



## The Systems of Directional Force

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All orthodontic techniques have individual, basic mechanical characteristics inherent in their force systems. The primary action of most popular techniques result in both *expansion* and *extrusion* of the teeth. Generally our orthodontic goals can only be achieved with a technique which results in either maintaining or *contracting* the denture and in *intruding* certain elements of the denture while maintaining other elements.

The removable appliances with bite planes and finger springs achieve both expansion and extrusion as basic characteristics.

The light wire techniques are capable of contraction but exhibit uncontrollable extrusive and intrusive forces in certain elements of the denture.

Both of these techniques are at a great disadvantage for bodily movement of individual teeth.

The straight wire techniques can achieve contraction, but because of the simultaneous action of first, second, and third order forces and their subsequent reactions, it is impossible to maintain the elements of the denture that are critical for maximum clinical results. These techniques limit one's efficiency, ability, and versatility.

An equally critical analysis of the advanced edgewise technique taught at the

Tweed Foundation reveals that it is unique in its mechanical characteristics. The systems of forces used allow contraction, intrusion and directional control of individual teeth as well as units of teeth. These characteristics give those who master this technique great clinical advantage in maintaining the denture within its environmental dimensions and in achieving orthodontic results that meet their most demanding goals.

In 1965, I, along with members of my study group, began to develop some modifications to the basic Tweed edgewise technique. I named this modification "*The Directional Force Technique*". Our study group seriously studied all the auxiliaries and their effect on the denture. Our goal was to achieve optimal denture repositioning with precise directional force control by utilizing the edgewise bracket, the archwires, and the proper auxiliary forces.

Before Dr. Tweed died he enthusiastically endorsed these modifications and our concept; he encouraged me to continue in my efforts to achieve more precise tooth movements through directionally controlled forces. We both felt that this would increase our ability to achieve the malocclusion correction that had heretofore been beyond our capabilities.

The Directional Force Technique as introduced in 1966 had as one of its unique

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features the immediate retraction of the cuspids distally into the extraction space as leveling and rotation correction was being accomplished. This was done by applying J-hook directionally oriented headgear force individually to each cuspid. It achieved the cuspid movement and simultaneously stopped the mesial migration of the incisors as the malocclusion leveled.

Many orthodontists accepted this one feature of the technique as the only modification and assumed they were treating with the technique if they placed a headgear force against the cuspids. This is certainly not true; the directional force technique is "a group of force systems utilizing directional control to precisely position the teeth in both arches so that they are in optimum harmony with their environment".

The directional force technique has continued to evolve through research and experience and will be described in its present status.

The technique is based on a philosophy and an appliance. The philosophy was conceived originally by Dr. Tweed. The past seventeen years have been spent defining and enhancing this concept.

The appliance is the basic tool for achieving our orthodontic goals. It must have the basic characteristics of simplicity, efficiency and comfort. It must be hygienic, esthetic, and above all, have a very wide range of versatility. These characteristics are most important to avoid limiting the clinical capabilities of orthodontic tooth movement.

The appliance of choice can be identified as "The straight bracket appliance". It consists of bands that carry single, double width brackets on the six anterior teeth, intermediate single brackets on the bicuspids, twin brackets on the first molars and a heavy edgewise tube with a mesial hook on the second molars. The bands also have attached lingual hooks on the molars and cleats on the bicuspids and cuspids that increase versatility, and are especially necessary in activating 3rd order bends. Each of the brackets and tubes are placed so that the slots are at right angles to the

long axis of the tooth and precisely positioned in relation to the incisal edges of the anteriors and the cusps of the posteriors. There are no tips, no slants, nor any variation in thickness in bracket or slot! The dimension of the slot and tube is .022" x .028".

The basic appliance just described is the only edgewise appliance available which offers the range of control and versatility that allows individualized tooth positioning for maximum environmental harmony. It has been suggested to me that to have the same individualized tooth positioning capability with the pre-tipped, pretorqued appliance would require an extremely large inventory of bracket bands requiring a minimum of three appliance changes on each patient. It seems that the supply houses advocating the pre-tipped, pre-slanted brackets with in and out features are aiming their sales for the generalist and the orthodontist who will accept mediocre or inferior mass results. Their objective is *aligned occlusions* and not individualized precise tooth positioning for environmental harmony.

The primary archwires used in the directional force technique is the .016", .018", and .020" round wire and the .0215" x .028" edgewise wire. The edgewise wire is reduced in varying areas and amounts to enhance tooth movement and control.

The auxiliaries routinely used are elastics and directionally oriented headgear. Primarily the high pull and the straight pull J-hook headgear furnish the extraoral force in a directional manner.

Most techniques are described by listing a number of steps in treatment. I would like to vary from this procedure by listing the various systems of forces used in achieving certain objectives as treatment progresses.

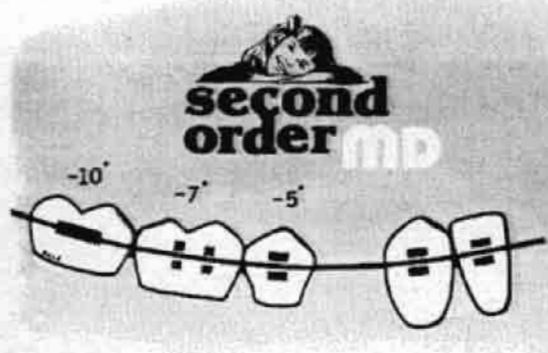
## I. The Force System of Denture Preparation

Denture preparation would include all the initial steps that prepare a malocclusion for correction: 1. leveling, 2. individual tooth alignment, 3. cuspid retraction, and 4. initial preparation of the terminal molars

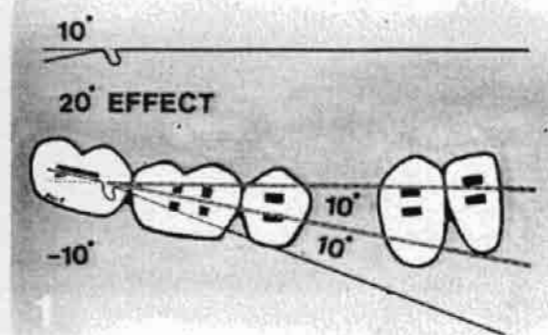
for stress resistance.

These systems of forces are best illustrated by line drawings. These were prepared by the talented Jack Dale, of Toronto, Ontario.

Pertinent elements of the system in the mandibular arch is a .016" round archwire with incisal curvature, malocclusion arch width, and bent in loop stops flush with the molar tubes. The distal portion of the archwire which lies in the molar tube is adjusted to effect a  $20^\circ$  distortion with the long axis of the terminal molar. The degree of bend in the wire is determined by an initial "read out" of the malocclusion (Fig. 1). For instance, if the lower terminal molar is inclined mesially  $10^\circ$  the bend would be  $10^\circ$  in severity (Fig. 2). If the terminal



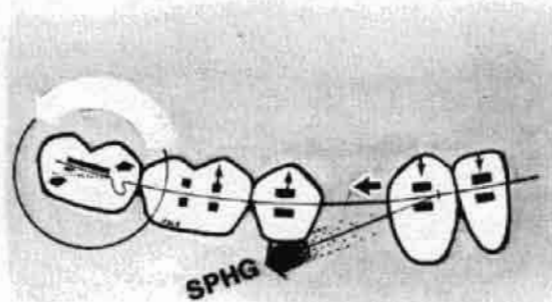
**Figure 1.** Original readout of mandibular arch (all readout inclinations are long axis to occlusal plane).



**Figure 2.** A  $10^\circ$  distal tip gives a  $20^\circ$  effect when the terminal molar is tipped mesially  $10^\circ$ .

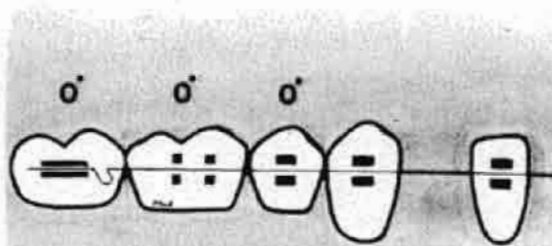
molar were upright in its original position the bend would be  $20^\circ$ . This bend is downward in the mandibular arch and

must be related to the original position of the molar. In addition to the .016" wire, a straight pull J-hook headgear is fitted so that the eyelets of the J-hook slide over the archwire and applies 8-16 ounces pressure mesial to the cuspid brackets. The cuspids should upright by approximately 2 millimeters the first month. The headgear will activate the distal force on the terminal molars (Fig. 3) and controls mesial move-



**Figure 3.** The .016" leveling arch is activated and controlled by the straight pull headgear as it applies distal force to the cuspids.

ment of the incisors as the mid-arch levels. This very simple force system is continued as long as the case is progressing rapidly. If progress is slow after two months, change to the .018" round archwire and add elastik chains from the bicuspid to the cuspid brackets. Ligate molar-to-molar-to-bicuspid and carry a  $20^\circ$  tip second order bend to the second molar which should now be level to the occlusal plane. When the cuspid is retracted or when it is as far as



**Figure 4.** When the cuspid is retracted all objectives of denture preparation should be completed.

needed for the positioning of the incisors, change to the .020" round wire, and continue 20° second order bends in the terminal molar. Keep bent in loop stops flush maintaining the exact original arch width with symmetrical anterior curvature. If further retraction of the cuspid is necessary continue both the elastik chain and straight pull headgear. If cuspid position is attained continue only the headgear. Denture preparation in the mandibular arch using this force system should be complete in four to six months if used as described (Fig. 4).

In the maxillary arch modification is made in two areas. First: The original read out of the maxillary second molar will generally indicate this tooth has a distally inclined plane relationship (Fig. 5) varying from +10° to +30°. The average is +20°. Whatever the original read out, use 10° of additional distal tip on the terminal molar. In Figure 6, the bend is 30° with an effect of 10°.

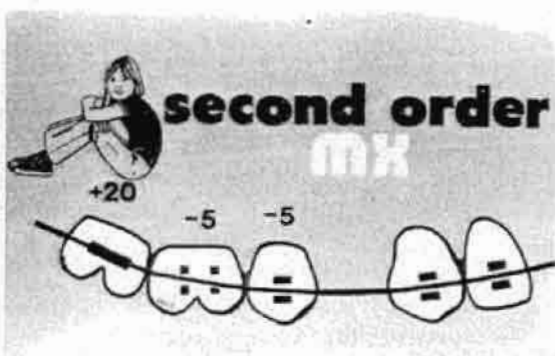


Figure 5. Original readout of maxillary posterior teeth.

The second modification of the force system in the maxillary arch is the directional force headgear. The high pull J-hook headgear is used for activating and giving direction to the tooth movement (Fig. 7). The eyelets are opened and placed mesially against the maxillary cuspid brackets. The headgear is worn from 8-12 hours each day. Elastiks are added if progress is not satisfactory. The maxillary .018" and .020" round wires are generally one month behind the schedule for the lower

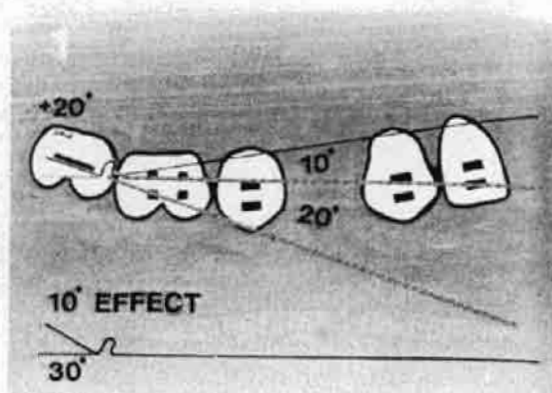


Figure 6. A 30° distal tip has a 10° effect on the 2nd molar because of its original inclination.

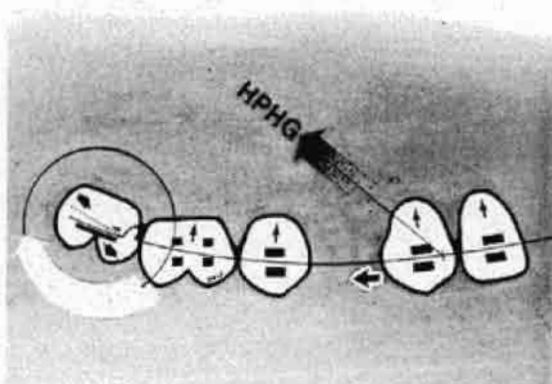


Figure 7. Action of the highpull headgear is to retract the cuspid, restrain the incisors, upright the 2nd bicuspid and 1st molar and control the 2nd molar.

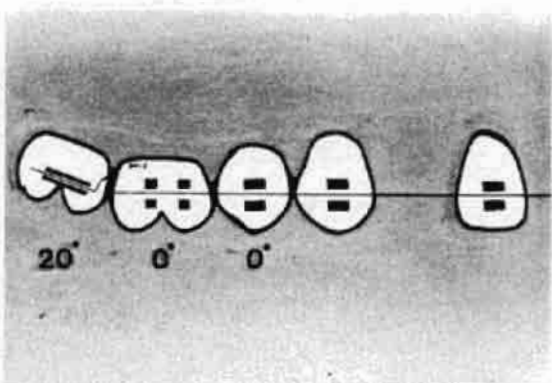
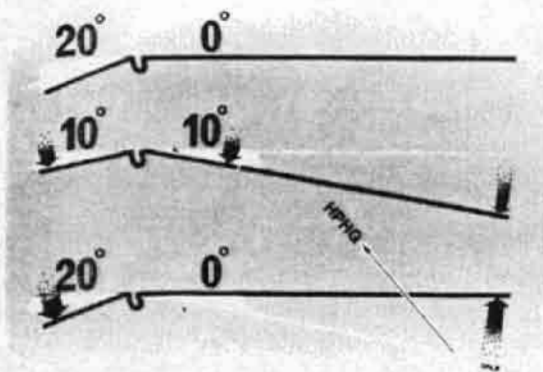


Figure 8. At the completion of maxillary denture preparation the cuspid should be fully retracted, the mid-arch level and the 2nd molar in its original position.

arch. I routinely stay in maxillary cuspid retraction with this force system until the cuspids are fully retracted or until a strong Class I relationship is established (Fig. 8).



**Figure 9.** The action of a 20° second order bend on a 2nd molar is to cause an equal and opposite reaction anterior to the bend. To achieve just action, the reaction must be counteracted.

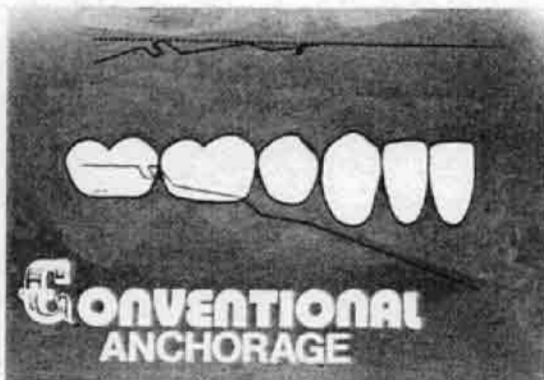
A careful study of the action, the interaction, and the reaction of teeth to bends in the archwire is critical (Fig. 9). The resultant knowledge is basic, fundamental and drastically effects our clinical results. These same actions, interactions, and reactions occur when the archwires are straight and the brackets are distorted.

Second order bends in the mandibular posterior segment are very antagonistic to the teeth in the anterior segment. Without excellent directional control and a careful application of second order forces in a sequential manner, all control of these teeth will be lost. The anterior teeth cannot support the simultaneous tipping of the posterior teeth; *anchorage preparation with Class III elastics as previously taught is unsound*. Class III forces are not high enough to support the intrusive force on the anteriors and they do not activate the distal tips properly (Figs. 10, 11, 12, 13, & 14). Note: please study Figs. 13 and 14 carefully.

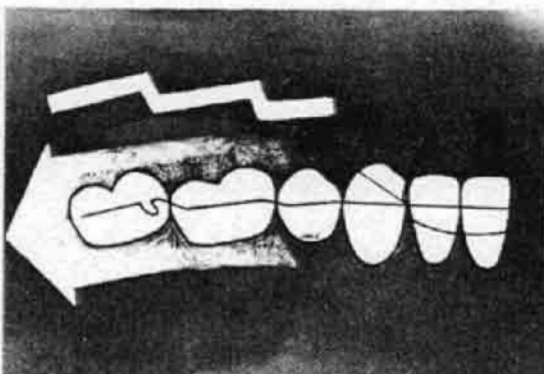
One can only conclude that Class III elastics should be used only on Class III malocclusions where mesial movement of the maxillary teeth is the objective.

Another area of unsoundness is the placement of compensating bends on the initial archwire before compensation is needed. Only after tipping should the bends have compensation.

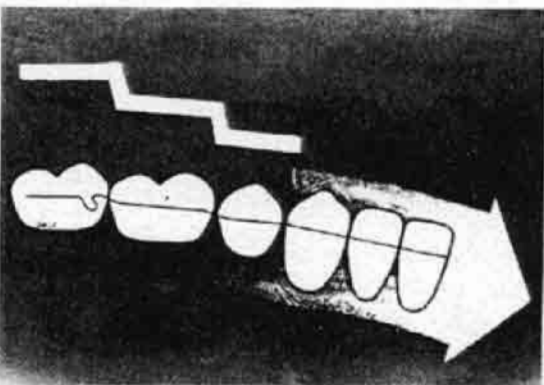
Second order bends in the mandibular posterior segment adversely affect the third order positions of the lower anterior teeth.



**Figure 10.** Conventional anchorage introduces coordinated tip backs with compensating bends simultaneously.



**Figure 11.** Conventional anchorage bends activated by Class III elastics were supposed to tip the posterior teeth distally and support the anterior teeth. This does not occur.

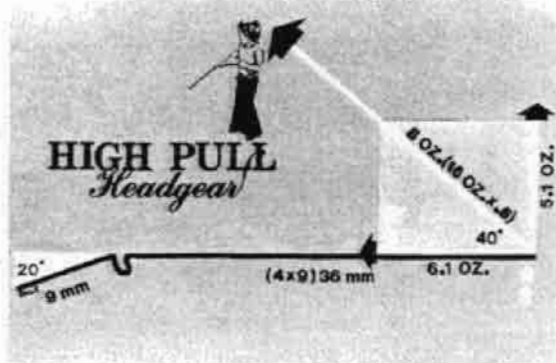


**Figure 12.** The actual result of the conventional simultaneous anchorage system is a step relationship of the posterior teeth, a drastic alteration of the occlusal plane and an intrusion of the anterior teeth. The maxillary arch is also adversely affected by the mesial pull of the Class III forces.

### CLASS III Elastics



**Figure 13.** The Class III elastic force of 8 ounces divided into its components gives 7.9 ounces of distal force but only .7 of 1 ounce of vertical support; entirely inadequate to counteract the reaction of the distal tipping forces on the anterior teeth.



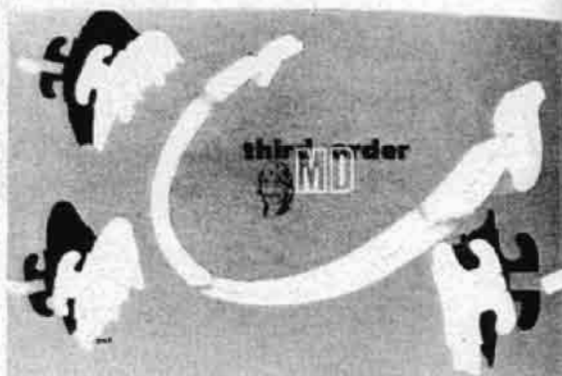
**Figure 14.** Substituting a high pull headgear for the Class III elastic force (same intensity) changes the components of the force to 6.1 ounce of distal force and 5.1 ounce of vertical support. It also has no effect on the maxillary teeth; a far superior force system.

These teeth generally require lingual crown torque; posterior tipping bends give labial crown torque to the incisors. This must be given careful consideration in arch fabrication and force application.

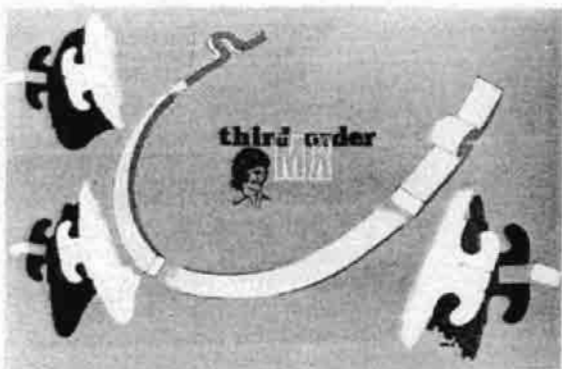
In the maxillary arch second order bends in the posterior segment are desirable and complimentary to the teeth in the anterior segment. The reaction of the posterior distal tipping forces intrude the incisors and give a lingual root torque effect. This is positive and complimentary to our objectives.

Third order reaction in the mandibular archwire is complimentary to all the teeth if

properly placed. Treatment objectives generally include some degree of lingual crown torque on all mandibular teeth. Therefore, the posterior and anterior segments work together in action, reaction, and interaction (Fig. 15).



**Figure 15.** Mandibular 3rd order posterior, mid-arch, and anterior forces are complementary in that our objective is generally some degree of lingual crown torque in all areas.



**Figure 16.** Maxillary 3rd order posterior forces are antagonistic to the anterior objectives.

Conversely, third order bends in the maxillary arch are antagonistic. The anterior segment needs lingual root torque while the posterior segment needs lingual crown torque (Fig. 16). It would not be wise to incorporate active torque force in both segments with opposite actions simultaneously. It would be prudent to apply active third order bends sequentially and in only one direction in the maxillary arch at any given time.

First order action and reaction effect expansion or contraction and are most easily

monitored. They usually are used to move individual teeth; the reciprocal units offer good stability for control. The interaction can affect the third order position of the teeth if expansionary forces are used. Labial crown torque must be controlled with counterforce.

## II. Denture Correction—Mandibular Arch

When the denture preparation objectives have been attained, the system of forces are altered to achieve the next series of objectives. These are called denture correction, and consist of: (1) retraction and up-righting of the lower incisors to their most ideal positions, (2) completion of space closure, and (3) positioning the teeth in the mid-arch and posterior areas into axial inclinations that will allow final coordination with the maxillary teeth for functional occlusion.

The elements of the force systems used include a reduced .0215" x .028" edge-wise arch with ideal first order bends; closed, vertical loops placed just distal to the lateral incisors; and bent in loop stops placed just distal to the first molar brackets. The wire has 7° of lingual crown torque in the incisal area with passive third order bends in the rest of the wire. Third order bends are complimentary in the lower archwire since all teeth need varying degrees of lingual crown torque. The second order bends are only placed on the terminal molars with 20° of distal tip. Vertical spurs are soldered gingivally between the central and lateral incisors (Fig. 17). It is very essential to have a read out before the archwire is inserted. These values are recorded for lower second molars, the lower first molars, and the lower second bicuspsids.

The archwire is activated by ligating from the terminal molar to the bent in loop stop and opening the closed vertical loop one millimeter at each adjustment. Further activation is achieved by applying a high pull J-hook headgear to the vertical spurs. (The J-hook is adjusted by bending the eyelet so

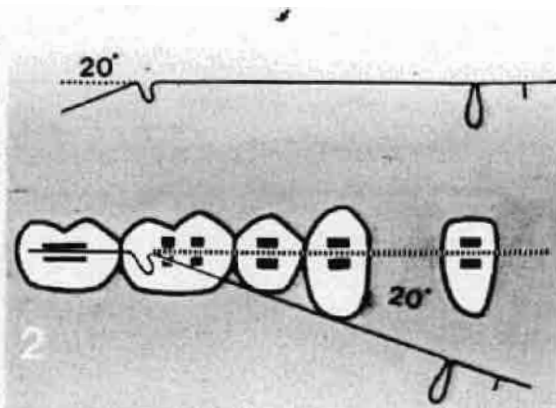


Figure 17. The mandibular archwire for denture correction.

that its lumen is horizontal.) The high pull directional headgear places a force that is 40° above the occlusal plane. This force overcomes the intrusive force on the incisors which is a reaction of the 20° distal tip in the terminal molar. The remaining headgear force is distal and allows uprighting and retraction to occur very rapidly (Fig. 18).

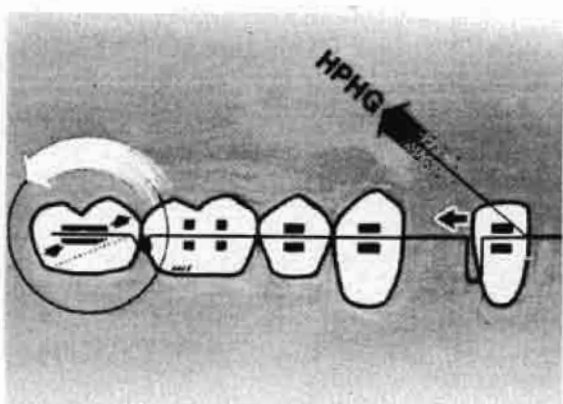
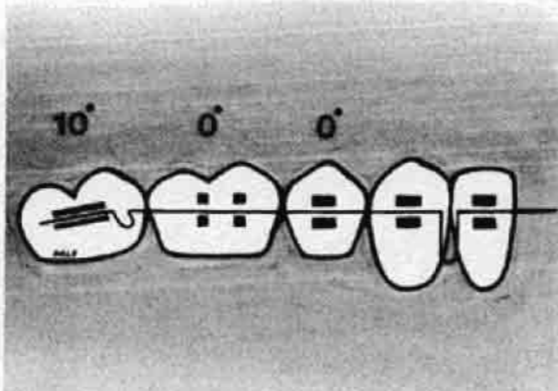


Figure 18. The mandibular arch force system activated and controlled by the high pull headgear to the anterior vertical spurs.

The 20° distal tip in the terminal molars maintains these teeth when the vertical loop is activated and tips them distally when the vertical loop is closed. By supporting the archwire with ten teeth and the high pull headgear the two terminal molars will begin to assume an anchorage prepared position. Approximately 10° of distal tipping of these terminal molars should occur. This system is maintained until the incisors are correctly uprighted



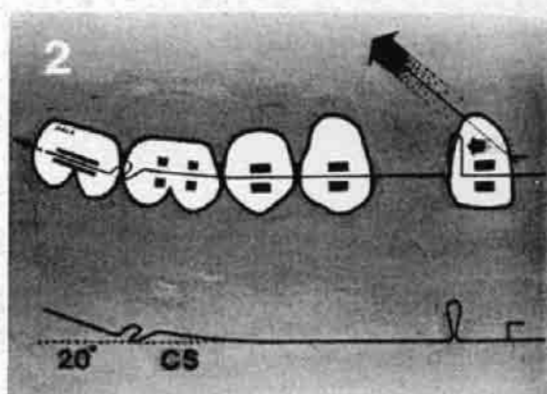
**Figure 19.** At this stage of mandibular denture correction the spaces are closed.

and all space is removed (Fig. 19). A cephalometric headfilm is necessary for monitoring incisal position. If more than one wire is required, the second wire has the vertical loop distal to the cuspid and the vertical spurs for the high pull headgear distal to the lateral incisors. The high pull headgear is worn to the lower arch ten hours each day.

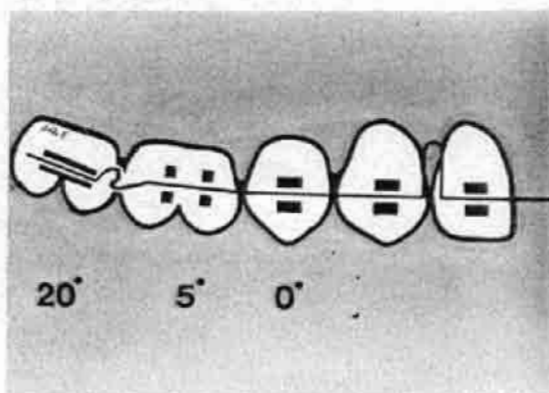
### III. Denture Correction – Maxillary Arch

Anterior retraction, space closure, and initial anchorage preparation within the maxillary arch is very similar to the mandibular arch. The vertical loops are placed just distal to the lateral incisors. Bent in loop stops are adjacent to the distal bracket of the first molar. The wire .021" x .025" reduced, has ideal first order bends. A read out of the posterior teeth is absolutely essential and is recorded and referred to each month. The values measured from the read out are used to determine the severity of the distal tip in the second molar area and will determine the amount of passive distal tip necessary in the archwire. If the read out shows greater than 20° of distal tip place that amount of distal tip bend, never less! The angulation of this bend will range from 20° to 30°, depending on the original read-out. A 10° distal tip is placed on the first molar and a compensating bend is placed mesial to the bent in loop stop. This allows excellent resistance to mesial molar movement when the vertical loop is activated. When

the loop closes, the high pull headgear force will start the distal tipping of the first molar. A gentle curve of Spee is also incorporated in the second bicuspid - first molar area. Third order bends are more critical in the maxillary force system since they are antagonistic in the maxillary arch. The anteriors should have passive lingual root torque; the posterior teeth, to and including the first molar, should have passive lingual crown torque. The second molar should carry 5° of active lingual crown torque. The archwire has soldered headgear hooks distal and gingival to the central incisors. The high pull headgear, used to retract the maxillary cuspids, is adjusted by closing the eyelet and recontouring the bow of the J-hooks. This high pull headgear has 30° of intrusive force and gives direction and activation to the system of forces incorporated into the archwire (Figs. 20 & 21).



**Figure 20.** The maxillary archwire as fabricated for maxillary denture correction.



**Figure 21.** At this state of denture correction the spaces are closed and the posterior teeth should be positioned as shown.



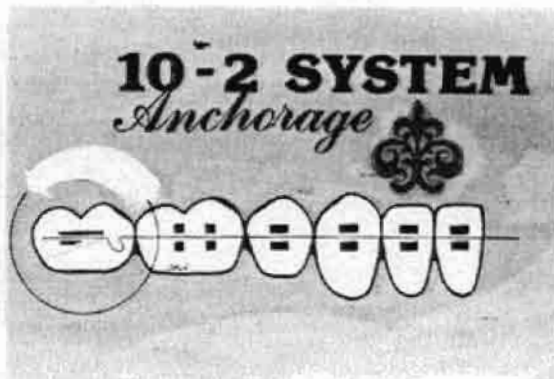
Both high pull headgears are worn simultaneously on the upper and lower arches, but the number of hours of wearing each will vary with each malocclusion. The directional control becomes more vital with the severity of the malocclusion.

It is important to note that both the mandibular and maxillary force systems are totally independent of each other. No Class III elastics or stabilizing arches are necessary. The maxillary arch force system is incorporated one month behind the mandibular arch system. Anterior retraction, space closure and initial anchorage preparation is being accomplished in both arches simultaneously. This should eliminate at least four months of treatment time.

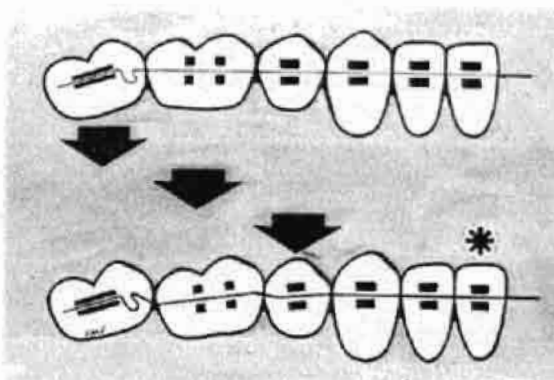
#### IV. Sequential Anchorage (The 10-2 System – Mandibular Arch)

When all spaces are closed and the incisors retracted, the vertical loop arches are replaced with .0215" x .028" continuous arches.

The mandibular archwire has incisal curvature, ideal first order bends, and bent in loop stops flush with the second molar tubes. At this point both second and third order read out figures are essential. These values are recorded; from this information the second and third order bends can be properly made. The lower incisor third order read out should be approximately 7° lingual crown; an additional 3° of torque is incorporated. The cuspids, bicuspid, first and second molars all have passive lingual crown torque. The final bend is 20° distal tip to the second molar. There are soldered vertical spurs gingivally between the laterals and cuspids. The difficulty of bracket engagement will determine the amount of arch reduction necessary. If bracket engagement is easy, little reduction of the wire anterior to the terminal molar is needed, perhaps twenty seconds. If bracket engagement is more difficult, then greater reduction is necessary. The terminal molar areas should be reduced one minute in the anodic polisher. It is important that the wire be seated in all brackets so that all ten teeth anterior to the second



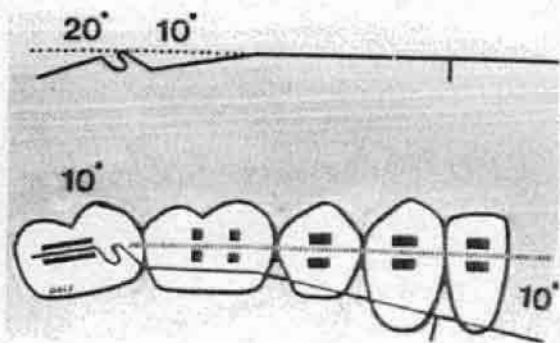
**Figure 22.** The 10-2 anchorage force system is sequential and always relies on 10 teeth to support 2 teeth.



**Figure 23.** The sequence starts with the terminal molar and progresses to the 2nd bicuspid. The high pull headgear supports the anteriors.

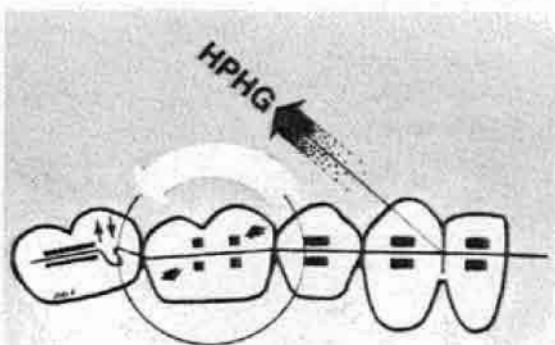
molars are stabilized while the two terminal molars will receive the active force—hence the "10-2 system" (Figs. 22 & 23). The high pull headgear is worn on the vertical spurs for ten to twelve hours daily. It adds further support to the archwire and activates the distal tipping action of the terminal molar. With this system of sequential anchorage it is absolutely essential that there be no pre-tipped brackets in the lower arch.

The tipping action on the terminal molars will be very rapid and effective. The archwire should be removed each appointment so that a posterior read out can be made. The terminal molar tip should be accurately readjusted to 20° by using the angulation chart. At the end of two months there should be a distal axial inclination of +10° to +15° for the second molar,



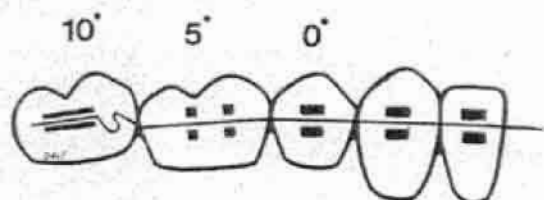
**Figure 24.** The second step in mandibular 10-2 anchorage preparation — 10° tip in the 1st molar.

a 0 to -3° for the first molar, and a 0 to -5° for the second bicuspid. At this time the second step of sequential anchorage is incorporated (Fig. 24). A distal tip of 10° is placed in the first molar areas. Compensating bends are carefully fashioned mesial to the bent in loop stops and must compensate for the distally inclined second molars. The archwire in the first molar areas must show a 10° bias when laid across the twin brackets. The first molar area of the archwire can be reduced 30 seconds to facilitate bracket seating. The second molars are now a part of the ten stabilizing units and the first molars are the two units receiving the action of the directional forces. For ideal response the high pull headgear is still applied to the vertical spurs anteriorly (Fig. 25). After one month

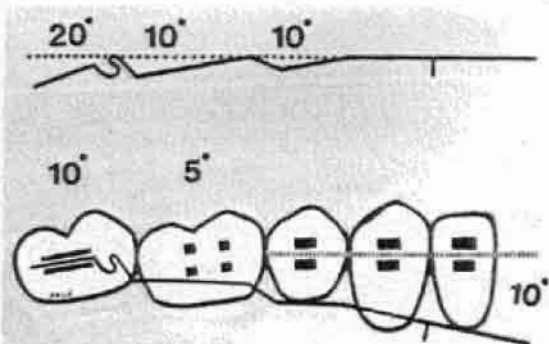


**Figure 25.** The 10-2 force system in action tipping the 1st molars and stabilizing with the remaining 10 teeth and the high pull headgear.

the archwire is removed. Read out figures should show +5° to +8° distal inclination of the first molars, the second molars should read out +10° to +15° and the second bicuspids 0° to -3° (Fig. 26). The third and final step of this procedure is to place a distal tip of 10° severity in the second bicuspid area, with a compensating bend just mesial to the mesial bracket of the first molars (Fig. 27). These bends

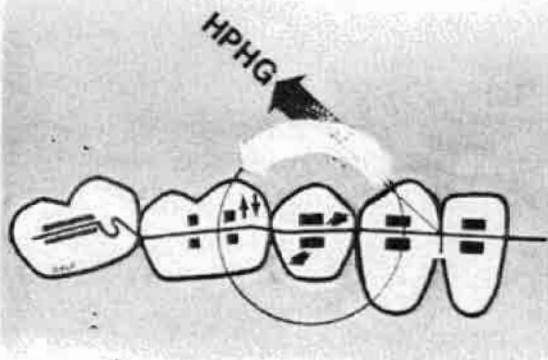


**Figure 26.** Read out values after sequential anchorage on the 1st molars.

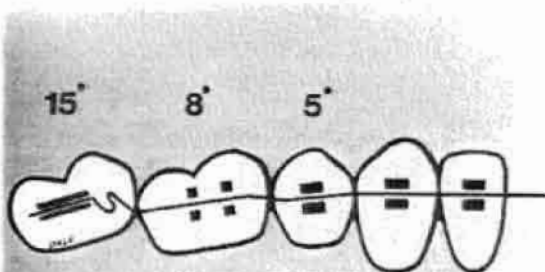


**Figure 27.** The archwire bent for the 3rd step of mandibular 10-2 anchorage.

must allow the wire in the second bicuspid areas to be on a bias to the bicuspid bracket when the wire is seated in the second molar tubes and first molar brackets. These compensating bends must be most carefully checked. The archwire is ligated to place; the high pull headgear is worn to the vertical spurs. Sleeping hours will usually be sufficient. At this point the first and second molars and the six anterior teeth



**Figure 28.** The headgear activating and supporting the 10-2 system on the 2nd bicuspid.



**Figure 29.** The final read out after completing 10-2 anchorage on the mandibular arch.

are a part of the ten stabilizing units. The two bicuspid are the recipients of the directional force system (Fig. 28). Read out values at the end of one month should show a distal axial inclination of  $+10^\circ$  to  $+15^\circ$  in the second molars,  $+5^\circ$  to  $+8^\circ$  in the first molar area and  $0^\circ$  to  $+5^\circ$  in the second bicuspid area (Fig. 29). A lateral headfilm should also show the lower incisors position to be lingually enhanced. If originally positioned at  $88^\circ$  they should now be at  $85^\circ$ . If more distal positioning of the lower teeth is necessary, jigs and the straight pull headgear or Class III elastics will be required.

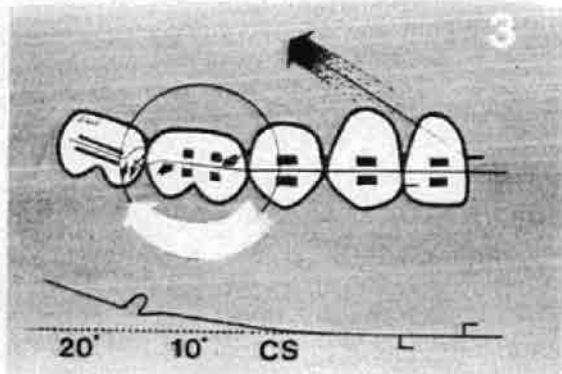
## V. (The 10-2 System – Maxillary Arch)

Approximately one month after starting sequential anchorage preparation in the mandibular arch the maxillary incisor

retraction and space closure with vertical loops should be completed. A new  $.0215" \times .028"$  continuous archwire is made to continue maxillary arch correction. It has incisal curvature, malocclusion arch width, ideal first order bends and bent in loop stops flush with the terminal molar tubes. Read out values of the third order position of the crowns is required. All teeth should be in normal inclination. If so, place passive lingual root torque in the maxillary incisor area and passive lingual crown torque in the posterior areas. If both areas need adjustment, do not attempt correction simultaneously. Correct the posterior lingual crown torque first, sequentially, from the second molars mesially. Then maintain passive lingual crown torque on the posterior teeth while activating lingual root torque in the incisors to achieve normal inclinations.

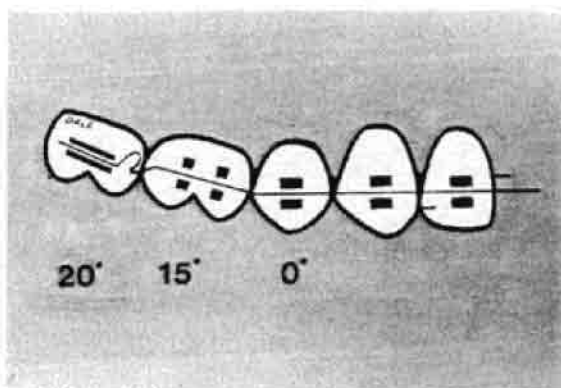
Third order forces are antagonistic in the maxillary arch and require the sequential 10-2 system for maximum results.

Read out values of the axial position of the posterior teeth should show approximately  $20^\circ$  of distal axial inclination in the second molars with the first molars and the second bicuspid level. This is consistent with the original position of the second molars and the subsequent directional forces that have been used. Because the original second molar distal axial inclination has been maintained the 10-2 system starts on the first molar rather than the second. Second order bends are placed in both the first and second molar areas with a compensating bend just mesial to the bent in loop stop that allows the previously distally inclined second molar to be passive. The second order bend on the second molar will be about  $20^\circ$  but is determined from the read out. The second order bend on the first molar should be  $10^\circ$  and is checked in the mouth to show the wire's relationship to the twin brackets. A slight curve of Spee is also placed in the wire. Hooks are soldered gingivally, distal to the maxillary central incisors for the J-hook high pull headgear. It places an intrusive distal force on the archwire enhancing the distal tipping action on the first molars and intruding the incisors for over-



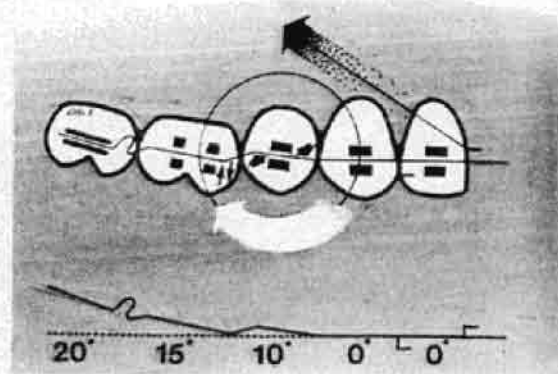
**Figure 30.** Maxillary 10-2 anchorage preparation starts on the 1st molar, the 2nd molar is already in excellent position.

bite control (Fig. 30). At the next appointment, the archwire is removed to place an additional 5° tip on the first molars. The wire now has 15° of second order distortion in this area. A read out will confirm tooth inclinations. Note: If the bite has opened too rapidly at this point, substitute up and down vertical elastics for the mandibular high pull headgear and continue as previously described.



**Figure 31.** The end of maxillary 1st molar 10-2 preparation.

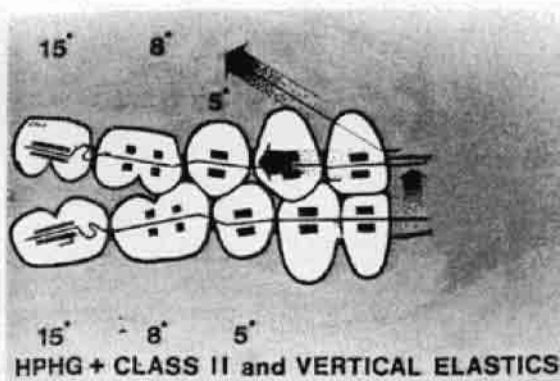
The subsequent monthly appointment should show the first and second molars distally inclined with no occlusion distal to the mesial cusp of the first molar (Fig. 31). Compensating bends mesial to the first molars and distal tipping bends mesial to the second bicuspid are placed. These bends should be 10° in severity. The high pull directional force headgear is continued (Fig. 32). At the next appointment, teeth



**Figure 32.** Final adjustment for positioning bicuspid in maxillary 10-2 anchorage.

in both arches should be in proper inclination. The anterior over bite should be slightly open with ideal arch form.

Denture correction will now be complete for the Class I malocclusions. For Class II malocclusions, a new system of forces must be used to complete denture correction. A careful study of the cuspid relationships will determine the next step. If the cuspid relationship is nearly Class I, ligate the lower terminal molar with a heavy ligature from the tube to the bent in loop stop and cinch tightly. Solder Class II hooks incisally and distal to the lateral incisors on the maxillary archwire. Increase the lingual root torque in the upper incisors and slightly increase the curve of Spee in the posterior area. Seat and ligate the archwire being careful to secure complete bracket engagement. Place vertical elastics from the gingival spurs distal to the mandibular lateral incisors, to the high pull headgear hooks located between the maxillary central and lateral incisors. Class II elastics are worn from hooks on the mesial of the lower second molar tubes to the Class II hooks soldered on the maxillary archwire. Six to eight ounces of continuous forces should be used. The maxillary high pull J-hook headgear should be worn 14 hours each day. If Class II elastics are not indicated on the lower arch, a straight pull J-hook headgear can be used by attaching it to the Class II hooks on the maxillary arch and wearing it simultaneously with the high pull headgear. It must be assumed that a careful diagnosis utilizing total space analysis has been used and posterior space



**Figure 33.** The force system directionally controlled for occlusal adjustment on Class I or end-on occlusions.

is available for maxillary distal en masse movements. Two to three months using this force system should accomplish a slightly overtreated Class I occlusion (Fig. 33).

If the cuspal relation at the end of the previous step was Class II, it is necessary to use another system of directional forces.

## VI. Class II Force System

It is absolutely essential at this time to make a final diagnostic decision based on the ANB relationship and the maxillary posterior space analysis, as well as patient cooperation.

If the maxillary third molars are missing or if the ANB is  $5^\circ$  or less and the patient is cooperative the system to be described will accomplish the best result. If third molars are present and are anywhere near eruption, they should be removed to facilitate maxillary distal movement.

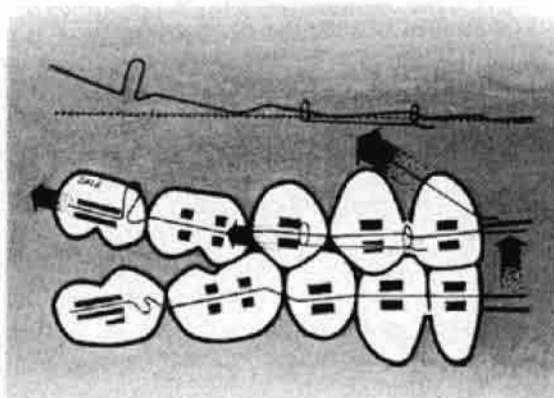
If the ANB relationship is  $5^\circ$  to  $8^\circ$  with a Class II cuspal relationship and a cooperative patient, the extraction of the maxillary second molars will be the most advantageous.

If the ANB is above  $8^\circ$  or the patient's motivation is questionable or both, then either the first molars should be removed or orthognathic surgical correction is indicated. Facial balance and harmony after correction should also be carefully considered in this decision.

The mandibular archwire is the same as previously described. It is seated, cinched, and ligated for maximum stability.

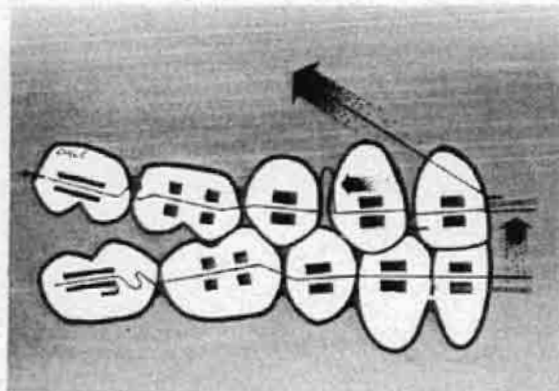
The maxillary archwire is modified by incorporating a closed bulbous loop flush with the mesial of the molar tubes. This wire is identical to the previous wire in all other areas. High pull headgear hooks are soldered distal to the central incisors gingivally. There are no Class II hooks but sliding jigs are fabricated and placed so that the distal eyelets contact the second bicuspid brackets and the mesial eyelet is midway between the cuspid and lateral brackets. A Class II elastic hook is soldered to the mesial eyelet of the jig.

The closed bulbous loop is opened about  $1\frac{1}{2}$  millimeter on each side; Class II elastics are worn from the hook on the lower second molar tube to the jig, with 8 - 10 ounces of force. Vertical box elastics are worn from the spurs on the lower archwire to the high pull headgear hooks on the maxillary archwire, and the high pull headgear is worn from these maxillary hooks.



**Figure 34.** The Class II Force System. Jigs could also be from mesial of 1st molar to mesial of bicuspid with a Class II hook mesial to cuspid for double elastic forces.

This is a very efficient force system with excellent directional control. Four months of wear with reactivation monthly should position the posterior teeth in an overtreated Class I occlusion (Fig. 34). This system will not strain the mandibular denture if the anterior vertical elastics are worn and if there is sufficient space available in



**Figure 35.** Final space closure after Class II correction if necessary.

the maxillary posterior segment. A new system which is very successful utilizes double elastics. The distal eyelet of the jigs is placed mesial to the first molar and the mesial eyelet is mesial to the second bicuspid. Class II elastics are used from the terminal lower molar to the jig and from the terminal lower molar to the Class II hook on the arch mesial to the cuspid. This system will retract maxillary anteriors along with the en masse movement of the posterior teeth.

After Class II overcorrection a new maxillary archwire may be needed with a vertical loop distal to the cuspids. Class II hooks and the same anterior forces are used to retract the anteriors and correct the overjet. This Class II force should be milder, using 4 to 6 ounces. Carefully controlled lingual root torque on the incisors is necessary (Fig. 35).

## VII. Denture Completion

The last phase of treatment is denture completion. It consists of very precise and varied systems of forces. These forces are based on a very critical study of the arrangement of each tooth in each arch. The relationship of one arch to the other and the relationship of the arches to their environment. Read out values should be made and necessary second and third order adjustments placed in the archwires. A progress headfilm and tracing can determine final lower incisor position as well as any minor control of the palatal, oc-

clusal, and mandibular planes that may be needed. The accurate tracing will also indicate the amount of lingual root torque necessary for the maxillary incisors. Visual clinical study can determine the lip line to maxillary incisor relationship, and the amount of cusp seating and artistic positioning that is necessary.

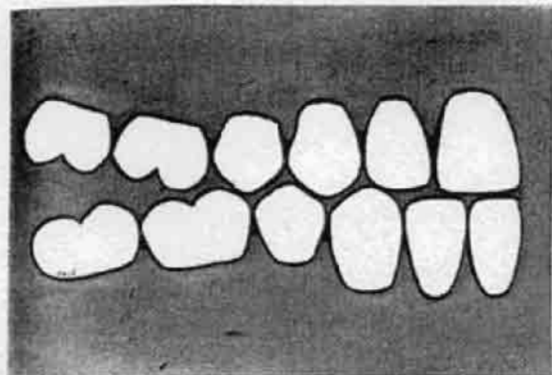
One should consider denture completion as "mini" treatment of the malocclusion, and repeat whichever systems of forces are necessary. When the original malocclusion is overcorrected, add final artistic positioning bends and cusp seating forces to give detail and quality to the overcorrection. Selective band removal will facilitate cusp seating and band space removal. Four to six months in ideal arches undergoing "mini" treatment and precision finalizing will add quality, individuality, and stability to the final result.

### Mini Treatment Check List

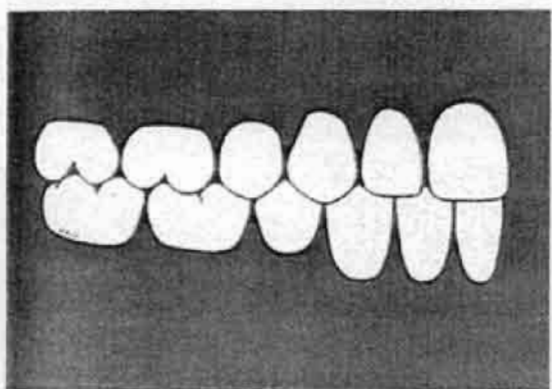
1. Check and correct any 1st order arch form asymmetry.
2. Finalize any minor rotations.
3. Finalize all third order positions.
4. Check and correct any root paralleling deficiency.
5. Check and complete any final space closure.
6. Add artistic bends on maxillary anterior segment.
7. Add cusp seating spurs and elastics to seat bicuspids and cuspids.

## VIII. Denture Recovery

When all bands are removed and retainers placed, the most critical phase of malocclusion correction occurs. I would like to refer to this period as the recovery period and the forces involved are those of the surrounding environment; primarily the muscles and the peridontium. I strongly believe that if our corrective procedures barely achieve normal relationships of the teeth there will be inevitable relapse. Any change will be away from the ideal toward malocclusion. However, if one completes the treatment to an over-correction of the major problems, all changes during



**Figure 36.** Ideal overtreatment position of a deep bite Class II extraction case at time of band removal.



**Figure 37.** Normal recovery of overtreatment offers best chance for permanent stability.

recovery are toward the ideal and offer our best chances for permanent stability and exceptional health, function, and esthetics (Figs. 36 & 37).

## IX. Conclusion

An overview of the systems of directional force has been described. The directional force technique is much broader

than just headgear application to the cuspids. It is a group of force systems which directionally position the teeth to be most harmonious with their environment functionally, physiologically, and esthetically.

These systems of directional force offer several new ideas in orthodontic treatment and although it is often said that some ideas are ahead of their times, I am convinced that . . . .

*It is time:* to properly position dentures with a directionally controlled system of forces.

*It is time:* to precisely bend wire to effect precision tooth movements for the individual patient.

*It is time:* to properly place the denture so that functional occlusion will develop a beautiful and healthy relationship of the teeth and a harmonious and balanced soft tissue overlay.

*It is time:* to discard the idea that some bracket manufacturer can determine your individual patient's malocclusion correction.

*It is time:* to use differential diagnosis, total space analysis, treatment timing, lateral headfilm monitoring, and clinical read outs to move teeth directionally to their most ideal positions.

*It is time:* to respect the dimensions of the denture.

*It is time:* to shorten treatment through sophisticated force systems, efficiently managed, and achieve superior clinical results.

## Credits

Art Work .....	Dr. Jack Dale
Consultation .....	Drs. Jack Cross, Herb Klontz, and the entire Foundation teaching staff.

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