Development of bioprogresive set-ups: -

Prescriptions for the fixed apparatus have been laid down for three variations, but all still use the basic bioprogresive precepts. First is the standard progressive setup; second is the full-torque bioprogresive arrangement; third is the “triple-control” bioprogresive.

Much effort, time, and expense would be required to make a perfect individual prefabricated set up in terms of torque tip and rotation for every tooth. It would possibly be a good practice if, indeed, this were the objective with the final appliance. However, in view of the need for buccal or labial inclinations for anchorage the overcorrection of rotations, and the over treatment of arch and jaw relationships, an absolutely straight wire finishing is not necessarily the goal and arch form is also a fundamental first-order consideration.

Considering the beauty of intraoral adjustments with the bioprogresive therapy, particularly those of a minor nature, the gain to be experienced with absolute torque, tip, and rotation bands, and brackets might be questioned.

**Standard bioprogresive**

As mentioned before, the edgewise appliance formed the basis for bioprogresive development. For the original bioprogresive therapy standardized tipping was studied designed, and modified over a period of years for clinical application (Fig. 5).
Minor adjustments were left in the hands of the operator for individual conditions in treatment and it was thought advisable to tap bands into place and swage them firmly onto the teeth. This is still considered the method of choice.

Torque was built into the upper incisors and all four canines with the standard setup. Originally, the torquing of the lower buccal segment and step bends in the arch for the premolars and molars were relegated to the arch wires. Many clinicians still enjoy this setup because a series of preformed arches was designed which, when placed into inventory, could be applied in the individual situation. In effect, the preformed, prefabricated band, bracket, and arch wire inventory was designed into a complete organized approach.
Full Torque

The torquing of the anterior teeth had already been made, and the only torque still to be accomplished was the lower buccal segments. Studies on patients with normal occlusion, skulls with normal occlusion, and actual practice and clinical experience led to the development of torque combinations for the lower molars and premolars. While new torque designs were made, rotation tubes were placed on the lower molars also. These were added as a first option to the original standardized bioprogressive arrangement (Fig. 6).

Fig. 6

This meant that near the end of treatment, if desired, untorqued wires could be used. Lateral step bends were needed, and even the bends were already placed in the preformed wires. In other words, all torque
requirements had been eliminated in the wire except for the variations needed.

First order provisions had been avoided- because of the need for bulking-up of the brackets, the danger of esthetic and hygienic complications, and the need to prevent lever action against the band itself. However, in view of requests from students and the attraction of straight wire, designs were explored to fit the bio-Progressive technique. It meant the need for three changes from the full torque appliance.

**Triple control setup**

In order to step certain teeth outward, the adjacent teeth would need to step inward (Fig. 7).
First, all the canine brackets would need to be raised to produce the buccal step for the first premolars. Second, because the molar needs to be stepped buccally from the second premolars and in order to obviate the step in the wire, the second premolar is raised so that it will be aligned lingually. The flaring of the upper molar tube to produce rotation of the upper molar was thought to produce needless extension into the buccal mucosa and complicate expansion. Many clinicians have difficulty in placing enough rotation and in remembering to adjust it at every appointment. The third move was to rotate the upper molar tube.

The options for variation in treatment still need to be available, however. For instance, if the patient has a Class II malocclusion and requires extraction of upper premolars only, the upper first molars should not be rotated. In this event, for best occlusion, the buccal section has no gable or bayonet for the molar. This means that the bracket is not raised and the rotation should not be made in the upper molar. If this is the setup in the upper arch, for best fit of the teeth the step bend is not made in the lower premolar area; nor is that tooth fully rotated distally. The original standard setup is therefore superior for these unusual cases. All this means that the individual treatment plan is needed before the orthodontist becomes concerned with which kit of bands is to be employed. There is little difficulty with the anterior teeth because all of that is essentially standardized and the minor variations required can be made very simply with intraoral adjustments. In an extraction case in the lower arch with the first premolar missing and the second premolar moved into the position in the arch normally occupied by the first premolar, a 7 degree torque bracket
would be needed on that; tooth, which means that the technique becomes further complicated.

**Standard bioprogressive (original)**

Let us now list these prescriptions, together with a certain rationale of their use. Second-order and third-order factors are built into the bracket and tubes A for the anterior teeth. First-order factors will be considered later.

**Provisions for tipping (second-order control) : - (Figs. 5, 6 and 7)**

The operator should be able in fitting, particularly with the band driver, to angle the band on the tooth up to 3 to 4 degrees without band distortion. The more malleable band can “draw” this much. Small angulations are too difficult to be seen with the naked eye for premounting, and therefore tipping of at least 5 degrees or more was recommended for prewelds, leaving the finer detail to the technician at cementation.

All bands therefore receive brackets parallel to the band margin except the following:

- **Upper lateral incisor** 8 degrees down on distal
- **Upper canine** 5 degrees down on distal
- **Lower canine** 5 degrees down on distal
- **Lower first molar** 5 degrees down on mesial

The tipping of the bracket (or tube) is a compensation for tooth morphology and natural fit of a band on these teeth. To reiterate, by driving, the band can be adjusted and stretched 2 to 3 degrees of angulation.
Provision for torque (third-order control) : - (Figs. 5, 6 and 7)

Some changes were made from time to time in certain angulations, but again feedback from problems in treatment and results achieved in thousands of cases lead the following prescriptions:

For standard bioprogressive, full-torque bioprogressive, and triple-control bioprogressive

Upper central incisor 22 degrees (root to the palatal)
Upper lateral incisor 14 degrees (root to the palatal)
Upper canines 7 degrees (root to the palatal)
Lower canines 7 degrees (root to the palatal)

For full-torque bioprogressive and triple-control bioprogressive

Lower second premolar: -14 degrees (root to the buccal except in first premolar-extraction case);

For full-torque bioprogressive and triple-control bioprogressive

Lower second premolar: -14 degrees (root to the buccal except in first premolar-extraction cases)

Lower first molar: -22 degrees (bracket or double-tube root to the buccal)

Comments on teeth

Incisors some may believe that 22 degrees of torque on the upper central incisor is excessive. However, a study of problems in initial arch placement in maxillary protrusion cases shows that first arch placement may lead to forward root movement. With the 22 degree bracket, torque is
automatically treated if the square or rectangular wire is used throughout treatment. Overtreatment is most often desirable, especially in Class II, Division 2 cases, and interincisal angles at 125 degrees or less have been found to hold most successfully. This low angle also seems to allow for posttreatment physiologic and growth adjustments without bite closure (Fig. 8)

It is well to drive the upper central incisor band downward on the distal in final seating for two reasons: First, it has a rounded contour which pulls the band in at the mesial call area; second, a 1 to 2 degree tilt of the bracket ensures the slight mesial inclination to help prevent diastemas. The lateral incisor originally was 17 degrees torque and 5 degrees tip. With practical experience, this was changed to 14 degrees torque and 8 degrees tip. Again in seating, the band is driven on the distal to ensure mesial
contouring up to 3 degrees or ending at 10 to 11 degrees, depending on the tooth. The entire issue is to make sure that the alignment of the bracket box is parallel to the incisal edge for function (Fig. 8).

**Canines** The 7 degree torque for the canines was introduced following four studies. First, 200 consecutive retained cases were photographed for occlusogram analysis. All of these were treated with conventional untorqued brackets on the canines. Thinning of labial tissue over the canines, some early recession of gingiva, and roots that appeared too prominent was noted.

Second, studies of intercanine angles were made from 60 degree oblique head films on normal occlusions. It was found that normal canines canted outward and met at 130 to 140 degree intercanine angles. The face of the crown did not possess enough curvature when the band was placed near the center third, where it is commonly located, to supply these angles routinely.

Third, studies of the position of canines during treatment, particularly in adults, indicated that buccal plate could be avoided and anchorage results improved if the roots were contained in cancellous bone. The standard straight bracket on the canine inclined the root too far to the labial and proved to make root angulation more difficult in adult extraction cases. This has also been observed in patients treated by the Begg method. This is one feature or difference in the bioprogressive and Andrews straight-wire arguments. Detorquing can be accomplished very easily near the end of treatment by contracting with r00™ wire if torquing of the central incisors or canines is considered excessive for individual case. However, in my experience, this is quite rare.
The fourth study was also of normal occlusion in skulls and cephalometric frontal tracings. The normal lower canines were slightly inclined laterally and forward. In their proper angulation, they stress down their long axes and therefore possibly support the corners of the mouth better than if the roots are inclined more lingually.

The angulation is 5 degrees standard for mesial inclination of the tooth. In the upper, driving to scat on the distal can add another 3 to 4 degrees. If individual teeth warrant it. Again, the bracket box should be parallel to the mesial and distal contact areas to ensure final occlusion.

**Lower posterior segments**

In the lower arch in ideal normal occlusions, a progressive torque will be noted. These are quite evident in a frontal head film. Studies of sectioned normal skulls suggest that the lower first premolar crown is almost straight upright. However, a lingual crown cant starts at the second premolar. Experimentally and from a practical viewpoint, this angulation averaged about 14 degrees.

The lower first molar was found to average about 20 to 25 degrees, and a 22 degree torque for the bracket or tube was found to be acceptable. Almost a 10 degree difference was observed between the first and second molars. Individual occlusions were noted in which a tube placed on the buccal surface of the third molar was 45 degrees. These torque positions of lower molar roots are highly significant for proper anchorage with bioprogressive therapy. The tipping of 5 degrees (down on the mesial) has been standard and worked out well for 20 years.
Bioprogressive Therapy

Provision for rotation and step outs

First-order control with standard and full torque bioprogressive

It is supposed that rotations of teeth in line with the arch may be considered 'first-order control. Certain of these provisions can be built into the brackets: lower molar, 12 degrees (to the distal); lower molar tube, 12 degrees; all remaining, teeth, as dictated by initial rotations.

The step-out step-in provisions in rising of selected brackets were discussed, with the full triple-control wire descriptions'. They were 0.6 mm. steps, on the average.

Rotation of teeth

Ligation to eyelets was needed for rotation when single brackets were used, although ligature “figure-of-eight” ties for reciprocal rotations have always been used, if available. If slight over rotation is desired with the Siamese bracket, one or all of four procedures may be considered:

The band may be cemented slightly off center, so that a single ligation will cause excessive rotation. This prevents the need for anti-rotation design on a bracket. Only one bracket need to be tied.

One bracket can be filled with an elastic or squashed shut with pliers to produce a block or fulcrum. It can be reopened later with a pin cutter if necessary.

Reciprocal ties or A-elastic chains can be used with Siamese as well as single brackets.

Lingual cleats are placed throughout for counter moments or couples of force which now can be provided from the inside of the arch. These
lingual cleats are highly efficient and are a strong argument for banding instead of direct bonding only to the labial or buccal side.

Because of the lower molar form and the need for right and left precontoured lower molar bands, it was decided to include in the lower molar tube design also a rotation of 12 degrees. This helped to further reduce arch wire manipulation. Again, studies of more than 100 normal and treated ideal occlusions led to this average for the typical setup. Even with this design, straight tubes are used or derotation must be put in the arch wire in one-arch extraction cases. This proves that no appliance, straight-wire or otherwise, can be completely “automatic” and that the clinician must still be in charge.

**Comments on banding of second molars**

There is little question that lower second molars need to be banded, used, and placed in their correct positions in the majority of cases, but it is not always necessary to band these teeth. With the bioprogressive setup, no problem is posed for picking up the second molar, as it may develop often late in treatment. Some I techniques have employed a convertible bracket but, because of the need for two 1 slots (or a double tube), this in itself is complicated. Very simply, with the progressive method a band with a bracket of choice is placed on the second molar. A separate short, straight section or looped section is then employed to rotate or level the second molar by entering the second tube from the distal aspect. This can be done without rebanding of the first molar. If, of course, the second 1 molar is available at the start, the tube is placed on the second molar for routine ideal arch control.
Some orthodontists make an issue of banding second molars, including the upper ones, in every case. Certainly, in finishing treatment of a patient, the final occlusion of the second molar is important because the mesiolingual cusp of the upper second molar has been seen to be involved in cross-mouth interference, particularly in patients treated or developing to flat occlusions or without canine or corner guidance in function. However, studies have shown that the second molar may not reach its normal occlusion with natural development sometimes until the age of 16 years. It is my practice, therefore, to band the upper second molar only rarely, and this is usually for cross-bites and Class III conditions. In many cases, banding the second molar complicates treatment and inhibits Class II correction and may even lead to needless extractions. Observations on thousands of postretention cases show that this tooth will usually drop into normal function on its own. The major exception is the presence of an impacted upper third molar. In this event, the third molar may be removed early or the second molar may be removed if the third molar is large, healthy, and in good position.

If the tooth is banded, a normal upper molar band is prepared, fitted, and placed. The upper second molar normally inclines slightly buccally. If Class II elastics are employed, the canting of the occlusal plane may intrude the upper first molar. In this event, banding of the second molar is advised routinely.

The background and philosophy for development of bioprogressive therapy has been briefly explained. Organized studies leading to biologic forces need and consequent wire sizes to be used have been reviewed.
The prefabricated fixed apparatus or bands and brackets used with technique have been explained. Feedback from treated cases, using intraoral photographs, study models, and particularly cephalometric analysis, has led to the gradual development of the present schemes. The standard bioprogressive setup, the full-torque arrangement, and the triple-control formulas have been described.

With the availability of prefabricated bands and bracket designs, organized in a plan together with performed arches and modules, most of the arch-wire bending at the chair has been eliminated.

With the fixed apparatus standardized for bioprogressive therapy, slight individual adaptation of bands can be made to make it a very efficient and economical procedure for routine clinical use—thus its flexibility. Second-order (tip) and third-order (torque) control are supplied in the bracket and tube design and their prefabrication as discussed earlier.

To reduce time-consuming arduous tasks at the chair while at the same time producing better standardized and controllable mechanisms of superior quality, many recommendations were made for commercial production of arch forms and sections or for rising of certain brackets for a triple-control arrangement

The arch sizes were organized in the bioprogressive system (fig. 9).
Fig. 9. The standard wires preformed to accompany the preformed bands and prefabricated assemblies. These wires come in various sizes and the millimeter reading in that which is measured between the distal aspects of the two lateral incisors in the typical patient. The utility, the double delta, the closed helix, the ideal, and the finishing arches are common sequences employed.

In order to select an arch wire, for the individual patient, a measurement was made from the distal margin of the lateral incisor to the same point on the opposite side and converted to a numbered arch. The system is standardized same numbered arch for each individual can be used throughout treatment without changing sizes in the five continuous arch types provided. In other words, a No. 5 ideal arch size would be followed by a No. 5 finishing arch. The arch types are the ideal, utility, double-delta, closed-helix, and finishing.

Provision in the standardized ideal arch for aid in detailing (first-order control): -

As stated before, the “ideal” arch principle is used essentially to perfect the individual arch. As the upper arch is coordinated to the lower (the lower is the Base) and brought together with intermaxillary traction, a finished occlusion will allegedly result with the edgewise arch philosophy. To help minimize the thickness of bulky brackets and to help simply
inventory and procedures, first-order control (step bends) are provided in performed arches. Loops and controlled activations are needed particularly for efficient treatment. During treatment the ideal arch is employed for near-final alignment and arch form. The essential differences between the design offered here and the traditional edgewise may be seen in Fig. 10.

![Fig. 10](image)

**Fig. 10.** Throughout the evolution of edgewise therapy the edgewise arch took forms, starting with Angle in 1929 (A), described by Wright in Anderson’s textbook the 1930’s (B), by Tweed in his textbook and practice in the 1940’s and 1950’s (C) on to the bioprogressive forms as described by Ricketts in the 1960’s and 1970’s (D) The conventional patterns are fashioned following the trifocal elliptical principle of Brodes and the biparameter catenary curve of Schulhof.

The bioprogressive arch form is characterized by flattening the canine area rather than boxing out at the canine eminence. A slight gable is used mesial to the canines and a definite buccal step is used at the distal aspect of the canine for the first premolar in both arches. Finally, definite step bends (and rotations if rotation tubes are not used) are made for the molars. This includes the lower rotation (12 degree average) as well as the upper rotations.
(15 degrees average). With the bioprogressive method, these step bends may be placed by the clinician technician, or assistant.\textsuperscript{41} with the triple-control bioprogressive setup, these steps bends are essentially eliminated)

**Other Preformed Arches**

The utility arch. This vertically offset arch is employed for a variety of Purpose. It is commonly a starting appliance but can be employed any time throughout treatment.

The double-delta arch. This arch is used for integration of buccal and anterior segments or for space closure following segmented therapy (Fig. 11).

The vertical closed-helix arch (torquing). This arch is used for space closure bat, used upside down in the upper arch, is very efficient for torquing with space closure of upper incisors (Fig. 11). It may, however, be used in the conventional (loop to the gingival side).
Fig. 11. The application of integrating arches. The double-delta loop serves as a spool reducer and is used to level and integrate the arches (A). Note that the intermaxillary traction should be placed over the mesial bracket rather than over the anterior loop is anchorage problems. Too much force on the anterior loop scleroses these teeth and inhibits convenient correction. If the elastic is to the anterior teeth, it should be very light and the total force should not exceed 300 Gm. at any time. For retraction of the upper anterior teeth, 90 Gm. is sufficient for each central incisor and 70 Gm. for each lateral incisor. Intraoral photographs (B and C) before and after activation on Patient K. B. (3-week interval) shows the same setup in actual clinical experience; a “T” series can also be seen. D shows a vertical helix being used for torquing incisors.

The finishing arch (horizontal loops included). This 0.018 by 0.022 inch arch is used for space closure, torque, arch-form control, and overtreatment at progressive debanding. This size of wire is employed because of spaces spanned (Fig. 12).
Fig. 12

**Fig. 12.** Progressive debanding is usually employed, the goals being space closure and overtreatment. The drawings (A) show the setup for extraction and nonextraction. B and C The actual arches in the mouth; the lower loops are opened approximately 1 to 1.5 mm and finishing in Class II cases is usually accomplished by distal retraction of the upper incisors from the pull of intermaxillary elastics off the lower incisors. This will keep the upper buccal segments from jerking forward. If the buccal segments are adequately overtreated, then conditions will permit tiebacks or activation of the upper loops from the stability of the upper molars.

Other auxiliaries in prefabrication and preforming procedures. The laser welded and plastic-covered face-bow.

The quad-helix appliances. Special application of each of these appliances is also needed.
The bumper or buccal bar. This large round wire is adaptable for bumper are in the lower arch and can be used in the upper arch as a traditional “E” arch, particularly for rotation, expansion, or contraction of upper molars.

The lingual retainer bar. This 0.038 inch blue Elgiloy bar is adapted and was assigned for making the 4/4 retainer directly in the mouth.

**Birth of “utility” therapy.** As a consequence, double tubes for the lower molar were designed. The utility arch was born as a new approach to treatment. This arch was so named with the observation that this approach offered a wide range of usefulness and served much as a wide variety of uses in a technique control and treatment of lower incisor overbite by intrusion, therefore, also was introduced as a method of treatment in nonextraction cases (Fig. 13).

*Fig. 13. A diagram of common set up for a class II div 2 cases, Twin buccal tubes and the upper triple buccal tube*

Deep bites could now be treated to the level of the premolars rather than by premolar extrusion. This made anchorage appear in a different light. The true occlusal plane was drawn through the buccal occlusion and not the
bisection of the incisor overbite (Fig. 14, 15 represent a patient treated according to this theory.)

**Fig. 14**

*Fig. 14. Patient S. R., a girl, from the ages of 9 years 7 months to 12 years 7 months. A. The beginning condition of the deep-bite. Class II, Division I, with crowding in both the upper and lower incisors. B. The case after the initial expression of the utility arch and the headgear. Note that the convexity has been reduced from 6 mm. to about 1-5 mm in this stage. The patient still has lip strain; this is the conclusion of the first stage. C. The buccal sections banded, a continuation of the upper headgear, and the patient now ready for canine retraction off buccal sections in the upper arch. D. The case following the use of intermaxillary traction on the buccal sections; the teeth are banded in preparation to overtreatment.*
**Fig. 15**

*Fig. 15.* Patient S. R. A. The over treated stage showing the patient brought almost to an end-to-end relationship with full-banded therapy exercised; the patient is now ready for progressive debanding and space closure. Note the flattening of the denture from now to retention. B. shows the patient wearing a fixed retainer from premolar to premolar in the lower arch. It shows an intermaxillary relationship that is holding and a convexity of 1 mm, together with the lower incisor to the APo plane of 1 mm, which is the peak of the curve of idealism in the treated orthodontic case. C. Frontal view with the nasal cavity narrowed and the upper arch narrowed. D. Frontal head film after treatment showing a good potency in the airway. The patient is holding well in retention.

**Reduction of wire sizes.** By this time the size of the wire was reduce to a 0.016 inch square to be used routinely in the 0.018 by 0.030 inch Siamese bracket. This technique and appliance provided a method for maintaining three dimensional control at all times, especially at the very
beginning. A return of Angle’s original principle of three-plane controlled forces throughout treatment was made. By employing the 0.016 by 0.016 inch blue Elgiloy utility arch with incisor depression, upper incisor extrusion was avoided during space closure incisors traction and intermaxillary traction. Techniques were designed to prevent the elongation of the lower molars (just contrary to the prescribed effect of the Class II activator). In addition, an effort to prevent some of the extrusion of the upper molars was also made in certain open-bite or long-face cases during treatment. New designs in the extraoral appliance were made for checking extrusion of the maxillary molar.

**Summary of bioprogressive development**

Industrial technology in orthodontics led to preformed bands. With the development of prewelds, the field gradually moved away from one simple bracket or tube to a torque-tip rotation setup for individual teeth. With these developments, the same general philosophy was extended into providing preformed continuous arches, performed sections, and predesigned modules to further eliminate work at chairside while increasing control, efficiency and standardization.

As it was realized that orthopedic change was possible and that maxillary alteration could be controlled, new application of the headgear was made. The upper incisors were deliberately not banded until the later phases of treatment. When it was observed that any of the teeth could be intruded, deep-bites were treated in the level of the premolars rather than extruding the posterior teeth which rotated the mandible backward. As it was realized that permanent expansion was possible through the premolar and molar areas and that changes in arch depth could be quite significant to the
prognosis, a whole new attitude developed with regard to sophisticated
treatment planning.

**Anchorage considerations**

Although sixty features of this technique have been listed, for the
purpose of anchorage consideration only five major distinctive qualities are
covered here. These are orthopedic or skeletal alterations, the use of growth,
the concept of cybernetic feedback in planning, and muscle considerable.
Although cortical bone was discussed in Part I, more respect and discussion
for cortical bone is thought to be important enough to warrant further
attraction.

Extraoral traction (skeletal anchorage). The normal lower incisor
varies but balance homeostatically to both jaws (Fig. 16).

**Fig. 16.** The 13-year norm as programmed in the computer. At age 13 there is very
little morphologic difference between males and females. Cut-offs for growth start
at age $14^{1/2}$ for girls while in boys growth continues to the average age of 19. Note
that the lower incisors at -1 to -2 mm. ahead of the APo plane.
The incisor is conveniently measured between pogonion and point A (the anterior limit of the denture base), from which areas the mouth muscles originate. These points change and are changeable with treatment. Thus, the calculation of original anchorage needs is related to two skeletal factors—the mandible (represented by Pm) and the maxilla (represented by point A). The essence in planning is the consideration of skeletal relations that will be present at treatment’s end and at majority together with functional equilibrium of the lips.

A first major factor in the calculation of anchorage needs is the determination of the tooth movement needed for the lower incisor. This calculation starts with the amount of orthopedic change desired in point A or a change in convexity (fig 17).

**Fig.17**

**Fig.17.** A. The composite of a group of thirty-one patients at age 8 years 8 months selected for Class II, high convexity. In comparison to the normal composite for that age the mandible is slightly shorter and reproduced and the maxilla is slightly protrusive, suggesting that class II malocclusion is a combination of both mandibular and maxillary problems. B, A cephalometric setup for the average of that group with 2 years of natural growth added to include changes for 2 years. Note, for the ideal, the reduction of the convexity and the placement of the lower incisors at +1, 22 degrees to the APo plane, which satisfies the esthetic equilibrium of the soft tissues. C, The analysis of changes needed for treatment in the foregoing typical class II case. In the chin growth is downward is downward and forward 5.2 mm. and the facial axis is not changed. The upper molar is moved approximately 4 mm. downward and 2 mm. backward. Note, in b, the alteration of
the palatal and the movement of the upper incisor together with the palatal, as would be exhibit by the use of cervical traction in the condition. In the before and after treatment tracings are superimposed over the corpus axis at Pm. Note that the lower incisor is introduced and brought forward; the molar is shifted forward approximately 2 mm. to account for the arch-form that usually accompanies treatment. Note also the relative change in the cant of the APo plane of point A is brought backward over the chin.

In a growing patient, however, the need for skeletal point A alteration is first contingent upon the amount of convexity reduction caused by mandibular behavior. The learned orthodontist is therefore obliged to make some sort of estimate of ultimate facial morphology at maturity; whether he calls it is prediction, a prognosis, or whatever.

The amount of change desired in the midface (point A and also the soft tissue nose) affects the decision for the choice of direction of force, its duration, and the timing of extraoral anchorage. Certain appliances are not known to affect skeletal behavior; others have been shown to produce effects. The needs decided upon affect the decision for anchorage preparation and amount of force to be employed later with maxillary traction. The convexity factor is to be considered even in simple Class I extraction therapy. Therefore, a cephalometric setup – or at least, the orthopedic thought form—is required in practically all cases for complete sophistication (Fig. 17, B).

**Natural growth as a factor in dental anchorage.** Natural growth expectancy – if understood—is a primary basis for planning. Orthodontics involves a plan for either maintaining or moving the molar teeth. This is obvious in Class II and Class III cases, but even in Class I cases with
extraction an issue may revolve around the amount of slippage forward of molars permitted in space closure (fig 18).

**Fig. 18**

Fig. 18. - Patient M. F., c girl. A, At age 9 there is a Class I malocclusion with open-bite crowded dentition treated with modified secondary edgewise in 1954. B, The effects of intermaxillary elastics with slippage and elevation of the lower molar as a result of space closure and Class II traction. C, The behavior of the occlusal plane as a result of extraction and space closure. If the bite were closed, the occlusal plane would probably have tilted extensively.

Very simply, the effort was made to determine the contribution that growth (or physiologic rotational change) can make toward the correction or to the detraction of the case. Use of the growth forecast plus the added; visualized treatment objective in a graphic form results in the treatment design. From this the clinician may determine whether an arch needs to be moved or left alone.
Mandibular growth contributes to anchorage planning in that the jaw movement through carries the entire arch and thereby reduces lower anchorage need. On the other hand, unfavorable growth or behaviors increases anchorage problems and further complicates the plan. Growth, included in the setup, is therefore equated to mechanical anchorage and is a very real phenomenon. A Treatment design with cephalometrics is quite fundamental even when no growth is expected or when the patient is an adult or a growing child with a Class I malocclusion (Figs. 19 and 20).

**Fig. 19**

*Fig. 19. A, Renderings of Patient S. R. with the arch form and length as copies from the wax impression or the photographic processed copy of the cast as shown below. Note the 4 mm. convexity, the elevation of the lower incisor, and the excessive maxillary dental protrusion. C, A considering of the short-range forecast with the treatment design. D, The long force cut with ultimate arch form and size relationship based upon requirements of the case. Note questionable third molar space.*
Anchorage needs are further complicated by two dental factors: the needs of the upper arch and the needs of the lower arch.

**Fig. 20, A.** The treatment design for Patient S. R., a girl, at age 9.54, constructed from comparisons of beginning, short-range, and long-range prognoses. The treatment alternatives on the right side will be noted, with certain findings programmed for treatment as required by patients of this kind. On the left is a comparison of the esthetics results at maturity. Note that the upper molar is to be moved backward approximately 4 mm. as the chin is growing forward and downward (in position 1). Note from position 2 that the maxilla and upper incisors are moved distally. Note also the change made from alveolar (in position 3). In position 4 the lower incisor will need to be intruded, while the lower molar needs to be stabilized. The treatment plan consisted of starting with the headgear on the upper arch and a utility on the lower arch, followed by continuing treatment with banding on the premolars in the lower and a section in the upper. This was followed, in turn, by a utility on the upper with intrusion and Class 1 intermaxillary fraction on the upper arch, leading up to idealization and finalization with progressive stripping. **B.** The actual analysis of Patient S. R. as treated, showing the strong relationship between the treatment planned by the computer and that actually produced. Compare the computer rendering to the actual changes as produced at short range (3 years as against 2 years in the plan).
**Muscular effects on anchorage.** Another major factor in anchorage is the observation of muscular anchorage—muscle, first of all, from the labiolingual or buccolinguval complex as demonstrated by the bumper techniques but further the kinetic chain of muscles concerned with the opening or closing of the bite and the rotation of the mandible. Physiologic stabilization of the mandible therefore, becomes a part of the consideration in applying a technique for treatment.

It appeared from detailed cephalometric study that the lip was strong enough to interfere the entire dentition to a position more backward than anticipated normally.

Later work in a series of clinical experiments led to the use of 0.045 inch wire placed around the arch and downward toward the sulcus; this was labelled “bumper.” Observations of that technique led to the conclusion that the lower lip alone was effective enough to move the lower molar distally, followed by the drift of lower premolars. This was clear evidence of the effectiveness of the perioral area not only to retract the anterior teeth but a inhibition of forward development of the entire lower denture in anchorage (Fig 21, A). The bumper came to be used infrequently because the utility trades the incisors and increases arch length (Fig. 21, B)
Fig. 21

Fig. 21. A. The effect of a lip bumper in moving the lower molar distally. Note that the 3 mm. of space opened no between the lower second deciduous molar and the permanent molar as a result of the lip force from a 0.045 inch wire covered with and stopped at the mesial aspect of the molar and placed near the crevice third crown of the lower incisor. B. Similar effect on the lower first permanent molar in the patient treated with only the utility arch. Intrusion and advancement of the lower against the lower lip actually moved the lower molar distally, as shown on this.

Cortical anchorage as a fundamental factor. The fifth matter of direct concern is cortical anchorage. Compact bone not only offers resistance to the tooth movement but, conversely, it can be used for anchorage and is recognized and employed to advantage. This is accomplished by situating the teeth behind the heavy compact elements of bone so that the pressure of the root is almost in direct contact with bone incapable of easy backward resorption.

This has proved to be a main source of anchorage for intermaxillary elastics for anchorage for retraction of teeth when it is desired that units within the same arch be moved (Fig. 22).
Fig. 22. A, Case demonstrating the effect of cortical bone on anchorage. This was a full Class II, Division 1 case treated without banding of the premolars. Note the anchor position of the lower molar. At one time 500 Gm. on each side was exercised in intermaxillary elastic pull. B, Torque (22 degrees) double-tube design with utility engaged. C, Another case showing intermaxillary elastics used off the buccally torqued lower molar while at the same time the lower canine is being ligated downward as the upper buccal section it being reduced. D, Upper and lower utilities working to intrude the upper and lower incisors as elastics are employed to reduce the Class II malocclusion. Note that premolars are as yet not banded. E, Buccal root torque on molar also helps to prevent forward displacement during space closure in extraction case. F, Uprighting of molar will tend to occur naturally with normal forces of occlusion, but finishing should be conducted to preparation for this event.

As movements were routinely studied, teeth did not always move as had been anticipated under usual prescriptions. In the analysis of these situations it was discovered that the roots did not move when teeth were brought into high pressure contact with the cortical plate of bone. Consequently, a study was conducted in which cortical bone was investigated at different stages of development. As the lower molar was tipped buccally at its roots and trapped beneath the external oblique ridge of external alveolar plate of bone in the mandible, better stability was observed (fig. 22). Anchorage, therefore, seemed to be effectively enhanced by a
procedure for holding or producing “buccal root torque” while at the same time are slightly expanding.

As the lower molar was tipped distally, the root seemed to be trapped beneath buccal plate and consequently became the anchor site. The crowd was observed to move distally by a tip-back bend on the molar at the same time that it was buccally expanded, particularly with the utility arch free of premolar banding (fig. 23).

Fig. 23 The analysis of Patient R. V., case shown in Fig. 45, A Class reduced by elastics and no premolars banded. A, Before treatment, at age 13 years 2 months. B, after class II traction, at 13 years 11 months. C, Four years later at 17 years 8 months. D, Analysis shows orthopedics of maxilla and only very slight displacement of molar with oral root movement during uprighting.
SUMMARY

While edgewise was the background, sufficient departure from traditional edgewise therapy has been made to warrant a new label, “bioprogressive therapy. It was so named because of the practice of progressive banding and a planned progression of events in sequential order. Eight steps usually form the frame of reference. Ironically, it can be applied in the very young and in the very old.

In order to fully apply the recommendation of the proponents of this method, mechanical forecasting, physiologic forecasting.

Size 0.016 by 0.016 inch blue Elgiloy wire is commonly but not extensively used. Loops or forms are bent in the wire for lighter and more continuous pressure on teeth to be moved. Soldering of auxiliaries has been eliminated as well as the heat treating of wires. The 0.016 by 0.016 inch to 0.016 by 0.022 inch yellow. Elgiloy is used for detailing near the end of treatment. The 0.018 by 0.022 inch is the largest wire employed, and it is used for spanning distances between teeth in the progressive debanding phases.

Anchor teeth are stabilized against cortical bone; hence, cortical anchorage. In order to position and control the teeth behind or away from cortical bone or against away from muscle or to intrude into or extrude away from the bony alveolus three-plane control is utilized. A limited use of round wire employed with this technique except for specific isolated conditions in which there is place for tipping or simple alignment and rotation of teeth. Used as a triple-control technique, the progressive method excels in proper overtreatment and for, delivery of anchorage.
A continuous arc-h is broken up into segments or sections so that movements in desired planes of space are not complicated and anchorage can be shifted in favor of the desired move.

The technique usually involves orthopedic correction, particularly in the maxilla, when such corrections are needed. When this technique is combined with the activator or mandibular posturing devices, an application can be made to provide an anchorage approach to include growth and maxillary and mandibular orthopedics.

Muscle anchorage definitely is considered in anchorage planning and utilized in its fullest application, even to posttreatment rebound.

The leveling of the arch by the extrusion of the premolars is considered to be contraindicated. Thus, intrusion of anterior teeth, either upper or lower, is a practiced art with a bioprogressive technique. With this approach, a tremendously wide range of flexibility is possible, and overtreatment is the byword. This flexibility permits the clinician to overcome tooth-size discrepancies, as overtreatment of a part of the arch can easily be attained.

Another virtue of the “progressive” approach to treatment is particularly thought provoking: absolute standardization is not appealing and is the aim. Rather, a body of principles has been developed. In depth diagnosis, prognosis, and designing are advocated for patient, depending upon his particular individual needs.

Visual objective “designing” with cephalometrics as a reference for planning is strongly recommended, although “intuitive planning” is
Bioprogressive Therapy

practiced with this method as well as others. In applying specific progressive therapy to its greater potential, however, the biologic and mechanical principles are put together cephalometrically for each individual patient only after his unique personal requirements are determined. In this manner, the philosophy and science of orthodontics can be practiced with the spirit of the artist.
UTILITY ARCH

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 bioprogressive 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.

The utility arch was born following the observation of depressed lower, second bicuspids in extraction cases. Following the move to lighter forces into the range Storey’s recommendations from a studies in 1952, it was not until about 1958 that oblique x ray studies showed, with sectional retraction, the lower second bicuspid could not withstand the tipping force against the first molar during unusual space closure.

It has been assumed, based on previous histological work and the ascertains of biologists and histologists in the field, that intrusion of teeth was impossibility. During space closure with loops, however, the canines often tipped backward excessively, particularly with rapid closure. In addition, the molar and bicuspid as a unit both tipped together. Actually, this action intruded the bicuspid.

In seeking a method to maintain an upright position on the lower molar and to thereby prevent bicuspid intrusion and the further collapse of the bite as many had previously witnessed in extraction cases. Ricketts made an attempt to employ the four lower incisors as anchorage in some manner. Single tubes were still in use on the lower molars. So, a simple .016 round
wire was formed as a continuous arch, placed under the second bicuspid brackets and loped over the molar tubes at the end, to be locked down behind the extension of the section retractor. This move before activation put the forward part of the arch downward toward the sulcus and, as it was raised and engaged in the lower incisors, it exerted an elongating affect on the bicuspid as a lever against the molars.

![Fig. 1](image)

Fig. 1 *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).*

This set up served to keep the anchor unit upright. In observing the behaviour of this mechanical arrangement it was soon discovered that the lower incisors tended to tilt forward, but also they were seen-to depress. Careful examination of intraoral x-rays and cephalometric tracings confirmed that the incisors had intruded. This rapid movement tended also to extrude the canine and tip it distally as the sectional was employed at that time.

Simultaneous with that development Ricketts attempted to reduce the wire size and character together with loop designs to keep the force within the 150 gins limit hypothesized then for cuspид retraction. The need for
lighter wires with milder forces had suggested the need for narrower bracket slots. A move down to the .018 bracket was made after certain experiments, and because of the discovered need for a second wire or section to operate in a different plane of space, the dual or double tube was initiated. Also in order to control the flaring of the lower incisors, the force was further reduced and a .016 x .016 blue Eligilogy was designed. Because of the span in the arch designed. Because of the need for a longer level with lighter force, it took the present form of the U arch. A step mesial to the molar was made as a buccal bridge section was formed together with an anterior step to reach up to engage incisors. In the beginning, it was only to be used together with retraction sections in extraction cases.

However after having made the observation of intrusion of the lower teeth, further applications of this design were made. Tipbacks against the molars with light wires began to show also an intrusion of the lower canines. The incisors remained in deep bite as it then became a greater problem to intrude the lower incisors through the depressed canines without again extruding them and tipping them distally. Obviously it was almost an impossibility to work these teeth simultaneously in the most desired positions in both planes of space. The utility arch then became the method of choice as a starting appliance in deep bites or with crowded lower anterior conditions.

Multiple loops were designed to engage the anterior teeth in crowded cases and subsequently it was seen that a wide variety of conditions could be handled. It could be used to gain arch length it could be used to close arch length. The loops could be incorporated at the location of any of the bends because the form of the arch itself constituted long vertical loops on either
It was particularly amenable to intraoral adjustments. For this reason, it was given the name utility arch, simply because of its utility. It therefore became the starting appliance for class II division 1 and class II division
**Fig 3 Intraoral adjustments**

It becomes the appliance in the mixed dentition case in order to avoid most of the need for banding of the primary teeth.

Many clinicians tried to abuse the use of the utility as did Ricketts in the beginning. It is hard to realize that a .016x.016 blue Elgiloy wire will offer sufficient strength and stability to do the job for which it is proposed. Just because the utility arch is a starting appliance, it should be understood that it can be employed again any time during the course of treatment to regain lest overbite due to retraction of anteriors. A wide Variety of stock utility arches are available and can be adapted into routine daily practice.

**Fig 4 Utility Arch**

**TYPES OF UTILITY ARCHES:**

Although many configurations for utility arches have been described four types of arches can be defined, based on their use.

Passive Utility Arch

**The Passive Utility Arch** (Fig. 5) is used for stabilization or space maintenance in either the mixed or permanent dentition. A passive utility
Utility Arch

arch can be used in the mixed dentition to maintain arch length during the transition of the dentition. In many respects, the utility arch acts in the same manner as a lingual arch because the passive utility arch prevents the mesial migration of the molars, particularly in the lower arch. The utility arch also may influence the eruption of the posterior teeth by holding the cheek musculature away from erupting teeth, allowing for spontaneous arch widening.

Fig. 5. Passive utility arch. Note that the posterior vertical segment fits snugly against the auxiliary tube of the lower molar band.

The passive utility arch also is used in the permanent dentition, primarily for the maintenance of anchorage. In non-extraction patients, the passive utility arch is particularly useful after molar distalization has been completed.

In many techniques (e.g., Wilson distalizing arch, NITI coils, distalizing magnets), a large space is opened posterior to the upper second premolars as the first permanent molar is distalized. One of the challenges to the clinician is to maintain molar anchorage while the upper premolars are retracted. In combination with a transpalatal arch, extraoral traction, or a Nance holding arch, a passive utility arch can be used to incorporate the
anterior teeth as anchor units. “Driftodontics” (i.e., tooth movement produced without active orthodontic forces being applied) then are used to allow the premolars to migrate posteriorly without active orthodontic treatment.

Passive utility arches also are used as anchorage appliances in extraction cases. Prior to canine retraction, a passive utility arch that extends from the first molars to the incisors is placed. Canine retraction then is initiated, using the incisors as additional anchor units.)

Activation. No activation of the passive utility arch is required.

**Intrusion Utility Arch:**

The intrusion utility arch (Fig. 6) is similar in design to the passive utility arch, but this arch is activated to intrude the anterior teeth (Otto et al., 1980).

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**Fig. 6. Intrusion utility arch.** A) The intrusion utility arch first is bent passively to the existing occlusion. Note that the posterior vertical segment lies at least 5 mm ahead of the auxiliary tube on the lower first molar. B) Retraction of lower incisors can be produced by grasping the distal end of the molar segment with a pair of Weingart pliers, pulling the segment posteriorly, and then turning the segment gingivally. C) Intrusive forces can be produced by using a loop-forming
Utility Arch

pliers to place an occlusally-directed gable bend in the posterior aspect of the vestibular segment.

After activation, a light continuous force is delivered by the long lever arm from the molars to the incisors. The utility arch should produce 60-100 gms of force on the lower incisors, a force level considered ideal for lower incisor intrusion (Bench et al., 1978). The overall effect is intrusion and possible torquing of the lower incisors as well as a tipping back of the lower molars. Expansion or contraction of intermolar width can be achieved by widening or narrowing the archwire. Molar rotation is produced by appropriately activating the molar segments of the arch.

Activation. Two types of forces can be produced using this design: retraction and intrusion. With a simple utility arch, a modest amount of incisor retraction can be achieved by grasping the end of the molar segment with a Weingart plier distal to the molar tube and then turning this segment gingivally after pulling the wire posteriorly through the tube (Fig. 6B). Care must be taken that the protruding end of the wire does not encroach on the soft tissue of both the cheek and gingiva. This type of activation prevents proclination of the lower incisors during intrusion.

Intrusion of the anterior teeth can be produced in one of two ways. First, the utility arch can be bent passively to fit the existing occlusion, as has been described previously. After ligating the utility arch into the anterior brackets, an intrusive force can be produced by placing an occlusally-directed gable bend in the posterior portion of the vestibular segment of the archwire (Fig. 6C). A loop-forming plier, such as the 881 loop-forming plier (Masel Orthodontics, Bristol, PA), can be used for this type of intraoral activation. These loop-bending pliers must have a concave surface next to
the loop-forming portion of the plier; therefore, not all loop-bending pliers, such as omega loop-forming pliers, can be used for intraoral activation of the utility arch.

Bench (1988) has advocated an alternative method of activation of the utility arch to produce intrusion. This type of activation involves placing a tip-back bend in the molar segment. The tip-back bend causes the incisal segment of the archwire to lie in the vestibular sulcus. The intrusion force is created by placing the incisal segment of the utility arch into the brackets of the incisors. This activation creates a moment that allows for the long action of the lever arm of the utility arch to intrude lower incisors. It has been our experience that placing distal crown torque in the molar segment sometimes leads to a posterior tipping of the first molars. Thus, activating the utility arch by placing a gable bend in the posterior aspect of the vestibular segment (Fig. 6C) seems to avoid unwanted molar tipping. In the case of a maxillary utility arch, tipping of the molars also is reduced through the concurrent use of a transpalatal arch.

Bench (Bench et al., 1978; Bench, 1988) also recommends the placement of buccal root torque in the lower molar region to anchor the roots of the molars in cortical bone. This type of force also produces lingual crown torque that is counterbalanced by placing 10 mm of expansion in the utility arch in the molar region during appliance fabrication.

**Retraction Utility Arch:**

The most common type of utility arch used by the senior author is the retraction utility arch (Fig. 7A). This type of utility arch can be used in either the mixed or permanent dentition to achieve retraction and intrusion of the
incisors by incorporating loops in the archwire anterior to the anterior vestibular segment.

Retraction (Fig. 7B) and intrusion (Fig. 7C) can be produced by activating the retraction arch in a similar fashion previously described for the intrusion utility arch. The incorporation of the loop into the design allows for a longer range of activation. Perhaps the most common use of the retraction utility arch is during the final stages of comprehensive edgewise treatment. In an extraction case in which the canines have been retracted, space opens distal to the upper lateral incisors. In non-extraction cases, a similar but smaller space is often open distal to the lateral incisors due to molar and premolar rotation as well as due to Class II mechanics.

![Fig. 7](image)

**Fig. 7.** Sagittal view of maxillary retraction utility arch. A) Before activation. B) Retraction of the molar segment of the archwire. C) An occlusally-directed gable bend has been placed in the vestibular segment of the archwire to produce incisor intrusion.

A retraction utility arch can be used to close this space by retracting the upper incisors. This arch also provides the necessary intrusion that often
must precede the retraction of anterior teeth.

The retraction utility arch is used less commonly in the mandible. However, it may be used in cases of dentoalveolar anterior crossbite in which there is some proclination and spacing of the lower incisors. In these types of cases, the anterior crossbite can be corrected using a retraction utility arch, while the spacing between the incisors is eliminated through the use of elastomeric chain.

Utility arches also can be combined with bonded orthopedic appliances. For example, buccal tubes can be incorporated into a variety of acrylic splint appliances (e.g., bonded RME, Herbst). A utility arch can be fabricated so that it is anchored posteriorly in the buccal tubes of the bonded appliance and then can be used to move the anterior teeth in all three planes of space.

At this point, a $90^\circ$ bend is placed with a 142 arch-bending plier. A loop-bending plier is used to place a loop in which the end of the anterior leg crosses behind the posterior leg. After a 5-8 mm vertical segment is formed, another right angle bend then carries the wire across the anterior teeth. A gentle anterior contour is placed in the wire to simulate arch form, and an offset also is placed in the canine region.

On the other side of the arch, the anterior vertical step is created in the interproximal area between the lateral incisor and canine. The retraction loop is formed with the loop-bending plier and then the loop-bending plier (rather than the arch-forming plier) is used to create the $90^\circ$ bend in the horizontal vestibular segment. The wire then extends to the posterior vertical segment at the middle of the second premolar. In most instances, the length of the
horizontal vestibular segment can be estimated, based on the length of the horizontal segment on the opposite side. Care must be taken to make sure that the utility arch does not encroach upon any fixed appliances present, including ball hooks or Kobayashi hooks.

Activation. As with the intrusion utility arch, there are two possible types of activation. First, a Weingart plier can be used to grasp the extension of the utility arch posterior to the auxiliary tube. The wire is pulled 3-5 mm posteriorly and then bent upward at an angle. Care must be taken that this protruding end of the utility arch does not impinge on the cheek or gingiva. Second, an occlusally-directed gable bend in the vestibular segment can be used to produce intrusion, as has been shown previously in Fig. 7C.

**Protraction Utility Arch:**

The protraction utility arch (Fig. 8) is useful for proclining and intruding upper and lower incisors.

**Fig. 8.** Protraction utility arch. Note that the posterior vertical segment is flush against the auxiliary molar tube. When passive, the anterior portion of the utility arch should lie approximately 2-3 mm ahead of the incisor brackets.

In the permanent dentition, it is used commonly for proclining and intruding maxillary incisors in Class II, division 2 cases, especially in
patients with an impinging overbite (Fig. 9).

Fig. 9. Movement of upper incisors using a protraction utility arch. A) Simple flaring. B) Protrusion and intrusion.

This archwire is used to provide clearance between the upper and lower incisors to allow for placement of brackets on the lower dental arch. The protraction utility arch also is used during the presurgical orthodontic phase of treatment in patients undergoing a mandibular advancement to decompensate the position of the upper incisors.

This type of utility arch also is used during the mixed-dentition period prior to functional jaw orthopedic appliance therapy. In the case of Class II patients who have retruded upper incisors, brackets can be placed on the upper anterior teeth, and bands can be placed on the upper first molars (perhaps supported by a transpalatal arch). A utility arch can be used to procline and intrude the incisors as necessary. Often a simple intrusion arch without loops is needed in the lower arch.

The anterior vertical step is usually 5-8 mm in length, depending on patient tolerance. The incisal segment courses through the incisor brackets, and the utility arch is completed in a similar fashion on the other side.

Activation. When the protrusive utility arch is passive, the anterior
segment lies about 2-3 mm anterior to its ultimate position in the incisor brackets. The protrusive force is produced by tying the anterior segment of the utility arch into the anterior brackets. An occlusally-directed gable bend in the posterior aspect of the vestibular segment is used to produce intrusion.

The protrusion arch is reactivated by removing the anterior segment from the brackets, bending the posterior vertical step forward from 90° to 45° and replacing the arch wire in the brackets. Other adjustments can be made in both the anterior and posterior vertical steps to produce further activation.

**CLINICAL PROBLEMS**

By far, the major complications associated with the use of utility arch involve the soft tissue. One of the major difficulties in fabricating the utility arch, whether it is for the maxilla or the mandible, is in placing the horizontal vestibular segment between the gingival and buccal tissues. If the posterior step is made too long, or if the horizontal segment encroaches on the gingival tissue, the wire can become embedded easily. If the horizontal vestibular segment is placed too far laterally, tissue irritation and the buildup of fibrous tissue along the inside of the cheek can occur; In instances in which tissue irritation occurs in the areas adjacent to the vestibular portion of the utility arch, clear or grey sleeving (“bumper sleeve”) may be used to shield the tissue from the edges of the wire.

Another major area of concern is the formation of the loops of the retraction utility arch. If these loops extend too far into the vestibular area or protrude anteriorly, severe irritation can result and patient discomfort can occur. The patient should be given wax at the delivery appointment to aid in
the break-in period after the utility arch has been inserted.
THE QUAD HELIX APPLIANCE

(Innovation by Dr Ricketts)

The quad helix appliance is an evolution from a type of vulcanite appliance originally advocated by coffin. The plain w arch expansion palatal type of appliance originally was used by Ricketts to treat cleft palate conditions. It was particularly advantageous because more action could be gained in the anterior area than in the posterior area (or the reverse could be true depending upon the activation). Many problems were encountered in its early use, particularly when it was made in the laboratory on the cast. Very often the .040 gold wires employed originally would be annealed at the site of the solder attachment and the forces of occlusion would distort the appliance. The general form of this palatal appliance is similar in form to the basic Crozat maxillary appliance. Also about this same time in 1947, a button was being placed on the palate with half round tubes for the use by Nance for holding arches. Ricketts modified this by placing loops for back action and building in active rotation.

In the beginning it was assumed that this was simply a dental appliance but after the advent of suture splitting, Ricketts studied many frontal head films of patients treated with the appliance which suggested that nasal cavity had widened more than the normal growth expectations.

In order to widen the range and yield more flexibility Ricketts incorporated helix loops in the posterior loops at the start. Later two more were employed in the anterior part of the palatal arch. With the advent of preformed bands, it was decided that the appliance could be made directly, just as it could be formed in the laboratory. Because the appliance would be
reactivated before insertion, it was not thought necessary, to be adapted in the absolute manner as would be on the cast. Therefore the notion was formed that this could be performed and prefabricated which would assist in quality control, standardization and efficiency in operation, and it was labeled the quad helix as descriptive of the four loops.

![The quad-helix](image)

**Fig1. The quad-helix**

In the beginning, it was called two in one, three in one or four in one appliance. Because the appliance is made with preformed bands with tubes previously mounted, it can also be used (after it has been deactivated) for a face bow attachment. Used passively and without activation, it can serve as a holding appliance. However, with the arms usually expanded resting against the lingual surface of the crowns of the upper canines or at the cervical margins of the tooth, it is usually considered to be an expansion appliance plus a rotation appliance.

When a palatal bar is constructed forward and bent downward in the mouth, it also may serve as a thumb sucking habit breaking appliance. If spikes are introduced against the anterior section and pointed downward in the space between the teeth, it is used as a thumb appliance.
If light spikes are soldered on the bar and extended downward, it can serve as a tongue thrust appliance. It can also be used as an anterior bite jumping appliance, or an appliance to unravel the crowding in anterior teeth when lighter palatal wires are extended to the anterior teeth. The basic appliance, therefore, has many uses and many forms or adaptations and is remarkably efficient.

Recent Research-

Dr Ricketts mentioned that the quad helix appliance exerts a palatal suture widening effect. It is slower and not as dramatic, but it separates the suture in pace with the speed of new formation of bone. As the frontal section of the laminograph x-rays were studied by Dr Ricketts, it appeared that new bone remodeling took place at a slower pace.

It appeared that after six months the effects of the jackscrew and quad helix were similar in extent of final nasal floor involvement.

One of the problem that was encountered with the use of the quad helix appliance, particularly used with excessive expansion, was that of tipping of the teeth outward. This could be guarded to some extent by torquing the roots buccally.
A fault with the use of the quad helix clinically is that the movements are often not excessive enough and are not retained long enough. A relapse in palatal expansion is often seen in the absence of improved nasal function, particularly when the tongue remains low in the oral cavity. Another hazard with this type of appliance was that it restricts space needed for the tongue. Care should be taken to adapt the wire at the time of cementation and the original activation and adaptation should be within 2 or 3 mm of the palatal tissues.

**Practical application-**

The following procedure was employed by Dr Ricketts for application of Quad Helix:

a. Bands were placed on the upper second deciduous molars for the very young case or the first permanent molars. Particular care was taken to adapt the lingual surfaces of the bands because this was a strong purchase area for this appliance.

b. The most appropriate preformed band was selected. These sizes after research were designed in .038 Elgiloy. The objective was to develop 500 grams of force for orthopedic movement when desired. Also the .038 Elgiloy facilitates intraoral adjustment. The original cast was used and the wire is formed with the fingers together with the three prong pliers to adapt the wire to the needs of the patients.

c. A white wax marking pencil was used to mark the soldering spots on the wire immediately in front of the posterior loops, depending upon the adaptation of the arms of the appliance.
d. A solder stick was used to flow the solder on the wire. The band was picked up in the tongs and approximated as the low fusing solder was flowed into the position.
ge. The amount of activation desired was placed on the wire.
f. The appliance was cemented, making sure the bands were well seated. There is reciprocal action, so the appliance must be activated during the cementing procedure.
g. A wide three prong pliers was used for final adaptation and activation.

![Fig. 3 Initial activation of quad-helix appliance for insertion.](image)

**Clinical Management**

A six week interval was usually observed before any further activation is needed. At the second visit, intraoral adjustments were made following which another six week period was observed. Activation was made by placing the pliers directly anterior to the posterior loop. The anterior arms can be adjusted independently of the molar activation by placing the pliers anterior to the molar.

Widening, contraction or uprighting the molars could be activated by pinching between the anterior loops. Usually only a little activation was made of the anterior arms and the wire is left out of contact with the anterior teeth until molar rotation was achieved. This was one of the outstanding features of this appliance because molar rotation is most often a problem.
Upper molar rotation could be gained immediately. Space was also gained very soon for the erupting side teeth, particularly the crowded upper lateral incisors.

**Indications**-

Several particular conditions thus seemed appropriate for this appliance by Dr Ricketts

1. All cross bites in which the upper arch needs to be widened.
2. Cases needing mild expansion in the mixed or permanent dentition, which frequently exhibit lack of space for the upper laterals and in which the long range growth forecast is favorable.
3. Cases of class II in which the upper arch needs to be widened effectively and the upper molar rotated distally.
4. Class III conditions in which the upper arch needs to be widened and advanced with class II elastics.
5. Thumb sucking or tongue thrusting cases with its various modifications.
6. Cleft palate conditions either unilateral or bilateral.

![Quad Helix Appliance](image.png)

**Fig 4 Quad helix Appliance**
EARLY TREATMENT

Stages of Early Treatment

For teaching and organizational purposes, Ricketts divided the subject into four phases. The first phase of treatment is called “Preventive”. The first approach to “early treatment” is in the deciduous or primary dentition, or even earlier.

The second phase is in the mixed dentition, and called as “Interceptive”. The interceptive label applies because the clinician is intercepting the development or eruption of the teeth during the transition from the mixed to the permanent dentition.

The last two categories are not “Early”. The third phase is “Corrective” in terms of having available the permanent teeth to manipulate. This is a popular course to follow for those using multibanded or tooth-bearing appliances. Ricketts mentioned that some orthodontists like to wait until the 12-year molars are erupted to start treatment. When this is the situation, the initiation of the corrective phase may be detained up to 15 or 16 years of age because patients often experience delayed eruption of the upper second molars and very late development of the upper thirds.

The last stage is called “Rehabilitative” because it applies to the adult. Rehabilitating a case with no growth or little potential of physiologic change falls in this category therefore, under adult orthodontics. Adults take a much different approach.
Interceptive Orthodontics

It is approached, particularly in the mixed dentition as space is made for eruption of the permanent teeth or orthopaedic alteration of jaw bases is attempted.

The youngest patient that Ricketts has ever treated was one week of age. In some cleft palate patients a restraining device is used against the premaxilla within the first week of life. There is a question about the wisdom of doing this routinely, and he did not recommended it except in very extreme cases in which inadequate lip tissue is present or want to wait for growth to give the surgeon a better opportunity with a larger bulk of tissue.

Patient in the Deciduous Dentition

Ricketts did not try to work with any teeth until the second deciduous molars have erupted. This tooth usually erupts at about age two and one-half, and the roots are fully formed at about age three. But there is another factor which influences the clinician to delay starting patients until age four or five years, and it involves the practical control and clinical management of the very young patient who is quite sensitive.

Records at Start of Treatment on Such Young Patients

Frontal and lateral headfilm, laminagraphs on sides, a panoral film, and photographs. Failure to diagnose and prognose at this age is one of the big mistakes.

The Nasal Airway Problems and Lack of Function

Most orthodontists and researchers in growth simply haven't looked at the nasal cavity as a vital vegetative part of the face and talk about the oral
cavity as if it is independent of the development of the first branchial arch and independent from respiration. Biologically, the functions of mastication and respiration have been connected with the same set of muscles and the same set of nerve paths.

In frontal headfilms, a small nasal cavity on one side and a larger one on the other side is seen. It may be that the patient had a unilateral obstruction and see the whole maxilla sucked inward and upward on that side. The best place to start is by taking routine frontal headfilms and look for symmetry of the nasal cavity. This is one of the primary uses of the frontal headfilm. Figure 1 demonstrates the effects of removal of adenoids, palatal expansion, and orthopedic headgear.

![Fig.1](image)

**Fig.1.** A. Female, age 7.8 years, adenoid patient with bilateral lingual crossbite. Note adenoid, low tongue, and upward cant of palate. B. Note narrow nasal cavity and narrow molars and position of unerupted canines. C. Rest position, showing habitual wide space and parted lips for oral breathing. D. Same patient at age 10.2 after adenoidectomy, palatal widening, and cervical traction. Note level of palate, closed lips, and elevated tongue. E. at age 10.2, note 6 mm increase in width of nasal cavity (from 25 to 31mm) in just over 2 years. F. Patient at finishing stage of nonextraction treatment, almost 13 years. Note normal airway.
**Microrhino Dysplasia**

Dr Ricketts mentioned that if the nasal cavity isn't developing properly, the tilt of the palate will frequently be elevated in front, as if it has been stopped in its vertical growth in the anterior part.

The lack of function in the nose seems to hold the front of the palate upward or prevent its downward descent. In these children clinically, you look right in their nose holes and the whole nose appears to be higher relative to the orbits.

A microrhino case (microrhino meaning small nose or small nasal cavity) will develop on its own from lack of function of the nose. Also the palatal growth inhibition as a result of certain kinds of vigorous thumbsucking in which a patient gets the whole shank of the thumb up into a markedly open bite and actually inhibits the downward dropping of the palate anteriorly.

The microrhino’s patient who has a thumbsucking habit is a very good prospect for us to manage orthodontically with extraoral traction, particularly with the Kloehn headgear. Palate can be brought down and tip backward to correct the malocclusion. It can also be done with a skeletal change rather than doing it by movement of the-teeth. It could come from allergies and asthma or even potential adenoidal obstruction.

An imbalanced facial height results in the untreated child. Nose is short, the nose tip is upward, the nostrils show, the upper facial height is short, and the denture height is extremely long. These cases are very difficult to treat later without surgery in the maxilla because of the extreme distance.
from the anterior nasal spine to the chin, requiring a stretching of the lips and creating unbalanced strain over that dentition. Later, with large denture height, teeth often are extracted or held backward; and still the patient ends up with mentalis action to compensate for the high denture height. Even with extraction, these patients still possess gummy smiles, the denture height and lip line do not match.

**Importance of Tonsils and Adenoids**

Ricketts theorized in the 50’s: adenoids could lead to an opening growth rotation of the mandible, and dealing with not only an inhibition of maxillary growth but also an alteration of mandibular growth in a patient who is effectively obstructed in the nasal cavity. With this kind of information, a very strong recommendation, particularly when patient’s x-rays confirm the diagnosis can be done.

**Recommendation in thumbsucking patient with a Class II, Division 1 protrusive malocclusion in a mixed dentition, an open bite, a tongue thrust.**

Dr Ricketts advised first to get adequate full records and study the case in terms of arch length and in terms of an assessment of the nature of the problem. For the history, inquire into the type of thumbsucking the patient is doing, perhaps even talk to the parents in private with regard to their attitude and what the child's home environment is. Then the records are processed and after the prognosis is made, using the long-range forecast get a frontal and lateral assessment with printouts to get a forecast of the patient's probable growth and a visualization of what the corrected face should look like. This then provides something to use as a feedback to make the decisions.
Start that patient with the quad helix appliance to which some spurs may be added if necessary. He started the rotation of the molars, the widening of the arch, and the Class II correction with that appliance, all at the same time. Then, as a second objective, he would suggest that this patient be treated skeletally so that the patient will have the opportunity to express normal development through the mixed dentition.

**Application of Headgear to Deciduous Molars**

Ricketts used it on both deciduous and permanent molars. He used a headgear on the upper second deciduous molars. If the upper second deciduous molars are fully formed at the age of three and last until the age of ten, we can put headgear on them just the same as we can put it on the first permanent molars and the same orthopedic effect is achieved as later with the first permanent molars, because the facial bones of the juvenile are more responsive and there is a mandibular growth spurt at that level. Headgear at about the age of four or five in a Class II malocclusion treats the malocclusion rather rapidly.

**Pressure Factors**

Ricketts stated that fifty (50) grams is light, one-hundred fifty (150) grams is considered intermediate force and five hundred (500) grams is for orthopedic treatment. The force applied is 500 grams a side, which means that you have 1000 grams total on the back of the neck.

**Early Intervention and Early Treatment**

Ricketts made a clear distinction between the goals and objectives of early treatment versus later treatment. A distinct objective of the late treatment in the permanent dentition is occlusal perfection. We can have the
opportunities in the mixed and in the deciduous dentition ages to make skeletal changes and to utilize growth and to intercept habit patterns and functional patterns that we will not have at a later stage.

Dr Ricketts made a clear distinction between the concept of setting up the jaws at the young level rather than setting up teeth at the late level. The permanent stage is left for refinement and finishing, rather than for the gross treatment of malocclusion. The tissues will show the difference between the two concepts and the stability will also be more than gratifying when comparisons are made.

In conclusion, he believed that early treatment can save the teeth and at the same time produce esthetics of the jaws as well as the teeth, accomplish optimal function before its too late and achieve remarkable stability.
HEADGEAR

Headgear traction is often a primary appliance or a starting device even at the permanent dentition level. Although a simple face bow appliance seems simple, it is a much more complicated tool than often considered. Great inconsistencies, differences in design and application have resulted from the lack of knowledge of the possibilities and advantages of these procedures.

EVOLUTION OF EXTRA-ORAL TRACTION:

The use of extraoral force is about 100 years old. The head cap” was described by Kingsley in 1866 and Farrar in 1870’s. However its objective was limited to retraction of upper anterior teeth as an outer brace was attached to labial arch bow engaged in crude bands or other forms of attachment to the anterior. The “caps” were formed from leather strips or cloth.

Angle in 1888 recommended that it be worn during the sleeping hours. Intramaxillary elastic rubber bands were used for traction by day. The use of this appliance was limited to maxillary dental protrusion in patients following upper first bicuspid extraction. By 1888 Goddard formed forerunner of head gears attached to rubber positioners currently used sometimes.

In 1898 Guilford talked about directional pull by activating rubber strands of the “skull cap” above or below the ear and his cap designs of 1 inch strips were grossly similar to many now in use.
Thus, up through the turn of the century extra-oral force was the main source of retraction of protrusive incisors.

By 1921, Case had extended the application of extra-oral therapy. Angle at the same time was looking more toward intra-oral or intermaxillary traction (Bake anchorage) and preserving the upper bicuspids. Case went on to describe three different extra-oral applications, all of which employed “sliding buckles for least possible discomfort”. First, was the usual directional pulls up the long axis of the maxillary anterior following maxillary extraction. Second, was an attachment to the lower anterior, to be used in open bites or protrusive conditions, also after lower extraction. Third and here is the first solid mention of upper molars to be moved distally the labial bar was extended, to the bicuspid area on the dental arch wire and forced the molars and entire arch backward (Much like Fisher mentioned later.) However, in the meantime, Angle had apparently won. For the next 15 years, great emphasis was placed on intermaxillary traction and full banding of teeth was initiated by Oppenhiem from Vienna, also in 1936. Although Oppenhiem presented his findings in 1936. the first cephalometric analysis of treated cases was presented by Brodie and the Illinois staff in 1938. It was determined that orthodontic treatment used at this time had little effect on structures other than alveolus and successes could be usually explained by holding of the maxillary dentition while growth of the mandible occurred.

Despite the theoretical opposition work started to be exhibited to show the effectiveness of the “head cap”. Kloehn reported at an Angle meeting in 1947 and made certain speculations from models and facial photograph records. Nelson in 1950, and both Nelson and Jerabak in a 1952 Tweed
meeting showed changes with cephalometrics. However, by now several different types of usage were emerging and became confusing to clinicians.

1. Recognizing the need for downward pull at the ends of the outer bow, Ricketts working with Downs applied only the neck strap portion of the Kloehn head cap. This was followed by Downs designing a full elastic neck strap or the cervical anchorage still popular today. Kloehn in the meantime also used only the neck strap.

2. Others came to attaching extra-oral traction to hooks on the arch wires with anterior teeth banded, some were attached to a neck strap which elongated the anterior teeth and closed the bite more severely. Others attempted a straight pull off the arch wire from the head cap, but still
used no face bow (Jarabak 1951). Still others chose to attach a smaller dental bow to the edgewise arch wire in the bicuspid area and used the neck or head for anchorage, as many now use it with the full banded appliance.

3. Finally, the full arch was banded and “high pull” was reintroduced to intrude the upper incisors.

Among all these methods, the Kloehn approach, with the neck strap he later adopted, became the method of choice. With cervical traction only arch length benefits even an the lower arch were appearing, Debates occurred as to the benefits of bite plates being used in conjunction with the headgear. Facial changes were often spectacular, but remained controversial.

All through these years the headgear appliances were being hand made. Brass wire was wrapped around the dental and face bow contacts to
act as a soldering assembly, the ends remained flexible and force applied at the apex of the arch moved the molars sideways and contributed to arch expansion. Beads of solder were employed as stops against the molar tubes.

In order to prevent distal tipping the outer bow was extended upward, to the level of the tragus of the ear, This also caused molar extrusion which aided in bite opening. A change was made from this tube set-up. However recognizing the problem of molar extrusion, 045 tubes were switched to a gingival location and bent bayonet stops were made with three-prong pliers.

By 1955 the face bows were being made commercially. In order to add stability and prevent breakage, two errors were introduced. One, the dental bow came to be made much too inflexible or rigid. Two, the dental arch was bent on a radius too small for a normal arch. Obviously, they were designed by men disciplined in extraction therapy and arch contraction.

Clinical research led to contraction and expansion type head gears for specific purposes. Arch changes were observed which could not be accounted for properly, such as spacing of the upper anteriors and width increases in bicuspid. However, other biologic factors now entered the picture. By 1955, Ricketts recognized maxillary change beyond the alveolar process and started building it into the objectives and treatment plan projection. Working with Klein, a series of cases clearly demonstrated alterations of growth behavior of the nasal floor. These were accumulated until 1960 when Ricketts compared 100 non-treated cases to 100 head gear cases over a period of 30 months, and in which strong forces were employed. The findings of Dr Ricketts study regarding behavior of the palate and point A with head gear treatment were eleven times greater than necessary to be statistically significant; It was no longer an argument.
Careful study of the frontal and lateral headplates showed sutures widening and in some patients an opening of the frontonasal suture was noted with plain Kloehn face bow use. Finally, the nasal cavity was observed to widen under the influence of cervical anchorage when the molars were given the chance to widen and a continuous arch was not present to inhibit maxillary separation. In addition, the palatal tipping downward anteriorly rotated the nasal floor backward. The anterior area and nasal spine took the soft tissue nose with it.

In order to gain space for this action in the maxilla, the lower incisors came to be deliberately overintruded in many deep bite cases. All this time Ricketts recommended only 14 hours of wear during non-school hours, and no bite plates were employed.

At about the time of the foregoing observations, Schudy and others recognized undesirable rotation of the mandible and an anti-Kloehn Moye took place. In order to encourage forward chin behavior, the neck strap was replaced by an oblique upward pull above the ear. This helped intrude the molar. Ricketts had tried this approach in a few patients in 1956, but he observed the Class II correction to be not as rapid and perhaps the patients were not good examples, may be the force was not great enough or continuous enough. At any rate, his results were not impressive in prevention of severely long facial pattern growth (over a long period of time).

Several factors, therefore, needed to be taken into account in the design of a new Ricketts’ headgear, The features and uses are listed.

1. Observations over a period of two decades have led to the conclusion that a neck strap force of 500 grams will produce orthopedic effects
This meant a strong bow, unannealed, to prevent bending or breakage and laser welding was introduced to control the wire properties.

2. The closer to the centroid of the root the force is applied, the less the extrusion forces will be needed.

3. Banding the anterior teeth and placing a continuous arch tends to bind the two halves of the maxilla together and prevents convenient permanent expansion. If these teeth were banded, the continuous arch wire was not to be used, as the dental bow can rest under the incisal bracket wing. The dental bow is progressively expanded as it is light enough to flare under tension.

4. An extra anterior elastic is not employed except on a very limited basis because of the needless throwing of them into overbite. The dental bow is engaged directly against the anterior teeth at the gingival 1/3. This helps move the total maxillary complex. In order to prevent shock on the anteriors a plastic covering of the laser weld was designed. Esthetics was also a problem and a reason for the plastic covering.

5. The inner bow was constructed “for center ground .05 tapered to a .045. This insured stability of weld and provided delicacy and flexibility and less discomfort to the molar teeth.

6. Progressive rotation of molars was needed. The dental bow material was made ductile and capable of numerous bends without breaking.

7. The inner bow also may serve as a ‘Lateral bumper’. This meant a larger radius for the anterior curve and also required bayonets to be bent inward thereby keeping the dental bow outward and freeing the buccal teeth of cheek or lip contact to permit natural development.

8. Wide variation in arch width is experienced. Two designs were made
one for either deciduous or small permanent extracted arches and the other for normal and large arches.

9. The headgear is to be worn 14 hours each day in the non-school hours, but some day wear is permissible. This will permit physiologic rebound during the day hours and promote less damage to anchor teeth.

10. The outer bow needs to clear the angle of the mouth. This meant a gentle labial step to the outer bow.

11. Some patients need prevention of upper molar extrusion. These often are patients with vertical patterns, low pain threshold. Poor mandibular physiology or damaged condyles. A loop was placed slightly mesial to the molars to receive a second highpull headgear with variable pull to prevent molar elongation. While the main pull came off the neckstrap.

12. Cleanliness of the neck strap holds down neck infections. The elastic strap with pad is discarded when it is wornout or dirty. It is made adjustable to the tolerance of the patient by a buckle and fixed loop.

13. The hooks are bent outward to engage the neck strap. The right hook is shortened to lock on the strap which is permanently fixed on the right side for ease of application and remembering by the patient.

14. The appliance may be needed later as part time retainer. The materials are durable, capable of sterilizations and capable of long term service.

With the foregoing factors in mind, the use of extra-oral traction can be quite versatile.

In summary, several features characterize its possible application.

1. It can be used as a tooth moving appliance when applied with light
forces (200 - 300 grams).

2. Tooth movement alone is slower in Class II correction and much more time is needed for treatment for the mandible to grow enough to make the correction. (This is where the computer growth set-up comes in, or at least a good manual objective forecast.).

3. It can be truly an orthopedic appliance used with heavy forces (500 grams or over). Almost two-thirds of the actual correction is made by skeletal change in the typical case with facial convexity. (Intermaxillary traction is used in non-orthopedic cases for reciprocal movements.)

4. Upon initial application the dental bow is advanced only 1 to 2mm from the incisors. As the molars start backward the incisor crowns are engaged at the cervical 1/3 and continue to upright almost ideally with further wearing without banding. This permits natural favorable adjustments to occur in both arches.

5. The younger the patient the better the chance of orthopedic correction. The young child sleeps longer and seems to adapt and cooperate better. It is used on the deciduous second molars at preschool ages.

6. It can be overused and produce undesirable concavity to the profile.

7. It can be misused or disastrously employed in patients where molar corrections are inadvisable from the beginning, even resorption of the disto-buccal root. (Hence, the need for diagnosis and objective planning.

8. Extraoral traction is best used as a biologic appliance as growth, physiologic and eruption factors are combined with the orthopedic qualities in the understanding of its behavior. These constitute great advantages in current bioprogressive therapy.
9. Above all it must be recognized that changes with its use are three dimensional and are usually permanent and stable when retention consists of progressive release.
MANAGEMENT UMBRELLA AND VTO

Dr Ricketts states that management is a unique skill; it is the ability to get other people to work with you and for you, to accomplish common objectives. In an orthodontic practice, getting the subordinates to work with you and for you is to treat the patient to happy ending, and to manage the patient so that he gives full cooperation in his treatment.

Management System for Orthodontics

As per Dr Ricketts, management system for orthodontists should include the following three things:

1. Quality: This includes quality of treatment result.
2. Quantity: This includes the number of patients treated.
3. Effectiveness – This includes the effectiveness of treatment design and office management.

According to Ricketts, a good management system should allow the increase of all these factors at the same time. Naturally, a system proceeds from some basic premises, which underlie the approach selected.

The basic premises as per Dr Ricketts are as follows:

1. Primary goal in orthodontics is satisfactory outcome. Diagnosis and treatment management is really the means to the end. Results come first. The question is how to get our results.
2. The practice of orthodontics in the future may be different from what it is today or has been in the past. Practice efficiency has always been important but it is of the utmost importance today because of the increasing difficulty in attracting patients, due to an increase in
orthodontists and decreases in the birth rate; the control of third party programs; and the rapid acceleration of the cost of operation.

3. Orthodontics being the oldest specialty in dentistry should be the leader in initiating true preventive procedures for the future.

4. Early treatment has to be a part of futuristic orthodontic planning since it is essential to preventive procedures for the future.

5. The orthodontist should be an authority on occlusion, including temporomandibular joint function.

6. Quantity is not necessarily an enemy of quality, if quality comes first.

7. The orthodontists needs better communication with patient’s parents, dentists and the public.

8. Time is one of our most valuable asses. It is reason in itself to become involved in a total management process.

The system which Ricketts used is the Lewis A. Allen Management System, which is based on a simple formula to plan organize, lead and control

1. Planning: The work performed predetermines a course of action to be followed.

2. Organizing: The work performed to arrange and relate the tasks to be accomplished.

3. Leading: The work performed to insure that people act in such a way as to complete our objectives.

4. Controlling: The work performed assesses and regulate results.
The management Umbrella Concept by Dr Ricketts

The management of the total practice according to Ricketts ultimately determines the degree of efficiency and effectiveness with which the orthodontist solves individual patient problems.

Knowledge of theory and skilled application of technique provide the basis for orthodontic practice, yet success depends on the achievement of the additional objectives of administrative efficiency, procedural control, and quality assurance. The methods of systems engineering, operations research and management science when applied to Orthodontics produce innovative practice designs and procedures that increase both the effectiveness of service and professional satisfaction.

Diagnosis and Treatment Design

According to Ricketts the more systematized is the diagnosis and treatment design less are the complications. In developing diagnostic and treatment design system, the simplest things that are done every day are thought about.

Three major objectives of orthodontic treatment:

1. Ideal functional occlusion.
2. The physiological stability of our results.

Total facial balance (cosmetics of the face and teeth)
Dr Ricketts listed following basic premise of Orthodontic treatment

1. Occlusion
   a. Tooth to bone health
   b. Intermaxillary efficiency
   c. Health of TMJ

2. Functional Equilibrium
   a. Tonsil and adenoid evaluation
   b. Habits
   c. Musculature

3. Aesthetic Equilibrium (Soft Tissue Analysis)

4. Growth and Development

Therefore the five functions of planning apply as follows

1. Forecasting the growth of the individual patient.
2. Setting the objectives through the use of V.T.O. which is like a blueprint in building a home.
3. Program a sequence of mechanics to get the objective from visual treatment objective.
4. Schedule an average time for these mechanics to function.
5. Budget to develop individually the cost for treating this case.

Ricketts felt that systems are necessary to develop the policies and procedures to make this happen routinely. He briefly outlined the steps of the diagnostic and treatment design system for Bio-Progressive Therapy, which he referred to as diagnostic programming.
In superimposition Area 1 (Basion-Nasion CC), Evaluation 1 is chin change. In this case, the objective is to allow $2^0$ of opening of the facial axis, to except the amount of chin growth shown, and to except that the upper molar will grow down the facial axis.

In superimposition Area 2 (Basion –Nasion at Nasion), Evaluation 2 is maxillary change, one of the objectives is to reduce point A only 2mm in this case.

In superimposition Area 3 (Corpus Axis at PM), Evaluation 3 is the lower incisors. In this case, just tipping of the lower incisors slightly is done. In Superimposition Area 3 also have Evaluation 4, the lower molars. In this case advancing the lower molars approximately 4mm.

In Superimposition Area 4 (Palate at ANS), Evaluation 5, the upper molars. In this case, upper molars are held even though this is Class II
division 1 malocclusion. Superimposition Area 4 also includes Evaluation 6, the upper incisor, and it is seen that the upper incisors have to be distalised.

In superimposition Area 5 (Esthetic Plane), Evaluation 7, the soft tissue and it is observed that there is a great amount soft tissue reduction in this case.

Dr Ricketts mentioned VTO as a blue print used in building house visual to forecast normal growth of patient and the anticipated influences of the treatment, to establish the individual objectives in treatment for growing patient must be planned and directed to the face and structure that the patient presents initially. The treatment plan should take advantage of the beneficial aspects of growth and minimize any undesirable effects of growth possible.

The visual treatment objective permits the development of alternative treatment plans. After setting up the teeth ideally within the anticipated or growth facial pattern, the orthodontist must decide how far he must go with mechanics and orthodontics to achieve them and what the alternatives.

In 1950-60 Ricketts attempted to predict treatment results and studied the possibility of growth forecasting. This was an outgrowth of cephalometric laminography of the temporomandibular joint. Long term growth forecasting had not proven trustworthy with the methods of projection used during the years of 1950 to 1965. However short term forecasting did prove adequate for the period of actual treatment when combined with the likely effects of the treatment. Treatment designs incorporating growth effects had proven to be quite appropriate and indeed could be recommended at a clinical level for the establishment of objectives and the planning of anchorage.
This idea was pricked up by Holdaway and termed a Visualized Treatment objective “, which was descriptive of the application, existing morphology and expected growth in modular increments provided a reference base. Superimposed on this behavior were the requirements of the individual patient, in terms of objectives and the required tooth movement. Desired changes in anterior teeth could be followed by the set up of the molars, depending on the needs and estimates of anchorage and arch form change.

Thus VTO as described by Dr Ricketts was very important for treatment planning and one of t
Ricketts Cephalometric Analysis

Clinical Application of Cephalometrics

In 1960 Ricketts published two clinical papers, first was a report on the morphologic findings in 1000 cases consecutively seen in clinical practice.

He dealt with description of morphology and dental relationship on one hand and on the other hand he discussed classification, categorizing conditions in terms of their clinical requirements and difficulty. The third was the study of change, comparing the morphology of a single patient at different stages of development or treatment. the fourth was its application in communication of the first three among clinicians and researchers, and between clinician and patient.

The fourth application made the clinician using cephalometrics stand above the rest. With the ability to describe and compare came the ability to explain things and to find out new information never before available. Above all was the ability to communicate with the rest of the profession in a sophisticated and meaningful language.

The second publication of 1960 by Ricketts was on analysis of treated cases. The possibilities and the effects of treatment using multibanded orthodontic technique and extraoral traction, the main sources of correction of that day, were explored in depth with cephalometrics.

Changes were measured in five different areas in a logical sequence. First were the changes in the cranial base. The second area was changes in the lower jaw complex, the third in the upper jaw complex and the fourth in
the upper and lower dentures. The fifth area was soft tissue changes in the nose and lips.

**Rickets analysis**

All Cephalometric analysis involve the identification of various craniofacial landmarks many such landmarks are traditional. Others however may be unique to a specific analysis. The less traditional points, planes, and axis used in Rickett’s analysis are as follows.

<table>
<thead>
<tr>
<th>A6</th>
<th>Upper molar</th>
<th>A point on the occlusal plane located perpendicular to the distal surface of the crown of the upper first molar.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B6</td>
<td>Lower molar</td>
<td>A point on the occlusal plane located perpendicular to the distal surface of the crown of the lower first molar.</td>
</tr>
<tr>
<td>CI</td>
<td>Condyle</td>
<td>A point on the anterior curve of the soft tissue chin tangent to the esthetic plane or E-Line.</td>
</tr>
<tr>
<td>-----</td>
<td>---------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DT</td>
<td>Soft tissue</td>
<td>the point on the anterior curve of the soft tissue chin tangent to the esthetic plane or E-line</td>
</tr>
<tr>
<td>CC</td>
<td>Center of cranium</td>
<td>The point of intersection of the basion nasion plane and the facial axis</td>
</tr>
<tr>
<td>CF</td>
<td>Center of cranium</td>
<td>The point of intersection of the pterygoid root vertical to the Frankfort horizontal plane.</td>
</tr>
<tr>
<td>PT</td>
<td>PT point</td>
<td>The junction of the pterygomaxillary fissure and the foramen rotundum: the outline of the foramen rotundum can be located by using the template designed for that purpose (Jacobson-Sadowsky lip counter template, Unitek Corp) or it can be approximated at the 10:30 (face of a clock) position on the circular outline of the superior border of the pterygomaxillary fissure.</td>
</tr>
<tr>
<td>DC</td>
<td>Condyle</td>
<td>The point in the center of condyle neck along the Ba-N plane</td>
</tr>
<tr>
<td>En</td>
<td>Nose</td>
<td>A point on the soft tissue nose tangent to the esthetic plane or e-line</td>
</tr>
<tr>
<td>Gn</td>
<td>Gnathion</td>
<td>A point at the intersection of the facial and the mandibular planes (cephalometric Gn as a opposed to anatomic Go)</td>
</tr>
<tr>
<td>PM</td>
<td>Suprapogonion</td>
<td>The point at which the shape of the symphysis mentalis changes from convex to concave also know as protuberance menti.</td>
</tr>
</tbody>
</table>
Ricketts Cephalometric Analysis

<table>
<thead>
<tr>
<th>Pog</th>
<th>Pogonion</th>
<th>The point on the bony symphysis tangent to the facial plane.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO</td>
<td>Cephalometric</td>
<td>The intersection of the facial plane and the corpus axis</td>
</tr>
<tr>
<td>TI</td>
<td>TI point</td>
<td>The point of intersection of the occlusal and the facial planes</td>
</tr>
<tr>
<td>Xi</td>
<td>Xi point</td>
<td>The location of the Xi point given below.</td>
</tr>
</tbody>
</table>

**Definition and location of Xi point**

The location of the X points is keyed geometrically to the Franfort horizontal and the pterygoid root vertical planes (PtV). The procedure follows:

1. Locate FH and draw PtV plane perpendicular to the FH plane.
2. Construct four planes tangent to points R-1, R-2, R-3 and R-4 on the borders of the ramus
   a. R-1: Deepest point on the anterior border of the ramus, located halfway between the superior and the inferior curves.
   b. Located on the posterior border of the ramus opposite R-1
   c. Deepest point of the sigmoid notch, halfway between the anterior and the posterior curves.
   d. Opposite R-3 on the inferior border of the mandible.
3. The constructed planes from a rectangle enclosing the ramus.
4. Xi points is located in the center of the rectangle at the intersection of the diagonals.
Fig 2

**Definition and location of planes**

1. Frankfort horizontal: Extends from portion to orbitale
2. Facial plane: Extends nasion to pogonion
3. Mandibular plane: Extends from gonion to gnathion (cephalometric landmarks previously defined)
4. PtV (Pterygoid vertical): A vertical line drawn through the distal radiographic outline of the pterygomaxillary fissure and perpendicular to the Frankfort horizontal.
5. Basion-nasion plane: Extends from basion to nasion; divides the face and cranium
6. Occlusal plane: The functional occlusal plane is represented by a line extending through the first molars and premolars.
7. A–Pog line: A line from point A to Pogonion is often to as the dental plane.

The esthetic line or plane extending from the soft tissue tip of the nose.
(En) to the soft tissue chinpoint (DT).

**Fig 3**

**Definition of location of axis:**

- **Facial axis:** A line extending from the foramen Rotundum (PT to Gn)
- **Condylar axis:** Extends from DC to Xi point used to describe the morphologic features of the mandible.
- **Corpus axis:** Extends from X to PM used to describe the morphology of the mandible and to evaluate dentition changes.

**Interpretation chart**

<table>
<thead>
<tr>
<th>Chin in Space</th>
<th>Mean values for 9 yrs old</th>
<th>Age Adjustments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial axis</td>
<td>$90^0 \pm 3.5^0$</td>
<td>No adjustment</td>
</tr>
<tr>
<td>Facial (angle) depth</td>
<td>$87^0 \pm 3^0$</td>
<td>Adjust $+1^0$ every 3 years</td>
</tr>
<tr>
<td>Mandibular plane</td>
<td>$26^0 \pm 4.5^0$</td>
<td>Adjust $-1^0$ every 3 years</td>
</tr>
</tbody>
</table>
### Ricketts Cephalometric Analysis

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Specification</th>
<th>Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convexity of point A</td>
<td>2mm ± 2mm</td>
<td>Adjust -1mm every 3 years</td>
</tr>
<tr>
<td>Lower incisor to A-Pog</td>
<td>+1mm ± 2mm</td>
<td>No adjustment</td>
</tr>
<tr>
<td>Upper molar to PtV</td>
<td>Age + 3mm</td>
<td>Add 1mm per year</td>
</tr>
<tr>
<td>Lower incisor to A-Pog</td>
<td>22° ± 4°</td>
<td>No adjustments</td>
</tr>
<tr>
<td>Profile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower lip to E-plane</td>
<td>-2mm ± 2mm</td>
<td>Less protrusive with growth</td>
</tr>
</tbody>
</table>

### Interpretation

<table>
<thead>
<tr>
<th>Chin in Space</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial axis</td>
<td>The angle formed between the basion nasion plane and the plane form foramen rotundum (PT) to gnathion. On the average this angle is 90 degrees. A lesser angle suggest a retropositioned chin, whereas an angle greater than a right angle suggests a protrusive or forward growing chin.</td>
</tr>
<tr>
<td>Facial (depth) angle</td>
<td>The angle between the facial plane (N-Pog) and the Frankfort horizontal. This angle provides some indication of the horizontal position of the chin. It also suggest whether a skeletal class-II or III pattern is due to the position of the mandible.</td>
</tr>
<tr>
<td>Mandibular plane</td>
<td>Measure an angle to FH. On the average, this angle is 26 degrees at 9 years of age and decreases approximately 1 degree every 3 years. A high or steep mandibular plane angle implies that an open bite may due to the skeletal</td>
</tr>
</tbody>
</table>
Ricketts Cephalometric Analysis

<table>
<thead>
<tr>
<th>Convexity</th>
<th>morphologic characteristics of the mandible. A low mandibular plane suggests the opposite (e.g. a deep bite)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convexity at a point</td>
<td>The convexity of the middle of the face is measured from point A to the facial plane (N-Pog). The clinical norm at 9 years of age is 2.0 mm and decreases 1 degree every 5 years. High convexity implies a class-II skeletal pattern. Negative convexity suggests a class III skeletal pattern.</td>
</tr>
</tbody>
</table>

Teeth

<table>
<thead>
<tr>
<th>Teeth</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower incisor to A-Pog</td>
<td>The A Pog line or plane is referred to as the denture plane and is useful reference line from which to measure the position of the anterior teeth. Ideally the lower incisor should be located 1.0mm ahead of the A-Pog line. This measurement is used to define the protrusion of the lower arch.</td>
</tr>
<tr>
<td>Upper molar to PtV</td>
<td>This molar measurement is the distance from the pterygoid vertical (back of the maxilla) to the distal of the upper molar. On average this measurement should equal the age of the patient +3.0 mm (e.g. a patient 11 years of age has a norm of 11 + 2 = 14mm. This measurement assists in determining whether the malocclusion is due to the position of the upper or lower molar. It is also useful in deciding whether extractions are necessary.</td>
</tr>
<tr>
<td>Lower incisor</td>
<td>The angle between the long axis of the lower incisor and...</td>
</tr>
</tbody>
</table>
Ricketts Cephalometric Analysis

<table>
<thead>
<tr>
<th>Inclinations</th>
<th>the A-PO plane (1 to A-PO) is measured. On the average this angle should be 28 degrees. This measurement provides some idea of lower incisor procumbency.</th>
</tr>
</thead>
</table>

Profile

<table>
<thead>
<tr>
<th>Profile</th>
<th>The distance between the lower lip and the esthetic (nose-chin) plane is an indication of the soft tissue balance between the lips and the profile. The average norm for this measurement is 2.0 mm at 9 years of the age. The positive values are those ahead of the E-line.</th>
</tr>
</thead>
</table>

Fig 4
THE GOLDEN DIVIDER

The golden divider may be used for morphologic analysis of the teeth, the skeleton and the soft tissues of the face.

Fig. 1 The Golden Divider

Fig. 1. It is based on the "Golden Section" also called the "Divine Proportion". Upon widening the divider, it will be noted that a short side and a longer side will be measured off proportionally as the divider is extended.

Fig. 2 Widening the divider produces two measurements in a ratio of 1:1.618.

Fig. 2. The longer side is 1.618 times the shorter side and the shorter side is 0.618 the length of the longer. In turn, the longer side is 0.618 the length of the total outer measurement. The golden relation (1:1.618) is called Phi and
given the Greek symbol $\phi$. This relation is based on underlying laws of mathematics, geometry, and physics.

The use of this instrument applies to esthetic values, because so many relations found to be beautiful to the human eye or comforting and pleasing to the human psyche follow these proportions. But, of greater significance are the biologic implications, as many things in nature follow the principle in proportionality of the golden section, the golden triangle, and the golden rectangle. The proportion is linked to growth and it relates to optimal function. Hence, it can be used for analysis of structural harmony and balance, and can be applied for treatment planning of the tooth, bone, and soft tissue relationships for all forms of dentistry, maxillofacial and plastic surgery.

**Tooth Relationships**

Useful parameters for the teeth start with the lower central incisors (Fig. 3).

![Fig. 3 Occlusion to demonstrate values](image)

Thus, the total of both lower centrals (10.8mm) is golden to both upper centrals (17.5mm), which starts a series of harmonic units in the occlusion. The next golden relation (across the arch, not in direct width of
teeth) is the measurement between the distals of the two upper lateral incisors (28.3mm) as related to the upper centrals (17.5mm). The next progression is the-width to the buccal surfaces of the upper first bicuspids (45.7mm), which is golden to the width through the lateral incisors in the normal beautiful arch. This is generally lacking in patients with malocclusion in all three types.

Another series is observed in from the width of the lower four incisors (on the arch) at 22.1 mm. The upper intercanine width measured at the cusp tips at 35.75mm is found in a golden relation to the lower incisors. Finally, the width at the mesial of the upper second molars (57.8mm) will be found to be in the golden relation to the intercanine width in beautiful arches, which helps in assessing arch form. The distance between the distals of the lower canines (31.5mm) is golden to the distance between the lower first molars (50.2mm) at the buccal grooves.

**Soft Tissue Relationships**

For the face, a connection is apparent in the smile, as the intercanine width is observed to be the same as the width of the nose at the alar rim as seen in a glamorous model.

For the width dimensions in the soft tissue, the nose, mouth, eyes and face are related. If the lateral rim of the nose (LN) width is taken as a unit of 1.0, progressively the mouth (CH), lateral canthus of the two eyes (LC), and the width of the head at the level of the eyebrow (TS) is a progressive golden series.

For vertical relations, it is best to start with the underlying skeleton as seen in the lateral cephalometric head plate. Eight golden relations were
identified from composites of 30 beautiful normal male subjects with ideal normal occlusions. For the vertical location of the lower incisor, the Point A (at subspinale in the maxilla) and the Point Pm (at the mental protuberance of the mandible) is used. In centric occlusion, if the distance from Point A to lower incisor tip is taken as 1.0, the height of the lower incisor to Pm is 1.618.

For relation of A to Pm itself, a golden proportion is seen to the Frankfort plane (porion to orbitale). If the level of orbitale (lower rim of the orbit) to Point A is taken as 1.0, the vertical height of the denture is 1.618, suggesting normal denture height.

Other values for surgical or orthopedic corrections are seen as the corpus axis (Pm to Xi point) is golden to the condyle axis (Xi to Condylion) or posterior superior aspect of the condyle head. The Xi point is the geographic center of the ramus. Also, maxillary depth is golden to pharyngeal depth. The cranial structures are seen to be golden in the anterior and posterior base S-N (1.618) + SBa (1.0). Nasion to cranial center (CC), at 1.618, is golden to cranial center to articulare on the Basion-Nasion plane.

For vertical facial relation in the soft tissue, another progressive series is seen as confirmed from composites of normal beautiful faces. Here, starting with the larger value, the face height is taken from Trichion (at the top of the wrinkled forehead or near the hair line in the young) to the bottom of the chin (soft tissue menton). If the lateral canthus level to Trichion is taken as a unit of 1.0, the height of eye to chin is in the golden proportion, if the face is beautiful. Inversely, from chin upward, the distance of the chin to the curve of the ala of the nose is taken as a 1.0 value and 1.6 is seen from
the nose to Trichion. This makes nose length (lateral canthus height to alar height) a congruent or reciprocal area or the "center" of the face.

From the eyes downward, a golden relation is seen from the nose (1.0) to the chin (1.618). Inversely, the bottom of the chin to the mouth at 1.0 leaves a 1.6 proportion from the mouth to the eye. Like nose length, the upper lip length is a reciprocal or an overlapping congruent area between the eye-nose-mouth-chin proportions.

If the alar rim to the upper lip (to stomion or lip embrasure) is taken as 1.0, the distance to the chin is 1.6 and the same distance to the eye is 1.6. This finally shows that three equal areas of the face are very nearly the same in beautiful faces. These are forehead to eye, eye to mouth and nose to chin.

For locating golden proportions in the profile aspect, the same limits of vertical proportions were found useful. It appeared that the base of the ear lobe was the posterior limit to the face. To nose tip these formed three golden rectangles like the foregoing equal areas, i.e. Trichion-eye, eye-mouth and nose-chin. As the horizontal nose-tragus base is studied, a golden section falls at the lateral canthus of the eye. Taking the eye-mouth vertical as 1.6, the canthus to nose rim is 1.0.
Fig. 4 *Golden proportion from eye-nose-chin*

Figure 4 shows the golden divider applied to the eye-nose-chin for facial height.

Fig. 5 *Golden proportion from nose-mouth-chin*

Figure 5 shows the divider on the ala of the nose, lip embrasure and chin to determine denture height and lip position.
ANIMALS AND GOLDEN PROPORTION
PLANTS AND FRUITS IN GOLDEN PROPORTION
MONOMENTS IN GOLDEN PROPORTION
FACES IN GOLDEN PROPORTION
HAND AND HEART BEAT IN GOLDEN PROPORTION
SOLAR SYSTEM IN GOLDEN PROPORTION
RADIOGRAPHIC EVALUATION OF TRANSVERSE SKELETAL DISCREPANCIES

The posterior-anterior (PA) cephalogram is the most readily available and reliable radiograph for identification and evaluation of transverse skeletal discrepancy. A standardised PA cephalometric radiographic technique that will allow superimposition of radiographs, comparison of linear measurements and evaluation of radiographs over time should be employed. Ricketts developed the Rocky Mountain Analysis and he suggested norms and choose specific radiographic landmarks. They were

JR – Jugale right;
JL – Jugale left;
AG – Antegonion right;
GA – Antegonion left;
ZR – Zygomatic light;
ZL – Zygomatic left

Using these landmarks, the effective maxillary width, effective mandibular width, and the frontolateral facial lines can be constructed. The effective maxillary width defines the width of the maxilla and is the linear measurement between the points JL and JR (bilateral points on the jugale process at the intersection of the outline of the maxillary tuberosity and the zygomatic buttress). The effective mandibular width defines the
width of the mandible and is the linear measurement between the points AG and GA (bilateral points at the lateral inferior margin of the antegonial protuberance). The frontolateral facial lines are two lateral lines constructed from ZR, ZL (bilateral points on the medial margins of the zygomaticofrontal suture, at the intersection of the orbit) to points AG and GA.

By using these landmarks, two separate differential measurements were utilized to evaluate transverse maxillary deficiency radiographically by Ricketts:

1. The maxillomandibular width differential
2. The maxillomandibular transverse differential index.

The maxillomandibular width differential is a measurement from the frontolateral facial line to JL and JR respectively, along the effective maxillary width line. This measurement is calculated independently for each side and compared with a normal value of 10+/1.5 mm. If this radiographic measurement is greater than 10mm, a transverse discrepancy between the maxilla and mandible is present. The difference between the measured distance and 10 mm summed from each of the two sides is the total transverse deficiency. This method is useful for determining the total discrepancy and demonstrating if there is a greater deficiency on one side or the other. However, it is not useful for determining in which arch the discrepancy is located.

The maxillomandibular tranverse differential index is the expected maxillomandibular difference (an established norm for different ages) minus the actual measured maxillomandibular difference. The expected
maxillomandibular difference is defined as the age-appropriate expected J Point – J point distance, the actual maxillomandibular difference is defined as the actual AG-GA measurement minus the actual J point – J point measurement.

If in a skeletally mature patient (15.5 years or older) the maxillomandibular transverse differential index is greater than 5mm, surgically assisted expansion may be indicated. If the differential index is less than or equal to 5mm orthodontic or orthopaedic expansion may effectively correct or camouflage the transverse skeletal problem. This method allows easier identification of which arch is deficient or excessive because actual values can be compared to normal value. These normal values were suggested for the Caucasian race and should not be considered normal values for all races and ethnic groups.
TRUTH IN ORTHODONTIC BELIEFS

Ricketts addressed the following statements in the editorial of truth in orthodontic belief.

1 “Molars do not intrude”

It was denied that the muscles of mastication can exert an intruding effect on molars through function. In other words, Ricketts believed that closing jaw muscles are not strong enough to exert an intruding pressure.

As the growth turgor of the mandible is expressed, and as facial development occurs, greater intermaxillary distance is created.

Teeth erupt into the space developed as the jaws grow apart (Fig. 1).

![Fig. 1](image)

**Fig. 1** Composite growth superimpositions of 73 untreated children.

Consequently, the molars continue to erupt until growth is completed (unless impeded by the tongue, as observed in posterior open bite).
Recent findings indicate that the lower first molar erupts from the corpus axis a mean of nearly 0.5mm per year. The upper first molar erupts a mean of 0.7mm per year from the palatal plane (Fig. 2).

![Fig. 2](image)

**Fig. 2**

*Fig. 2 Additional superimpositions of 73 untreated children, showing eruption patterns of upper and lower first molars.*

On the mandibular growth arc, however, the whole arch moves upward and forward. As viewed biologically, the first molar erupts about 1.2mm per year in a vertical direction (Figs. 3, 4).
Furthermore, it is clear that in longer faces, as greater-than-average vertical development occurs, the teeth compensate by filling in the additional space until they encounter muscle resistance to their eruptive force (Fig. 5).
Fig. 5 Morphology of long-faced patient (Bacchus) compared to short-faced patient (Adam).

One can estimate, on the basis of animal studies and clinical findings, that the pressure of eruption is 0.2 grams per square millimeter of enface root surface. This would place the eruptive capacity of each of the first molars, upper and lower in the range of 20-25g.

Theoretically, any continuous magnitude of force in this range would essentially inhibit molar eruption. Any greater continuous pressure would produce an intrusion, as estimated from a starting force of not more than 80g for clinical practice. Such forces are easily within the limits of the muscles of mastication, which is measured in kilograms.

Of great importance to this issue is the behaviour of the lower molars during cervical traction of the upper molar in the correction of Class II
malocclusion. There is of course, a vertical component to cervical traction that prevents molar tipping. If heavy, continuous forces are exerted on a 20 or more hour a day basis with cervical traction, the muscles of mastication will often overcome. This behavior has been described as the "Wedge effect".

However, if forces do not exceed 500g in the mixed dentition (or 350g in the deciduous dentition) and bite plates are not used, and pain has not been overwhelming to the patient, with extrusion of the upper molar, the lower molar has been seen to intrude in hundreds of patients. This is not merely an anecdotal finding.

![Image](image.png)

**Fig. 6**

*Fig. 6 Three cases in which intrusion of lower molars accompanied extrusion of upper molars from cervical traction.*

In these patients, the occlusal plane, which originally was located above Xi point, moves downward during treatment to the level of Xi point (or preferably, below it). Measurements from the corpus axis during the period
of cervical traction show the lower molar to be decidedly intruded by 2mm or more, when it should have been erupting 0.5mm per year. This occurs with no appliance on the lower arch. When a utility arch is placed for management of the lower arch, buccal torquing of the roots of the lower molar will produce even further gains in lower molar intrusion or lower molar crown height reduction during cervical traction.

The pull of the elastics, which exert a vertical force of about 50g, would normally cause the lower molar to be extruded and the upper molar to be intruded, as measured from the palatal plane. Upper molar intrusion from Class II elastics would, of course, occur primarily in patients who do not yield by lowering of the mandible. Therefore, in these patients the forces of mastication intruded the upper molars.

In conclusion, to build an orthodontic philosophy upon the belief that a molar cannot be intruded by the forces of mastication would be a miscalculation.

2. "Management of the vertical growth of the alveolar processes as the primary function of the orthodontist."

Ricketts have shown some evidence that in the short term (meaning the one-year period of treatment), the vertical growth of the condyle at the ramus can also be affected with cervical traction. This can be seen in a greater increase in ramus height during treatment than would have been expected without treatment (Fig. 6). Even more important, high-pull traction to the upper arch can intrude the upper molar, with a resultant loss of vertical support or even compression of the mandible, which would inhibit some condylar and mandibular growth.
All of these influences with the possible exception of treatment-induced condylar compression and damage seem to have a transitory effect. Within three to five years after treatment, mandibular growth is usually but not always restored to its predicted size and general form.

The next statement is, "Vertical growth of the posterior portion of the maxilla cannot be stimulated or inhibited." It is true that it is difficult to get a handle on the body of the maxilla from a purchase on the teeth, which are held in the alveolar process.

Movement of the entire upper jaw complex, including the intermediate bones, has been demonstrated beyond any shadow of a doubt by Dr Ricketts.

**Fig. 7**

**Fig. 7** Comparison of changes in maxillary base, measured by SNA angle, between 100 treated Class 11 cases, 10 years after treatment, and 100 untreated cases.
In conclusion, the assumption that control of the alveolar processes is the sole possibility for vertical orthodontic management of the growing child is consistent with an ideology that will eventually become a relic of the past.

3. "Lower incisors should not be intruded to level the arch in growing patients."

Dr Ricketts mentioned that when composites are compared to controls of normals (corrected for age, size, and sex), it is easily observed that in most deep bites, the lower incisor is in supraversion. In deep-bite Class II conditions with high convexity, the lower molar is near normal and all the other teeth are in abnormal positions.

Fig. 8.

Fig. 8. A. Normal sample at age 8. B. Class II, deep-bite, high-convexity sample at age 8. C. Components of the Class II condition.

He believed that the lower incisor can be successfully intruded, when proper upper incisor position and interincisal angles are restored and when normal function is established, the relationship will hold. Cases with lower incisor intrusion were demonstrated to be stable 30 years ago. The utility
arch was developed in 1960, and many other modalities are currently used for management of the lower incisor.

According to Ricketts the lower incisor may be difficult to manage properly with round wires. For best long-term stability, best control of the mandible, and best utilization of growth during treatment must be achieved and in deep-bite cases treat to the level of the lower first premolar rather than extruding. This provides the least disturbance to the facial pattern, and ensures the least likelihood of post-treatment adjustment by preventing any increase in lower face height, which increases lip tension.

In fact, it is obvious that the lower incisor, when intruded into a wider portion of the mandibular symphysis, can be brought forward satisfactorily and safely. Such a practice will avoid the flat mouth and the flat face. Quite frequently, this is the method of choice when all the alternatives are considered. Another factor not often understood is that intrusion of the lower molar (or inhibition of eruption) is a significant factor in holding the lower incisor upright as it is finished with the ideal arch.

![Fig. 9 Possible effects of lower molar height on final occlusion.](image)
In Class II, division 2 cases, both the upper and lower incisors are at fault. In these deep bites, intrusion of both the upper and lower anterior segments is required to prevent excessive mandibular rotation.

The level of the upper incisor is an aesthetic consideration related to lip length. The divine proportion is a standard in the relationship of the upper incisor to the lower. It should be brought in mind that the whole palate can be tipped, taking the lip and nose with it. The smile line, or the margin of the upper lip in the passive smile, should be approximately at the level of the gingival crest of the upper incisor segment. Complimentary nasolabial angles should also be a goal. All these factors must be taken into account in establishing techniques for the management of the lower incisor.

4. "There are good reasons for extracting second bicuspids rather than first bicuspids."

Ricketts commented that form and strength of the first premolar is a factor, but there are other reasons for upper second premolar extraction, such as sustaining space closure distal to the canine and management of the upper canines, which fit in the bifurcation of the roots of the upper first premolars. In 1993, many orthodontists consider a patient who once would have been a four-second-premolar extraction candidate now to be a nonextraction candidate. Slippage of anchorage is often required for second premolar extraction. Additionally, a choice can be made between premolar extraction and early removal of the third molars.

Extraction of the lower second premolar makes it necessary to contact the lower first premolar with the lower first molar, and the contact at the distal of the first premolar is rather narrow. The form of the first premolar is such that it frequently does not make good lingual
contact with the upper premolar. Therefore, the best choice he suggested was to extract upper second and lower first premolars and modify the mesiobuccal angle of the second toward the anatomy of the first premolar.

5. "Differential anchorage is nature's way of harmonizing the temporomandibular joint and the teeth."

The statement was made that in natural growth, the lower molars seldom move forward appreciably in relation to the symphysis. Such an interpretation of growth and eruption of the lower molar, as mentioned above, is entirely dependent upon the method of superpositioning. If the lower border of the mandible is used for reference, the impression is gained that the lower arch does sometimes move distally. As observed with implants, however in normal development the lower border of the mandible is resorbed as the angle drifts on an arc upward and backward. This shows that when the lower border of the mandible is employed as a reference, an erroneous impression might be gained with regard to mandibular development as well as to the eruption of the teeth. Two other references are much better for the display of lower arch development, the corpus axis and the arc method.

The beauty of the corpus axis is that it is based on Xi point and Pm and thus shows a remarkable tendency to stay level with the occlusal plane, which tends to move with Xi point. It is the best method found by Ricketts for accurately predicting occlusal plane behavior. Studies have shown that the lower molar tends to move at a right angle to the original corpus axis, upward and forward at about 0.5mm per year.
In truth, however, as shown with the discovery of the mandibular arc, the entire lower arch continues to move upward and forward as space is made posteriorly for the second and third molars by the forward drift and eruption of the lower arch. The lower molars offer more limited resistance to forward movement unless the roots are torqued buccally and the arch is slightly expanded in an attempt to lock them underneath the buccal cortical plate. The upper molars move forward more easily, particularly because the main resistance is toward the palatal root.

6, "The most important part of orthodontic treatment is the management of the six upper anterior teeth."

Ricketts mentioned that proper angulations and torquing are difficult to achieve without numerous archwire changes. He had prescribed three different bracket formulas, called a "trimorphic formulation", that account for the original malocclusion, the facial type, and the growth pattern.

Fig. 10. Distribution of interincisal angles as related to "trimorphic" bracket formulation.
Patients with interincisal angles of 120°-125°, with a tendency for uprighting, are treated as the "proversion" type. Those with interincisal angles of around 130° use the "neutroversion" formula. The "retroversion" formula is for long faces and Class III conditions, with interincisal angles in the range of 135°.

With these formulations, frequently only two or three archwires are needed. In a Class II, division 2 case with retruded upper incisors, an upside-down loop is placed mesial to the canine so that in retraction, the action will be dispersed among the roots rather than expressed in lingual tipping of the crowns.
VIEWS OF DR. ROBERT M. RICKETT’S ON BIOPROGRESSIVE CONCEPTS

In JIOS interview of Dr. Robert M. Ricketts in August 1993 and Interviewed by Dr M.K. Prakash, Dr V. P. Jayade, Dr Sumukh Deodhar and Dr K .M. Mistry.

- Views on Edgewise bracket designed to control teeth.

  Any bracket should have five functions:

  1. The first is that through a wire it will control the height. This is the reason for accuracy in bracket placement.

  2. Control of angulation (mesiodistally). The Edgewise, winning over the Ribbon bracket was due to vertical slot’s weakness. The vertical and angulation control was difficult and often needed an auxiliary spring.

  3. The third function of the bracket is “Torque”. This is buccolinguial or labirolinguial long axis control.

  4. The fourth function is first order movement or lateral control. Due to tooth width differences, the arch wire was stepped outward for the canines, premolars and molars. By rasing the base of the bracket step bends were eliminated.

  5. The fifth need for performance in a bracket is “rotation” this was an original Edgewise weakness. Satisfaction of this weakness was done by designing two brackets, or a “Siamese” bracket with two brackets connected. The present edgewise bracket satisfies all these requirements and with its use with a 0.018” x 0.030” slot for lighter pressure and horizontal entry for a wire.
• Bypass wire or utility wire:

The utility wire was a result of attempting to sustain molar anchorage in extraction cases. He tried to use the lower incisors to prevent forward movements of the lower molars during sectional mechanics while retracting lower canines. It was in 1960 he started using it in day to day orthodontics regularly.

The name utility was given by assistance in his office Marty Lewis, in 1962 that derived the name from the baseball game.

He stated about design modification of utility arch wire and used the standard state utility and custom utility with loops or accessories. He further stated that when it is spanned from the molar to the incisor in the lower arch, the wire is subjected to food during chewing. In order to avoid distortion from function, the wire was offset to the gingival area or to the vestibular area. But, another advantage was that it provided more wire, made the force lighter and also formed an open loop. If a ‘Z’ or ‘S’ bend was made in standard utility it could be straightened out for arch length increase and can also be employed for closing spaces. In very crowded conditions, it is formed by loops between the incisors with rest against the lower lip and acts as a bumper, to move molars distally.

The vestibular section of utility arch acts as a shield against the pursing of the lips during swallowing. Hence, the lateral movement of three molars occurs without direct force on that. Also, the premolar drifts distally. They tend to flow into the area of least resistance.
• Flexibility of utility arch wire:

   He stated that flexibility together with three plane control and lighter forces were needed. The bands could be activated directly in the mouth easily with the new plier (i360) designed in 1992. Excellent control in three dimensions is provided with the light square wire if it is understood and mastered.

• Torque in the lower anterior segment of utility wire:

   Straight wire and a straight bracket will place the lower incisor $16^0$ forward, which is about ideal so there is no need for incorporating torque. One factor more critical was the height of molar control of the occlusal plane. He preferred the occlusal plane to remain below Xi point. This holds the incisors upright. The more canted the plane, the more protrusive the incisor. This is another reason for cervical traction on upper molars to hold the plane forward posteriorly.

   If the lower incisor were inclined forward too much, the straight bracket will upright it and vice versa. Ironically while intrusion occurs the lower incisors with the utility wire are often uprighted too much and we must keep opening up buccal space. The molars distalize and tend to take the incisors lingually while intrusion occurs.

• Metapositioning:

   Ricketts mentioned that a favourable change in the position of the teeth following treatment is metapositioning. This ‘Settling in’ process is now metapositioning, it is not relapse.
AWARDS RECEIVED BY DR RICKETTS

1. William Gogswell Distinguished Service Award in Oral Surgery, 1974

2. Recipient of Albert H. Ketcham Award for American Association of Orthodontist, 1975


4. Associated Journals of Europe Award, 1983 - Hinman Award
HONORS RECEIVED BY DR RICKETTS

1. Chairman of Orthodontic Section, American Dental Association, 1952
2. President of Western District Dental Society, 1956
3. Associate Editor of California Society State Dental Association, 1958-62
4. Chairman Research & Education for Pacific Coast Society of Orthodontists and Southern California State Dental Association, 1963-66
5. Consultant to the Cleft Palate Program at St. Johns Hospital, Veteran’s Administration Hospital,
6. Chairman, Foundation for Orthodontic research 1967
7. Professor of Occlusion, University of Southern California School of Dentistry
8. Professor of Orthodontics, Loma Linda University School of Dentistry, 1971-present.
9. Visiting Clinical Professor, University of Texas, Houston, 1976

Dr. Robert Ricketts has devoted his professional life to lecturing, teaching and practicing orthodontics for over 45 years. He is the cofounder of Bioprogressive therapy and has been a major force in the development of computer aided diagnosis. He has developed a variety of orthodontic products that are used throughout the world. He has published many articles as well as Provocations and Perceptions in Cranio-Facial Orthopedics. He is an active part of the Orthodontic Education process at University of California at Los Angeles, Loma Linda University, University of Texas, University of Oklahoma and University of Southern California. The
University of Illinois and Loma Linda University [ias set aside research Libraries in recognition of Dr. Ricketts. He is the founder of the American Institute of Bioprogressive Education and was instrumental in establishing the Foundation for Orthodontic Research.
LECTURE, COURSES CONDUCTED BY DR RICKETTS

1. Practice Management, Introduction to bioprogressive therapy and Mechanics
2. Anatomy, Bones, Vertebrae, Cranium Introduction to Cephalometrics
3. Anatomy Mandibular Complex, Analysis Frontal/Lateral Tracing
4. Anatomy Maxillary Complex, Growth & Forecast Analysis
5. Physiology, Divine Proportion, Physiology Functional Environment
6. Mechanics Activation Mechanism, Fixed Ricketts Formula
7. Mechanics, Headgear & Quad Helix, Utility arch, Sectional Mechanics
8. Occlusion and Finishing Straight Wire - Retention, TMJ in Orthodontics
9. Cephalometric analysis including treatment planning forecast (short and long term)
10. Growth prediction - Diagnosis and treatment planning with emphasis on early treatment and interceptive orthodontics
11. Bioprogressive philosophy and differences between various straight wire appliances
12. Bioprogressive mechanics with the five principals
   1. Extraoral therapy the utilization of headgear as orthodontic/orthopedic appliances
   2. Quad helix mechanics
   3. Utility arch technique
   4. Segmented mechanics
   5. Ricketts straight wire appliance
BIBLIOGRAPHY


22. Editorial Response "Truth In Orthodontic Belief" Robert Ricketts JcoNov 1993