Relating The Mandible To The Maxilla In Treatment Of Class II Malocclusion

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The problem of making the upper and lower teeth fit together properly is one which has interested orthodontists for many years. Yet our clinical efforts, generally speaking, amount to little more than establishing a cusp and groove relation of the teeth. Considering the fact that more anatomic parts than teeth are involved this is substantially less than the best. In Class III treatment, seeking a good cusp and groove relation is apt to result in a fairly accurate jaw relation but in Class II treatment (and even in Class I) the mandible may be displaced slightly forward on one or both sides. The displacement is often too small to be detected using lateral head x-rays and it is likely to be overlooked clinically because muscles adapt to the new position. Sometimes this adaptation is temporary and the result is relapse of molar relation or dual bite. Other times it is quite permanent resulting in a convenience or protrusive bite which may or may not cause trouble later. There are times when these troubles are beyond the operator's control but often they can be avoided by having a little more respect for centric relation. If the majority of Class II malocclusions are to be thoroughly corrected, it is necessary not only to have a rather exacting objective, but also to check frequently during treatment to see that it is being attained.

It is the purpose of this paper to present what I feel should be the objective in Class II treatments as far as jaw relation is concerned, and to suggest several methods for attaining it.

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In order to achieve the best in jaw relation it is necessary to consider the position which the mandible assumes when vigorous muscle forces are being applied, for example, during the act of swallowing or during the final phase of the closing stroke in mastication. To illustrate this point, consider the recent work of Paul Hayes[1] on surgical correction of Class III malocclusion. Numerous investigators have observed that the mandibular rest position and the occlusal position does not always coincide (Fig. 1 A). There may be several millimeters difference between the two positions in some cases while in others there is little or no translational movement from rest to closure. Dr. Hayes has found this analysis useful before surgical correction of Class III malocclusions. It has been a common observation that many patients develop an open bite after such an operation and until recently no satisfactory explanation has been offered. Hayes observed that open bite develops in the patients whose rest position and occlusal position differ considerably while it does not occur in the cases where the two positions coincide. When the teeth are wired together and healing is allowed to take place with the condylar segments in rest position (Fig. 1B) away from the support of the articular eminence, an open bite will result because, when fixation is removed and function begins, the condyle seeks the support of the fossal slope and as a result the mandible assumes a more posterior

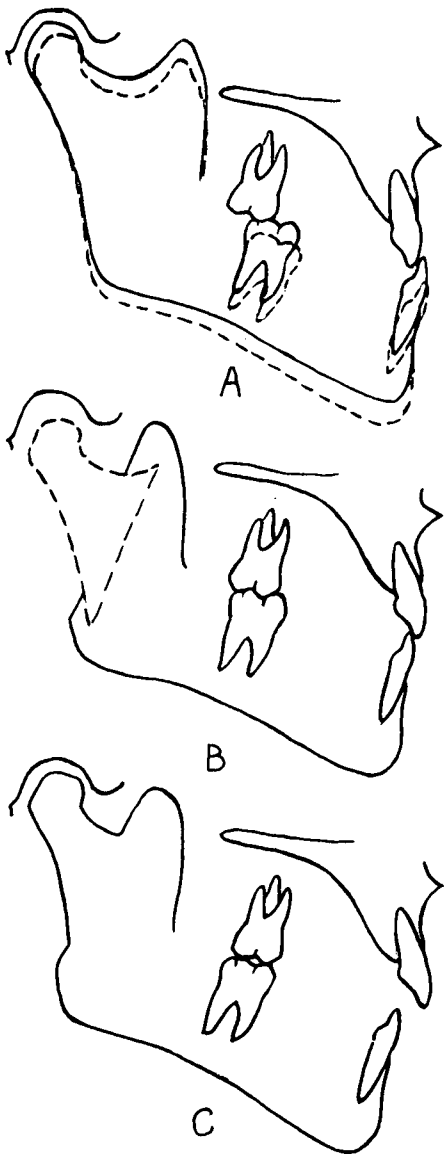


Fig. 1. Open bite develops after surgical correction of Class III malocclusion when healing takes place with condylar segment in rest position. From Dr. Paul Hayes.

position (Fig. 1 C). Dr. Hayes is now devising a method of securing the condylar segment in functional position, while healing takes place, in order to prevent open bite in such cases.

This observation illustrates another point which is important in relating the jaws. The condyles must have the support of the articular eminence if the mandible is to function normally. This is not meant to imply that the temporomandibular joint bears heavy stress. Robinson[2] has schematically analyzed the forces acting on the joint and this analysis has been expanded by Page.[3] Page noted that the resultant force of the closing muscles is approximately parallel to the fossal slope and because of this he believes that only moderate stress would be directed against the fossal bone no matter how ponderous the force that operates against the teeth. Many believe that the temporomandibular ligament assumes a substantial share of the stress in this area. Therefore, when we say that condyles must have a bearing point, we simply mean that both condyles must be against the anterior slope of the fossa when teeth are in occlusion if jaws are to be properly related.

Next it is important to consider the extent to which the mandible is retruded in normal function. There are a number of observations which indicate that the mandible reaches maximum retrusion, or nearly so, in normal function. Consider, for example, the cinefluorographic studies of Jankelson.[4] In speaking of the relationship between centric relation and swallowing he says, "The vigorous retrusion of the tongue explains why the mandible was inevitably carried into maximum retrusion during involuntary deglutition when the path of closure was free of occlusal interference and clarifies the common observation that in those cases where the mandible is prevented by cuspal interference from attaining centric occlusion, it goes to that position after interference is removed."

Sleichter's[5] study of seventy-one dry skulls and thirty-three living persons

shows that the amount of retrusion from centric is very limited. Less than one fourth cusp retrusion was the rule on the living subjects while it was only slightly more on the dry skulls.

Posselt[6] has shown that if extreme movements of the mandible are recorded graphically in the median plane a characteristic figure is obtained (Fig. 2). In addition, these boundary movements can be repeated exactly, a factor which would be of immense value in relating the jaws if the centric position were always on the border movement path. There is considerable controversy over this point, however. McCullum and Granger, for example, would favor point D while Beyron[7] and Posselt and many others would favor a position about 1 millimeter anteriorly. The important thing to remember is that the centric position is very close to the most retruded position.

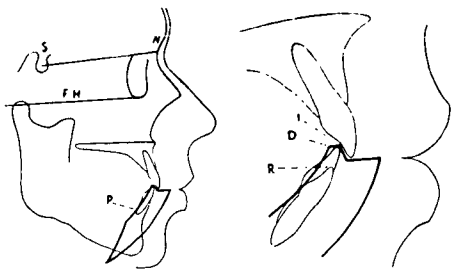


Fig. 2. Border movements of the mandible. From Beyron.

Another study of interest in this connection was made by the author. It has been observed that about eighty per cent of adults can retrude slightly beyond the intercuspal position. In an effort to determine whether this was true for children, accurate records were kept on one hundred seventy children between the ages of five and fifteen years. Seventy of the cases examined were untreated Class I malocclusions and one hundred were untreated Class II malocclusions. The average age of both groups was twelve years. In checking the retruded position the patient was seated upright in the chair and instructed to open and close as the mandible was held in retrusion. Care was taken not to have the patient exceed hinge range which usually means not more than one half to three fourths inch opening at the incisors. It was found that seventy-three per cent of the Class II malocclusions and seventy-six per cent of the Class I cases could not retrude beyond intercuspal position. Those cases in which retrusion was possible could usually retrude less than one fourth of a cusp.

Even though most studies seem to indicate that there is a preferred mandibular position during function and that this position is very close to the most retruded position, it is conceivable that a range of anteroposterior positions is possible if the articular eminence is favorably formed. For example, the condyle could be supported in several positions on a fossal slope such as that illustrated in Figure 3 A while only one position would be possible with the slope illustrated in Figure 3 B. But recognizing that a range of positions is possible in some individuals, one should consider how function might differ in protrusion and retrusion.

Perry[8] has observed in an electromyographic study of the masseter and temporal muscles that the working side temporal initiates the closing movement in normal occlusions while in some Class II, Division I malocclusions the masseter was the first to give

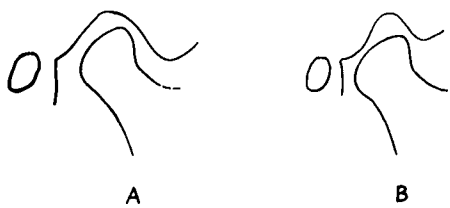


Fig. 3.

recordable action potentials. His explanation of this seems perfectly logical when he states, "Perhaps the steeper curves of Spee and potentially retrognathic mandibles might necessitate a forward thrust of the mandible to obtain a more functional occlusion." Thus it seems probable that at least one characteristic of a protrusive bite is that closing muscles are contracting in abnormal sequence. Very probably the external pterygoid is overactive too.

From the clinical standpoint the protrusive bite is generally believed to be undesirable. Joint problems are quite common among adults with this relation. The only trouble is that this type of relation is not very clearly defined and about the only way to diagnose it accurately is to place flat splints over the occlusals of the upper or lower teeth or take teeth out of occlusion for several hours with a bite plate. If the mandible settles back to a more posterior position, undoubtedly it should function there.

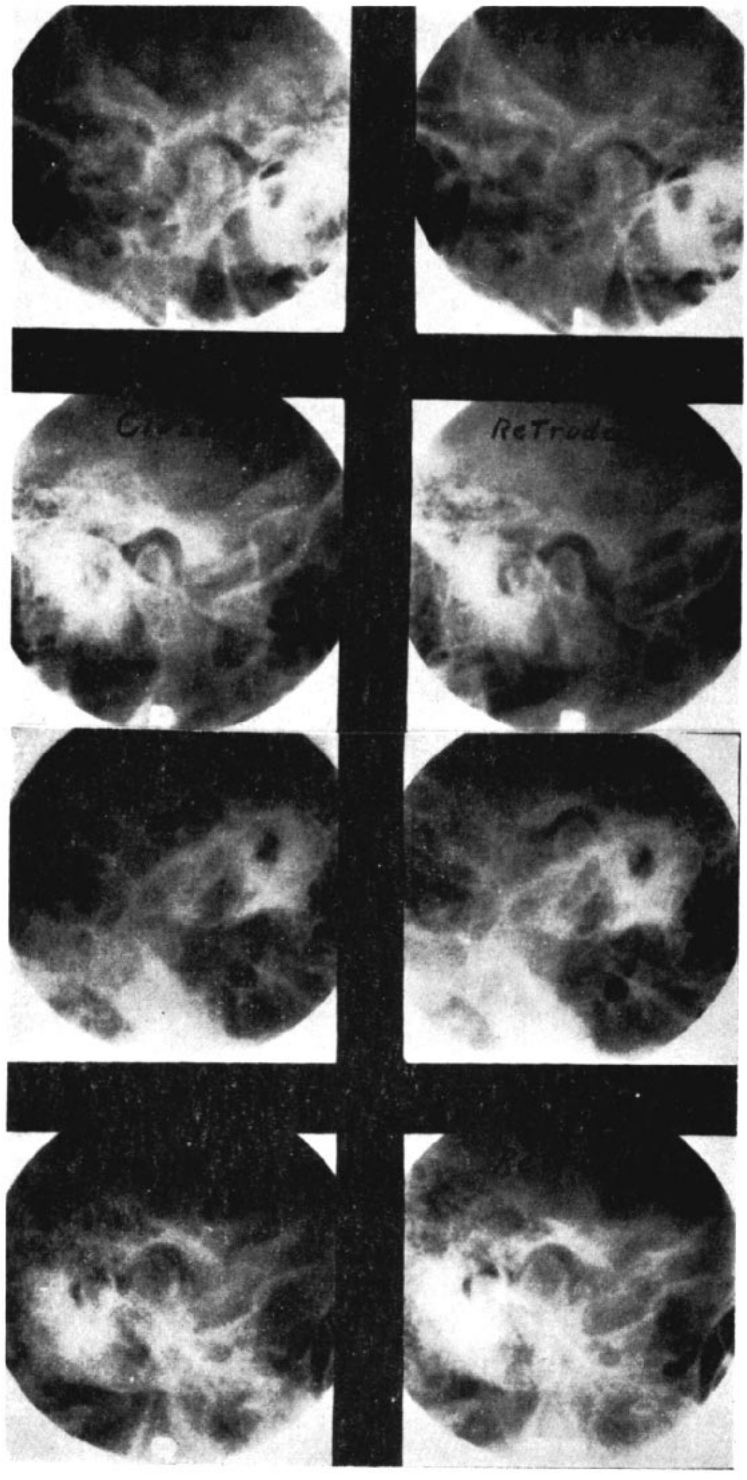
The rest position analysis is not always accurate in such cases. Rest position may be stable from an electromyographic standpoint but for clinical purposes it cannot always be trusted. To illustrate this, consider the case in Figure 4. This patient had a long history of temporomandibular joint trouble; she could retrude her mandible about one half cusp but otherwise had an apparently normal occlusion. A rest position headplate was taken before insertion of a removable occlusal splint which allowed her to bite in a more retruded position. The solid line shows this position. After eight hours of wearing the splint another rest position headplate was taken. This position is shown by the dotted line. Since the joint pain disappeared whenever the removable splint was worn, it seems logical to conclude that the more retruded rest position was the true one. One weakness of the rest

Fig. 4.

position analysis is that a protrusive bite is not always detected.

As previously implied, the retruded position may not always be reliable either. There are some who contend that condyles will be displaced posteriorly if jaws are related in this manner. The amount of displacement possible is said to depend on how much space is available posterior to the condyle when the mandible is in centric relation. Others contend that retruding the mandible places the condyles in correct position, that there is an upward and forward movement against the fossal slope because the temporomandibular ligament guides them to that position.

In order to help settle this argument temporomandibular joint x-rays were taken of three groups of patients. The technique for taking the x-rays is similar to that described by Updegrave[9 10] except that the patient sits upright and a head positioner of the author's design is used. As many as six x-rays can be obtained on one eight by ten film without moving the head. Naturally there is some distortion because of the angle at which they are taken but, since the head does not move, the distortion would be the same in each picture. A retruded wax bite is



taken first. With this in place the patient is positioned for the x-ray of the left joint. The wax bite is then removed and the teeth brought to natural closure for the next picture. This procedure is repeated for the right side making four pictures for each patient.

The first group consisted of ten patients whose mandible could not be retruded beyond the intercuspal position. As might be expected, no difference was observed between the retruded and closed position (Figs. 5 and 6), but there was often a large space posterior to the condyle when the mandible was in retrusion indicating that the temporomandibular ligament probably does limit the posterior movement. Naturally, the old clinical practice of retruding the mandible is ideal for relating the jaws in this type of case and the hinge axis registration is most accurate when the articulator is used.

In the next group were ten cases whose mandibles could be retruded beyond intercuspal position. All were adults with excellent occlusions and exceptionally healthy mouths. No tendency for the condyles to move upward or upward and forward against the articular eminence was observed in any of their x-rays. Instead, one condyle showed no measurable change in position while the other moved away from the eminence (Figs. 7 and 8). The retrusion in all of the cases was predominantly unilateral and the amount the condyle moved back averaged about a millimeter. It seems that, while these patients do not function in what is commonly regarded as the most retruded position, the condyles are on their most retruded bearing points when teeth are in occlusion. The fact that the condyle moves backward away from the eminence rather than deeper into the fossa indicates that this is true. In this respect they are similar to those whose mandibles cannot be retruded beyond intercuspal position.

It would seem logical to regard this retruded position as abnormal because the mandible is in a non-functional position, at least on one side. Further proof of this is the observation that heavy biting force is not possible when the mandible is in this position. By placing the fingers at the angle of the mandible as the patient tries to exert biting pressure it will be observed that the masseter muscles do not contract vigorously until the teeth slide forward into occlusion. In addition to this, if teeth are taken out of occlusion temporarily with a bite plate, the mandible does not seek a more posterior position. This suggests that the occlusal position is correct and that no cuspal interferences are present. It seems reasonable to assume that the rest position analysis would be accurate for such cases providing it is not used with an articulator.

There are two main difficulties in using a rest position bite with the articulator. There is no way to locate an accurate center of rotation in the condyle and there is the possibility that movement from rest to closure will be translational. On the other hand, this type of case presents quite a problem for those who use the hinge axis registration because condyles are likely to be displaced posteriorly away from the fossal slope. The split hinge articulator seems to be a definite improvement over the rigid symmetrical types in common use but the possibility of dis-

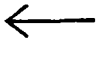
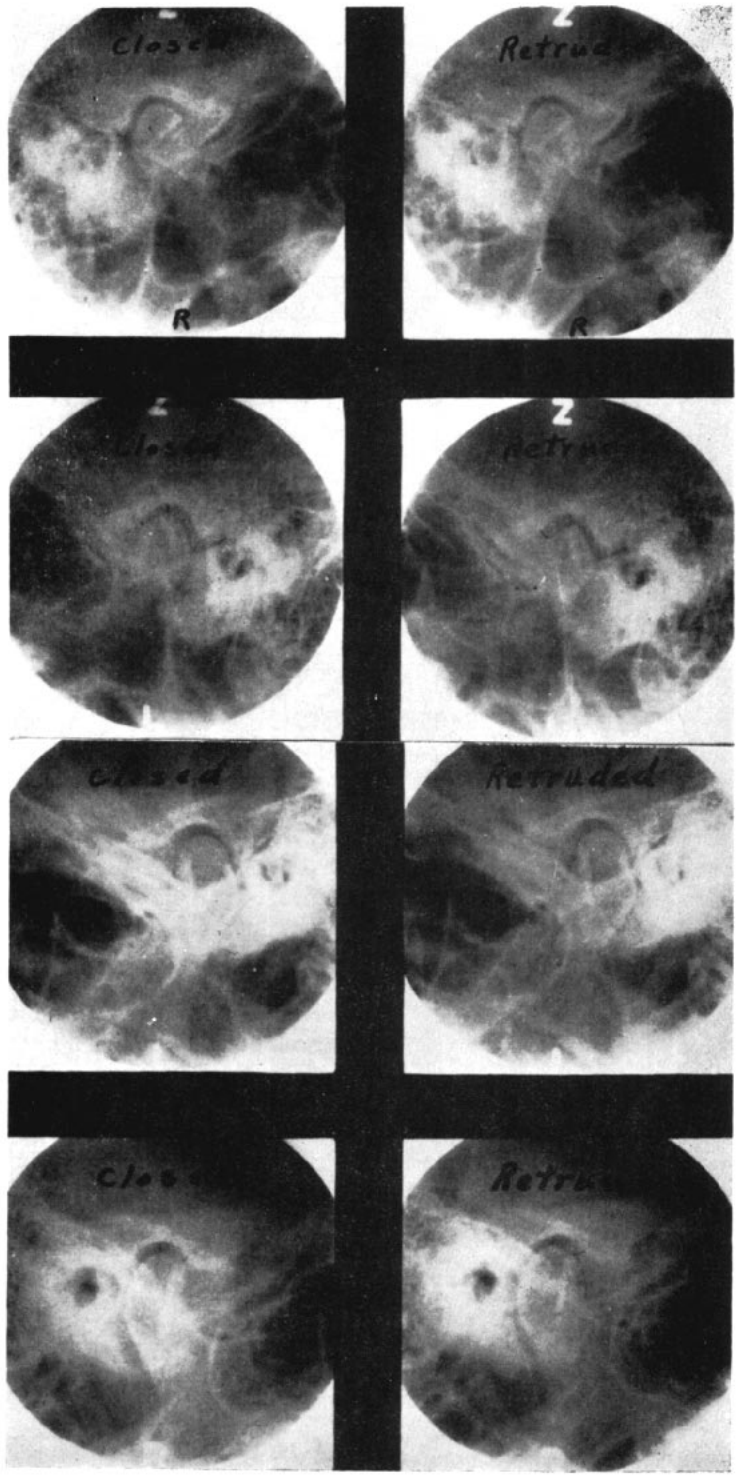


Fig. 5. Above, Treated Class II malocclusion. The patient cannot retrude beyond intercuspal position. There is no change in condylar positions when mandible is retruded. Fig. 6, Below, normal occlusion. The patient cannot retrude beyond intercuspal position; there is no change is condylar positions when the mandible is retruded.



placing condyles posteriorly still exists. It seems probable that this abnormal retrusion is being obtained frequently in restorative dentistry by those who use conventional articulators with retruded wax bites and hinge axis registrations, but it is doubtful that such a relationship could ever be permanently established by orthodontic means. There is also clinical evidence to support this belief. For example, occlusal grinding has been performed on a number of such patients to eliminate the forward slide and the result has not remained stable. Shifting of teeth soon occurs so that retrusion is once again possible. In addition to this, it has been my experience that some cases cannot be treated to what is commonly regarded as the most retruded relation even though mandibular growth is good and great care is used in treatment.

Displacing condyles posteriorly should be of little concern in orthodontics, particularly in Class II treatment. Even in Class III treatment it is doubtful that a posterior displacement can be permanently established. Clinical support for this statement is the fact that orthodontists have been forcing the mandible into maximum retrusion for years in the treatment of Class III malocclusion without harmful effects. In fact there is less joint trouble in these patients than either the Class I or Class II.

The third group of cases consisted of ten treated Class II malocclusions. A different type of retrusion was found in most of these patients even though cuspal relations appeared to be similar to the normals when the mandible was retruded. In eight of the ten cases the condyles moved deeper into the fossae in an upward and backward direction. The movement was bilateral in eight cases but not always equal on each side. An example of this type of retrusion is shown in Figure 9. This type of patient, unlike the normal occlusions, can often exert heavy biting pressure while the mandible is retruded and, if the teeth are taken out of occlusion with a bite plate, the mandible will seek a more posterior position. It seems reasonable to conclude, therefore, that such patients do not have a normal bite even though cuspal relations are good. This protrusive relation is sometimes found in patients who have never been treated orthodontically but it is doubtful that such a relation should be considered normal. This type of case is shown in Figure 4.

To illustrate further that there is considerable variation in condylar movement when the mandible is retruded manually Figure 10 shows another case in which a considerable amount of retrusion was possible after treatment. X-rays (Fig. 11) show that both condyles move deeper into the fossae but the left (upper right photo) also moves away from the eminence.

When considering how far the mandible should be retruded as teeth come into occlusion, it seems important to remember that the majority of normal occlusions and the majority of untreated malocclusions have one thing in common. The mandibular condyle cannot be forced upward deeper into the fossa. When retrusion beyond intercuspal position is possible, the condyle merely moves backward away from the

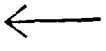


Fig. 7. Above, Normal occlusion. The patient can retrude beyond intercuspal position; left condyle moves away from the support of the articular eminence when the mandible is retruded. Fig. 8, Below, normal occlusion. The patient can retrude beyond intercuspal position; right condyle moves away from the support of the articular eminence when the mandible is retruded.

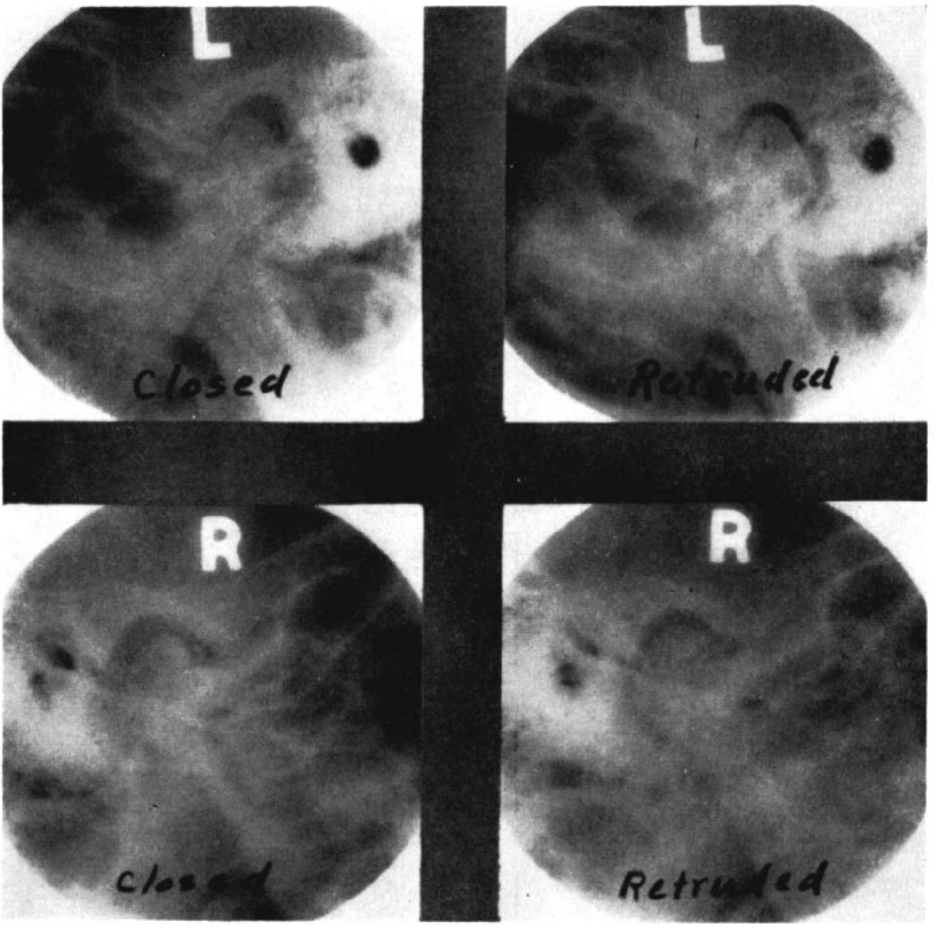


Fig. 9. A treated Class II malocclusion. The patient can retrude beyond intercuspal position; both condyles move deeper into fossae when the mandible is retruded.

Fig. 10. Treated Class II malocclusion.

articular eminence, usually on one side only. It seems safe to say that when teeth are in occlusion the condyles should be supported on their most retruded bearing points on the fossal slope. The only difficulty is that neither the rest position nor manual retrusion is completely reliable in placing the mandible in this position.

With this as an objective, however, it is possible to use the retruded position as a clinical guide providing its limitations are recognized. It has the advantage of being accurate for the majority of patients of orthodontic age and there is also considerable merit

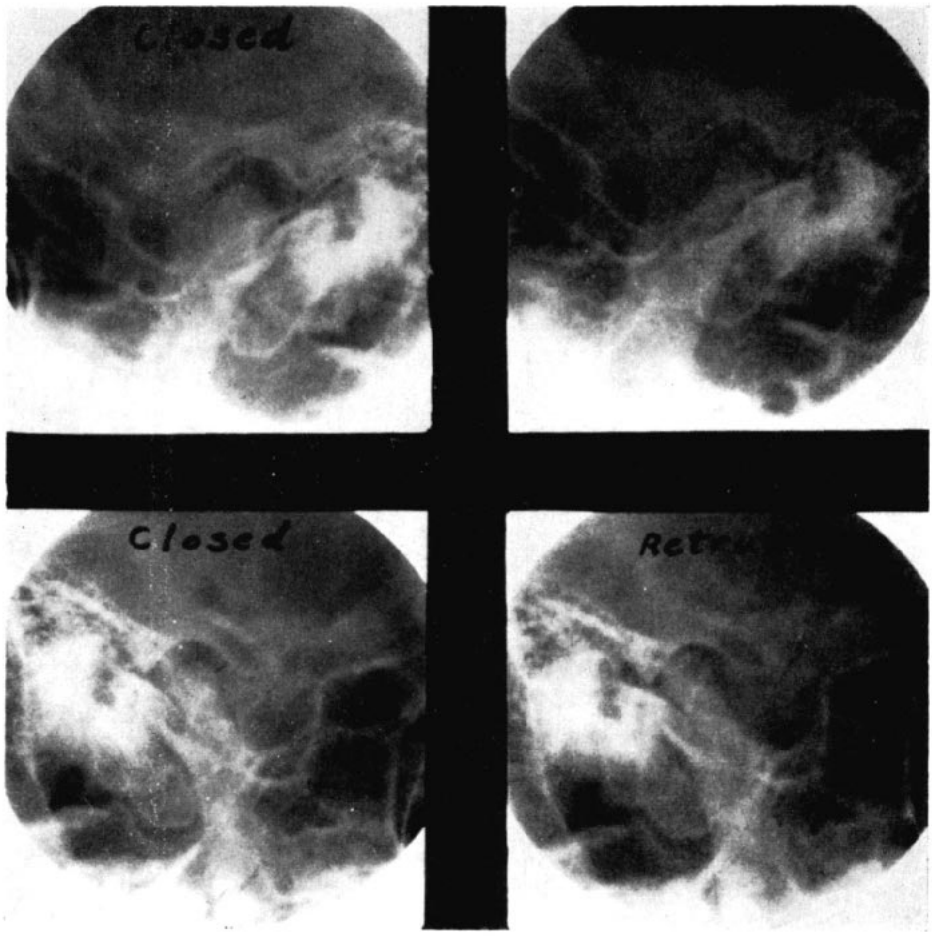


Fig. 11. The treated malocclusion shown in Fig. 10. The patient can retrude beyond intercuspal position; boh condyles move deeper into fossae and the left condyle also moves off the articular eminence. (Upper right photo)

in having teeth in contact when jaw relation is checked rather than several millimeters apart as they are in rest position. Another advantage is the ease with which buccolingual discrepancies are observed. Buccolingual positions of teeth affect the anteroposterior position of the mandible so it is important that they be observed. In Figure 12 is a case in which the mandible is displaced because of a unilateral buccolingual discrepancy. This type of faulty relation is rather common but it is likely to be overlooked unless the retruded position is used.

If the retruded position is to be used as a guide, it should be realized that only about seventy per cent of the cases can be treated to the retruded relation, and this requires more than an average amount of effort. The remaining thirty per cent will consist of some cases which have normal jaw relation even though slight retrusion is possible, some which are not good after treatment but which may improve as a result of good mandibular growth and others which will remain less than ideal. If the mandible can be retruded beyond the natural closing position

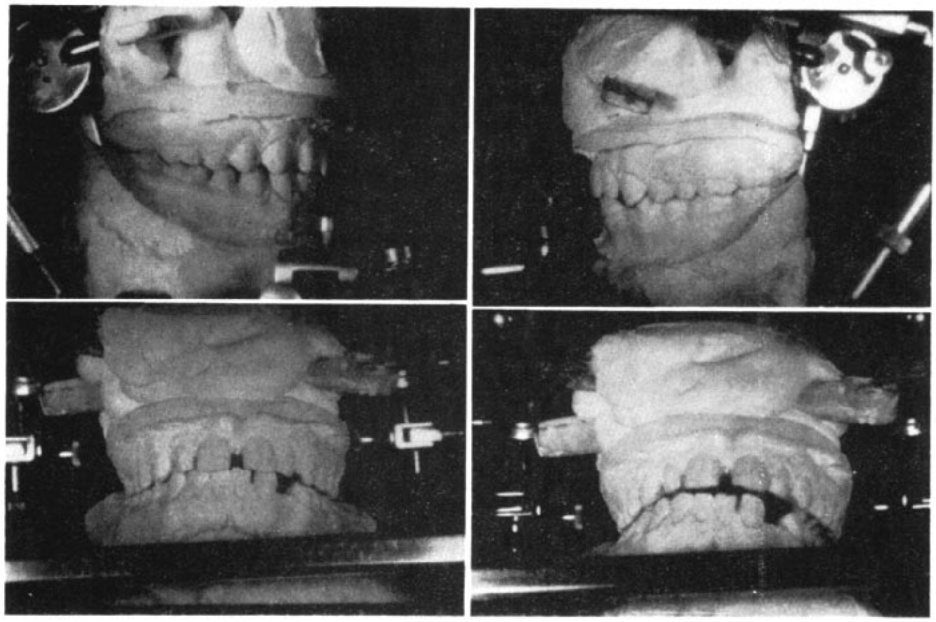


Fig. 12. Faulty buccolingual relation between upper and lower arches is seen when the mandible is retruded, lower right.

and we are interested in determining whether or not the relation is normal, it would seem advisable to make several additional observations. First, the amount of retrusion possible should be very slight. A great amount of retrusion would lead one to suspect that jaw relation is faulty. Second, a small amount of midline deviation is often normal when the mandible is retruded but, if the deviation is great and the posterior teeth are not related well buccolingually, the relation is certainly not normal. Third, if both masseter muscles contract vigorously when the mandible is retruded, chances are good that the condyles are supported on the articular eminence and that the mandible should function in this retruded position. Fourth, it would seem that the direction of condyle displacement as seen in temporomandibular joint x-rays would be helpful. Relation is probably normal if one condyle merely moves off the eminence rather than deeper into the fossa.

Suggestions for Attaining Correct Jaw Relation in Class II Treatment

These suggestions are offered realizing that there may be other methods of obtaining the same results particularly in cases where patient cooperation is good. The important thing, however, is to have the objective in mind and to check at frequent intervals during treatment to make sure it is being attained. Generally speaking, these suggestions fall into three main categories: minimum use of Class II elastics, sectional treatment rather than en masse movement of teeth and coordination of arch widths.

First consider the non-extraction Class II treatment. In Figure 13 are the records of a boy eleven years of age. Notice that second molars have already erupted. This case was treated without Class II elastics except for three weeks toward the end of treatment when they were worn on one side only. In Figure 14 are the casts

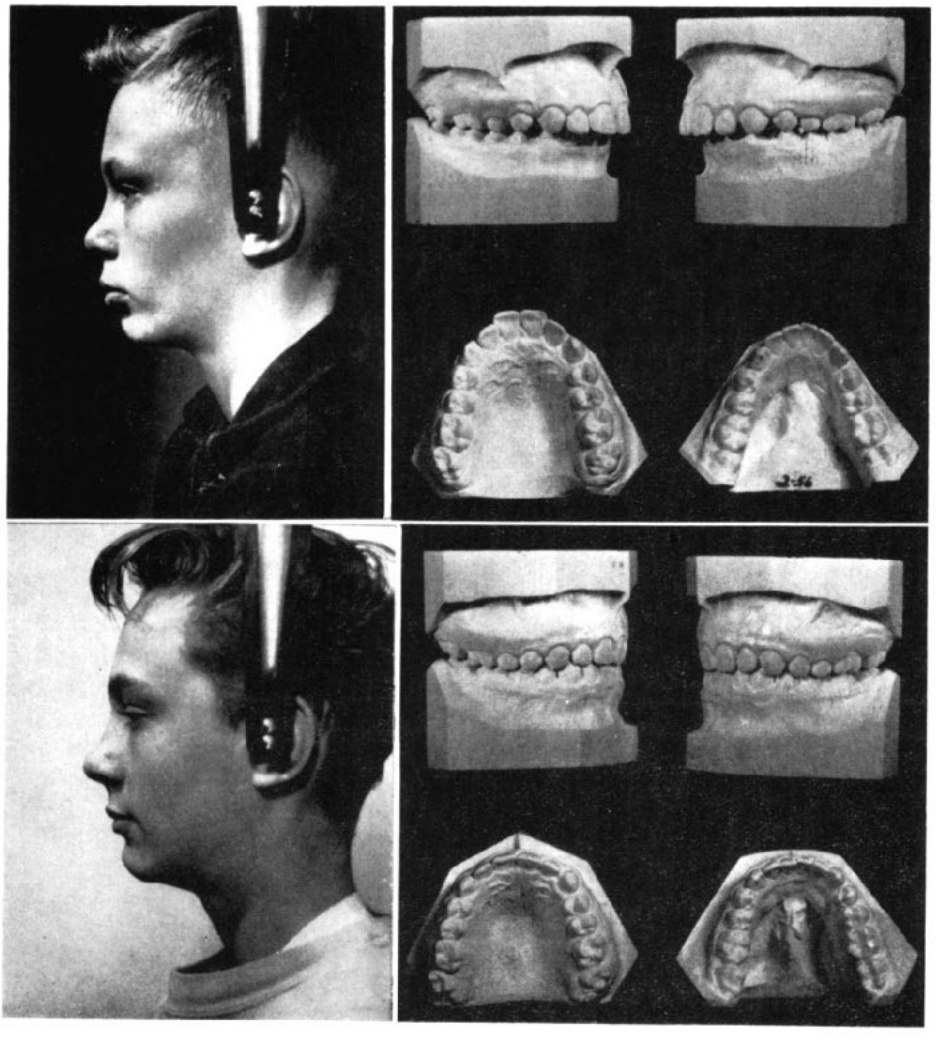


Fig. 13. Above, before treatment. Fig. 14, below, six months after retention.

and photos six months out of retention. This brings up the question of when these cases should be started. It is my belief that most Class II non-extraction cases need not be started before the late mixed dentition period when there are perhaps one or two deciduous teeth remaining. Early mixed dentition treatment with bite plate and headgear is all right if there is no objection to four or five years of care. But most of these cases require full appliance therapy after deciduous teeth have been lost if satisfactory results are to be obtained.

In correcting a case of this kind, the upper first molars are banded and the headgear is worn until a Class I molar relation is established or until the headgear falls too far below the upper incisors (Fig. 15 top). The lower arch is also being leveled during this time with an edgewise arch. Particular attention is given to raising the first bicuspid in relation to the cuspid. After the upper first molar is tipped back, the

upper buccal teeth are banded and an .018 or .020 arch is tied in (Fig. 15 center). This uprights the molar so that the headgear does not fall below the upper incisors. Figure eight ties are used to close spaces and bring the buccal teeth back in Class I relation. By this time the lower arch is leveled and special attention has been given to arch form (Fig. 16). Care is taken to avoid widening across the lower cuspid area but the arch is purposely widened slightly in the first bicuspid area by means of a step-out bend. If the arch is too narrow across this area, cuspal interference will affect the anteroposterior position of the mandible. Conversely, care should be taken not to expand the upper arch or torque the bicuspids and molars buccally. After the buccal teeth are in Class I relation the upper incisors are banded and a space closing arch is used to bring them lingually (Fig. 15 below). The amount of labial torque used in this area varies with the inclination of these teeth. It may be advisable to band the upper incisors before they are brought lingually in order to prevent too much space from developing between them, but they are not tied into the arch until lingual movement is begun.

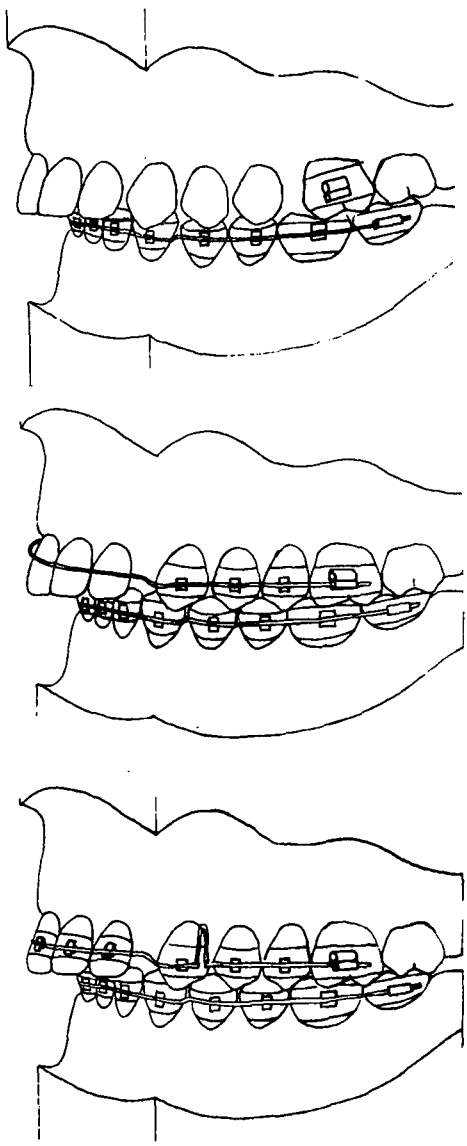


Fig. 15. Treatment of Class II non-extraction cases without intermaxillary elastics. Headgear is applied to the molars throughout treatment.

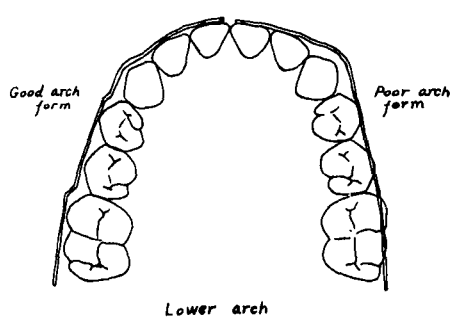


Fig. 16.

This type of treatment is not advocated on any case which has arch length problems or too much fullness around the lips. The operator is at the mercy of patient cooperation if this type of treatment is to be used and he must also be rather patient because some cases treated in this way will require nearly two years of care. But

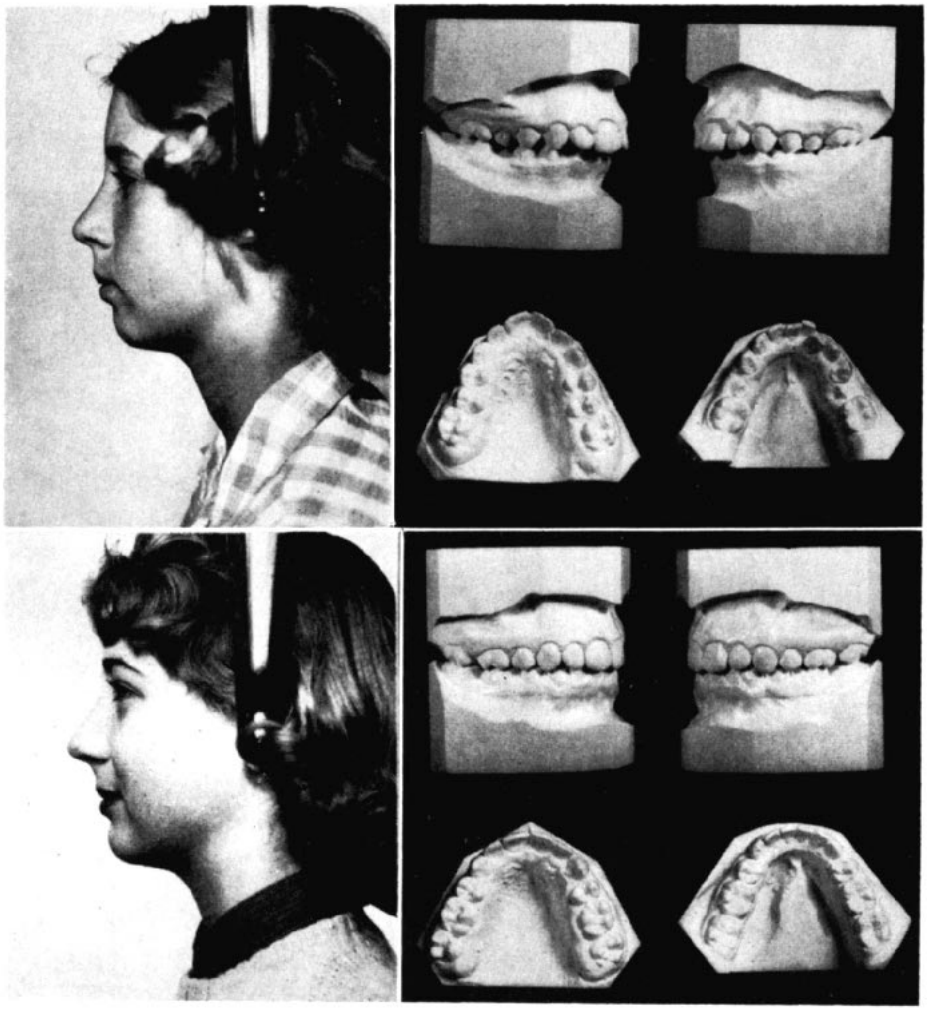


Fig. 17. Above, before treatment. Fig. 18, below, after treatment.

there are advantages in using this method of sectional tooth movement over the conventional Class II elastics and second order bends. There is less danger of displacing the mandible forward and it makes non-extraction cases out of many border-line extraction cases. Even where the lower arch offers sufficient anchorage for the use of Class II elastics, treating the buccal segments first seems to be a good plan because it allows the operator to feel his way, so to speak. If a good relation cannot be established between the upper and lower buccal teeth, it is quite certain that incisors cannot be moved to correct position. Even though this type of treatment may extend over a little longer time the appointments can be shorter so actual treatment time is not increased.

Consider next the treatment of a Class II four bicuspid extraction case. The records of such a case are shown in Fig. 17 and 18. Bands are placed on all teeth except the incisors at the beginning of treatment and space closing is started simultaneously in both arches

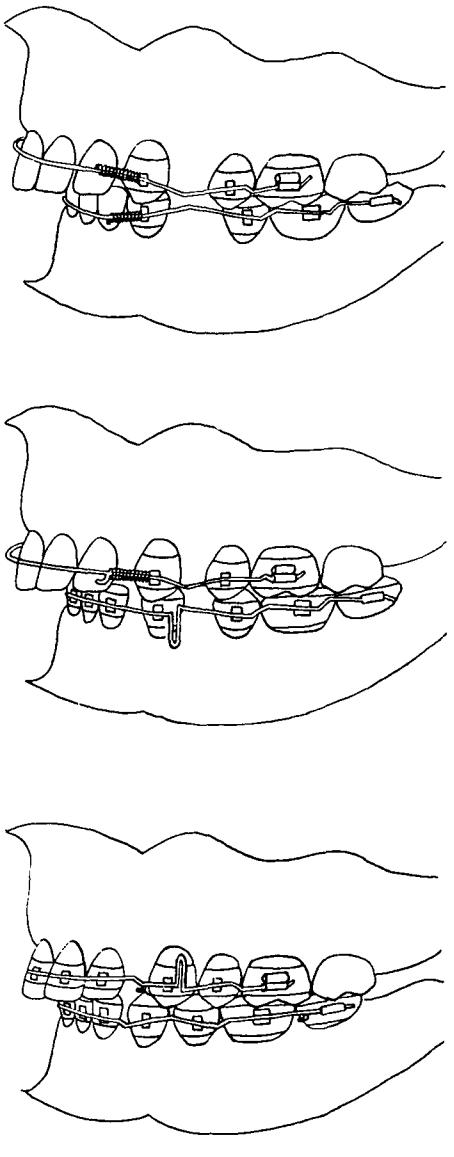


Fig. 19. Steps in treating Class II extraction cases. The headgear is applied to the upper molars throughout treatment. Molar relation is corrected before extraction spaces are closed.

(Fig. 19 top). Upper second molars are not banded unless a crossbite relation exists. A headgear is worn from the beginning of treatment. Notice the bend in both archwires at the site of extraction; this is incorporated in each succeeding archwire as treatment progresses to keep roots parallel. When the lower cuspids are upright, the lower anteriors are banded and a space closing arch inserted as soon as possible Fig. 19 middle. Space closing continues in the upper arch as before. If the molar relation does not show signs of being corrected, a new upper arch is made with stops in front of the molar tubes which allows the arch to stand away from the upper incisors (Fig. 19 middle). Class II elastics are then worn during the day and the headgear at night until the upper first bicuspid space is closed and the buccal teeth are in Class I relation (Fig. 19 below). After the molar relation has been corrected, the upper anteriors are banded and space closing continues in both arches. When ideal arches are placed, special attention is given to coordinating arch widths as in the non-extraction case. Figure 18 shows the completed case. Active treatment was fifteen months. Examination of plaster casts only would indicate that this case is not quite as nicely treated as the extraction case shown in Figure 10. The overbite is a little deeper, the cusp and groove relation is not quite as ideal and the upper incisors are probably a little more upright than some would like; but the jaw relation is very good and from the functional standpoint I believe it is much better off than the other one.

This plan of treating the buccal segments first and correcting the Class II relation before all spaces are closed prevents the mistake of moving the lower cuspids and incisors too far back. For esthetic reasons it may be desirable sometimes to move the lower anterior segment as far posteriorly as possible but this can be accentuated in Class II extraction treatment. Sometimes I think it is necessary to settle for a little less in the way of esthetic improve-

ment to obtain a better relation of upper and lower teeth and jaws. Closing the spaces first and attempting to correct the Class II relation later is more likely to result in failure in the form of incomplete correction of molar relation, relapse of molar relation or protrusive bite.

Cases involving extraction of upper bicuspids only would seem to be less of a problem than either non-extraction or four bicuspid extraction cases but convenience bites are easily produced if attempts are made to move six upper anteriors back using only the bicuspid and molar on each side as anchorage. The headgear is important in this type of treatment and usually it is advisable to place a full appliance in the lower arch. Even though Class II elastics are not applied, the lower appliance is useful in reducing the overbite, correcting slight asymmetries and coordinating the arches buccolingually.

No matter how the Class II malocclusion is handled, it is well to remember that our job in treatment is to move teeth rather than the mandible, to guard against forward displacement rather than encourage it. With help from growth our work is made easier and often a good relation will be obtained in spite of our lack of care. But adequate mandibular growth alone does not always insure good jaw relation. It seems necessary to pay considerable attention to details and vary treatment according to the response if good results are to be obtained in many cases. Sometimes despite our best efforts we must settle for less than an ideal relation and in those cases we can be thankful for adaptable muscles but it does not seem wise to depend too much on this kind of adjustment. It is comforting to have the protection of the proprioceptive system but it does not give us the right to ignore centric relation. If we are going to be fair with our patients we must regard functional efficiency as highly as we do esthetic improvement.

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