Bio-Progressive Therapy, Part 7: The Utility and Sectional Arches in Bio-Progressive Therapy Mechanics

VOLUME 12 : NUMBER 03 : PAGES (192-207) 1978

RUEL W. BENCH, DDS
CARL F. GUGINO, DDS
JAMES J. HILGERS, DDS

Every major approach to orthodontics has had one characteristic which stands out in the minds of orthodontic clinicians universally as a medium for describing that particular approach or technique. Probably the most recognizable single entity in the Bio-Progressive Therapy would be that of the Utility Arch. It forms the base unit around which the mechanics in all types of cases can be employed. It is the catalyst which ties together all the different types of mechanotherapy that will be discussed.

The purpose of this article is to discuss the fabrication, activation and use of the lower utility arch and its role as a beginning appliance in the mechanical therapy. A basic understanding of the mechanical and physiological responses attendant to use of the utility arch will set the stage for a later discussion of mechanics in the classical malocclusions.

Historical Perspective

Contemporary, full-banded, edgewise orthodontic approaches have assumed that the most efficient method of effecting rotations and leveling the deep curve of Spee in the initial phase of treatment is through the utilization of a series of light, continuous round arches. Historically, when clinicians began to use continuous round wires to level the arch, several distinct moves were developed to counteract some of the detrimental responses that were observed as the round wires worked themselves out.

When a flat round archwire, or one with an incorporated reverse curve of Spee, is placed on the lower arch, the usual response is that the lower bicuspids are extruded, the lower molars uprighted (tipped back) and the lower incisors tipped forward (Fig. 1). In order to avoid the forward movement of the lower incisors, these arches were either tied or cinched back. However, as the reverse curve of Spee in the round arches expressed itself, the roots of the lower incisors were thrown against the dense cortical bone of the lingual planum of the symphysis. This acted as an anchor which resulted in the same forward movement of the lower incisors, but also effected a forward movement of the lower molars (Fig. 2).

In an attempt to counteract the forward movement of the lower arch with this type of leveling procedure, Class III elastics were superimposed to hold the lower incisors back as the lower arch was leveled. This then meant that the lower incisors and upper molars were under the influence of eruptive Class III elastics (Fig. 3). To counteract this response, either hi-pull headgear was initiated or extractions were necessitated to prevent the unwanted side effects of the round arch leveling. It is evident that a whole series of counteractive procedures was initiated to minimize the resultant detrimental effects that round arch leveling therapy created.

When even the smallest continuous round arches are tied in to level an arch and effect rotations,

an expansive movement is placed on the buccal segment teeth which tips them up and out (to the buccal) to unfavorable axial inclinations. In nonextraction cases, where round arch leveling therapy is utilized, quite often the first half of treatment is used to counteract the detrimental effects of the continuous round wire rather than moving the teeth directly toward their most ideal final locations.

In extraction cases, the response with continuous arches poses similar problems. Where lighter, more continuous pressures are exerted to retract the cuspid teeth, a forward tipping of the molar anchor unit and an intrusion of the lower second bicuspids is evidenced. The lower incisors, often brought forward in the leveling process, must be roundtripped in their retractive movement.

Development of the Utility Arch

It had long been felt that intrusion of the lower incisors as a medium for leveling the deep curve of Spee was an impossibility. Late in the 1950's Robert Ricketts and others attempted to counteract the tipping that occurred in the buccal segments in extraction cases by utilizing the supposedly immutable lower incisors as an anchor unit to hold the lower second bicuspids and molars upright in the retraction process. Round arch segments were laced from the lower molars and bicuspids to the lower incisors as the cuspids were retracted. It was noted that not only were the buccal segments maintained in an upright position, but that the lower incisors intruded with this light, continuous pressure. Later, there was a development of what is now classically described as the step-down base arch, or Ricketts' Lower Utility Arch. Although the utility arch itself has not changed drastically in design from its early conception, understanding of its actions and reactions in the face of mechanics employed and growth response has been greatly enhanced. It was discovered that not only did this relatively simple sectional arch solve some of the most troublesome orthodontic problems, but that its benefits extended to many other, much more subtle, areas.

Roles and Functions of the Lower Utility Arch

A. Position of the Lower Molar to Allow for Cortical Anchorage.

The cortical bone extension of the external oblique ridge is the normal supportive buttress to the lower buccal segment teeth. Tweed noted that "the best anchor unit is an undisturbed tooth", and clinicians have long talked about keeping the lingual cusps of the buccal segments down in order to enhance their anchorage position. Skull sections (Fig. 4) demonstrate amply that the lower molars, bicuspids, and even canines, have the buccal portion of their root structures supported by the cortical bone of the external oblique ridge. Biologists have shown that tooth movement through this dense cortical bone is retarded or slowed by the lack of blood supply, which diminishes resorptive characteristics.

It is important to note that in their normal eruptive positions, the lower molars do not need to be moved buccally, or even torqued buccally, to put them in their ideal anchorage positions. If the actual eruptive position and support is simply maintained from the very start of treatment, and the tooth is uprighted (when it is tipped and rotated mesially in the deep curve of Spee), its normal position is one of anchorage for the particular tooth. As was mentioned previously, one of the problems with continuous round arch leveling is that the initial movement of the lower molars is to upright, expand and disturb the axial inclination (buccal root torque) of not only the lower molars, but the entire lower buccal segment.

Following uprighting of the lower first molars, the clinician should be able to palpate the mesial root of the lower molar in its ideal axial inclination following utility arch therapy.

B. Manipulation and Alignment of the Lower Incisor Segment.

When treated as a segment, the four lower incisors are manipulated from the lower molar to align and either hold, intrude, or extrude these teeth in the initial phases of therapy. In addition, by altering the design of the lower utility arch, it is possible to advance or retract the lower incisors without disturbing or depending upon the canines or bicuspids. It should be considered that the lower incisors and the lower buccal segments are in two different planes of space. The lower incisor teeth respond ideally when they are treated as an individual segment. When they are tied to the buccal segment teeth (those in a different plane of space) early in therapy, their ideal response is limited by movements of the buccal segment teeth. Additionally, pressures ideally suited for aligning and intruding of the lower incisors are difficult to deliver when they are not treated as a separate unit or segment.

C. Stabilization of the Lower Arch, Allowing Segmental Treatment of the Buccal Segments.

In most Class II cases, where the lower incisors and canines have extruded to meet an occlusion dictated by the overjet, the buccal segments-- especially the canines-- should be treated segmentally in order to take advantage of the most direct movement of these teeth toward their final ideal location. With continuous round arch therapy, when the lower incisors are tipped forward, the reciprocal response in the canines is to bring the crown forward and the root back, rather than to intrude these teeth. If the lower incisors can be intruded in their own plane of space, prior to intruding the lower canines, each segment is treated individually and responds with a most efficient type of tooth movement. By stepping around the bicuspids and canines early, the incisors can be brought past the lower canines when necessary, intruded when necessary, and treated as a separate entity not dependent upon the individual movements of the buccal segment teeth. Following early maintenance of anchorage at the molars and proper positioning of the lower incisors, separate rotations and leveling can occur in the buccal segment teeth without disturbing the idealized location of the other segments.

D. Physiological Roles of the Lower Utility Arch.

When there is a loss of proprioception in the incisor region by removing the lower incisors from palatal or incisal occlusion, the mandible reacts by reaching forward to search out proprioceptive input. This "activator" or "reaching" effect allows the mandible to thrust forward slightly and pick up the inclines of the maxillary dentition early in treatment, often allowing a beneficial muscular response which can be helpful in correcting Class II malocclusion. As long as the mandible is not reaching forward at the end of treatment, the initial unlocking of the anterior occlusion, followed by the distal movement either of the upper jaw and/or teeth, results in a prevention of interferences which quite commonly retard easy movement of the dentition.

When considered with adjunctive headgear therapy, early removal of incisal interferences by virtue of intruding the lower incisors is quite beneficial in creating space for the maxilla which is moving downward and backward, closing the overjet. Remember-- the rotational effect in the maxilla quite commonly produces a deeper bite and, unless incisal trauma is avoided by either advancing the upper incisors or intruding the lower incisors, the usual sequelae of incisal trauma is that the mandible rotates in a clockwise direction, thereby deteriorating the effective position of the chin in the face. Early intrusion of the lower incisors maintains the principle of treatment of overbite before resolution of the overjet.

Also, by setting torque control on the lower molars and incisors early in treatment, dictation of the final arch form is enhanced by allowing the buccal segment teeth to erupt and be formed by the tongue and buccal musculature. Most often, a natural, undefined arch form is created rather than a dominated, "textbook type" of arch form which may not be ideal for that individual case.

E. Overtreatment.

With continuous arch therapy, it is difficult to overtreat the buccal segments until the upper and lower incisors have been brought to an end-to-end alignment. By treating the upper and lower incisors as separate segments, freeing the buccal segment teeth for unimpeded correction of the Class II malocclusion, it is not necessary to tie overbite control to overjet control. Since they can be treated as separate functions, it is possible to treat the overbite (by intrusion of upper and lower incisor teeth) at the same time that the buccal segment teeth are being corrected. It is not unusual to go back to utility arches later in treatment to avoid the incisal interferences which commonly creep back into cases as a result of space closure and masticatory function.

F. Role In Mixed Dentition.

The utility arch allows incisor alignment and molar control during the transition dentition by stepping around the deciduous buccal occlusion. This means that most arches can be leveled without depending upon extrusion of the buccal segment teeth. An in-depth discussion of the application of the utility arch in early treatment will follow in a future article of this series.

G. Arch Length Control.

The lower utility arch serves as a determinant of arch length maintained, gained or lost in several distinct ways:

1) Uprighting the lower molar.

When a deep curve of Spee exists, and there is the ability to upright the lower molar, the tip-back in the lower utility arch serves to bring the roots of the lower first molar forward. Since the center of

resistance of the lower first molar is slightly below cementoenamel junction at the top of the mesial root, the simple pivoting of the lower first molar will typically allow for a 2mm forward movement of the root and a 2mm backward movement of the crown. This is, in effect, trading space down in the alveolar bone for space in the arch; and can account for approximately 4mm of arch length gain at the same time the curve of Spee is leveled (Fig. 5).

2) Advancement of the lower incisors.

Where the lower incisors are lingually placed (or retrusive) and can be brought downward and forward as a separate function of the utility arch, Steiner's rule would dictate that for each 1mm (cephalometrically) that the lower incisors are brought forward, 2mm of arch length is gained. The possibility of effecting this downward, forward movement of the lower incisors is dictated mainly by the symphyseal form and visualization of the esthetic objective (VTO).

3) Expansion in the buccal segment teeth.

Since the lower incisors and molars are treated as separate segments, an allowance for a natural expansive development in lower buccal segments is created. Quite often, when the upper arch is expanded early in the development of the dentition, a natural functional expansion in the lower arch will occur. Ricketts' rule dictates that for each 1mm of expansion across the canines, 1mm of arch length is gained. For each 1mm of expansion across the bicuspids, or deciduous molars, ½mm of arch length is gained; and for each 1mm of expansion across the molars, 1/3mm of arch length is gained.

4) Saving "E" Space.

In the usual case, some space can be gained when the lower deciduous second molars are lost. The replacement teeth-- the lower second bicuspids-- can allow 2.5mm more or less space as per Nance.

As demonstrated in Table I, in those cases where all of the above can be discriminately used, it is possible to pick up large increments of space with the utility arch. Even in extraction cases, where the deep bite exists, it is possible to either enhance the anchorage available in the case or to utilize more space than the 14mm extraction sites typically allow. It becomes rather evident why the broad range of brachyfacial type cases are predominantly nonextraction and the dolichofacial type cases are oriented more toward extractions. It is the feeling of the authors that it is the utility arch and a slow, deliberate and functional type of expansion that allows a greater number of cases to be treated within the nonextraction range.

Physiological Vs. Mechanical Responses

In order to describe why the lower utility arch is fabricated as it is, it is important to understand the biological or physiological responses that occur when activations of tipback, torque, and expansion are applied to the lower molars; and actions of intrusion, torque, and alignment are applied to the lower incisors:

1) 30° to 45° Tip-back Applied to the Lower Molars.

Due to the fact that dense cortical bone supports the lower molar on the buccal and the relative position of the erupted or erupting lower second molar, a tip-back applied singularly to the lower molars will upright these teeth bringing their roots mesially (the lower molar will tip around a center of resistance near the top of its mesial root) and the crown distally. Since the lower molar is supported on the buccal by a heavy cortical plate and at the distal by the lower second molars, the most usual movement of this tooth with a straight uprighting force is a distal rotation (Fig. 6).

In extraction cases, where there is both a mesial component of force (the retraction section) and an uprighting component of force, a definite distal rotation must be placed to avoid a mesial rotation of the lower molars. There is a difference between the nonextraction case utility arch and the extraction case utility arch. Therefore, in nonextraction cases, fabricating the distal leg of the lower utility arch with definite distal rotation applied to the lower molar will quite often cause an excessive over-rotation of these teeth, due to the nature of the posterior buttress of the second molar and the buccal buttress of the external oblique ridge.

2) 30° to 45° Buccal Root Torque Applied to the Lower Molar.

Anything but passive torque at the lower molar will result in a differential crown-to-root movement. Since the lower molar cannot differentiate between buccal root torque (i.e. movement of the lower molar root to the buccal) and lingual crown torque (i.e. movement of the lower molar crown to the lingual), when a 45° buccal root torque is placed on the distal legs of the utility arch, the amount of movement of the root to the buccal is proportionate to the amount of movement of the crown to the lingual. The center of resistance for the lower first molar (in the frontal plane), is slightly below the cementoenamel junction (Fig. 7). The only way that buccal root torque can be expressed by buccal movement of the root and stabilization of the crown is by expansion of the arch . Both for enhancing the cortical bone support to the lower molar (anchorage), and for regulating or allowing normal arch width, it is important that the distal legs of the utility arch be generously expanded prior to placement in the mouth. As was discussed in the article on orthopedic alteration, expansion of the inner bow of the headgear is also quite influential in defining lower arch width.

3) Long Lever Arms Applied to the Lower Incisors.

When a long lever arm works off of the lower molars, the effect at the lower incisors is a change in torque. If, at placement, there is 0° torque at the lower incisors, as the arch intrudes (moves gingivally on its arc from the molar) there is a slow progressive change to place a labial crown torque (or lingual root torque) on the lower incisors .

The overall effect of this torque change is to bring the lower incisor root back into its area of support, the lingual planum alveolare, and minimize or prevent its further intrusion. This will quite often result in a labial flaring or tipping of the lower incisors (Figs. 8 and 9]/img]). This is dictated somewhat by the original labial inclination of the lower incisors and their relative position of the symphysis, as well as symphyseal type ([img=10]Fig. 10). In the more brachyfacial types of cases, where the lower incisor is more vertically inclined and does not sit high in the alveolar process, root torque at

the lower incisor region has little effect on the intrusion of the lower incisor teeth. Most often these teeth will intrude very effectively. In those cases where the lower incisor is proclined more labially (such as the double protrusion), straight downward pressures to intrude the lower incisors will quite often end up tipping these teeth even further labially. The most efficient intrusion of the lower incisors-- or any tooth, for that matter-- is when intrusive force applied is parallel to the long axis of the tooth. In most cases, a slight labial root torque (5° to 10°) will free the apex of the lower incisor teeth from the lingual planum and allow its intrusion without labial flaring. Cephalometric appraisal of the symphysis size and form as well as the inclination and support of the lower incisor is critical in the intrusive management of the lower incisor teeth .

4) 75 Grams of Intrusive Force Applied to the Lower Incisors.

The mandibular utility arch is best fabricated from .016 X .016 Blue Elgiloy wire in order to create a lever system that will deliver a continuous force to the lower incisors in the range of 50 to 75 grams. The design of the mandibular utility arch is dictated by the requirement that this light force be delivered in a continuous manner off of a long lever arm from the molar to the incisors. The arch is stepped down at the molar, lies in the buccal vestibule, and is stepped back up at the incisors to avoid interference from the forces of occlusion that would distort it. This buccal bridge section is flared slightly buccally to prevent tissue irritation opposite the vertical steps as the arch approaches the tissue and the incisor teeth are intruded.

Although the mandibular utility arch is a continuous arch from molar to molar, it should be considered a sectional arch in its function. Each molar is treated separately as to torque, tip-back, and rotation, as are the buccal segments, as well as the lower incisors (Fig. 11).

Fabrication of the Mandibular Utility Arch (Fig. 12)

1) Step Height (Fig. 12A).

The vertical step height in the lower utility arch is from 3mm to 5mm. The only function of the vertical step is to bring the malleable .016 X .016 Blue Elgiloy wire out of the occlusion to avoid deformation with functional movements. Although the buccal vestibule is most often deep enough to easily allow the 5mm stepdown, problems with tissue irritation can be avoided by keeping the step height at 3mm. Since the four vertical steps in the utility arch are usually formed with a How plier, pliers whose working beak would be approximately 3mm to 5mm should routinely be used in fabricating this archwire. Prior to placement in the molar tube for measurement, the first 3mm step is formed. The distal leg is then placed in the buccal tube and a mark made on the wire about 2mm to 3mm distal of the lower lateral incisal bracket. This space will allow for some alignment of the lower incisors as well as giving the archwire some leeway in fit when it is tied in.

It is uncommon to see gingival or buccal tissue impingement with the utility arch when the step height is correct and the buccal arms are contoured in a proper manner. However, for those patients exhibiting a nervous tendency to catch their cheeks under the buccal arms of the utility arch, or

situations where a swallowing pattern dictates an upward thrust of the buccal musculature (tongue thrusters), it is possible for lacerations of the tissue to occur. Also, as with all other orthodontic appliances, there is a period of adjustment before minor keratosis of the tissue forms to prevent further tissue irritations. If this irritation is noticed, the arch should be removed for a week or two and then replaced. The impingement will usually not recur.

2) Placement of Labial Root Torque.

The wire is bent back up at the mark made distal to the lower lateral incisor bracket and, at this point, while the wire is held by the How plier, rather than being bent straight down and maintained in the same plane of space (Fig. 12B) the wire is bent at a slight inward angle (in the same direction as the curvature of the mouth). When the wire is bent gently inward 10° to 15°, labial root torque is being applied to the anterior portion of the utility arch. Holding the wire at the anterior vertical step, the anterior arch form is then contoured by sweeping the anterior portion of the arch between the forefinger and the thumb (Fig. 12C).

3) Finishing the Opposite Side.

The left side of the utility arch, having been completed, is laced over the lower incisors and a mark made 2mm to 3mm distal to the opposite lateral incisor bracket. Again, a 3mm to 5mm step is made on the right side of the arch. No attempt is made to account for the labial root torque which has been placed in the anterior arch form, but you will notice that the right side of the arch will have a tendency to lie slightly more lingually than the left side of the arch. This can be accomodated for later when final details are applied to the utility arch. By measuring the span on the right side, either in the mouth or from the previously measured left side, the last vertical step is made at the mesial of the opposite side first molar (Fig. 12D).

4) Contouring the Buccal Bridges.

The buccal bridges are then gently contoured with the fingers or with a contouring plier, to account for the gentle curvature of the arch along the buccal segment where the utility arch will lie. It should be noted that oftentimes slightly more contour is needed to circumvent the cuspid prominences. The anterior (torqued) segment of the utility arch is then held with a How plier and the buccal bridges (Fig. 12E) flared to the buccal. This will allow the buccal portion of the utility arch to avoid tissue impingement as the anterior portion of the arch moves gingivally and will also start to place some of the buccal root torque at the lower molars. At the same time, holding the anterior vertical leg of the utility arch, the buccal bridges are generously expanded to assure that a buccal root movement will be applied to the lower molars, rather than a lingual crown movement (as explained earlier in the article). Depending upon the individual case, the distal step of the lower utility arch should be expanded approximately 1cm per side, 2cm overall (Fig. 12F).

5) Activation of the DIstal Legs.

At this time, the proper activations in the distal legs of the utility arch are placed in order to

maintain torque control, to begin to align the lower incisors, and to upright the lower molars. Torque at the lower molars is normally placed by holding the buccal bridge approximately half way through its length with a How plier. The vertical step at the molar is then twisted to the buccal with the fingers to both torque the lower molar, and to further flare the posterior vertical step away from the bulbous tissue which lies at the gingival portion of the lower first molar. If more torque is needed it is usually placed by holding the posterior vertical step and twisting the wire directly at the tip-back (Fig. 12G). Care should be taken to make sure the proper amount of torque has been placed as well as buccal flaring of the bridge and the vertical steps to avoid tissue impingement. The activation to intrude the lower incisors and upright the lower molars (tip-back) is placed by holding the posterior vertical step with the How plier at its last bend. The posterior legs are then tipped back approximately 45° and are symmetrically aligned parallel to each other. As was mentioned earlier, when the lower molar is uprighted, it will also rotate distally, so that placement of a distal rotation bend in the nonextraction utility arch will quite often overrotate the lower first molar. This is very individual, however, and is dictated by the needs of each particular case.

6) FInal Arch Form and Activation Characteristics.

The lower utility arch should have a form unlike any other arch placed in the Bioprogressive Therapy. Its anterior arch form is tightly contoured to the lower incisor teeth. This will allow the lower incisors, especially the lower lateral incisors, to intrude without advancing their crowns (thereby throwing the roots into the lingual planum alveolare and preventing easy intrusion). A 5° to 10° labial root torque will counteract the forward tipping action quite common with intrusive arches and will both bolster anchorage (by virtue of the reverse torque) and allow the lower incisor roots to avoid the cortical bone at their apices. The buccal bridges are flared to avoid tissue impingement and are expanded liberally in order to avoid lingual crown movement of the lower molars. The posterior legs are parallel to each other, and 45° buccal root torque has been placed to maintain the buccal cortical support in the lower molar region. It should be noted that when more torque is placed in the posterior vertical step, more expansion is necessary. The final configuration (Figs. 12H and 12I) of the lower utility arch should be placed over the plaster model of the lower arch to confirm its proper symmetry and construction (Fig. 13).

Placement of the Mandibular Utility Arch

Just as the Blue Elgiloy wire is easy to bend, it is also extremely easy to deform. Even though this type of wire is utilized to deliver proper pressures to individual teeth, care needs to be maintained in placement to avoid loss of some or all of its original activation. When the lower molars are tipped mesially, placement of a 45° tipback without disturbing this activation can be quite difficult. As the arch is placed, the tipback is best protected by holding the entire posterior vertical step of the utility arch (especially the tipback) with a How plier. As the distal leg is seated in the gingival tube on the left side, note that the arch sets at a bias to the occlusal plane on the opposite side, and that the anterior section will start to drop down into the vestibule. Typically, with the help of an assistant, the anterior arch can be brought up to the level of the lower incisors and maintained in that position by the assistant while the other side is seated in the tube. The opposite

side should also be held at the tipback to prevent distortion at that bend. One can then go back and tie in the lower incisors and engage the anterior brackets without unduly distorting the activation (Fig. 14).

If the anterior vertical step impinges in the canine region, it may be gently flared away from the tissue by supporting the buccal arm against the tissue with a finger. This will avoid distorting the posterior vertical step (thereby causing the lower molar to rotate mesially). If there is impingement of the posterior vertical step, the wire should be removed and more buccal flaring incorporated because any intraoral adjustment of this posterior vertical step will cause distortion of rotation, torque and/or tipback.

Intraoral Adjustments

Normally, intraoral adjustments are made on the second or third appointment following initial placement of the utility archwire, and are made on/y if the original activation is not sufficient. Due to the sectional nature of the lower utility arch, and the relative flexibility of the Blue Elgiloy wire, intraoral adjustments to the arch to reactivate desired movements are possible. The plier most often used to initiate intraoral adjustments is the large Tweed (three-loop tier) plier. Special attention and care should be exercised in order to maintain proper incisor and molar control. Improper adjustments can easily distort the overall application of the wire itself. As a general principle intraoral adjustment should be made either parallel or perpendicular to the section which is being reactivated. This will keep the action in the same plane and will not deflect the original torque in the wire.

Activation in the molar area is made perpendicular to the molar section either on the posterior vertical step or adjacent to it on the buccal bridge. The plier must be applied from a posterior direction in order to be at a 90° angle to the molar section. Fig. 15 demonstrates the ideal location of intraoral adjustments to reactivate the mandibular utility arch.

It is important to recognize the impact of step height on reactivation of the utility arch. When the vertical step height is 5mm (or more) and a reactivation bend is made on the buccal arm (Fig. 16), as the tipback is enhanced, the posterior vertical step, in essence, cants backward and increases the effective length of the wire itself. With the 5mm posterior vertical step, this will usually result in an advancement of the lower incisors approximately 2mm per side, or a 2mm forward movement at the incisal edge. By reducing the step height to 3mm, the amount of increase in arch length is cut to 1mm per side or 1mm of advancement of the lower incisors. It should be recognized that intraoral adjustments, although they are quite efficient in reactivating the intrusive effects of the wire, most often result in an advancement of the lower incisors. Intraoral activations should be abstained from where it is critical to avoid lower incisor advancement.

Increasing the amount of tipback by an intraoral activation bend directly on the vertical step itself can effectively increase the intrusive moment of the arch without adding to arch length itself.

Because the intraoral bends are typically placed with the wire tied in, symmetry of the tipbacks

can be maintained in only one fashion. If the Tweed plier is closed on the wire without using its full mechanical closure, the usual result is an asymmetry in activation. Practice on a typodont with the utility arch tied in will demonstrate that a uniform symmetry of the tipback can be maintained if a full measure of closure is applied by the plier.

Incisor Adjustments

Intraoral adjustments to the incisor section should be made on the anterior vertical step or directly adjacent on the buccal bridge. These adjustments to the anterior section should be made parallel to the anterior contour. To accomplish this adjustment, the plier must be placed from the posterior direction in order to parallel the contour of the anterior section. It should be noted that activation closer to the incisors themselves results in a change of torque, whereas activations closer to the molars result in a change in the amount of intrusive pressure.

The authors feel that it is important to learn care and control of mandibular utility arch without intraoral adjustments before reactivation intraorally is conducted. It is, however, an extremely useful mechanism for reactivation of the wire without undue chair time.

Design Modifications of the Basic Utility Arch

Just as the basic utility arch is beneficial as a beginning appliance in Bioprogressive Therapy, whether in an extraction or nonextraction case, it is also a useful appliance in the progress of treatment to maintain torque control, tooth inclination, and intrusion of the incisors throughout therapy. With any approach to mechanics, initial biteopening procedures are quite often followed by a deepening of the bite as the incisors extrude during space closure and/or the molars and bicuspids tip due to the forces of occlusion. Modifications of the lower utility arch are also quite beneficial in advancing or retracting the lower incisors. By simply incorporating loop systems into the basic utility arch, its function can be greatly enhanced as a force delivery system which defines movement of the incisors and molars in all planes of space. Some of the typical variations of the mandibular utility arch which are utilized during therapy are shown (Fig. 17). Use of these arches will be covered in detail when mechanics of the classical types of malocclusions are discussed .

(TO BE CONTINUED IN NEXT ISSUE)

Figures

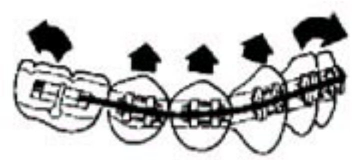

Fig. 1 Dental reactions to continuous round wire with reverse curve of Spee.

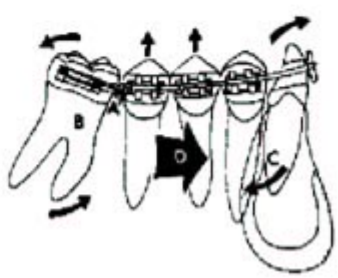

Fig. 2 Dental reactions to continuous round wire with reverse curve of Spee and tieback.

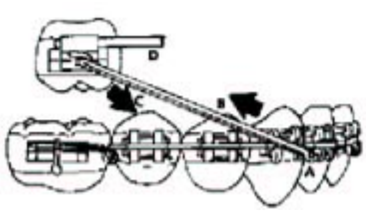

Fig. 3 Dental reaction to continuous round wire with Class III elastics, and hi-pull facebow.

Fig. 4 Support of dense cortical bone and its normal relationship to lower buccal segment teeth.

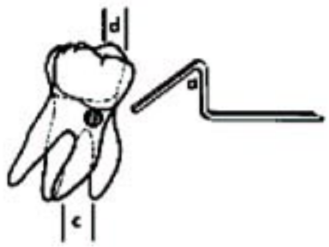

Fig. 5 Uprighting effect of (a) simple tipback on lower first molars shows center of resistance (b) at the gingival base of mesial root. This allows a forward movement of the mesial root (c) and trades space in the alveolar trough for arch length (d

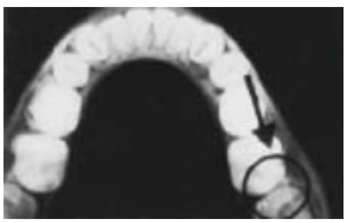

Fig. 6 Arrow demonstrates a common relationship between the erupting first and second molars. Uprighting the lower first molar against the buttresses of the external oblique ridge and the second molar automatically distally rotates the first molar. This needs to be taken into account in nonextraction utility arch fabrication.

Fig. 7 Liberal expansion (2cm) of the lower utility arch allows a center of resistance (a) high enough to minimize lingual crown movement. A utility arch without expansion (b) results in a lower center of resistance and more lingual crown movement than buccal root movement. If the upper molar is not expanded as it is moved distally with headgear (c), the inclines of that tooth force the lower molar lingually as the center of resistance is moved toward the apex of the tooth.

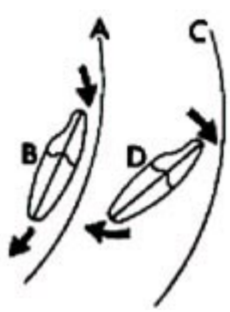

Fig. 8 The arc of intrusion from the lower molar (A) that is parallel to the long axis of the tooth (B) results in a more effective intrusion (typical of brachyfacial types). The same arc (C) applied to a labially inclined tooth (D) results in a further labial flaring and less intrusion (typical of double protrusions).

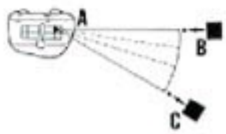

Fig. 9 The utility arch works as an arc (A) off of the lower molar and no torque (B) in the lower incisor region progressively becomes labial crown torque (C) as the incisors intrude. Mild labial root torque counteracts this mechanical response and allows the incisors to avoid the lingual planum of bone.

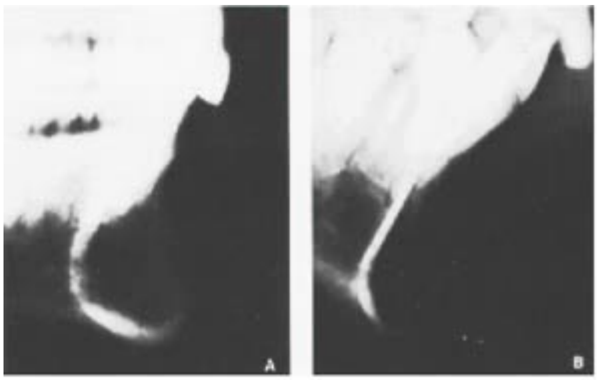

Fig. 10 A. Note relationship of lower incisor root to overall symphyseal form, tooth inclination, and lingual planum alveolare. The teeth are situated ideally for efficient intrusion. B. Dolichofacial case with labially proclined lower incisors sitting atop a long narrow alveolar process. Efficient intrusion in this symphyseal form is difficult at best.

Fig. 10 Note relationship of lower incisor root to overall symphyseal form, tooth inclination, and lingual planum alveolare. The teeth are situated ideally for efficient intrusion. B. Dolichofacial case with labially proclined lower incisors sitting atop a long narrow alveolar process. Efficient intrusion in this symphyseal form is difficult at best.

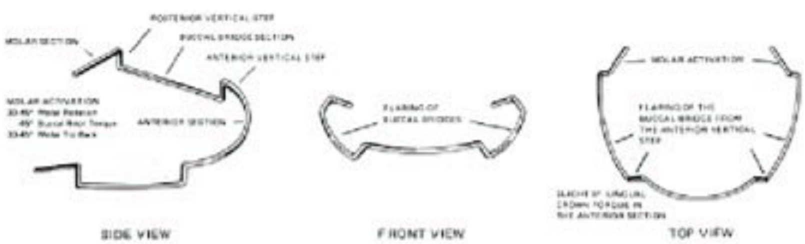

Fig. 11 Mandibular utility arch.

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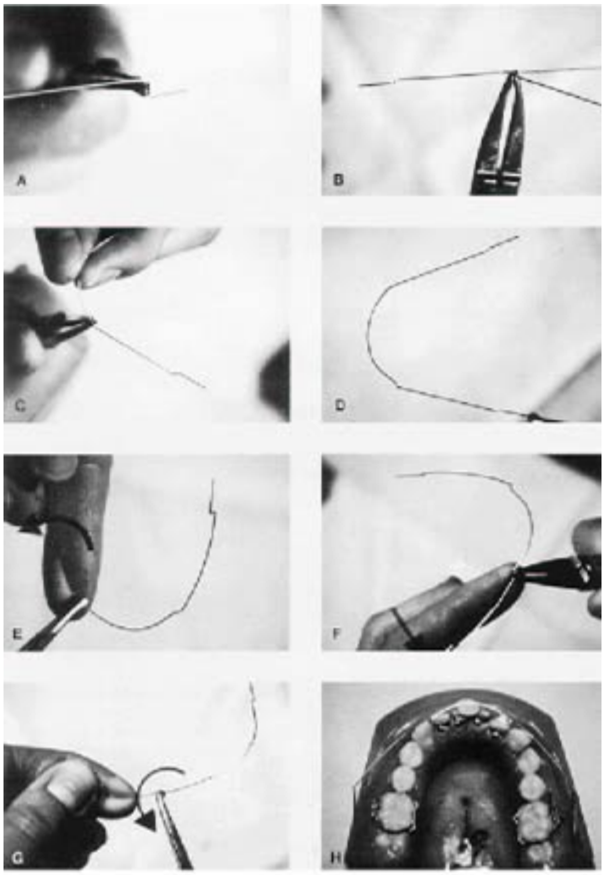

Fig. 12 A-H Fabrication of the mandibular utility arch.

Fig. 12 Fabrication of the mandibular utility arch.

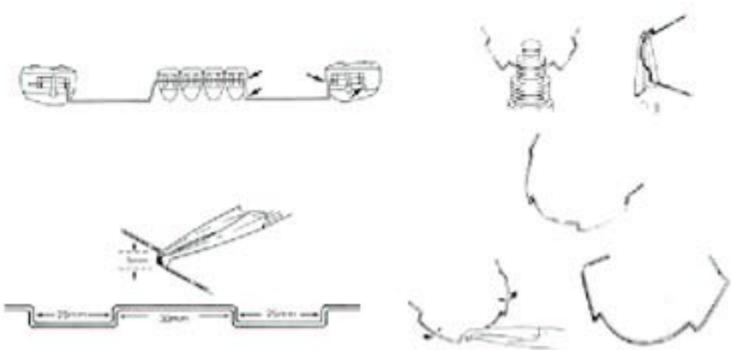

Fig. 12 I Fabrication of the mandibular utility arch.

Fig. 12a Fabrication of the mandibular utility arch.

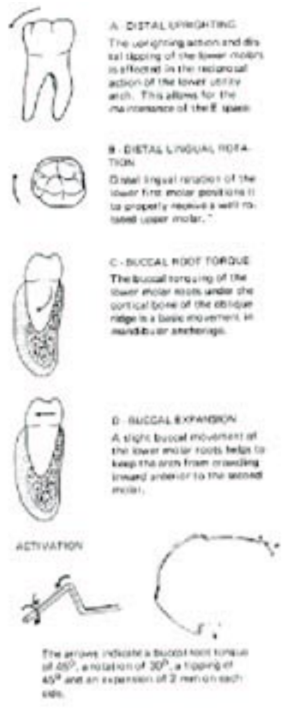

Fig. 13 Purpose of molar activation.

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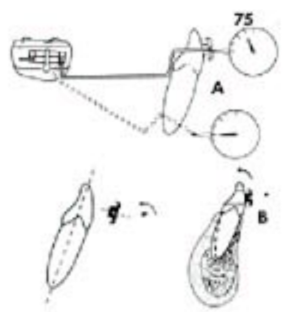

Fig. 14 When the lower utility arch is engaged In the lower Incisors, approximately 50 to 75 grams (A) of Intrusive force should be applied. Slight labial root torque (5° to 10°) allows the lower Incisor to avoid cortical bone in its intrusive movement (B).

Fig. 14 When the lower utility arch is engaged In the lower Incisors, approximately 50 to 75 grams (A) of Intrusive force should be applied. Slight labial root torque (5° to 10°) allows the lower Incisor to avoid cortical bone in its intrusive movement (B).

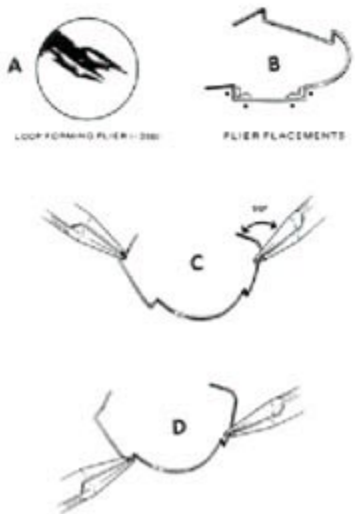

Fig. 15 A large Tweed plier (A) is used to make intraoral adjustments. Plier placements (B). To effectively increase intrusion, plier placement is at the molars (C). To change torque, plier placement is at the incisors (D).
Fig. 15 A large Tweed plier (A) is used to make intraoral adjustments. Plier placements (B). To effectively increase intrusion, plier placement is at the molars (C). To change torque, plier placement is at the incisors (D).

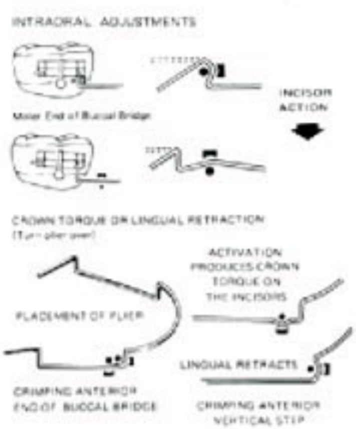

Fig. 16 Intraoral adjustments.
Fig. 16 Intraoral adjustments.

Fig. 17 Typical variations of the mandibular utility arch.
Fig. 17 Source: JCO on CD-ROM (Copyright © 1998 JCO, Inc.), Volume 1978 Mar(192 - 207): Bioprogressive Therapy Part 7: The Utility and Sectional Arches in Bioprogressive Therapy Mechanics.

Tables

Table I Average Arch Length Characteristics with Differential Growth Patterns

	BRACHYFACIAL	DOLICHOFACIAL
1. ADVANCE OR RETRACT (STEINER'S RULE 2:1)	3×2 = +6 mm	3×2 = -6mm
2. BUCCAL EXPANSION (RICKETTS' RULE)	+3.5	0
3. UPRIGHT LOWER MOLARS	2×2 = +4	0
4. SAVE "E" SPACE	+4	+4
5. EXTRACTION OF PERMANENT TOOTH UNITS	0	+15
	+17.5 mm	+13 mm

Fig.