Bioprogressive Therapy and Diagnostics

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Summary

The bioprogressive technique is a fixed orthodontic technique, developed in the 1950s by Robert Murray Ricketts. This article provides a brief overview of the history of orthodontic practice, explaining the development of "Ricketts technique", methods and principles that are incorporated in his bioprogressive therapy. It also discusses the importance of diagnostic methods, introduced by the author, that are still recognized as an important part of orthodontic therapy planning. This article explains the influence of bioprogressive philosophy on modern orthodontic techniques.

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Introduction

The bioprogressive technique, developed from the edgewise technique, also contains elements of the light wire technique. In 1925 Angle described the edgewise appliance (1). In the 1930's many articles about the application of this technique were published (2, 3). The originally described edgewise (the so-called "primary edgewise") is a technique in which bands are cemented to teeth and the therapy begins when all the permanent teeth have erupted. Brackets on the bands have a straight slot and the wire engaged into the brackets needs to be bent in order to secure the movements and a regular arrangement of the teeth in the dental arch. Rotations and horizontal movements of the teeth (in/out) were done by first-order bending ("step" and "bayonet"), while the torque was done by third-order bending. Teeth angulation (second-order movement) was accomplished by positioning the bracket to the band at an angle, i.e. with an inclination in the mesiodistal plane or, alternatively, the band was cemented at a certain angle. The dimensions of the soft gold alloy wire used by Angle are 0.022" x 0.028". The main feature of edgewise is that control of tooth movements in all three dimensions is achieved throughout the therapy.

The second stage of the development of the edgewise technique ("secondary edgewise") is characterized by the use of a round wire in the straight slot of the edgewise bracket. The round wire, used in leveling, results in the undesirable flaring of the teeth, particularly expressed in the lower dental arch.

The third stage of the development of edgewise ("tertiary edgewise") may be looked upon as a modification of the secondary edgewise, also called Tweed edgewise. Tweed introduces the use of Class III elastics, beside the "tip-back to-hold" anchorage in the lower arch, in order to avoid labial tipping of the lower incisors brought by the use of round wire. He is the first to use 0.0215" x 0.025" stainless steel wire.

Since the clinicians were trying to improve and modify the original method in their everyday work,

new challenges relating to the edgewise technique appeared in the 1940's. Objections were raised to frequent resorptions of roots and the appearance of bialveolar protrusion in the therapy of deep bite due to the use of round wire in the leveling stage. Inadequate therapy frequently resulted in the extraction of the first premolars (4).

Advantages of the use of light forces in contrast to heavy forces and their effect on tooth movement was frequently discussed in the 1950's (5, 6).

All these stages of the edgewise technique development have served as the basis for the development of the bioprogressive method. Ricketts proposes the bioprogressive technique as an answer to the needs of orthodontic therapy.

Development of the bioprogressive technique

Bioprogressive therapy was so named because it progressively includes particular groups of teeth into the therapy (first the molars and the incisors, followed by the canines and the premolars), with therapeutic interventions applied in a planned sequence.

There are three varieties of the technique that may be used. They are all based on the basic presumptions of the bioprogressive concept. These are the following: bioprogressive setup, full-torque bioprogressive arrangement and triple-control bioprogressive (7).

In the *standard bioprogressive setup* torque is incorporated in the brackets for the upper incisors and all four canines. First and third-class bending for the lateral lower segment is still done on the wire.

In the *full-torque bioprogressive arrangement* the setup in the superior arch is like the standard setup, but in the inferior arch a torque is added to the tube of the lower molar and the bracket of the lower second pre-molar. At this stage there is no need for third order bending, except in some cases, which greatly facilitates the orthodontist's work. First order bending is still done on the wire.

In the *triple-control bioprogressive setup* the bracket design also includes first order movements. Brackets of the upper canines and the second upper premolar are thicker in order to ensure the buccal movement of the first premolar and/or molar. Also, a distal offset for the rotation of the upper molar has been added to the tube. This is the true straight-wire technique; there is no need for bending the wire at all, all movements are ensured by the design and/or by the correct setup of the appliance (8).

Today's Ricketts brackets of slot dimension 0.018" also come in the so-called standard and the bioprogressive setups. The only difference is that the torque in the bracket for the lower second premolar in the bioprogressive variety is -14°, while in the standard variety it is 0° (Table 1).

The values of torque and angulation differ significantly in relation to the widely used Roth technique (Table 2).

Elements of the bioprogressive technique

The wire used in the bioprogressive technique is Elgiloy 0.016"x0.016". The size of the wire is standardized for individual cases. The distance from the distal edge of the lateral incisor of one side to the distal edge of the other side is measured. The same wire size is used for an individual patient at different stages of therapy, e.g. ideal arch size 5, finishing arch size 5, etc. The following arch types are used: ideal arch, utility arch, double-delta arch, closed-helix arch and finishing arch.

The *ideal arch* is used at the initial stage of therapy to form the individual dental arch. Pre-fabricated arches are used, that already have bent insets and offsets. The form of the arch is characterized by its straightening in the canine region and the absence of its prominence. The offset is distal from the canines for the first premolar in both dental arches. Offsets are made for molars, too, as well as a distal offset for the rotation of the lower molar (12°) and the upper molar by 15°. In the triple-control bioprogressive setup no bending is needed, since it is all incorporated in the appliance.

The *double-delta arch* (Figure 1) is used for closing the space after segmental therapy and the *closed-helix arch* for closing the space. Its inverse use in the superior arch, which at the same time torques the upper front teeth, is interesting. The *finishing arch* (Figure 2) has horizontal loops. 0.018" x 0.022" wire is used to close the space, torque the teeth and control the form of the dental arch.

Beside these standard wires, the bioprogressive therapy applies other pre-fabricated segmental type elements, such as maxillary cuspid retractor, mandibular cuspid retractor (Figure 3), ideal buccal segmental arch, back action uprighter or intruder (Figure 4), "T" arch and horizontal helix. The use of *segmented arches* has been introduced because of the need to control movements of tooth groups or an individual tooth more efficiently, particularly at the first stage of therapy (7, 9). The bonding of the arch by a single, joint wire is postponed to a later stage of therapy by double-delta arches.

Ricketts "utility" therapy

The utility arch (Figure 5) has been developed within a new approach to therapy. This is an arch which starts the therapy, but it may also be used at any later stage of the therapy.

The arch was named for the wide possibilities it offers and for the various effects it can bring about during the therapy. It has made possible a controlled lower incisor intrusion in cases of deep bite (10-15). The wire that is bent into the utility arch is a 0.016" x 0.016" blue Elgiloy. Unlike rigid stainless steel, this wire is made of chrome-cobalt alloy that may be bent more easily. The warming of the wire is not recommended for it increases the force the wire exerts; for a movement like intrusion a light force should be applied. Utility arch consists of a molar segment inserted into the molar tube, with the posterior vertical segment joined to it at a 90° angle; this segment is usually 3-4 mm long in the mandible and 4-5 mm long in the maxilla. Its extension is a vestibular segment passing at the level of the marginal gingiva edge without touching it. It is followed by the anterior vertical segment 4-5 mm long in the mandible and 5-8 mm in the maxilla, joined by the incisal segment, which passively lies in the brackets of the incisors before it is activated. The utility arch looks the same at the other side, ending in the tube of the opposite side molar. With regard to application, there are four different utility arches.

The passive utility arch is used for preserving the space or for stabilization in mixed and in permanent dentition. In mixed dentition it can preserve space during the replacement of teeth, preventing mesial molar movement. By moving the cheeks away from the lateral teeth, the arch facilitates the transversal expansion. In permanent dentition it is primarily used to preserve anchorage.

The intrusion utility arch looks like the passive arch but is activated for the intrusion of the front teeth, against which a continuous light force is exerted. Beside intrusion, the bending of the wire gingivally on its way out of the molar tube has a retrusion effect and prevents labial tipping of the lower incisors during the intrusion.

The retrusion utility arch is used in mixed and in permanent dentition for the intrusion and retrusion of the incisors. The arch contains loops and is activated like the previously described intrusion arch.

The protrusion utility arch protrudes and intrudes the upper and the lower incisors. It is usually used in Class II/2 therapy.

Ricketts cephalometric analysis

Ricketts analysis has undergone a series of modifications. The first version had only five variables. The analysis was later expanded by the introduction of new points and lines (Figure 6,7). Originally, Ricketts points were the following: Xi - the geometric centre of the ramus of mandible; PM - point on the front border of symphysis between point B and Pog; DC - point in the centre of the condyle neck at the point it crosses the BaN line. Beside this, Ricketts introduced changes that happen during growth into his analysis (Table 3) and on the basis of them predicts the ultimate result of the therapy (VTO - Visual Treatment Objective). Beside the cephalometric analysis and the prediction of growth as the guidelines for the therapy, the author also mentions the "intuitive" planning of the therapy as being of the same importance (16, 17).

Analysis of profile soft tissues

An important factor in the analysis of profile soft tissues is the aesthetic line (Ricketts E-line) which connects the pogonion point with the tip of nose, i.e. the pronasal point (Figure 8).

In mixed dentition, both lips are on that line (18, 19). With age the lips retract, moving behind the aesthetic line in a young adult: the lower lip by 2 mm and the upper by 3 mm (12).

This analysis makes a distinction between three facial types:

Concave - the lips lie behind E-line above average;

Flat - average position of the lips (lower 2 mm, upper 3 mm behind E-line);

Convex - the lips are touching or are in front of E-line.

The height of the upper lip and the contact line between the lips and the occlusal plane are analyzed on the profile, too. The distance between the subnasal point and the point of lip contact is measured. The occlusal plane is normally 3.5 mm below the lip contact line (at the age of 8-9 years). Each year this distance shortens by 0.1 mm until growth completes. An estimate of the height of the upper lip is important for determining the optimum position of the incisors. If the occlusal plane is high, the teeth remain hidden behind the lips and it is recommended, for aesthetic reasons, that the position of the occlusal plane is changed to bring it as close as possible to the normal relationship with the lip (18).

Conclusion

Although presented more than half a century ago, Ricketts technique is still modern. It is based on the biologic principle of the use of very light forces. Principles, developed and designed more than half a century ago, are present in today's techniques (Alexander, MBT, Roth...) which use continuous light forces for the movement of teeth, using new technologies (nickel-titanium martensitic archwires).

The use of the utility arch introduced by Ricketts makes possible fixed therapy in the early mixed dentition (20, 21). Segment arches facilitate the movement of individual teeth in the desired direction and the anchorage may be planned more efficiently.

Another advantage of the bioprogressive technique, emphasized by the author himself, is that its purpose is not an absolute standardization of treatment; there are certain principles, but the diagnosis, planning and manner of the therapy are individualized to fit the specific needs of each patient (8). There is no doubt that the introduction of Ricketts cephalometric analysis and VTOs into orthodontic diagnostics is very significant. Today there is almost no diagnostic software that does not include the parametres of Ricketts analysis as its key element. Ricketts E-line is not only an important part of the analysis of soft tissues, but also a matter of aesthetics, which is an indispensable part of contemporary orthodontics.