Diagnosis And Treatment Of Class II Malocclusions

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This paper is a review of treatment procedures, diagnostic facts and theories that will show what can be expected in the correction of Class II malocclusions. These malocclusions will be in both the mixed and permanent dentition, in male and female, moderate and severe. These are not new ideas or methods, but ones that I have acquired through the years. In my hands and within the scope of my ability I can now achieve results that are acceptable to the concepts of what I feel good treatment should accomplish for the patient.

The main cephalometric characteristic of a Class II malocclusion is the mandible in posterior relationship to the maxilla. This may be quantitatively expressed by comparing the angles SNA and SNB and calculating the difference, which is the ANB angle. The greater the ANB angle, the more that face appears to have an extremely weak chin or the chin appears to be retruded in relation to the upper face or dental arch.

DIAGNOSIS

Our first consideration in orthodontic treatment is the correct diagnosis. All pertinent and important facts should be itemized if the orthodontist hopes to mold the child's teeth, features and smile into a thing of beauty and permanence.

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As long as the orthodontist has to move teeth or place them in a position to resist relapse, then he should know whether there is adequate space in the arch for all the teeth free of rotations. Of the methods of determining arch length, I prefer Tweed's method of measuring the available space against the required space in the mandibular arch; his method is very precise and rapid. Especially is this information necessary when diagnosing a mixed dentition Class II. When dealing with mixed dentition cases, it is necessary to use intraoral x-rays to obtain the mesiodistal diameters of the unerupted permanent teeth. These measurements are recorded on a card and are used in the diagnosis.

It may be well to dwell for a few minutes on some facts that should be kept in mind when analyzing and planning treatment for borderline extraction cases. If there is concern about arch length in the mandible, if the incisors are crowded or a tooth is blocked out, don't wishfully think that the incisors can always be tipped a little farther forward or the arch expanded to include the blocked out tooth. The result will be eventual collapse. We should recognize where additional arch length is lost. One should remember that in each arch it requires four to six millimeters of extra space for band material depending upon how well the bands are fitted at the contact points. Another factor to consider is the additional arch length; three to five millimeters are required to level or reduce a deep curve of Spee.

There is a tendency to look only at the anterior teeth and bicuspids to judge the amount of crowding in an arch. Equally important is the position and size of the unerupted second molars and growing third molars. If the crowns of the forming second molars are sliding along the curvature of the distal root of the first molars, then it is questionable whether the first molars can be maintained during the treatment and retention period as the second and third molars develop and erupt. Poor x-ray technique can change the relative position of these teeth on the film; however, I'm confident that careful x-ray technicians obtain constant and accurate relationships of these posterior teeth. Therefore, I give a great deal of consideration to the position and size of the posterior erupting and unerupted teeth in diagnosis and treatment planning.

Care and accuracy should be paramount in tracing lateral head films so that valuable diagnostic information will not be lost. Good tracings should clearly show the areas used for registration points as well as the sites of tooth movement and bone growth. The component parts of the face and skull do not always grow and develop in an orderly manner; we often superimpose one area at a time to note changes in tooth movement and growth[2]. With good tracings all types and ways of superimposing are possible; in this way more can be learned about orthodontic treatment procedures and their results.

Orthodontists must recognize limitations in the treatment of some cases, especially severe Class II malocclusions. Our greatest limitations and compromises occur most often when we treat severe Class II malocclusions after the main growth period has passed for that child, usually in a girl eleven and one-half years and older or a boy over fifteen years. We are also often forced to be satisfied with less than ideal results when treating severe Class II malocclusions with extreme facial skeletal patterns and growth deficiencies. On the other hand, however, there are the Class II malocclusions that have a skeletal pattern in which the mandible is quite normal in size, shape and position relative to Frankfort plane but is decidedly retruded in relation to the maxilla and upper face. When faces are within the latter range, they can be designated as having a good basic facial pattern. The ANB angle is, roughly, the guide as to the severity of the Class II malocclusion; a case can be classified as mild when the ANB angle is three degrees to five degrees, severe when the ANB angle is five degrees to eight degrees, and disfiguring when the ANB angle is eight degrees or more.

In treatment planning one should take into account the mandibular plane angle as well as the shape and size of the mandible. One need not be so concerned with the excellent mandible well-oriented to Frankfort plane; in these cases there nearly always seems to be a sufficient chin which improves with growth and treatment. In mandibles not so favorably located in reference to Frankfort plane, I am convinced that we can often make notable changes in the bony and soft tissue profile in the area of the chin. Many times the chin button can be increased when the mandibular plane angle is reduced and when the anterior teeth and their bony support are moved lingually.

The mandibular plane angle is seldom reduced much during treatment; however, some bone deposition can be shown on excellent mandibles during the treatment period, especially on growing males. The lingual movement

of the mandibular anterior teeth and their alveolar bone is the main contributing factor in developing a more prominent chin. This can be accomplished more readily in the mixed dentition.

The distance between the extension of the line NB and the pogonion point on a lateral head film tracing expresses the amount of bony chin or the chin button. The soft tissue chin usually conforms very closely to the bony chin and the amount of chin button reflects the degree of strength in the soft tissue profile of the lower face. It is very difficult to estimate the amount of chin a child will develop during growth. Male adults, on the average, have more chin button than female adults and growth continues for a longer period of time in the male. Mandibles that are more nearly parallel to the Frankfort plane (low mandibular plane angle) tend, as we know, to develop a good chin button. Likewise, there is considerably less chin button in the steeper mandibular plane angle cases.

The lack of a chin button makes the profile seem worse, while the greater the chin button, the better the profile appears. Holdaway shows the importance of the chin button by coordinating it with Point A to Point B and the angle of the maxillary and mandibular incisors.[2] When his formula is followed, a most pleasing profile may be obtained for the patient. The Steiner analysis likewise takes into consideration these important measurements.[3]

Treatment

One should exercise great care in the treatment planning in all cases but especially in those with an excellent basic facial pattern and a good potential for more growth. It is wise to be conservative where growth and treatment may possibly help to develop

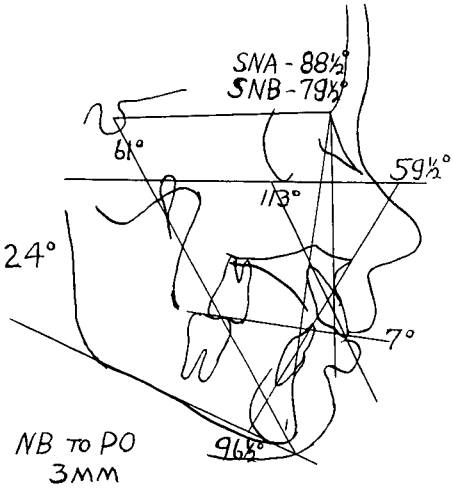

Fig. 1

considerably more chin button.

One can expect excellent results with good orthodontic treatment in the Class II, Div. I malocclusion shown in Figure 1 because this eleven-year old boy has an excellent basic facial pattern with a favorable growth potential. One can approach with confidence, however, the treatment of severe or disfiguring Class II malocclusions in which the basic facial patterns are not good. When confronted with this type of case, one should not compromise treatment; instead, do everything possible to give the patient a well-balanced and harmonious face. With the application of sound mechanical procedures, points A and B can be repositioned farther lingually. If the age factor is favorable and there is growth during the treatment period, one can expect a sizable reduction of the ANB angle and a favorable increase of the chin button.

Case #436, is a boy, aged nine years and ten months, with a disfiguring Class II, Division I malocclusion. The chin is weak and ill defined (Fig. 2). This mixed dentition case (Fig. 3) displays a deep overbite in the incisal area; the models show some crowding and protrusion in the maxillary and

Fig. 2

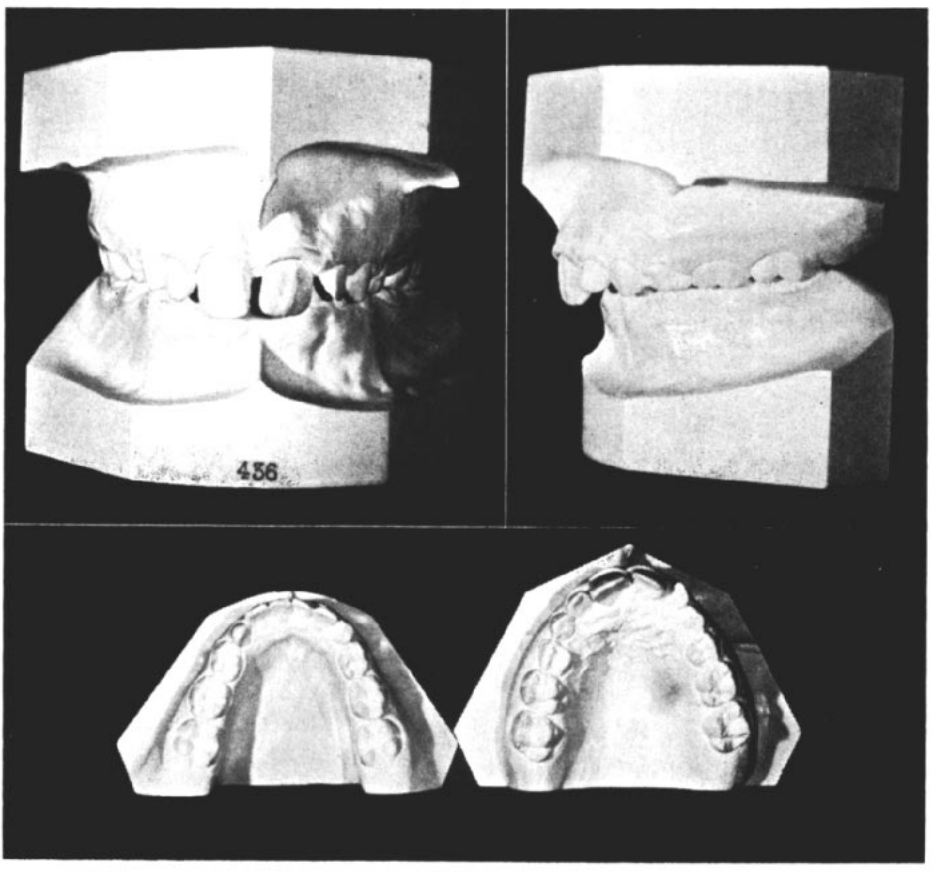

Fig. 3

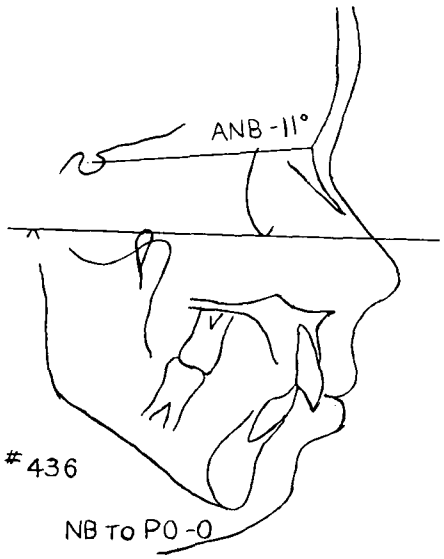

Fig. 4

mandibular anterior region. The full mouth x-rays revealed a notching and bifurcation in the bone between the upper centrals. A frenectomy was performed after first closing the space.

The lateral tracing (Fig. 4) displays a severe ANB angle with the entire maxillary arch forward. The lower border of the mandible is steep; there is very little chin, thus the entire face is very convex. The maxillary incisors are bodily forward and too upright; the mandibular incisors are tipped labially of their basal bone.

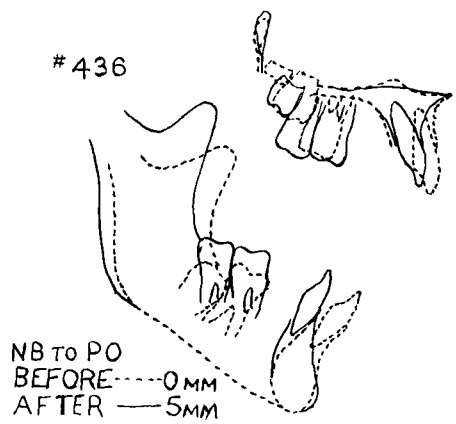

Fig. 5

The maxillary incisor teeth and the first molars were banded and the case was given headgear treatment for six months. Then all four first bicuspids were removed and the remaining teeth, both permanent and deciduous, of both arches were banded. The treatment procedures followed were those advocated by Tweed for mixed dentition, Class II, extraction cases.[5]

The before and after treatment tracings of the two mandibles are superimposed on the lower border at the lingual symphysis to show the changes of the incisors, point B, and the chin button (Fig. 5). Point B, in the after treatment tracing is decidedly lingual by seven to eight mm. and there appears to be deposition of bone on the most anterior portion. There has been considerable growth in this mandible. The body and the ascending rami have had good growth along with increased alveolar heights in the posterior area. A great deal of the facial improvement is due to a change in the chin button, brought about by the retraction of point B and forward growth of the mandible. Looking at the maxillas, superimposed on the hard palate (Fig. 5), you will notice the lingual bodily movement of the maxillary incisors along with their good axial inclination. This case was very favorable for this type of movement because there was sufficient bone to move these teeth lingually, thus greatly reducing the SNA angle.

The after treatment tracing (Fig. 6) shows a well-balanced face that is within normal limits for profiles exhibiting rather a steep mandibular plane angle. The maxillary and mandibular teeth are now in a stable position on basal bone and in a good Class I relationship.

Because there was considerable

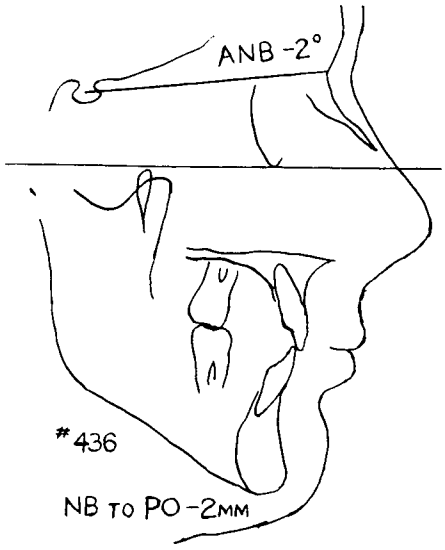

Fig. 6

growth between the before treatment lateral head film tracing and the final posttreatment tracing (a time lapse of four years and two months (Fig. 7), it seems that a better comparison of growth and treatment changes could be shown in the middle and lower third of the faces by superimposing

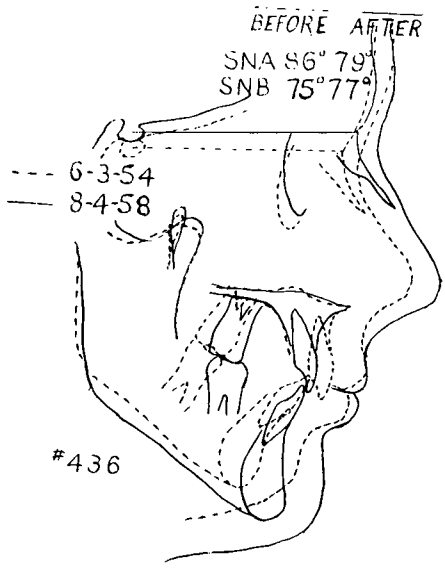

Fig. 7

the tracings on the hard palate and the anterior nasal spine. Vertical growth occurred in both the upper and lower face. Horizontal growth occurred mostly in the mandible, some between sella and nasion and very little in the maxillary area. His photographs show the soft tissue improvement when teeth are moved bodily and point A and point B are repositioned (Fig. 8). Even though the mandibular incisors and point B were moved lingually, forward growth of the mandible slightly increased the SNB angle. The decided increase of the chin button greatly reduces the convexity of the lower third of the face. I believe that treatment was started at an advantageous period and the mechanics of treatment were such that these favorable results were made possible. The soft tissue change has kept pace with the skeletal changes giving normal tone to these tissues.

When treating severe Class II mixed dention cases, it is usually advisable to treat thoroughly and accomplish as much as one can while the deciduous teeth offer good resistance, then retain and wait until all the permanent teeth erupt. At that time a short period of treatment should finish the case quickly.

I feel the two phases of treatment in this case have given a more permanent and gratifying facial change than could have been obtained by waiting until all the permanent teeth had erupted and treating only in the permanent dentition. Total elapsed time was three years and nine months with but two years of banded treatment including both deciduous and permanent dentition work.

The lateral head x-ray (Fig. 9) for patient #547, was taken when this girl was eleven years and three months of age. Models and photographs were made two years later and treatment was

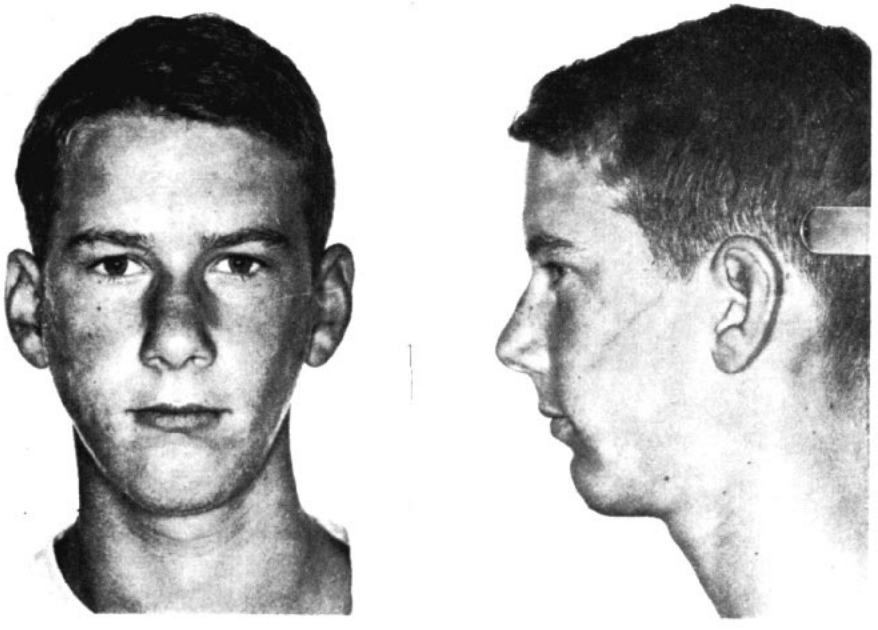

Fig. 8

started in another few months. By tooth classification this case would be designated as a Class I malocclusion, but by skeletal and soft tissue profile, we must change this classification to a Class II, Div. I malocclusion of moderate severity (Fig. 10). The mandibular first molar on the right side was submerged due to bulbous roots. The mandibular incisors are tipped forward and slightly crowded (Fig. 11); the overjet is fairly severe, the overbite quite deep, but there is a good basic facial pattern. Even though the patient had a good chin button, it was decided that extractions were necessary to attain the best esthetic balance and stability of the dentures. Therefore four first bicuspids were removed and treatment inaugurated for Class II, Div. I type of malocclusions.

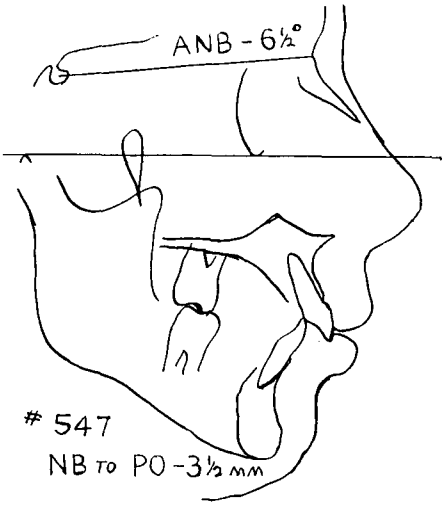

Fig. 9

The after treatment tracing was made shortly after the case was retained. The convexity of the face has been eliminated through growth and treatment. Both the maxillary and mandibular anteriors are now well over basal bone.

The before and after tracings are superimposed on SN at nasion (Fig. 12). Without too much over-all growth, this point is adequate for show-

Fig. 10

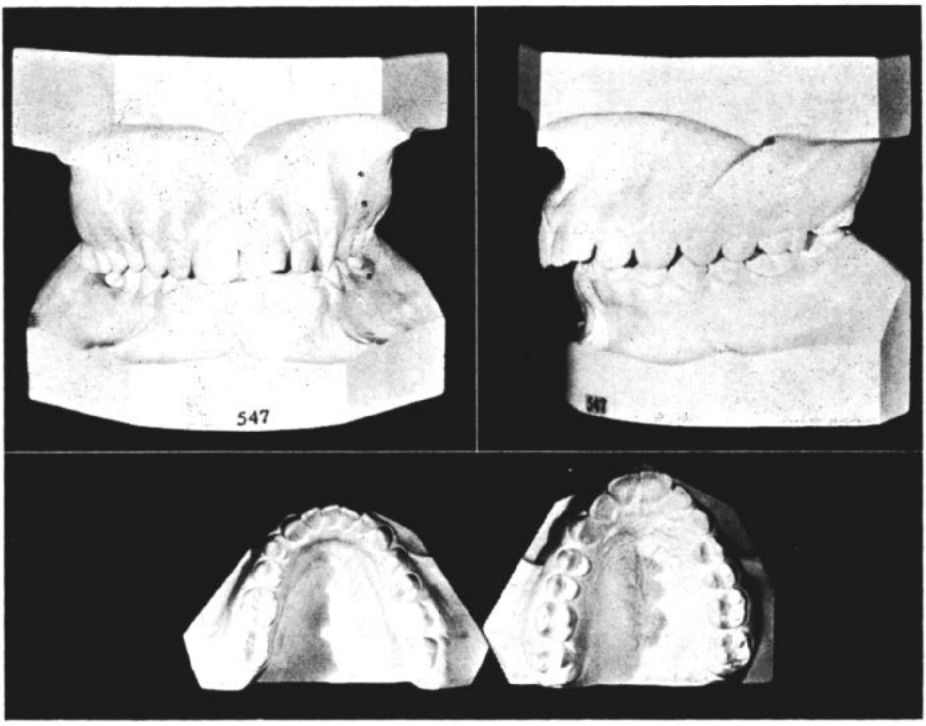

Fig. 11

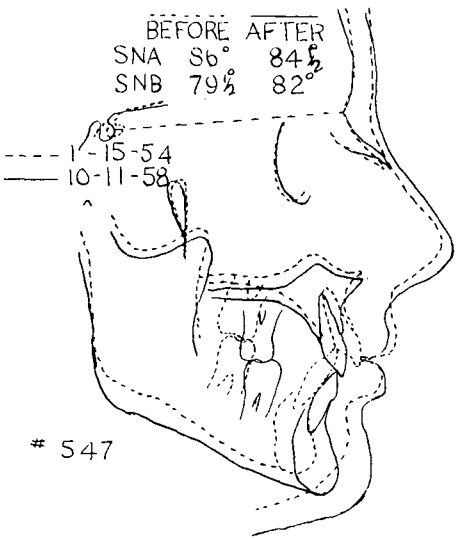

Fig. 12

ing general profile changes. The elapsed time between these two tracings is four years and nine months. During that time there was some general overall growth with a much greater amount in the mandible and a lesser amount in the maxilla. The forward growth of the mandible was the main contributing factor in reducing the facial convexity so noticeable in the soft tissue change in the lower face. The other sources in reducing the convexity were the slight lingual repositioning of point A and the bony deposition on the chin.

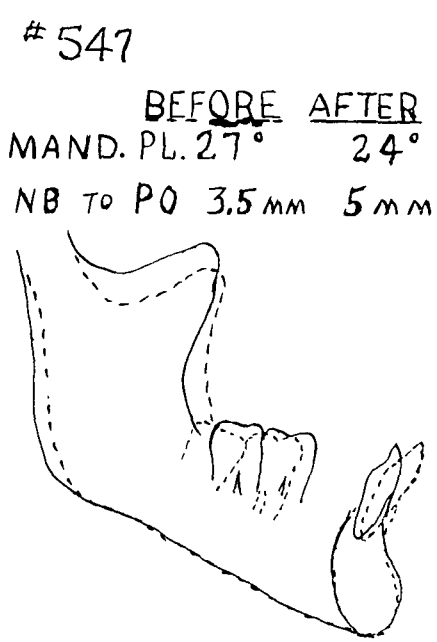

Fig. 13

The before and after mandibles are superimposed on the lingual symphysis (Fig. 13). Besides the lingual positioning of point B which helped increase the chin button, there was some bony deposition on the most anterior portion of the chin. There was also a decrease of the mandibular plane angle of a few degrees. The submerged mandibular right first molar was brought into normal occlusion. The models also show a well-balanced denture that should be stable during and after retention (Fig. 14). The final photographs are seen in Figure 15. Total treatment time was two years and two months.

A Class I malocclusion in a girl age eleven years, six months was included to illustrate what can be accomplished in children where there is little or no chin button (Fig. 16). Other than a high facial angle everything is normal except the chin. If there had been an adequate chin, the face would be very pleasing instead of being a Class I double protrusion in appearance. The case was treated as a double protrusion with the removal of the first bicuspids, even though there was an excess of space in both maxillary and mandibular arches. Treatment planning called for the retraction of both the maxillary and mandibular anterior teeth as far as possible.

The before and after tracings are illustrated in Figures 17 and 18. There is a lapsed time of two years three months between the tracings. Treatment results show that favorable facial esthetics

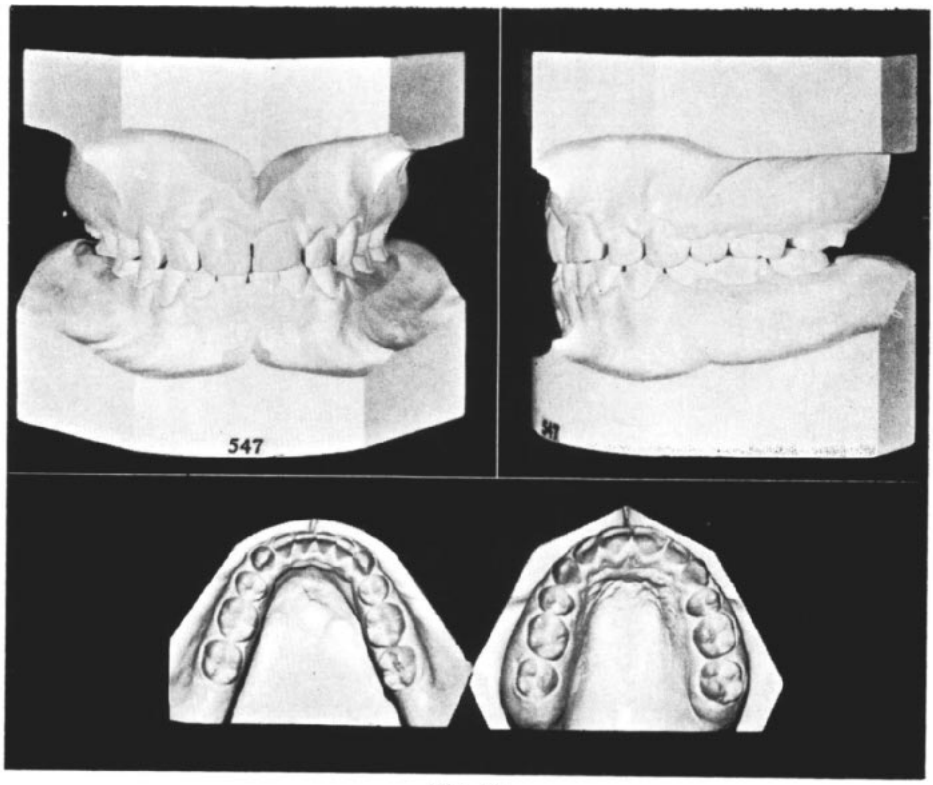

Fig. 14

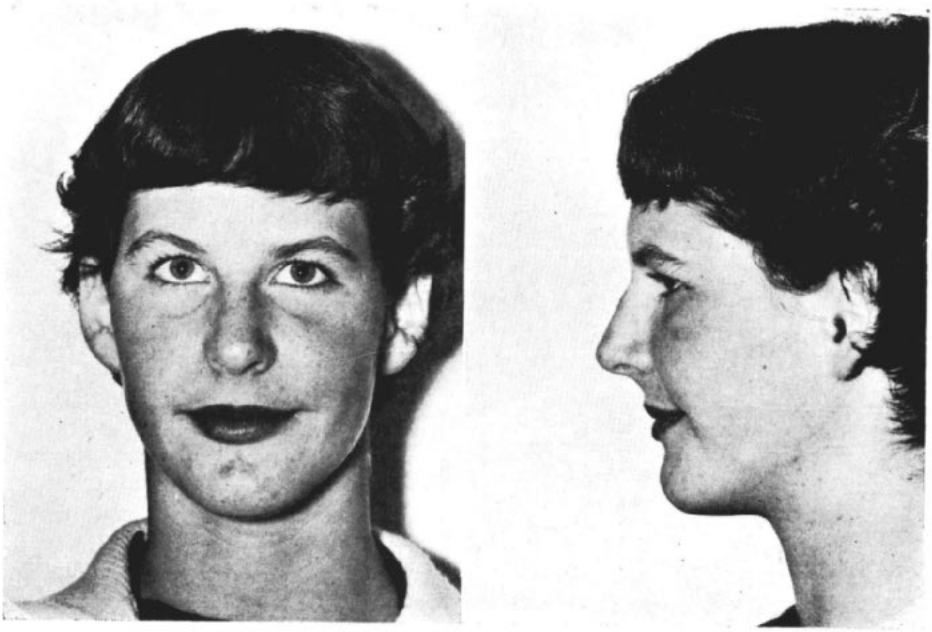

Fig. 15

Fig. 16

were obtained. This was a compromise treatment because the teeth were placed lingually on the denture base. Figure 19 depicts the models before and one year after treatment. There now is two mm of chin button and point B is six mm lingual of its former position. This, plus the reduction of point A an equal amount, gives the profile a better balance (Fig. 20). This girl was also a perverted swallower, which took many months of habit cor-

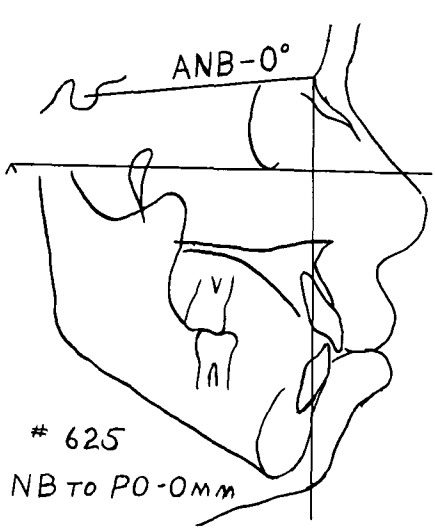

Fig. 17

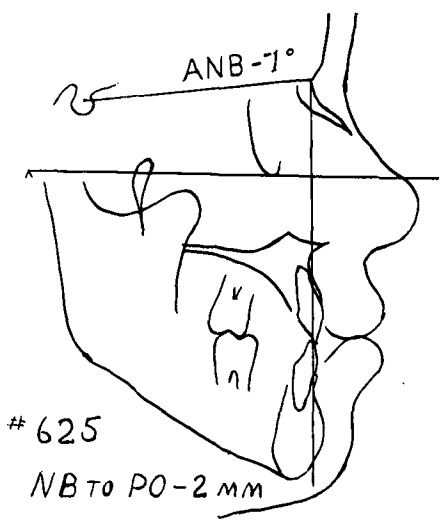

Fig. 18

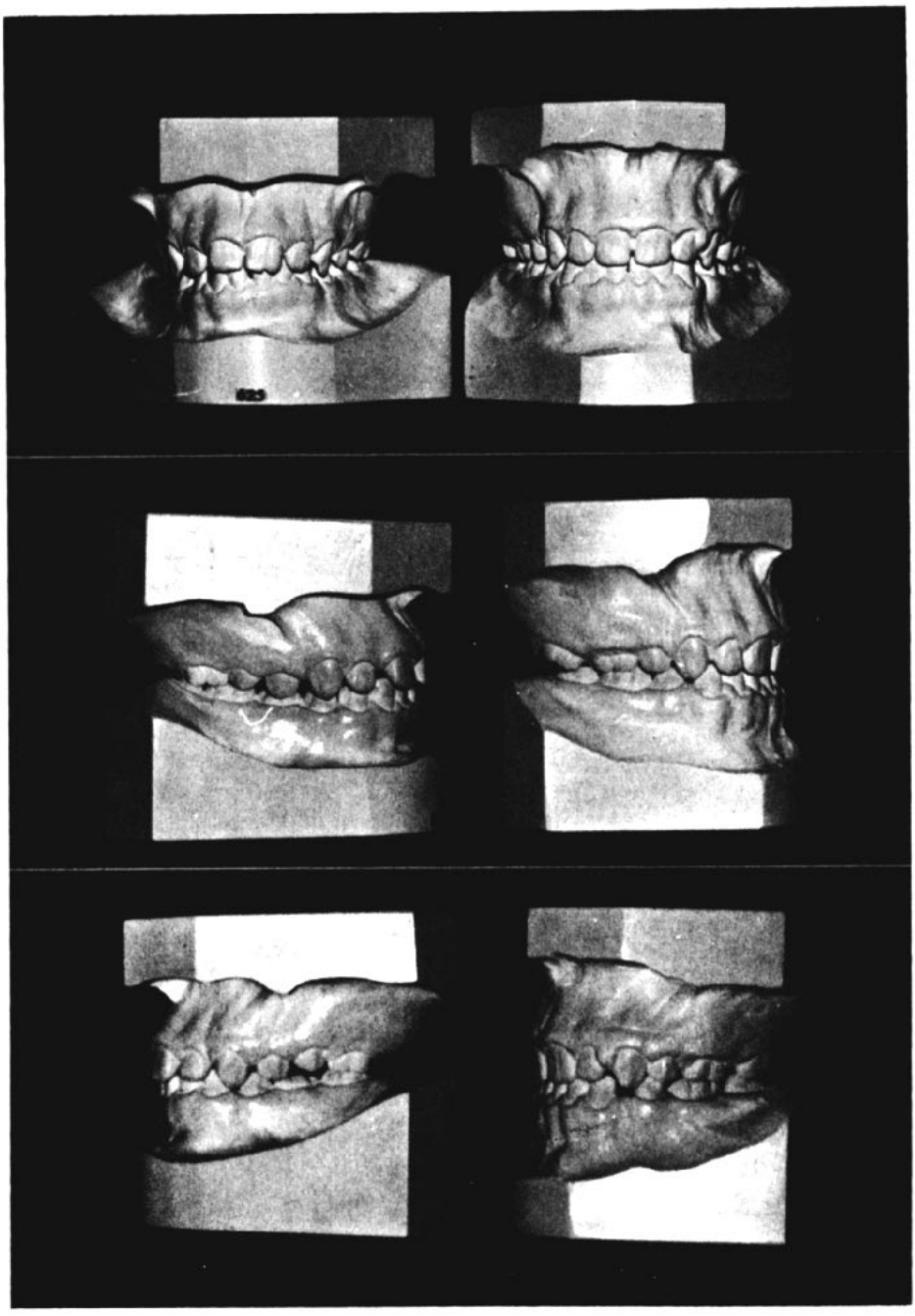

Fig. 19

Fig. 20

rection therapy to be assured that retention was stable.

The positions and sizes of unerupted second molars were mentioned earlier. Figure 21 (above) shows second molars with plenty of room to erupt. When treating a case with similar spacing in the unerupted second molar area, with a slight anterior discrepancy, the chances of holding the first molars from mesial drifting are very good and with the added possibility of gaining a little more space. Also these molars can usually be tipped well back in anchorage preparation with little or no forward root movement.

Figure 21 (below) illustrates the x-rays of the same mouth taken two years later. You will notice that there is still room for the second molars to erupt and so far they are erupting normally. If one extracts in a borderline case, even though it may be a Class II with posterior spaces like this, he may have a difficult job finishing the treatment. I am now careful to note the size and position of second molars and I think we should consider later the third molars in this same light.

Second molars that are crowded against the roots of the first molars can be seen in Figure 22 (above). The chances of their erupting into good positions without affecting the first molars are very slight. Their tendency while erupting is to move the first molar farther forward in an already crowded and shortened arch. When extracting in a case that shows this

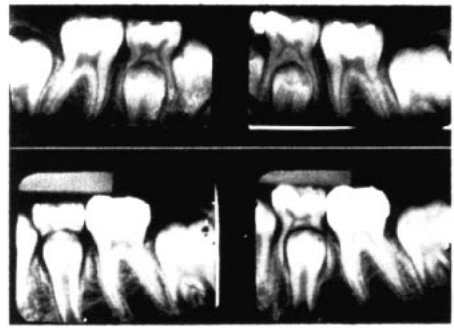

Fig. 21

Fig. 22

much crowding it often seems that the posteriors move forward more and faster than the anteriors go lingually during treatment. The extraction space seems to melt away. The upper first molars were even locked into the distal portions of the second deciduous molars. Note the position of the second mandibular bicuspid to the roots of the second deciduous molar; the same case a year and a half later (Fig. 22, below). It appears that the mandibular deciduous second molars have been pushed forward from their normal positions so that the first and second bicuspid crowns are not in the same relative positions with the deciduous molar roots. The second molars in the maxillary arch seem to have insufficient room to erupt. The long axes of the mandibular first, second and third molars tend to converge at a point just above the occlusal of the first molar. With the second and third molars erupting in this direction, it appears that they will certainly adversely affect the cuspids and bicuspids that are also in the process of erupting, and later the four incisors.

It was previously stated that additional arch length is necessary when a deep curve of Spee is reduced. This is important to consider in borderline extraction cases along with anterior and posterior crowding of the erupted and unerupted teeth.

Any one of us would prefer to treat cases with low mandibular plane angles rather than angles of thirty degrees and above. The low angle cases usually have a better growth pattern which can be more accurately predicted during treatment than can high angle cases. Also, the low angle cases usually have more chin button and a good chance of additional growth during treatment. One should remember that the chances of bettering the profile in cases with mandibles having a steep angle are decidedly poorer than the low angle mandible cases. Two mandibles of the same length and shape will give two distinct patterns in the lower portion of the face when in one case the mandibular plane angle is twenty degrees and the other at thirty-five degrees. The twenty degree mandibular plane angle face will generally be straight with a definite chin. The thirty-five degree mandibular plane angle face will be more convex, longer in the lower third of the face and have a less prominent chin. The same amount of chin button on two mandibles, placed side by side, will vary greatly when placed under Frankfort planes at the different degrees. The same amount of growth in these two mandibles will, in the low plane angle case be mostly forward, while in the high plane angle case it will be more

downward. By the same token the twenty degree angle case usually has a flatter occlusal plane. Equal mandibular bone growth will allow more room for teeth to erupt in the lower angle mandible.

These are some of the reasons good basic faces improve with treatment, while the poor basic faces often improve very little. Sometimes the mandibular growth in high degree angle cases is so slight that SNB is less after treatment than before treatment.

For these reasons I am convinced that one should use every effort to keep the upper and lower anterior teeth from elongating. One should not steepen either the occlusal or mandibular plane but flatten them, if possible.

One can expect to bodily move any or all teeth in the mouth under optimum cooperation. The limits of tooth movement are the amount of basal bone that exists, the time involved and the condition of the tissues. Obviously it is foolish to move a tooth until the root is badly absorbed. Tooth movement, when done on younger patients eight to eleven years of age, is much faster, generally more permanent and shows less damage to the hard and soft tissues. Good tooth movement, as we all know, is possible in older patients, even though the growth period is practically finished.

Much of the success of Class II treatment depends upon the handling of the maxillary incisors; in severe Class II malocclusion they usually erupt until they are supported by the lower lip, in a more or less stable position. The treatment plan should call for the retraction of these teeth without elongating them; many times we even plan to depress them. Because the maxillary incisor roots are conical in shape and because of their tipped-forward position, the tendency during their retraction is for the crown to go lingually and incisally. To bodily move and maintain these teeth in a good axial position, in the neighborhood of 110 degrees to Frankfort plane, requires careful procedures in torque control, elastic forces and headgear assistance.

One of the common contributing factors to minor and major collapse of treated cases is perverted tongue and swallowing habits. The tongue is generally the most serious offender.[4] If normal swallowing and tongue thrusting habits have not been corrected where they have been a problem, then the finest treated case may collapse from these abnormal muscular pressures.

Summary

In summarizing, the essayist would like to stress the following facts:

(1) The gross improvement from treatment of severe Class II, Div. I malocclusions is brought about by the reduction of the ANB angle. This is accomplished by lingual positioning of point A and forward positioning of point B.

(2) When it is necessary, improvement of the chin can be accomplished by lingual positioning of the mandibular incisors and point B.

(3) It is necessary to establish and maintain excellent anchorage to accomplish these gross tooth movements.

(4) Coordinating treatment with the best growth period. The degree of favorable orthodontic change is related closely to growth. Many of these changes can be accomplished, to a lesser degree, in nearly matured children.

While treating a Class II malocclusion we should keep in mind the three basic principles we are striving to obtain: (1) pleasing esthetics, (2) stable dentures, and (3) least possible damage to the teeth and tissues.

These basic treatment necessities are carried through most successfully when the appliances are kept simple and progressive, when the case progresses rapidly with adequate forces used, and above all, when we receive excellent patient cooperation.

Fourth and Pike Bldg.

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Dr. R. H. W. Strang

I do not hesitate to pass personal judgment that Dr. McCulloch is a most expert and outstanding orthodontist; however, I cannot help but differ with the essayist in his statement of what a Class II malocclusion may be. I firmly believe that the position of the mandible and its superimposed denture designates Class II and Class III from Class I. True, we may find borderline cases that may be classified either way but it seems to me that the basic principle for classification should be located in the growth pattern of the bones rather than in the occlusion of the teeth.

From research reports it seems questionable whether any tooth movement can be held responsible for added growth in the bone extraneous to the alveolar process. Camouflaging deformities seems to be one of the prerequisites of our specialty. If natural growth then adds to our efforts, we are just fortunate.

I certainly agree with the essayist in his emphasizing the fact that we are wise not to attempt to improve certain cases in which errors of occlusion and esthetics are of minor degree. Also that it is essential to consider carefully deficiency in growth posterior to the first molars as well as anterior to them. Extraction of maxillary second molars, where third molars are present, is very practical in certain cases. On the other hand, I believe it is a mistake to extract second mandibular molars as a treatment procedure because of their importance as anchorage auxiliaries in eliminating excessive overbite and maintaining the correction subsequent to treatment.

Dr. McCulloch's paper exhibits painstaking preparation and expert treatment procedures. It warrants careful study when published.

Dr. George Hahn

You have just listened to an excellent paper in which Dr. McCulloch, in a very able manner, has presented the modern concept of diagnosis and treatment of Class II malocclusions. To expect all of us to agree fully with what the author presented would be incredible, although I am sure that it will be more in tune with the thinking of the younger men in the profession than it will with those of us who have had the opportunity of observing our successes and our failures over a long period of years. Because I do not subscribe fully to all that is offered in the new philosophy of orthodontic diagnosis and treatment planning I am labeled by some of my contemporaries as an antiquated orthodontist. Be that as is may, it is from such a perch that I will briefly discuss this paper.

I like Dr. McCulloch's statement, and I quote, "The lateral headfilm

and resulting tracing has proven to be a very important aid in diagnosis. Possibly too much emphasis is placed on lateral headfilm tracings. Maybe we are looking at lineal profiles with angles, degrees and millimeters too much while forgetting about the patient as a real person". At the moment so much emphasis is being placed on the forty-five (at the time this is written) methods of diagnosis by geometrical formulae that the value of a little horse sense in treatment planning is largely overlooked. Someone has well said that any of these analyses at best can provide only a generalized guide and can all too easily lead the unwary astray.

There is one question that we could afford a little time to pray over. Are we treating to develop a preconceived facial pattern for a teenager or should we not be giving some thought to the health, stability and longevity of the human dentition?

After all it isn't so much the anatomy of the face that makes a person attractive. It's the soul of the man that shines through. Give almost any normal human being of mature age a satisfactory occlusion with reasonable prospects that it will be buried with him and you don't need to worry too much about the facial pattern. Look about you.

The face and dentition of the child because of its inherited characteristics and the fact that it is an ever-changing and growing and developing part of the human body should not automatically and with finality be subjected to predetermination by geometric analysis, which, as used by many present day orthodontists, disregards the individual as such in favor of the average. Fortunately Dr. McCulloch has repeatedly called attention to this in his paper.

Dr. McCulloch has discussed at considerable length the chin button and its place in the human face with special attention as to when and in which cases orthodontic treatment should be directed toward its development. Unless one is absolutely sure of his ground it is dangerous to overemphasize this one feature in the formative period. In many individuals the normal development of the so-called chin button is coincidental with maturity. If you want your patient at thirty-five to look as though a mule had kicked him in the face at six years of age go ahead and deliberately build a chin button.

I cannot fully agree with Dr. McCulloch's statement, quote, "If we are concerned about arch length in the mandibular arch and the case is slightly crowded or a tooth is partially blocked don't wishfully think that the lower anteriors can be placed a little forward or the arch expanded without eventual collapse". Almost any orthodontist with sufficient years of practice behind him to have observed his patients grow to maturity can point with justifiable pride to such cases treated before the extraction era in which arch length was increased and a reasonable amount of expansion was obtained and the end result was permanently satisfactory. However, to stimulate this growth or development, or whatever one chooses to call it, it is almost essential that treatment be first instituted before the completion of the twelve year old dentition.

It will be interesting to those of you who are still able to say "aye" when the roll is called twenty years from now to revaluate the results of what at the moment appears to completely satisfy the requirements of modern orthodontics.

Dr. Howard M. Lang

The paper just presented by Dr.

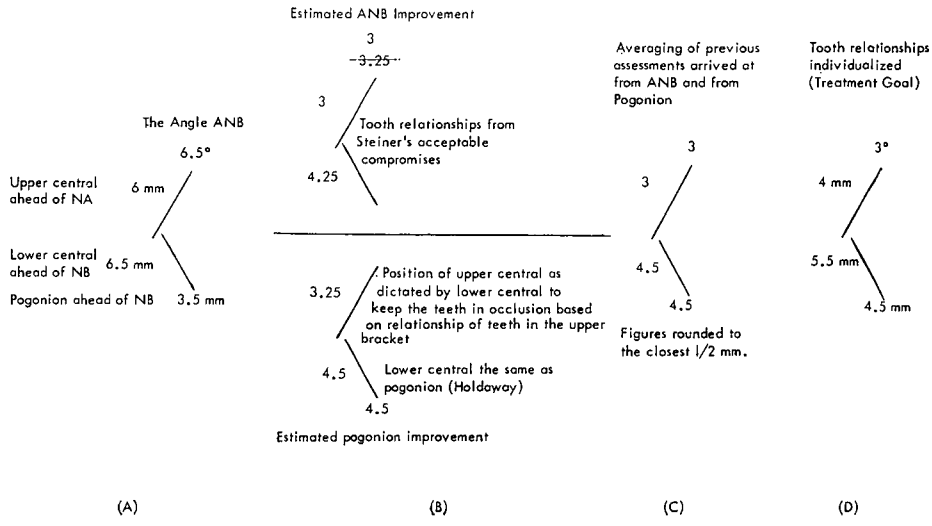

Fig. 1

McCulloch has shown admirably how teeth were moved from extreme positions of malocclusion to most favorable relationships of balance with each other and to their bony structures with tissue harmony. In examining the cephalometric tracing of case (J.H.) #547, you find a very good facial pattern with good forward growth potential in the lower part of the face of a girl eleven years, three months of age; it is most unlikely that she has reached her full facial maturity.

Your panel of discussers, Dr. Hahn, Dr. Strang and I feel that perhaps this case could have been treated with excellent results without extraction. Whenever you find a symphysis possessing the characteristics of this one shown in the tracing, where pogonion is three mm ahead of the line NB, you can expect additional favorable changes of bone deposition and facial balance as adulthood is reached. With a mandibular plane angle of 27° with Frankfort, or as I have measured it 33° with the line SN, we observe another favorable reading for good mandibular growth potential. This is further verified by the measurement SL (from the Steiner analysis) which is 58 mm, whereas the average length has a reading of 51 mm.

In analyzing this case by applying the Steiner analysis we would arrive at the treatment goal in the following manner (Fig. 1).

In determining the treatment procedures to arrive at our treatment objective, we must observe what has to be done with the mandibular teeth. Thus we shall use the procedure from the Steiner analysis as shown below (Table I).

TABLE I
Lower Arch

Increases total arch length +	Decreases total arch length —	
	2	Arch length discrepancy
0	0	Possible expansion
	2	Repositioning $\overline{1}$ from 6.5 to 5.5
1	0	Repositioning $\overline{6}$ by uprighting
0	0	E Space
	4	Cl II elastic pull
0	0	Extraction
	—7	Net arch length

If Class II elastics were not used there would be only three mm of arch length to be gained in the lower arch. Surely with the good results you have shown, you could have gained this much arch length discrepancy and held it. Therefore, with good treatment procedures, extraction in our opinion was not necessary.

In the analysis of this case (Table I) we planned on moving each molar distally one-half mm but, I am certain, with Class III elastics as used in anchorage preparation we could increase this to the amount required; or by expanding sufficiently to pick up one mm of arch length we could lessen the amount of distal movement. In Figure I D, our treatment goal relationship of the lower central to pogonion is one mm ahead of the pogonion measurement. As Holdaway points out, in favorable growth patterns a difference of two mm is acceptable; thus by moving this tooth one mm forward we have increased arch length by two mm. As you see, there are numerous possibilities of getting the lower teeth into acceptable alignment with their bony structures. By "setting up" sufficient anchorage the maxillary protrusion could be overcome in the usual manner; or one could properly position the mandibular teeth and then, by using a Kloehn type face bow, move the maxillary teeth distally to their correct relationships with their opponents.

Many of us have observed that a slightly protrusive denture in a young adult will not appear as such when growth changes occur and facial maturity has been reached. A plea for caution in extraction of teeth in this age group is indicated. This young girl's face, we feel, is now too flat or concave. If you will draw a line from the anterior portion of the fleshy chin to the anterior portion of the upper lip and extend it upwards until it reaches the line SN, as Holdaway advocates, you will see that most of the nose appears ahead of the line. For a well-balanced face of a young adult I would like to see this line split the nose. In other words, there should be as much nose behind the line as there is in front of it. Using Holdaway's angular measurement of this line to SN we find a reading of 76°. When comparing this with the angle SNB, 82°, we have a difference of 6°, or this facial line with the NB line forms an angle of 6°. Dr. Holdaway states that favorable differences range from 6° to 9°. Thus from this assessment we also find the face on the concave side. Therefore we feel that extraction was not indicated cephalometrically.

In the paper Dr. McCulloch pointed out nicely the important diagnostic relationship that the lower second molar has to the first molar in determining whether there will be sufficient arch length after its eruption to accommodate all teeth without crowding. If the second molar is in a position where it is partially locked under the height of contour of the first molar, there will undoubtedly be considerable mesial drift of the teeth anterior to it unless proper steps are taken to minimize it.

In the mixed dentition stage at the loss of the lower second deciduous molars, the first molars need not be allowed to drift appreciably forward to crowd the teeth anteriorly. Arch length can be saved to allow a slightly crowded condition to be unravelled by keeping the molars where they are, or by moving mesially-inclined teeth distally. You will observe a mesial drift of 1.7 mm of each lower molar, as Dr. Nance pointed out, when the mesial buccal cusp of the upper first molar is mesial to its normal functioning relationship, i.e., mesial to the buccal groove of the lower first molar. This condition oc-

curs when the upper second deciduous molar is narrow mesiodistally. The first molar therefore erupts forward of its normal functioning position and must be moved distally by extraoral force if lower arch length is a problem. When the molars are properly locked in occlusion, I have observed less mesial drift of these teeth with some lingual movement of the lower anteriors. Thus pogonion appears to be more prominent, just as it did in these cases of Dr. McCulloch's where he has moved the anterior teeth bodily lingually.

When there is a question of holding the arch length after treatment, I would recommend a cemented lower cuspid to cuspid retainer to be worn many years along with a lower Hawley retainer to assure more favorable stability of the denture.

Dr. McCulloch stressed the importance of maintaining arch form and cuspid width — a most important point. However, in extraction cases cuspids may appear a little wider than the original malocclusion due to the movement of these teeth distally into a wider area or "channel" of bone. This slightly greater width, I have found, can be maintained very satisfactorily.

Thank you again Dr. McCulloch for your paper showing excellent tooth movement and orthodontic results. All have enjoyed hearing it and will look forward to studying your article in detail at their leisure.

Dr. McCulloch

It has been brought out in the discussion of this paper that Class II nonextraction malocclusions were not specifically mentioned nor used in any of the illustrations. The omission of nonextraction cases is not due to the lack of suitable material, but to the more pronounced facial changes that can be shown in many of the severe Class II malocclusions in which the removal of teeth is necessary. The amount of ANB angle decrease can be shown as well in the nonextraction Class II as in the extraction Class II malocclusions, but the lingual positioning of point B can be carried to greater degree in the extracted malocclusion cases, thus showing more of an over-all chin button increase.

The necessity of removing the first bicuspids in case #547 is questioned. If I were now treating this case or similar cases, I would apply a lingual tipping force on the mandibular incisors rather than bodily moving them lingually over basal bone. In these cases with an already adequate chin button, we would expect less chin button change by not disturbing point B, and that can be done by careful tipping control of the mandibular incisors.