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Tweed's Philosophy - A Review

Shelly Jain[1], Ragni Tondon[2], Kamlesh Singh[3], Rohit Kulshrestha[4], Vinay Umale[5]

[1,4]Consultant, [2]Professor & Head, [3]Professor, [5]Senior Lecturer, [1,2,3,4,5]Dept. of Orthodontics, [1]Private Practice, Aurangabad, [2,3]Saraswati Dental College, Lucknow, [4]Private Practice, Mumbai, [5]Yogita Dental College, Khed, Maharashtra

***Corresponding Author:**
Email: kulrohit@gmail.com

Abstract

One of the great contributors to edgewise technique is Charles H. Tweed (1895-1970), a student and close associate of Angle, who introduced into the literature an "edgewise" appliance, based on the basal bone concept. His method of treatment discarded the first molars as the key units in corrective procedures. This review article is about the life's work of Charles Tweed which traces back to the history, philosophy and technique of Standard edgewise appliance. This evolved as the first speciality of fixed orthodontic appliance, and made it possible to move teeth in all three planes of space with a rectangular wire. Standard edgewise technique was the base foundation from which all the fixed orthodontic appliances have been made. This technique was a major breakthrough and lead to the evolution of fixed orthodontic appliances.

Keywords: Tweed, Head plate correction, Diagnostic facial triangle.

Introduction

The recent development of cephalometrics has had a profound change in clinical orthodontics worldwide. Empiricism is being replaced by scientific considerations. Orthodontists should be most grateful to the early pioneers of cephalometrics. Men such as Bjork,(1) Broadbent,(2) Brodie,(3) Downs,(4) Margolis,(5) Moore,(6) Reidel,(7) Salzmaz,(8) Schwarz,(9) and many others have contributed greatly to our knowledge facial growth and kindred subjects. Charles Tweed did fourteen years of cephalometric study of living persons — some adults, but the majority growing children, between 13 and 16 years of age.

Since 1951, he treated and followed through retention approximately 500 patients.(10) His analysis and treatment procedures are based mainly on the following:

1. A good visual clinical examination.
2. The diagnostic facial triangle
3. A knowledge of facial growth trends.(11)

Classification of facial growth trends Tweed took lateral cephalograms of all young patients undergoing a pre-orthodontic guidance program. Some 12 to 18 months later a second head plate was taken and tracings made of both cephalograms. These tracings are superimposed on S-N, with S the reference point. If this was done prior to any mechanical treatment procedure, according to him it was possible to determine the type of facial growth trend that must be contended with during treatment. It was important to ascertain the type of facial growth trend as early as possible for it:

- concerned the prognosis,
- when to begin the treatment,
- the length of treatment time and,

Faces of all children grow, downward and forward in one of three ways. Therefore, he classified facial growth trends as: Type A, Type B, and Type C, each type having a subdivision.(12)

The Development of Diagnostic Facial Triangle

Charles Tweed in his article: "Was the development of the diagnostic facial triangle as an accurate analysis based on fact or fancy?" Stated the following: 'Before launching into the subject matter of this article, which concerns a simple, workable, but extremely accurate diagnostic analysis for the treatment of malocclusions, I should like to call attention to two facts:

1. All claims made will be supported by the results of both visual and cephalometric clinical research on living subjects over a period of twenty-five years.
2. I shall not expect my readers to accept personal opinions, mine or anyone else's, as valid reasoning.(13)

For more than six years Tweed, after the death of Angle practiced and advocated a philosophy of orthodontic treatment which demanded the full complement of teeth. During this time, late in 1934, as a result of his inability to create balance in more than a few of his patients, he began analyzing his practice results. This project called for models, photographs, and x-rays of all patients treated by him up to that time. Records were secured for more than 80 per cent of the patients in his practice.

The photographs were divided into two groups:

1) Those with balance and harmony of facial proportions
2) Those in which these qualities were lacking.

On studying these records he realised those patients possessing balance and harmony of facial proportions had mandibular incisors that were upright over basal bone.(14) The patients who lacked these attributes of facial proportions had teeth that were too prominent, and the mandibular incisors were not upright and over basal bone. He also noted that the lack of harmony in facial contour was in direct proportion to the extent to which the denture had been displaced mesially into protrusion. In his treated cases he also observed that all four orthodontic objectives had been attained in only 20 per cent of these cases. Tweed's orthodontic objectives were:

1. The best balance and harmony of facial lines.
2. Stability of denture after treatment.
3. Healthy mouth tissues.
4. An efficient chewing mechanism.

The result of this experience prompted him to search for and secure models and photographs of many normal persons who never had orthodontic treatment. A study was made of the facial balance and harmony of these persons. The relationship of teeth to basal bone in these normal faces was carefully noted, especially the variation in the inclinations of the mandibular incisors. These non orthodontic normal persons having the most balance and harmony of facial lines demonstrated that the inclination of the mandibular incisors, when related to the plane formed by the lower border of the mandible, is 95 degrees or +5 degrees.[15,16] The range of the inclinations of the mandibular incisors of non orthodontic normal persons is approximately 10 degrees and is virtually the identical range found in the treated cases in which he had accomplished his four orthodontic objectives and had attained the desired balance and harmony of facial proportions (Fig. 1).

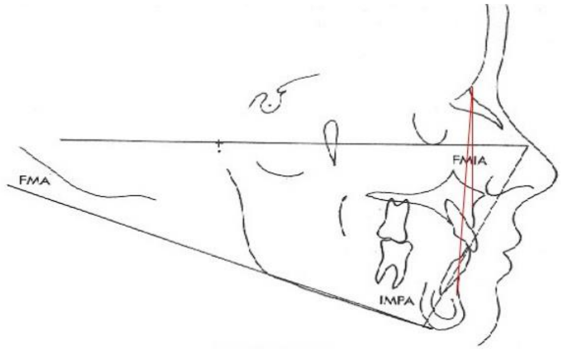

Fig. 1: Diagnostic Facial Triangle

The conclusions that he drew from these studies were that if the orthodontist is to attain facial aesthetics and dentures similar to those found in non-orthodontic normal persons, he must position the mandibular incisors within this normal range of 90 degrees minus or plus 15 degrees. Tweed made considerable effort to place them so without resorting to the removal of teeth.[17] In some instances, he did this by overexpansion of the dental arches, but too often it was possible only at the expense of impacting both unerupted second and third molars.[18,19] The usual aftermath of such treatment was relapse when retention was discontinued, plus lasting damage to investing tissues. To possess this concept of the normal and to be unable to execute it in treatment procedures frustrated him and resulted in the decision to extract some teeth.[20]

Tweed's Analysis

The analysis consists of the Tweed's triangle formed by:

1. Frankfort horizontal plane.
2. The mandibular plane.
3. The long axis of lower incisor.[21]

The Frankfort plane is established by connecting a point 4.5 mm, above geometric centre of the ear rod and an orbitale point midway between the left and right lower borders of the orbits. The mandibular plane is drawn along the lower border of the mandible and was extended posteriorly to connect with Frankfort plane. Anteriorly this plane connected menton, and posteriorly it bisects the distance between the right and left lower borders of the mandible in the region of the gonial angle. The third leg of the triangle is made by extending the long axis of the mandibular central incisor downward to the mandibular plane and upward to the Frankfort plane. Thus, the angles FMA, IMPA, and FMIA are formed (Fig. 2).[22]

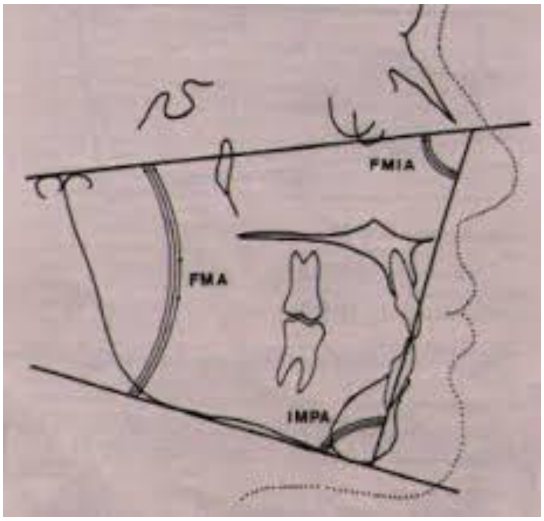

Fig. 2: Tweeds Analysis

From this analysis he concluded that,

1. In steep-angle cases that read 30 degrees or more, the mandibular incisors were compensated so that the FMIA was 65 degrees or more. (More means toward 70 degrees, not 60 degrees).
2. In cases in which the FMA was 25 degrees plus minus 4 degrees; an effort is made to attain an FMIA of 68 degrees or better. (Better means toward 70 degrees not 65 degrees.)
3. In those cases in which the FMA reading was 20 degrees or less, an endeavour is made not to exceed an incisor angulation greater than 94 degrees when related to the mandibular plane.
4. The importance of the size of the FMIA in creating satisfactory facial aesthetics as a result of orthodontic treatment.[23]

The FMA is probably the most significant value for skeletal analysis because it defines the direction of lower facial growth in both the horizontal and vertical dimensions. The standard on normal range of 22° to 28° for this value projects a skeletal pattern with normal growth direction. An FMA greater than the normal range indicates excessive vertical growth and an FMA less than the normal range indicates deficient vertical growth.[24] The IMPA defines the axial inclination of the mandibular incisor in relation to the mandibular plane. It is a good guide to use in maintaining or positioning these teeth in their relationship to basal bone. The standard of 88° indicates an upright position and, with a normal FMA, reflects optimal balance and harmony of the lower facial profile. If the FMA is above normal, the orthodontist must compensate by further uprighting the mandibular incisors. If the FMA is below the normal range, compensation can be made by leaving the mandibular incisors at their pre-treatment position by positioning them more to the labial. Labial inclination of the mandibular incisors is generally limited to 94° in patients with normal muscular balance because of tissue health and stability.[25]

Head Plate Correction

Tweed also utilized IMPA correction on the cephalograms according to his treatment objectives and called it head plate correction. He accordingly calculated the space requirement in the arch based on the amount of change required to place the lower incisors correctly over the basal arch. Orthodontists across America and Europe treated cases according to the IMPA goals of Tweed's triangle. In India too during 70's, the treatment planning was based using Tweed's objective of IMPA guidelines.

- FMA greater or equal to 30 degrees mandibular incisors are compensated by so that FMIA ranges from 65-70 degrees. Prognosis– Fair and extraction are usually indicated.
- FMA is equal to 25 degrees plus minus 4 degrees, efforts should be maintained to attain FMIA 68 to 70 degrees.
- FMA equal or lesser than 20 degrees then IMPA should not exceed 94 degrees.

In this analysis, Tweed stressed the importance of FMIA angle, and recommended that FMIA should be maintained at 65-70 degrees.[26]

Cephalogram Correction

To arrive at the measurement referred to as the "cephalograms correction". Tweed relied primarily on the diagnostic facial triangle.[27] The values for space required and space available is obtained by model analysis. An assessment of the relations between the axial inclinations of the mandibular incisors and the basal bone was made on a tracing of the lateral cephalograms. The amount of alveolo-dental protrusion or retrusion was assessed and incorporated into the mixed dentition analysis.

Tweed Foundation research has established the following relationships:

- When the FMA is between 21° and 29°, the FMIA should be 68°.
- When the FMA is 30° or greater, the FMIA should be 65°.
- When the FMA is 20° or less, the IMPA should not exceed 90°.[28.29]

If for a specific FMA (30°) the FMIA (49°) did not correspond, an objective line was traced to form the required FMIA (65°). Then the distance between this objective line and the line that passed through the actual axial inclination of the mandibular incisors was measured on the occlusal plane with pointed callipers to the nearest 0.1 mm (6 mm). This figure was multiplied by 2 to include right and left sides (12 mm). The total was the cephalometric correction, which was then added to the difference between space required and space available to yield the total discrepancy.[30]

Anchorage Preparation

According to Tweed, Anchorage preparation is the most important step clinical orthodontics. Although highly controversial, this procedure is lightly dwelt upon by many a great many clinical orthodontists. During Tweed's era, many orthodontist had disbelief in anchorage preparation procedures and were of the opinion that "An undisturbed tooth affords the greatest resistance to movement" but Tweed felt that one single separating wire or a single band on a molar, or on any other tooth for that matter, and the term "undisturbed" no longer applied to it.[31] Charles Tweed was influenced by the research that had been done by Kaare Reitan in Oslo, Norway, who stated "When teeth are tipped distally as they are in anchorage preparation. Osteoid tissue appears to been laid down adjacent to the mesial surface of the tooth being moved distally".[32] Thus Reitan concluded that this new calcified osteoid bundle bone does enhance the resistance of the tooth to mesial movement when force is applied, if tooth were subjected to class II intermaxillary force. Thus, such conclusions make it the necessity for anchorage preparation.[33]

Tweed explained anchorage preparation from a somewhat different view point—mechanical rather, than physiological. He stated "Most men, at some time in their lives, have gone camping and have pitched a tent. Why did they slant the stakes at such an angle that the pull of the tent ropes against the stake would not exceed 90 degrees? By experience, they know that if a strong wind blows, the incorrectly positioned stakes driven into the ground too vertically will be pulled upward and toward the tent and will be uprooted.[34] They have learned that stakes will be uprooted more readily if the angle of pull on a stake is more than 90 degrees to its long axis. This occurs regardless of the media surrounding the stake and whether it is wet or dry. Simply stated, anchorage preparation is mechanical in nature. If we position the teeth in the buccal segments of the mandibular denture in upright positions, with the terminal molars tipped back like tent stakes so that the pull of the inter maxillary elastics, when related to the long axes of the terminal molars, does not exceed 90° when the mouth is functioning, the entire mandibular denture will be more stable and better able to resist forward displacement.[35] If movement does occur, it will be slow mesial bodily movement of the entire mandibular denture.

On the other hand, when we fail to prepare anchorage or leave the anchor molars in their mesially inclined, undisturbed positions, the action of the inter-maxillary elastic Class II pull is upward and forward. This condition will result in the elevation and uprooting of the terminal anchor molars. When such reaction is allowed to occur, it is followed by excessive depression of the mandibular incisors, with a drastic and unnecessary alteration of the occlusal plane. The FMA will open up and point B will drop downward and backward as the entire mandibular denture is tipped and displaced forward into protrusion. The degree to which anchorage should be prepared will vary considerably. Unless we are purposely endeavoring to move the teeth in the mandibular buccal segments forward or to move point B downward and backward for some specific reason, the terminal mandibular molars must always be uprighted or kept upright in such positions as will prevent their being elongated when Class II intermaxillary force is used.[36] Tweed classified anchorage preparation into three categories: (1) first degree, (2) second degree, and (3) third degree.

First degree anchorage preparation: First degree anchorage preparation is applicable to all malocclusions with ANB angles ranging from O to 4 degrees in which facial esthetics are good and in which total discrepancy does not exceed 10 mm. This type of malocclusion is mainly limited to high cuspid, pseudo-Class III and true Class III cases. The degree to which anchorage should be prepared in such cases is minimal or first degree. First degree, means that the mandibular terminal molars must always be uprighted and/or maintained in such an upright position as to present their being elongated when Class II intermaxillary force is used. As a general rule, this means that the inclination of the mandibular terminal molars should be such that the direction of pull of the intermaxillary elastic force during function will not exceed 90 degrees when related to the long axis of these teeth.[37]

Second degree anchorage preparation: Second degree anchorage preparation is necessary for malocclusions in which the ANB[38] exceeds 4.5 degrees and facial esthetics make it desirable to move point B anteriorly and point A posteriorly. These cases are usually Class II in nature and require prolonged Class II intermaxillary mechanics. They usually accompanied by Type A, Type A Subdivision, Type B, and Type B Subdivision growth trends. When second molars are in full eruption, they should always be banded. The degree of distal tipping of the mandibular terminal molars is more severe than is necessary in first degree anchorage preparation. The mandibular terminal molars must be tipped distally so that their distal marginal rides are at the gum level. This is minimal. The direction of pull of the Class II intermaxillary elastics when related to the long axis of the terminal molars should be greater than 90 degrees during function, so that the terminal molars will be further depressed than elongated.[32,39]

Third degree or total anchorage preparation: Third degree or total anchorage preparation is necessary in extremely severe malocclusions in which total discrepancies vary from 14 to 20 mm. or more but the ANB angle does not exceed 5°. In the permanent dentition these cases are, as a general rule, Class I in nature, with exceedingly irregular teeth. If the patient has a bimaxillary protrusion with regular but mesially inclined teeth, the condition can be very deforming and will require strict attention during treatment to correct the facial deformity. Jigs are necessary for third degree or total anchorage preparation in the mandibular arch. In these instances all three posterior teeth from and including the second premolar teeth to and including the terminal molars must be tipped distally to anchorage preparation positions. This means that both second premolars and first molars must be tipped to disto-axial inclinations of such a degree that the distal marginal ridges of the terminal second molars are below gum level. In such positions, their mesial displacement during the period when prolonged and vigorous inter maxillary force is being used will not be great, nor will they become elongated. At times the mandibular molars will even depressed. In some very difficult cases anchorage must be prepared in both mandibular and maxillary dental arches prior to attempting the retraction of first the cuspids and then the teeth in the incisal segments.[40]

Standard Edgewise Bracket

The original edgewise bracket, 1.25mm wide, has now come to be known as the “narrow” bracket. The first new size, introduced a few years after the narrow bracket, was 2.5mm wide. This was the first attempt at gaining added mechanical advantage bracket width, and though it was originally intended for use on the molar teeth as an aid in tipping control, it's obvious advantages soon led to its use on other teeth as well. The next step was soldering two narrow brackets in exact alignment on the same band. These are the precursors of today’s multiple brackets that are milled as a single unit on common base. Keeping the brackets on a single base keeps the slots in alignment and simplifies the attachment of more than one bracket to a single tooth. These which may be called twin, double, dual, or Siamese brackets, vary from about 2 to 4.5mm in overall width. Triple brackets, with the same spacing as the 3.5mm double brackets and an overall width of 5mm, are preferable to the extra-wide spacing of two brackets for most applications where this added width is required. The original dimensions of the bracket slot and the opening in the molar tube of the standard edgewise appliance were .022” X .028” (0.56mm X 0.71mm). Several bracket slots of smaller dimensions have been introduced since, the most popular being .0185” by .025”, 0.030”. While these are manufactured to a .0185 inch standard to provide freedom of full-dimension wires, they are usually referred to as 18-thousandths slot.

Buccal Tubes: The last tooth in the arch that is banded, which is usually a molar, has been commonly to as the anchor tooth. A section of tubing, instead of some type of edgewise bracket is placed on the buccal surface of the anchor molar band and is called the buccal tube.

In the original edgewise appliance the original buccal tube was a piece of .022” X .028” gold or nickel silver tubing soldered to the molar band. Although the length of this tubing has varied considerably, that mostly used has been 3/16 or 1/4 inch. The buccal tube is for insertion and stabilization of the arch-wire, which is inserted into the tube horizontally therefore completely encased in the sheath-like structure.

The Arch Form

The most important component of the basic appliance is the arch wire. It is the part that gives the appliance its name; thus, the edgewise arch appliance signifies that a rectangular wire is formed into an ideal arch form and related edgewise to the buccal and labial aspects of the teeth (Fig. 3). Modernization of the technique has permitted the generous use of many other kinds of arch wires: we have round, square, and rectangular wires of different sizes, wires made of groups of smaller wires, and arch wires made of different metals, e.g., gold alloys, stainless steel, elgiloy, and others.

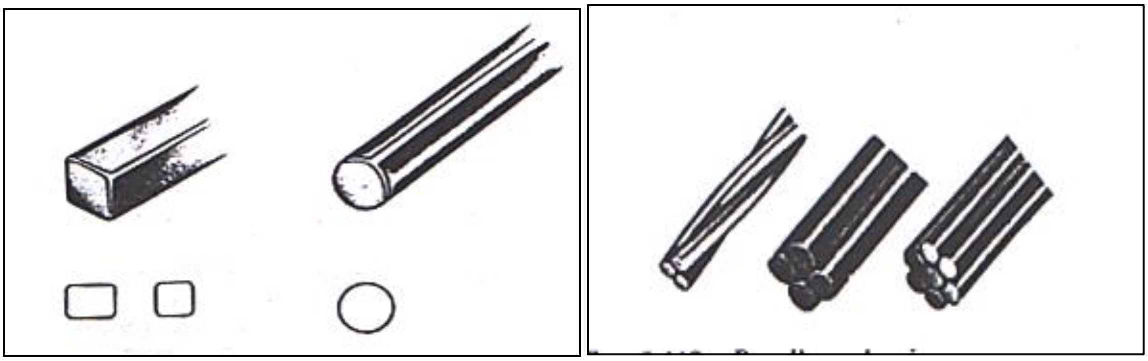

Fig. 3: Wire forms and Bundle arch wires

Using these wires in the beginning and intermediate phases of treatment, the ultimate objective ideally is the placement of the full-sized rectangular**,** ideal arch wire to complete the case. The edgewise arch (or its substitute) is placed labially to the teeth and is therefore a purely labial appliance.[41]

First, Second and Third Order Bends

All teeth can be moved, in whatever direction the operator desires. All that is required is knowledge of how a tooth moves and how to direct the force to move it. Some teeth move easier than other, some move in one direction better than another, bodily movement is more difficult than tipping, and, although it is easier to erupt a tooth than to depress or intrude it, all teeth can be intruded. First order bends refers to the buccal lingual movements of the teeth. Second order bends refers to the mesial distal movements and third order bends refers to the torque application.

Headgears in Standard Edgewise Technique: Cervical strap is a device worn about the upper part of the neck to provide a source of posterior traction to the denture; it is attached by way of a face bow and arch, hooks, or other means (Fig. 4). It was derived from the head cap by an evolutionary process. The head cap was first used in 1802 by Cellier and in 1803 by Fox to support a chin cup. Neither man claimed this to be occipital anchorage, but rather a supporting device for the chin to prevent subluxation during other oral procedures. Kingsley introduced the headcap as occipital anchorage in 1836,[2] although Gunnell[5] in 1822, Schange,[8] in 1841, and Kingsley[11] in 1866 also used it.

Fig. 4: Headgear

Finally, Angle adopted it as a means of extra oral anchorage.[(6)] It did not enjoy widespread popularity, however, until Oppenheim had written much about its successful use. Oppenheim developed a simple treatment for Class II malocclusions that restrained the maxillary first permanent molars from migrating downward and forward with the growth of the jaws, thus achieving a normal relationship with the mandibular molars. This was done by the application of an occipital anchorage (headcap) to the maxillary first molars, and time and growth accomplished the rest.[(42)] Contemporary orthodontists— Kloehn, Fisher, Nelson, Tweed, and others— have again established the use of the headcap as a potent source of anchorage for the distal traction of teeth.[(43)] They have demonstrated that the constant application of force made possible by this device gives slow but positive results. Since its reaction causes no demonstrable damage to either the cranium or the neck, it is considered to be the only truly stable anchorage in orthodontics.

The early head caps were cumbersome and unsightly, to say the least, and unless the patient was extremely cooperative, they were not likely to be worn as desired. They generally were composed of a maze of straps about the cranium which gave support to a neck strap. Angle used a net type of cap. Although many orthodontists still use essentially the original design, the head cap was redesigned in an attempt to stimulate the wearing of the device; its parts were gradually reduced until only one strap the neck strap remained. Those of us who use the neck strap believe that it is as efficient as the head cap. With the abandonment of the head cap in favor of the neck strap, it was inevitable that the name "head cap" would be changed to one more descriptive, thus, the "cervical strap".

Steps of Treatment in Standard Edgewise Technique

Tweed mechanics is divided into the following distinct steps which included in order:

1. Alignment and leveling
2. Anchorage preparation
3. Retraction of maxillary and mandibular canines
4. Retraction of maxillary and mandibular incisors
5. Root uprighting
6. Artistic positioning
7. Final space closure[(38)]

Discussion

The Tweed philosophy was developed by Charles H. Tweed in the 1930s and 1940s. His technique was based on a modification of the original edgewise appliance,[(6,8)] given by Edward Hartley Angle.[(2,3)] Through years of study and clinical experience Tweed believed that in order to achieve a functional mechanical balance the key to successful correction of malocclusion was to position the mandibular incisors over basal bone.[(46)] He then developed his diagnostic facial triangle,[(47)] (which later was adapted to cephalometry), which became known as the Tweed triangle.[(44,45)] Tweed's four basic treatment principles were based on aesthetics, function, health of the investing tissues, and stability of the end result.[(31)] These principles were used to determine whether or not extractions were needed.

Tweed mechanics was originally divided into three distinct steps which included in order: anchorage preparation (primarily of the lower dentition), En masse antero-posterior movements of the teeth in order to correct the dental relationships, and final detailed tooth positioning.[(38,39)] In all he believed that the mandibular teeth should be positioned over mandibular basal bone. Anchorage was achieved by inserting tip back bends in the wire in order to distally tip or move the posterior teeth. The forces necessary for this movement was achieved by using Class III inter maxillary elastics and headgear that was applied to the upper arch to prevent mesial drift of that dentition. It is believed that once the incisors are upright over basal bone and the posterior teeth are in distolingual axial inclinations, anchorage preparation is complete. At that point, it was felt that Class II intermaxillary elastics could be used to correct the antero-posterior relationships, and subsequent final detailing.[41,43,44,48,49]

Douglas H. Macgiplin did a cephalometric study[50] on 125 Class II adolescent patients. The treated patients were divided into four groups by technique and extraction pattern: straight wire technique with four first premolar (4/4) extractions, straight wire technique with upper first and lower second premolar (4/5) extractions, Tweed technique with four first premolar (4/4) extractions, and Tweed technique with upper first and lower second premolar (4/5) extractions. There was a significant difference between the vector angle of mandibular displacement in each treated group when the superimposition techniques (i.e., cranial base and maxillary base) were compared. He found a significant difference between the Tweed treated group and the straight wire treated groups. The Tweed groups showed a more forward horizontal displacement of the mandible than the straight wire groups. There was a difference in extraction patterns only in the Tweed treated groups. The Tweed treated patients with 4/4s extracted had a greater horizontal mandibular response.

The Begg philosophy was first introduced in 1954 when Begg described Stone Age Man's attrition. From his studies of the aborigine he concluded that the third molar migrated forward approximately half an inch between teen age and the time of its eruption. This migration was accomplished by the attrition of the contact areas and the occlusal surfaces. Begg observed a very healthy condition of the gingiva in the aborigine and suggested that we resort to an artificial compensation of attrition by eliminating the four first premolars in conjunction with orthodontic treatment. Begg introduced the term "differential force"[51] and described its ability to put bodily moving forces against tipping moving forces. His theory was primarily based primarily on Storey's and Smith research in which, force values of six ounces produced physiologic tipping movement in single rooted anterior teeth and yet little effect on bodily movement of multirooted posterior teeth. Kesling, Williams, Von der Heydt Perlow, Parker, Perlow, McDowell, Sims, Barer, Newman[23] and others have written further on the subject of the Begg's philosophy. They agree with the theory of differential force as a force great enough to move some teeth but not enough to move others. John Barton did a study that involved the cephalometric comparison of eighteen cases treated with the pure Begg technique and eighteen cases treated with the edgewise appliance in conjunction with a cervical Kloehn headgear and found SNB decreased more with the Begg technique which was also reflected in the ANB.

The occlusal plane showed a greater opening by the Begg technique. The maxillary first molars were extruded more from the headgear technique. The mandibular molars were extruded a similar amount. The facial height increased during both treatments. Anchorage loss was greater in the maxilla from Begg. The maxillary incisors were not torqued sufficiently by the Begg technique. The several theories concerning force are still unresolved as facts, and may remain unresolved. The controversy of light forces as opposed to heavy so called orthopedic forces is complicated by disagreement regarding, whether those forces should be continuous or intermittent.

Storey and Smith[52] demonstrated in 1952 that the magnitude of the force was not the important factor, but rather it is the pressure per square area that governs the response of a given tooth unit to force application. Their views have been supported by Sandstedt[53] and Schwarz.[14] Tweed's original concept of establishing mandibular anchorage, he proposed procedures to prevent the development of localized areas of high force loads. In 1964 Reitan[43] observed that the degree of tooth movement depends on the character of the alveolar on the duration of the experiment.

Schwarz[54] Stuteville,[55] Skillan[56] and Reitan[57] Moyers and Bauer,[58] and Huettner and Young[59] have reported studies of tissue reaction in response to orthodontic forces in begg's and standard edgewise. Halderson Storey and Smith' Storey,[52] and Sved have considered the mechanics as related to the distance/time factors. The results of those studies are by no means conclusive; but evidence is strong that the pressure applications (with the exception of extra- oral force) in the Begg technique and the edgewise approach are not as divergent as superficial observations indicate. Although the forces in the edgewise technique are generally heavier than those utilized in the pure Begg technique the difference of tooth control may generate similar per square area pressures.

In 1972 Andrews reported on 120 casts of non-treated subjects with dentitions he considered to be optimal. His purpose was to seek data that uniquely characterized these dentitions and to establish basic standards against which deviations could be recognized and measured. Andrews referred to these standards as the "Six Keys to Normal Occlusion".[60] The commonality of objectives for most persons meant to Andrews's that it should be possible to develop an efficient appliance, economical in both time and energy requirements, for achieving these goals. The result was the Straight-Wire Appliance ("A" Company, San Diego, Calif.). The Roth appliance ("A" Company, San Diego, Calif.) is one of the available SWA bracket prescriptions. Paul and Bernard[61] study was to compare the treatment results of Roth appliance (RA) cases with those treated with standard edgewise appliance (SEA). The following conclusions can be made about the RA and the six keys to normal occlusion: (1) Despite using the RA, experienced clinicians still found it difficult to achieve all of the six keys to normal occlusion, and the RA scored significantly higher than the SEA for the angulation and inclination of the maxillary posterior teeth.

Conclusion

The edgewise appliance has endured the test of time. Angle was determined to use it to correct malocclusions while preserving "the full complement of teeth," through 42 years development and improvement. He collaborated with Charles H. Tweed, who after countless failures, introduced the extraction of four first premolars and anchorage preparation to produce facial balance. The magnitude of effort that is being directed toward the further sophistication of the appliance; the comprehensive nature of the clinical research being carried on by the Tweed Foundation and others; and the intense worldwide interest in the Foundation, its objectives, and its study course, it is difficult to imagine that this very worthwhile invention will ever depart. The edgewise appliance has stood the test of time and will be used by many more generations of orthodontists.

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