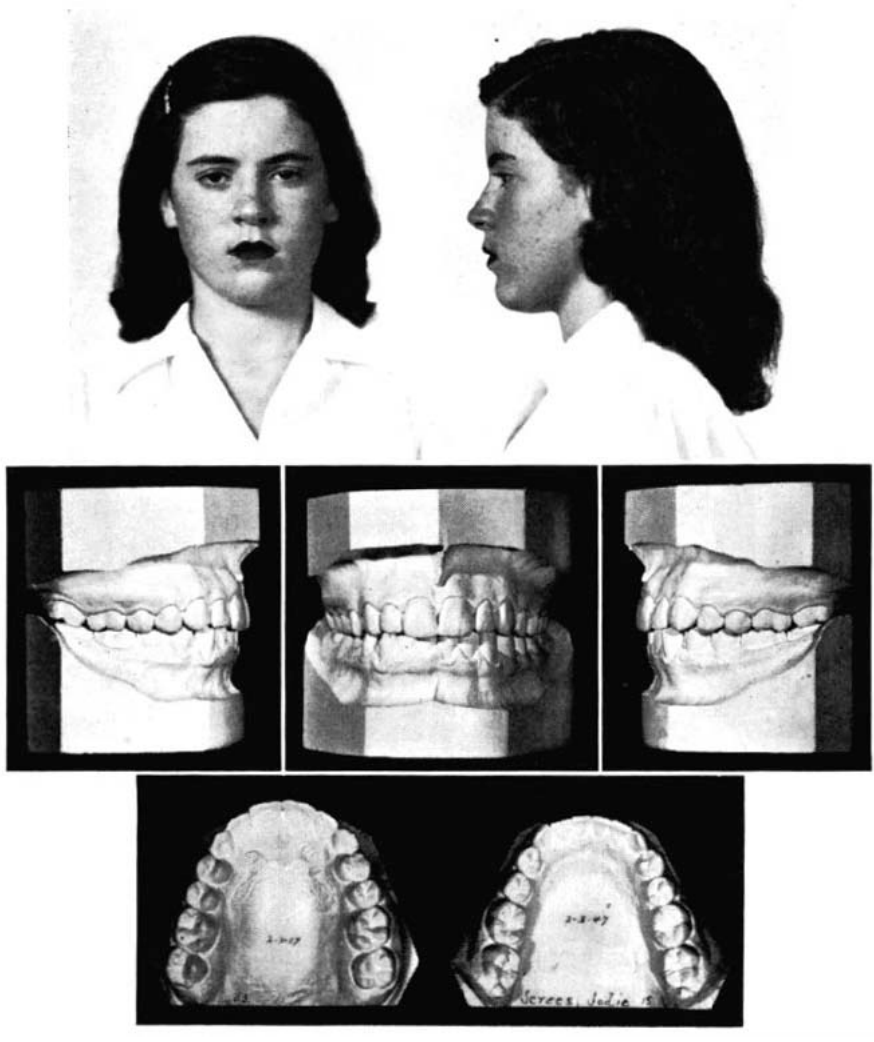

FIG. 9. Casts and photographs of patient shown in Fig. 8. Note the facial balance in the photographs and the midline in the casts.

Figure 10 shows the casts of a girl 12 years of age. Measurements of the teeth yielded significant information. The mandibular central incisors, cuspids, 1st bicuspids and molars were of average width while the lateral incisors and 2nd bicuspids were of maximum width. All maxillary teeth were average, thus there was shown to be disharmony in the size of the teeth in the mandible and disharmony between the dental arches. The cusps of the teeth and their inclined planes were average. In the mandibular dental arch, the contacts of the six anterior teeth were broken and the cuspids were rotated. Inter-dental arch relations were bilaterally end-on in the molars and bicuspids region and the upper lateral incisors were in

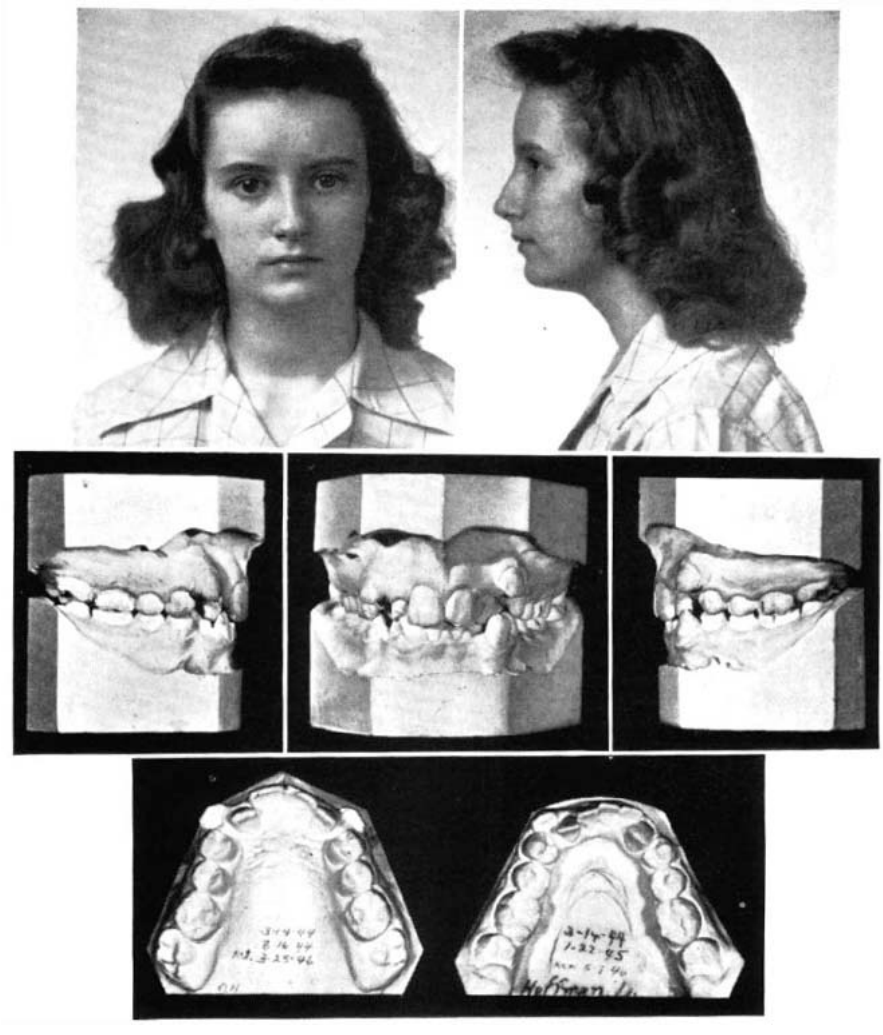

FIG. 10. Casts and photographs of a girl age 12. Note the facial balance and the axial positions of the incisors.

lingual occlusion. Axially the crown of the molars and bicuspids were slightly forward but not excessively so — most apparent were the 1st bicuspids. The arches were relatively symmetrical with the mid-lines approximately correct. Alveolar development was good. Muscular function was good and there was no suggestion of mandibular displacement. The skeletal pattern was good with normal development, and the component parts of the head and face were in harmonious balance. This is the type of development and harmony that belies a severe malocclusion when the lips are in repose. The lips and cheeks were normal and the tongue was normal in size and position. General posture was good and there were no habits. X-ray and medical examinations were negative.

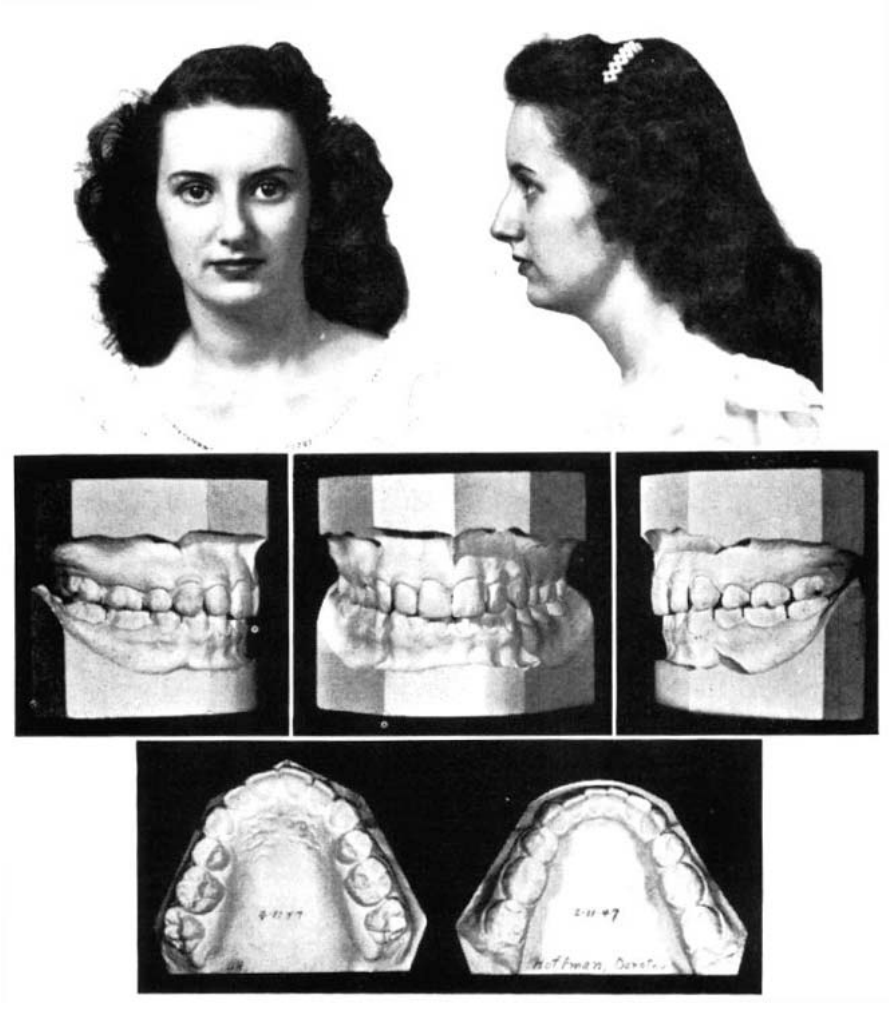

FIG. 11. Casts and photographs of patient shown in Fig. 10. Compare maintenance of facial balance.

Summary: Because of the balanced relations of the jaws and face, this case was classified as Class I with a forward drifting of all buccal segment — popularly referred to as a bi-maxillary or double protrusion.

The aims in teatment were to preserve the existing facial balance and harmony. To do this, one of two procedures were necessary: (1) either move all four buccal segments distally to provide for the alignment of the six anteriors, or (2) sacrifice dental units. The latter course was chosen because of the difficulty associated with accomplishment in the first alternative, and also because of the disharmony in the size of the dental arches previously described.

Figure 11 shows the occlusal and esthetic results. It will be observed that there has been no change in facial balance. The only change is an increase in size as the result of growth.

Since the overbite and overjet have remained the same and also since the maxillary central incisors have retained their original axial positions and relations to the skeletal anatomy, as shown by the photographs and casts, it is assumed that this shortening of the mandibular dental arch has resulted from a forward movement of the molars and bicuspids, which changed their mesio-distal relation to the upper. Cephalometric X-rays would be invaluable here for verification of clinical observation and measurements.

Permit me to emphasize again that the clinician for the most part is dependent upon the study of normal occlusion as the basis for his professional success. Indispensable diagnostic information is obtainable from models, X-rays, and photographs even though there has been a tendency on the part of orthodontists to ignore these methods for the past fifteen or more years. To be sure, cephalometrics has added important information concerning growth and development together with their influence on the denture, but as yet it is only an aid to the solution of our problems and must be recognized as such and placed with the other aids in modern orthodontia. I believe that the cases presented herein support this contention and if this paper has helped you to re-affirm your faith in the basic concepts of your profession, it has served a worthwhile purpose.

—Sherland Building