Past And Present Concepts Of*
Anchorage Preparation

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Anchorage preparation to many is quite a stranger. Most of us are aware of its existence. Some are acquainted with its origin. Others have seen its accomplishments. Few orthodontists are actually using it. Just what is it? The term anchorage, as used in orthodontics, refers to a source which can resist the reactions of orthodontic forces.

A discussion of the development of present day concepts of anchorage involves a review of the search through the years for the ideal appliance — one which permits force application from a perfect source. A review of the literature is a fascinating subject. Time will permit only a brief mention of a few of the background contributors. For those of you who are interested there are several well-written articles and a great deal of information in the early books and writings of Angle[1], Case[2], Guilford[3], and others. Brodie[4] gave a fine review of this subject at the last biennial meeting of this society.

It is interesting to note that Pierre Fauchard in 1728 described the first arch which was a flat perforated ribbon. This arch, or "bandeau", was ligated through the perforations to the teeth. A reciprocal series of forces was set up pitting against each other each of the teeth involved. This made use of the principle of reciprocal anchorage. A century later, in 1841, Schangé devised an arch soldered to a skeleton crib which afforded positive purchase on the teeth. He also developed the first clamp band.

Occipital anchorage was introduced by Kingsley in 1866. There are many who claim that the ultimate in anchorage was developed years ago through the use of these occipital or extraoral forces.

The early bands were problems because of tooth decay. With the advent of the cemented band, orthodontia became a more exact science, and credit for the cemented bands, according to Angle[1], goes to MacGill in 1871. Dr. Angle, in 1886, wrote about the use of small delicate tubes and shortly thereafter he described in the literature the "E" arch, or expansion arch. The jackscrew had become quite popular and was used for many years.

In 1898 Calvin Case[2] advocated the use of reciprocal elastics to effect movement between individual teeth in opposite arches. However, it remained for Baker, with the use of Angle's "E" arch, to apply those elastics in the correction of Class II irregularities. In his seventh edition, Dr. Angle called intermaxillary anchorage the "ideal force". The reciprocal activity of each end of the rubber band, he claimed, provided the best anchorage for the correction of the Class II condition and the creation of normal occlusion.

Prior to the use of intermaxillary forces occipital anchorage had become quite popular. The sequence of usage of many mechanisms is somewhat obscure. In reviewing the several sources[1 2 3 4 5 6] of information about the development of these devices it was apparent that at the turn of the century and shortly thereafter, many men, working independently, seemed to be

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trying feverishly to develop the ultimate in orthodontic appliances.

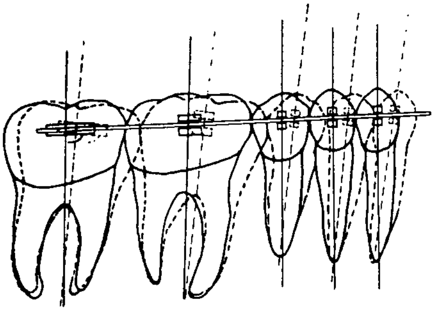
The demands on anchorage became greater as more refinements in force control were developed. Spring levers working from the round arch and anterior bands with ligatures tied to spurs improved the technical manipulation of the individual dental units. Orthodontic texts were written and anchorage was classified into several categories—simple, compound, stationary, etc. It was decided that the best anchorage in the mouth was one which permitted only the resistance teeth or anchor teeth to be moved bodily. This was called stationary anchorage.

As the search for better anchorage developed, it became apparent that more control was required over the individual dental units. As a result, Angle, expanding on this thesis, developed the pin and tube appliance and then the ribbon arch to afford greater mechanical advantages. This was an aftermath of the use of intermaxillary force which required all of the teeth to be resistance factors or anchorage units in the arches. The edgewise appliance, as first described by Angle in 1928[7], was designated as the "latest and best" of the time. Even today the many possibilities afforded by it are just being realized. However, the pendulum swings and modern orthodontics is again applying some of the so-called simple anchorage devices very successfully in the treatment of many types of malocclusion.

We have become aware of the many problems that have developed because of anchorage inadequacy and many men have advised the use of auxiliaries such as muscular, tissue borne and occipital supports. An excellent analysis of the anchorage problem was published recently by Earle Renfroe[8]. He analyzed the resistance factors of all the known sources of anchorage — the teeth, bone, musculature and extraoral areas. In this article he stresses the application of some of the early principles advocated by Angle, Case, Dewey, McCoy, and others. He analyzed the efficiency of several auxiliaries as anchorage mechanisms.

However, we will sidetrack the discussion of these devices and pursue the development of the edgewise mechanism and the anchorage possibilities afforded by it. The force exerted by the edgewise mechanism, as it was originally intended by Dr. Angle, involved the principle of short reciprocal levers directed from each tooth through the arch to its adjacent tooth on either side. The principle of bracket purchase involved fixation of an .022 x .028 archwire into a bracket designed to receive this wire. The first treatment results reported cephalometrically through the use of edgewise appliances were made in 1938 by Brodie, Downs, Goldstein, and Myer[9]. One of the conclusions concerning the effect on the mandibular arch or the anchorage unit in the Class II, Division 1 cases was that considerable mesial movement of the mandibular buccal segments occurred.

In order to assess properly the meaning of such a conclusion one must consider the problems associated with the use of the edgewise arch. There is clearance or leeway between the archwire and bracket. Because of the jiggling between the wire and the bracket the teeth will tip if a mesial force, such as a tieback ligature, is used (Fig. 1). This is especially true when the use of intermaxillary Class II activity is applied (Fig. 2). Here the teeth not only tip, but due to the directional pull of the elastics the posterior teeth are elevated in the mandibular arch. This creates problems, such as tipping of the occlusal plane which, subsequent to retention, very often allows a return



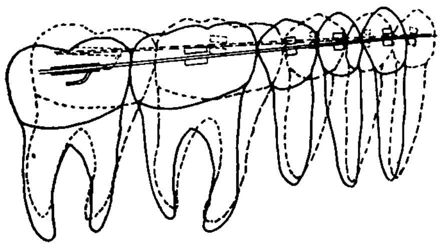


Fig. 1, above. Mesial tipping which occurs when a straight arch is tied back.
Fig. 2, below. Mesial tipping and elevation of lower molars when Class II mechanics are applied.

of overbite. It was thought that reinforcing the edgewise mechanism with a soldered lingual arch or stabilizing plate would help. This was done to increase the anchorage potential. These auxiliaries had certain advantages and were found to serve nicely in meeting specific demands. For example, to reinforce the arch to permit uprighting of tipped cuspids or a single unerupted tooth, a removable or soldered lingual auxiliary arch is quite effective. It is also useful in some cases in which the entire arch is pitted against one or two teeth. However, such auxiliaries will not afford effective resistance to the tipping action on the occlusal plane of the intermaxillary pull. Many of us have found ourselves removing lingual arches after they have embedded themselves deeply into the lingual mucosa.

Tweed, perplexed with the problems that he found through the use of the edgewise arch in his hands, decided that the only way to get a satisfactory anchorage was to prepare it. Originally, he attempted to do this by moving the anchorage unit into a disto-angular inclination (Fig. 3). He evolved his well-known Tweed philosophy of placing the mandibular incisors over basal bone and repositioning the remaining teeth in such fashion that they not only were in harmony with the anterior teeth, but also at such angular relationship to the pull of intermaxillary force as to resist displacement. His mechanics of doing this are well known.

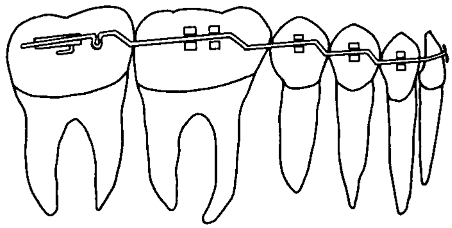


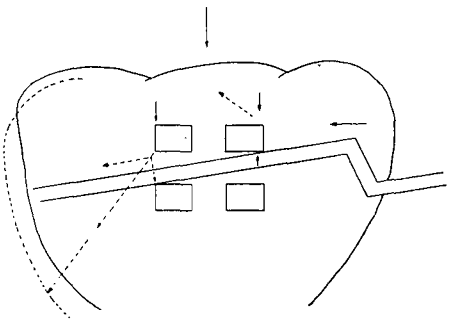
Fig. 3 Diagram of a prepared arch.

When it was first presented, the term "anchorage preparation" did not seem to be in harmony with basic biological and physiological evidence. Clinical usage, however, has justified its application. It has been used quite successfully for some time.

What makes a prepared anchorage unit different from a conventional arch with a heavy wire? An analysis of the forces is interesting. If it be true that a prepared unit has a greater tendency to resist displacement, there must be a physiological explanation that can be accepted. It is probably agreed that biological resistance to bodily movement is greater than the resistance to a tipping force. There must, therefore, be greater purchase of each tooth along the root surface as it is pulled mesially in a prepared unit in which it is difficult to tip teeth, as opposed to the simple tipping action of the teeth against the alveolar crest and the apical bone area. Since the tooth and the periodontal structures are designed to resist the forces of occlusion which are in a downward direction, any vector of orthodontic force in that direction is undoubtedly going to resist movement to a greater degree than a force exerted in any other direction. Such is the case of the so-called "prepared" tooth. The combined action of the bodily resistance of each tooth to movement and the absorption of a certain degree of the intermaxillary force in an apical direction is offered as a possible explanation of the efficiency of the "prepared" unit.

The present term given to the application of anchorage preparation is "dynamic anchorage". The mechanical requirements insist that the tip-back bends in the anchor arch be periodically activated slightly to exert active purchase against the brackets. It is also necessary to religate the tie-backs to place tension in the archwire. The principle is to neutralize the small amount of mesial tipping of the tooth due to "play" and to keep the tooth in such position that the resistance to the intermaxillary force tends to continuously keep the mesial movement of the anchor teeth in a bodily direction. The anchorage arch must always have active second-order bends to exert purchase on each tooth when elastic pull is exerted. Without the second-order bends in the anchor arch, the pull of the elastic is transferred to the archwire directly on the anchor molar tooth and indirectly through contact pressure to the remaining teeth in the buccal segments and again directly to the anterior teeth. The use of the teeth in the buccal segments as stationary units is lost when this elastic pull is not transferred equally or at least to a greater degree among several of the teeth rather than the molar tooth with its sheath. Second-order bends, tied-back to the molar sheath, offer a mechanical pressure on each of these teeth directly through the archwire rather than indirectly through the contact point.

How is the anchorage arch prepared? This has been described by Tweed[10] and is well-known. The maxillary arch has a heavy .022 x .028 archwire reinforced by occipital anchorage during which time Class III elastics are worn. When the headgear is not worn, very light elastics are placed. Cephalometric records have shown that there is very little mesial migration of the maxillary arch during this time. The mandibular archwire is reduced in size. The Class III force may be applied directly to the mandibular archwire in the canine area or directly to the molars by means of sliding yokes. During the process of preparing the anchorage unit, occlusion, which has often been referred to as an antagonist to tooth movement, can be made to aid the movement of teeth through what Tweed calls "racheting" action of the tooth on the archwire (Fig. 4). This may be explained as the same type of activity that occurs when the teeth are deflected forward during occlusion in the creation of the anterior component of force. Due to the inclination of the teeth and the direction of the path of closure, one of the factors influencing the anterior component of force, as explained by several authorities, [6 11 12] is a forward vector that is created when the teeth occlude. During the anchorage preparation step, occlusion, as it strikes the tooth, transfers this force through the bracket to the archwire. A disto-gingival vector of force is produced as the bracket strikes the archwire. The buccal teeth are guided down the inclination of the wire by the distal intermaxillary force directed against the teeth aided by the distal "racheting" effect of occlusion.



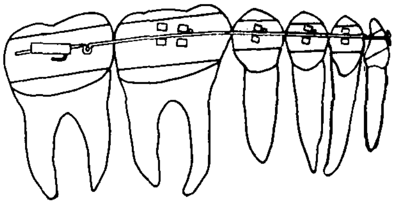


Fig. 4, above. Diagram of the forces acting upon a tooth undergoing the process of anchorage preparation.
Fig. 5, below. Diagram of a prepared mandibular arch using inclined brackets and a straight archwire.

There is another method by which anchorage may be prepared (Fig. 5). Considerable success has been reported through the use of inclined brackets in the buccal segments as advocated by Holdaway. The essential difference between the two methods is that with the application of Class II force the archwire will slide through the brackets when a straight wire is used. It is the contention of those who subscribe to this method that, although some mesial tipping occurs when the Class II mechanics are applied, if properly preceded by use of Class III mechanics from the placement of the first archwire, the teeth will tip no farther than the amount of play between archwire and bracket, and then frictional resistance will prevent further tipping. The brackets are deliberately angulated to compensate for this tipping. The straight wire loses the advantage of direct purchase between the archwire and each tooth in the buccal segments; however, by simplifying the technique of the anchorage preparation much time and effort are saved.

Considerable controversy has existed during the past several years concerning the necessity for anchorage preparation. There are those who subscribe to the principle of preparing mandibular anchorage in all cases in which Class II mechanics are to be applied. There are others who are yet to be convinced of the necessity for such procedure except perhaps in the most unusual circumstances, and even then they question the creation of any beneficial effect. There are many among us who at some time or other have made a half-hearted attempt at "setting up anchorage" and, during the course of treatment, have become alarmed at the severity of the overjet and perhaps the open bite that had begun to develop. We quickly and silently condemned ourselves for permitting such a "mess" to develop. At that time we were thoroughly convinced that anchorage preparation was not advisable and such unscientific procedures were not to be condoned. Why get involved in a back and forth movement in the mandible when headgear and mild Class II mechanics are all that are needed to correct the average Class I condition?

One concession must be made by even the most skeptical among us; that is, many cases have been demonstrated clinically with models, headplates and photographs wherein dramatic change has been induced by mechanics involving major anchorage preparation in the mandibular arch.

There have been several recent studies on consecutively treated cases taken from the office of Dr. Charles Tweed in which anchorage preparation was used on all severe Class II, Division 1 and bimaxillary protrusion cases. The results have demonstrated that spectacular changes have occurred.

It is not the intent of this paper to promote the objectives of Dr. Tweed nor to agree with him in what necessarily should be the goal of treatment in our orthodontic service, However, one cannot but be greatly impressed with the extent and frequency with which favorable changes occur in "growth response" and with the improvement in denture base relationships in his cases. In a discussion of apical base changes Holdaway[13] gives his explanation of the favorable facial and denture responses in Tweed's cases. "First, Tweed begins all such cases with Class III elastic pull, tipping back the lower teeth to establish what he terms dynamic or 'toe-hold' anchorage of the lower arch in order that these teeth will later resist the displacing action of the vigorous Class II elastic pull. The immediate effect is to tip the occlusal plane downward at the distal side due to the downward and forward pull of the Class III elastics. These lower positioned upper molars tend to become the fulcrum point around which the mandible rocks when it is later held forward by Class II elastics.

"Second, lower molar teeth that are well tipped back resist the usual tendency to elongate, a tendency so noticeable when Class II elastics are applied to a lower arch without first tipping them back . . . therefore, we have a situation in which the upper posterior teeth are encouraged downward early in treatment before they are appreciably tipped back; and the lower anchor units, if properly prepared, are encouraged to resist the elongating effect (Fig. 6).

"Third, Tweed's treatment is vigorous. Approximately one-third of his total treatment time is devoted to the preparation of lower anchorage, and still his overall treatment time averages about fifteen months for extraction cases and thirteen months for non-

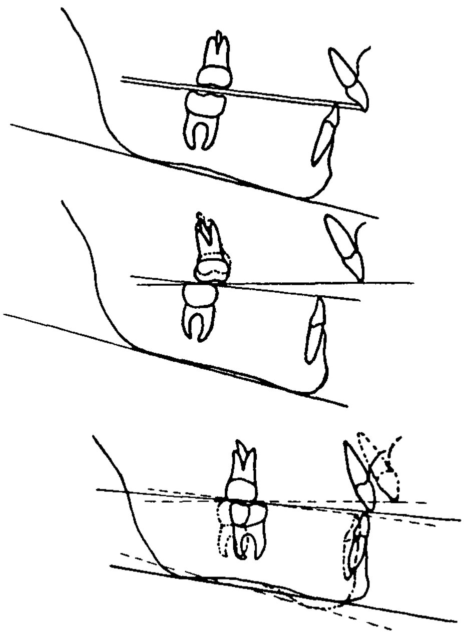


Fig. 6 Illustrations of Holdaway's explanation of changes in the occlusal planes during Tweed treatment. Top, upper and lower occlusal planes before treatment. Middle, upper and lower occlusal planes after anchorage preparation. Bottom, after Class II mechanics are applied. Dotted line represents position of teeth at the end of anchorage preparation.

extraction cases."

The recent study by Stoner, Lindquist, Hanes, Vorhies, Hapak, and Haynes[14] did not follow Holdaway's contention that this response occurred in most cases so treated. Assuming anchorage preparation was used as advocated, there was found that in addition to the above-described changes, the mandible would follow a desirable downward and forward growth or positional change during which time there was a minimal mesial displacement of the denture on the ridge. However, the lower molars elevated somewhat, and the lower incisors depressed slightly (Fig. 7).

Also found were cases with no forward change at all in the mandibular

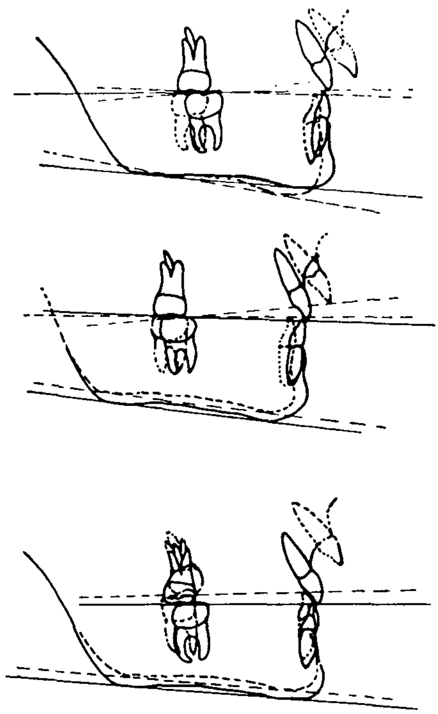


Fig. 7 Three types of responses when Class II mechanics are applied after anchorage preparation.

arch. The entire maxillary arch descended an amount equivalent to the vertical growth in the mandibular arch.

There were other cases (not shown diagrammatically) in which the bite opened with the mandible moving posteriorly following the same type of tooth movement as shown in the third diagram in Figure 7.

Still other cases showed few mandibular changes, but maxillary changes were demonstrated in a posterior direction. Point A moved posteriorly as much as 7.5 mm. when the cephalometric radiograph was superimposed on SN at N and 6.0 mm. when superimposed on SN at S (Figs. 8, 9, and 10).

These changes did not necessarily correlate. The outstanding accomplishment was that, according to Tweed's standards and many others, facial esthetics were improved during the course of treatment and the anterior horizontal differences between points A and B were nearly always reduced considerably. The conclusions implied that in some cases anchorage prepara-

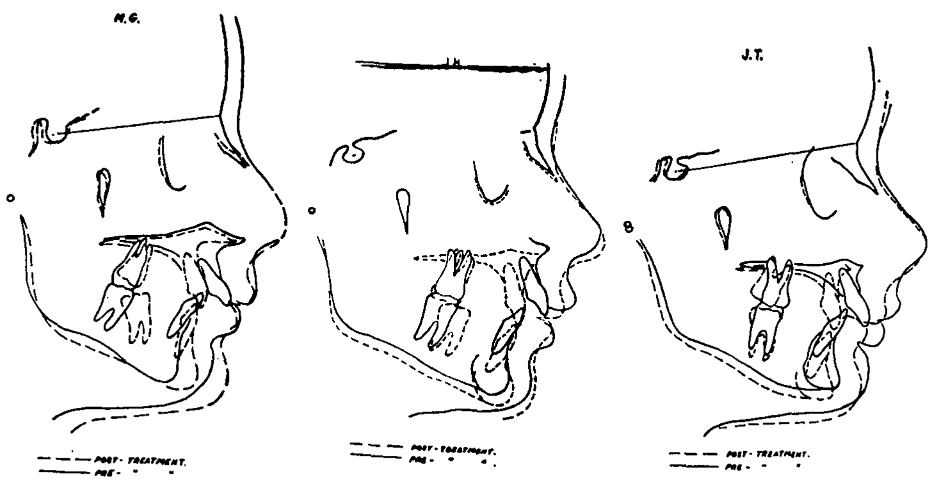


Fig. 8, left. Case M.G. Superposed on SN at N. This case was treated using a prepared mandibular arch. Note excellent growth in the mandible, change in position of point A, and bodily retraction of the maxillary incisor. Fig. 9, middle. Case J.H. Superposed on SN at N. A prepared mandibular arch. Mandibular growth good but not as favorable as Fig. 8. Maxillary changes are favorable. Fig. 10, right. Case J. T. Superposed on SN at N. Another prepared lower arch. Mandibular growth not favorable but dramatic change in the maxillary arch occurred.

tion permitted a directional growth response in the mandible which might not have occurred to as great a degree unless the lower incisors were lingually positioned to permit such change. In the maxillary area a similar but opposite directional change occurred (restraint) which was manifested by a distal recontouring of a portion of the maxilla, especially in the anterior apical base area.

We recognize that facial change, as has been pointed out by Bjork[15], Downs[16], and Lande[17] is naturally changing through the years from a convex to a flatter profile. Orthodontically we are trying to aid nature achieve the type of change that would normally occur to a degree. It is possible in many instances to recognize and anticipate the degree of change that will occur within the growth potential of the individual case. Careful thought must be given to the selection of the proper type of mechanics and treatment. In so doing, the decision to utilize prepared anchorage, as opposed to natural, reinforced or extraoral anchorage, must be made with the knowledge of the possibilities and limitations of the anchorage required.

It must be understood that favorable growth responses have been demonstrated when many different technical procedures have been used. A concept of anchorage must depend on an evaluation of the inherent growth potential of any given case and an acceptance of objectives to be attained in treatment. In many cases anchorage preparation will only be necessary if certain goals or objectives of treatment are to be achieved. If the retraction of the mandibular incisors is considered necessary, it offers an effective means to retract these teeth. If maximum reduction in denture base discrepancies is desired, retracting the mandibular incisors has been found to permit the mandible to come forward or give additional room for bodily retraction of the maxillary incisors or some combination of both. There are, however, limitations to all technical procedures. Figure 11 shows three different cases with similar skeletal patterns. All were within an active growth period and were treated differently. The first was treated by means of a bow-type removable headgear only. The second was treated by extraction of upper first bicuspids and light Class II elastics with a headgear on the maxillary arch. The third case was treated with anchorage preparation in the mandibular arch. We believe the treatment in each of these cases was quite effective (Fig. 12). The benefits derived in the first case are clearly demonstrated. In the second case the severe A-B relationship coupled with the steep mandibular plane, indicating poor growth potential, limits the application of a prepared anchorage in the correction of this Class II relationship. The third case demonstrates how, with a steep mandibular plane, effective treatment can be accomplished with considerable desirable change. The changes in the first case could have been further improved if the case had been treated with a prepared mandibular arch after this step.

The use of prepared mandibular anchorage has some decided advantages in the correction of certain Class II discrepancies and bimaxillary protrusion cases. For instance, it reduces distortion of the occlusal plane. It is very effective in minimizing overbite problems; it permits control in positioning of the lower anterior teeth during treatment and minimizes total arch displacement. It effectively offers additional anchorage for bodily retraction of the maxillary incisors. It also seems to be followed in some cases with mandibular growth and in others offers resistance factors which permit the maxillary

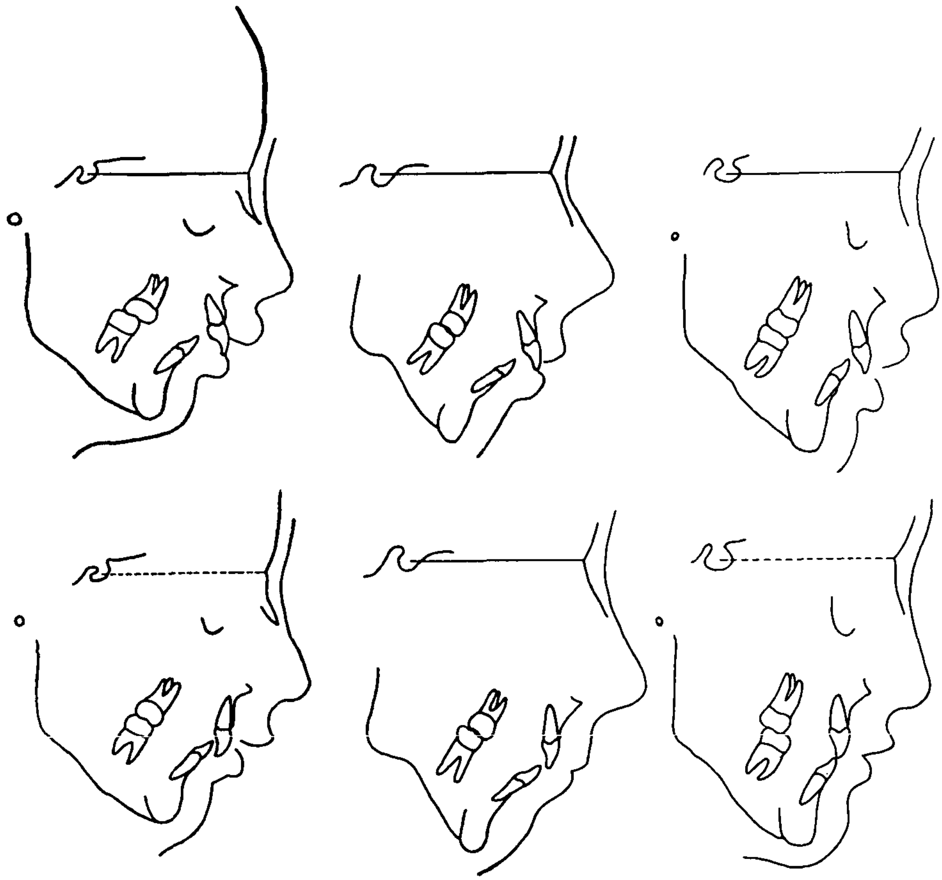


Fig. 11, above. Three cases with severe patterns before treatment.
Fig. 12, below. The same cases in Fig. 11 after treatment.

base to change. On the negative side—it is a complicated technique. It is unnecessary in mild arch length cases in which there is little A-B discrepancy. In steep mandibular plane cases combined with very severe A-B denture relationship in which favorable mandibular growth is probably unobtainable, the desired improvement may not be forthcoming.

We have dwelled a great deal on anchorage preparation. However, it is not the final answer nor is such procedure the only method of treatment in many of these cases. After all, many cases do not exhibit A-B relationships that need great change. Nor does it necessarily follow that the arch length requirements of a given case demand the utmost conservation of anchorage. At this time we will discuss the present day application of extraoral anchorage. Much has been written about the effect of occipital and cervical forces on growth and development during the treatment in the mixed dentition. The present day application of occipital anchorage as advocated by Kloehn[18], Nelson[19], and others [20 21 22] has demonstrated the positive effect of such force on the development of the dentition. There is a decided influence on the position of the teeth and its denture base. It has been demonstrated cephalometrically that there are limitations to its use depending on the initial pattern, the severity of the malocclusion, and the unpredictable factor of growth response. The term "growth response" is used loosely since its effect in these cases as analyzed recently by Graber[23] has not been conclusively demonstrated to be valid.

There are many refinements of application of this force which have specific advantages. Occipital force may be directed to the archwire by a hook in the canine area. The direction of pull can be controlled to exert distal traction along the line of the arch or even in an upward direction. The disadvantage of the downward pull of cervical anchorage when directed to the anterior section of the maxillary canine area results in an elongation of the anterior teeth and deep overbite problems at the termination of treatment. The intraoral bow transferring pressure to the arch in the molar area has the advantage of avoiding this problem but has the disadvantage of being unable to permit directional control of pressure on the anterior teeth as effected by the so-called "Northwest" or "Steiner" headgear.

In addition to being used as an active force in the movement of teeth or as a device in the control of growth, occipital anchorage has many other anchorage possibilities in modern orthodontics. There is the currently popular method of reinforcing the existing anchorage by extraoral means. The headgear is used in the mandibular arch to reinforce the Class II mechanics. It may be directed against the lower molar teeth by means of a bow and Fischer attachment to the archwire in the molar area or through the use of additional round tubes on the upper molars. The headgear can be used as an added anchorage factor in space closure when moving canines. The use of occipital force by itself in selected cases can eliminate the complicated mechanics of anchorage preparation. The disadvantage of this is that it may take longer; its effect varies considerably in different patients and is especially difficult in those cases where cooperation is a problem. With older patients intermittent wearing in the adult dentition may be too slow and not sufficiently effective to accomplish a satisfactory end result.

The use of anchorage units outside the mouth certainly has an advantage in some hands over a poorly manipulated and improperly prepared anchorage arch. However, in using this technique one must recognize the limitations imposed by such technique.

There are many problems created through improper use or attention to anchorage control. Many of us have experienced excessive tipping of buccal segments and undesirable labial inclination of mandibular incisors when injudicious application of elastic force was applied. Lack of attention to the rotations during treatment creates the problem of correction at the end of treatment. Care must be taken to avoid such conditions, for they become a tax on the anchorage units. For instance, correction of a rotated anterior tooth with a removable lever is usually quite simple. However, a highly resistant rotation or several highly resistant rotations may tend to exert an undesirable effect on the anchor arch, especially when the arch is also being used for the correction of Class II or Class III problems. In extraction cases there is the problem of root paralleling. If it is avoided through proper archwire manipulation or the use of inclined brackets as advocated by many men, correction of this tipping problem will eliminate a taxation on our anchor areas and substantially reduce treatment time. Many a well-treated case has been ruined by loss of anchorage in the correction of minor irregularities. Proper appliance manipulation could have avoided these troubles in the first place. Whenever the mechanics are such that undesirable anchorage responses are created, then we must reinforce anchorage or change our mechanics in such a manner as to prevent or eliminate the unwanted tooth movements. The reduction of natural anchorage values in the opposing arch is also important.

To conclude this paper we will summarize briefly what we consider the so-called modern concept of anchorage. It involves the use of existing anchorage, prepared anchorage, and reinforced anchorage. Proper diagnosis through recognition of anchorage availability must be made. In Class II cases we must accept the fact there will probably be migration of the buccal segments. This may be desirable at certain times. If the mechanics are such that there is maximum response and the case ends with a stable denture with desirable improvement in facial form, then we have properly applied the modern concept of anchorage. The timing of force application within favorable growth periods is undoubtedly a major factor in the success of a given technique. If a discrepancy in denture bases exists, then it is believed that a properly prepared mandibular arch will do more to reduce the intermaxillary discrepancy with a corresponding improvement in soft tissue profile in more cases than by other more conventional methods of treatment. This necessarily implies that treatment be instituted during a period of active growth. Dr. Angle's contention that the reciprocal effect of intermaxillary force had considerable benefits in both arches seems even more valid today. Through the years certain undesirable effects of intermaxillary elastics have shown up. The use of anchorage preparation tends to minimize these effects and increase the treatment potential of many cases. Recognition must be made, however, of exceptions in very severe growth patterns. Little benefit will result if anchorage is prepared in cases represented by exceptionally steep mandibular planes coupled with the exceptionally large A-N-B angular relationships. Compromises in treatment must be made in such cases. During treatment if it is found that the existing anchorage is not sufficient, occipital or cervical forces can reinforce this anchorage. Such procedure may be used in non-extraction Class II cases or in Class II, Division 2 arch length cases where additional arch or loss of arch length will upset treatment. Reinforcement of the existing anchorage with intermaxillary elastics to prevent the buccal segments from being carried forward when using vertical loop sections to retract the canines or the maxillary incisors is possible. There are other devices that may be used to reinforce existing anchorage. The soldered lingual arch and the removable lingual arch or palatal plate with finger springs are helpful in space closures.

Extraoral anchorage may by itself be used as the motivating force in the correction of selected cases. If used wisely with proper cooperation in many cases, much satisfaction is derived in reducing the severity of the malocclusion. However, one must recognize that without the complete edgewise appliance in many cases, it is found that to gain one end, very often some sacrifice of our ideals of detailed, finished treatment is required.

Finally, in consideration of the entire problem of present day concepts of anchorage, the selection of the method of anchorage control in the future will depend upon information derived from the study of treated cases with selected types of mechanics and a comparison of the end results in terms of facial balance, stability, and ease of manipulation.

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Bibliography

1. Angle, Edward H.: Treatment of Malocclusion of the Teeth, Ed. 7, *S. S. White Dental Manufacturing Company,* Philadelphia, 1907.
2. Case, Calvin S.: Dental Orthopedia, *Lakeside Press,* Chicago, 1908.
3. Guilford, S. H.: Orthodontia, Ed. 4, *T. C. Davis and Sons,* Philadelphia, 1905.
4. Brodie, A. G.: Orthodontic Concepts Prior to the Death of Edward H. Angle, *Angle Ortho.* 26, 144-154, 1956.
5. Anderson, George M.: Practical Orthodontics, Ed. 8, *C. V. Mosby Company,* St. Louis, 1955.
6. McCoy, J. D.: Applied Orthodontics, *Lea and Febiger,* Philadelphia, 1946.
7. Angle, E. H.: The Latest and Best in Orthodontic Mechanism, *Dental Cosmos* 70: 1143-1158, 1928.
8. Renfroe, Earl W.: The Factor of Stabilization in Anchorage, *Am. J. Ortho.* 42: 883-897, 1956.
9. Brodie, A. G., Downs, W. A., Goldstein, A., and Myer, E.: Cephalometric Appraisal of Orthodontic Results, *Angle Ortho.* 8: 261-351, 1938.
10. Tweed, Charles H.: Technical Procedures (Unpublished) for Advanced Course in Edgewise Technique, Tucson, 1956.
11. Salzmann, J. A.: Principles of Orthodontics, *J. P. Lippincott Company,* Philadelphia, 1943.
12. Strang, Robert H. W.: Textbook on Orthodontia, Ed. 3, *Lea and Febiger,* Philadelphia, 1950.
13. Holdaway, Reed A.: Changes in Relationship of Points A and B During Orthodontic Treatment, *Am. J. Ortho.* 42: 176-193, 1956.
14. Stoner, M. M., Lindquist, J. T., Vorhies, J. M., Hanes, R. A., Hapak, F. M., Haynes, E. T.: A Cephalometric Evaluation of Fifty-Seven Consecutive Cases Treated by Dr. Charles Tweed, *Angle Ortho.* 26: 68-98, 1956.
15. Bjork, A.: Nature of Facial Prognathism and Its Relationship to Normal Occlusion, *Am. J. Ortho.* 37: 1951.
16. Downs, W. B.: Variations in Facial Relationship: Their Significance in Treatment and Prognosis, *Am. J. Ortho.* 34: 812-840, 1948.
17. Lande, M. G.: Growth Behavior of the Human Bony Facial Profile as Revealed by Serial Cephalometric Roentgenology, *Angle Ortho.* 22: 78-90, 1952.
18. Kloehn, S. J.: Guiding Alveolar Growth and Eruption of the Teeth to Reduce Treatment Time and Produce a More Balanced Denture and Face, *Angle Ortho.* 17: 10, 1947.
19. Nelson, B. G.: What Does Extraoral Anchorage Accomplish? *Am. J. Ortho.* 38: 422, 1952.
20. Closson, Donald A.: Extraoral Anchorage, Its Indications, Use, and Application, *Am. J. Ortho.* 36: 265, 1950.
21. Jerrold, Harold E.: Occipital and Cervical Anchorage and Their Application, *Am. J. Ortho.* 31: 597, 1945.
22. Fischer, Bercu: Orthodontics—Diagnosis, Prognosis, Treatment *W. B. Saunders Co.,* Philadelphia, 1952.
23. Graber, T. M.: A Cephalometric Appraisal of the Results of Cervical Gear Therapy, *Am. J. Ortho.* 40: 60, 1954.