A Philosophy and Practice of Orthodontic Retention

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The philosophy of retention has changed over the years as knowledge has increased.

About 1900 retention consisted of holding teeth in position until believed stable. This philosophy of stability changed when the Huning case of Dr. Angle demonstrated that anterior teeth can change axial inclination during and after retention. This was the beginning of the realization that teeth continue to change axial inclinations as the children continue to complete their growth to adulthood.

Hellman's study on growth further emphasized facial changes occurring during growth so that by 1920-1930 the philosophy of orthodontic treatment and retention had come to mean the care of the child's occlusion from the beginning of the first observation of the patient through all of the remaining stages of growth to adulthood.

In 1930 Dr. Frederick B. Noyes illustrated this when he said that he would "place appliances only while the child's dentition required mechanical stimulation and then would remove the appliances and let growth continue 'unimpeded' until further treatment became necessary." Thus, orthodontic treatment and retention often consisted of the placement and removal of appliances frequently during the ten to fifteen years that the child was under orthodontic care.

My father, Dr. Guy B. Steadman, had a similar philosophy, starting many cases in the mixed dentition and following them through with treatment and retention to the complete dentition as adults. This is the philosophy of Dr. G. B. Crozat and the use of his appliance, as told me by one of his former students. How many other orthodontists of this era followed this philosophy is not known, but it must have been a great many since Dr. Max E. Ernst of St. Paul still follows this philosophy having practiced orthodontics for over fifty years; and, incidentally so do I.

About 1940 as the picture of the normal, growing child began to take shape in the Broadbent-Bolton Study, Dr. Broadbent used this information in his orthodontic practice. On the basis of the findings in a child's head roentgenograms, orthodontic treatment would be employed only when the child's dental growth pattern began to fall behind his or her normal pattern. It was not long before Dr. Broadbent had the reputation of being "the orthodontist who straightened children's teeth without appliances." Thus, we see that Dr. Broadbent has the same philosophy of treatment and retention as those previously mentioned except that he uses a series of cephalometric roentgenograms upon which to base his determination of the need or lack of need of appliances, as well as the time of treatment and retention required.

Today, by utilizing the knowledge presented us in the Broadbent-Bolton Study of *The Face of The Normal Child*, it is possible to practice orthodontics in a manner, the most beneficial to the child that has ever been available in the history of our pro-

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fession, i.e., to follow the child's growth by serial cephalograms and institute treatment only when the child is falling behind his own particular growth pattern. This means following the child until he becomes an adult toward the end of his second decade and at the beginning of his third decade of life. For those children who do not have normal facial growth patterns, the study presents a basis for determining the amount of deviation from the normal that is present; treatment and retention can be performed accordingly.

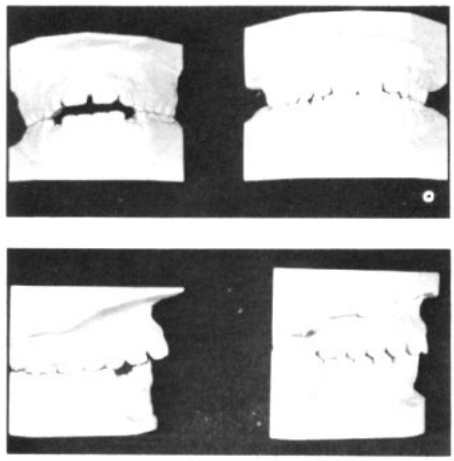

Fig. 1

Procedure

Unfortunately, many of the children whom we have for patients either have such poor growth patterns or are unable to attain sufficient growth that they present insufficient space to accommodate their own complete dentition. Add to this difficulty the very many children who have developed abnormal muscular habits, both mimetic and masticatory, and it becomes only too evident that the orthodontists' problems frequently are not easy ones to bring to happy conclusions.

A review of some of the procedures of retention discussed in the literature seems desirable. Dr. A. P. Rogers in his articles has shown the tremendous benefits which can accrue to a cooperative patient by means of muscle therapy. More orthodontists should employ muscle therapy to maintain the mechanical corrections instituted during treatment because, unless muscle function will support the teeth in the corrected positions, the teeth will be moved out of position again as determined by muscle function. Figure 1 illustrates the models of a child who corrected her own tongue and lip habits by wearing a mouth shield made from powder and liquid acrylic. Thus, teeth must be retained in their corrected positions until muscle function will support them there; the time for this varies for each patient, and can be determined only by trial and error. Generally this is not until the third molars are erupted or extracted.

Prevention of relapse or the means of retention must be varied to counteract the specific etiology or etiologies of each malocclusion:

1. Class II malocclusions caused by the maxilla growing anteriorly more rapidly than the mandible can be retained when necessary by the continued use of extraoral anchorage applied to the upper molars, i.e., stops placed on the dental arch to be in contact with the tubes thus preventing the arch from pushing against the upper central incisors. The amount of force applied by the neckband need not be as great as that usually employed during correction, but must be sufficient to retard the continued forward growth of the maxilla to the same speed as that of the mandible. This is determined by maintaining the first permanent molars in Class I. As the patient becomes older this force usually can be decreased and often stopped completely. Trial and error is the only gauge.

2. Malocclusions with spacing of the upper anteriors can be retained also

by extraoral anchorage if the spacing tends to recur. For this condition stops are placed on the dental arch from five to ten mm mesial to the molar tubes for stability so that the dental arch rests against the upper incisors and all of the neckband force is transmitted directly to the incisors. The force of the neckband and the time of wear must be just sufficient to keep the spaces closed continuously. Gradually the length of time and/or force can be lessened. A Hawley plate could keep the spaces closed, but the tongue would push the upper dentition forward into a Class II.

3. With malocclusions in which both conditions 1 and 2 are present, the stops are situated to just contact the molar tubes when all of the incisor spaces are closed.

4. Some malocclusions are the result of insufficient maxillary growth to maintain a Class I relation with the mandibular dentition. Extraoral anchorage employing a chincup with vertical prongs from which elastics can be stretched to the distal of the upper first molars is usually effective for increasing forward movement of the maxilla. This, of course, requires an upper archwire to maintain the upper dental arch form, to prevent shortening the arch length and thus producing rotation of upper teeth.

5. Where mandibular overgrowth is too much for the above retention, extraction of lower first premolars with retraction of the lower anterior segment into good overbite-overjet relation must be employed; even then the previous chincup retention might also be employed.

6. If mandibular overgrowth is too great, of course, mandibular resection and, if necessary, maxillary expansion is the final procedure. Resection usually is postponed until growth is nearly completed, thus retention should not be necessary if mandibular overgrowth were the only etiology of the malocclusion.

Overbite is produced by the manner in which the tongue and masticatory muscles function. If their habits can be changed to support the incisors in the corrected overbite relation, then the overbite will stay corrected; if not, then the deep overbite will return. Generally this calls for prolonged retention to maintain lower and/or upper arch length from molar to incisors to prevent recurrence of an excessive occlusal curve in either or both dental arches. In the lower dentition a lingual arch gingival to the cuspid-to-cuspid retainer is most effective; in the upper arch a Hawley plate is usually effective, provided that incisal rest lugs for the upper incisors are soldered to the labial arch of the Hawley plate. The incisal rest lugs must be situated carefully near the middle of the incisal edge to prevent tipping of the incisors. The depressive force of these lugs will prevent elongation of the upper incisors. The method of embedding the incisal lugs (in the form of flat metal) into the acrylic on the lingual of the upper incisors does not prove satisfactory because it tends: a) to depress the lower incisors thus producing an openbite; or b) to tip them lingually thus producing an undesired overjet.

Probably the most annoying situation to both the orthodontist and the patient occurs when the lower anteriors start crowding at about sixteen years of age in seemingly perfectly stable occlusions, both untreated and orthodontically treated. There are several known causes and no doubt other causes we do not know. Among the known causes are: (a) Exceptional vertical growth of the cervical vertebrae which enlarges the pharyngeal space accompanied by insufficient tongue growth so that the dentition begins to collapse. Before the

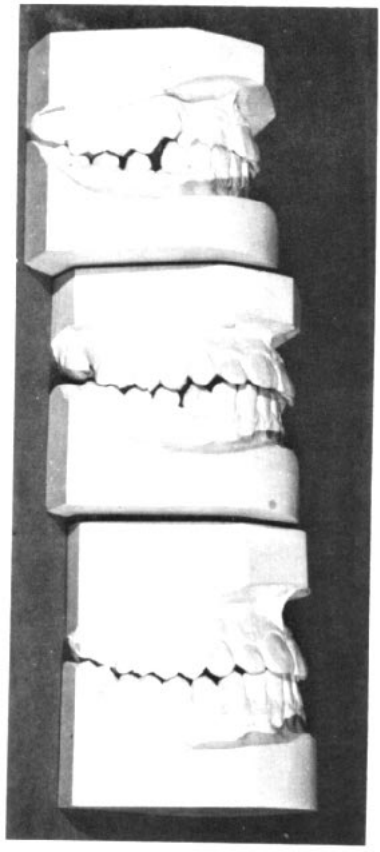

Fig. 2

cervical vertebrae began their spurt of growth the tongue was sufficiently large to prevent collapse of the lower dental arch. As the cervical vertebrae begin to outgrow the tongue, the tongue becomes withdrawn into the enlarged pharyngeal space and so can no longer support the dental arches in the previous manner; consequently the teeth tend to crowd and rotate because of lack of lingual support to counteract the inward force of the buccal and labial musculature. No solution has been found to this problem. (b) Recurrence or initiation of a mentalis, buccinator or other mimetic muscle hypertension forcing and crowding the incisors lingually against an unchanged tongue. If the cause is a habit, it may be broken again, but sometimes the cause is genetic, psychologic or occasionally psychiatric, and then, of course, out of our control. (c) There is much argument concerning whether or not erupting third molars can produce crowding of the other teeth through an increase in the Anterior Component of Force. That they can and do is demonstrated in Figures 2 and 3 illustrating the models of a patient whose lower right first permanent molar was extracted at nine years of age. An attempt was made to move the lower second molar into its space, but the treatment failed leaving a Class II relation of premolars and canine on this side. This condition persisted for five years after appliance removal and during retention until the lower right third molar began to erupt. This increased the Anterior Component of Force on this side enough to force anteriorly the lower second molar,

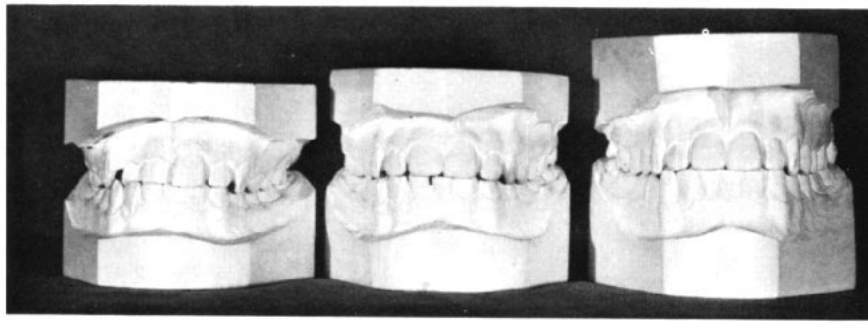

Fig. 3

second and first premolars, and canine into a Class I relationship by the time it had fully erupted one year later; this also shifted the lower midline to the left until it coincided with the upper. Similarly it is this increased Anterior Component of Force which closes the spaces remaining or recurring in some bicuspid extraction treatments.

If there is question about whether or not the extracted first premolar spaces may reopen, it is best to leave the bands on the first molars, second premolars, occasionally the cuspids and to place a segment of arch wire in the tube and brackets to prevent tipping. When the Anterior Component of Force has closed the first bicuspid space by pushing the molars and second premolar mesially, the bands can be removed, and these teeth will be erect when otherwise they may have been tipped undesirably. It is not uncommon for the first premolar space to reopen in only one or possibly two quadrants; this procedure need be followed only in the quadrant so affected.

Broadbent has shown graphically the manner in which the third (as well as second and first molars) erupt in the *normal* child. He also has shown the manner in which the lower third molar fails to erect itself and becomes horizontally impacted when the mandible fails to grow as that of a *normal* child. Horizontally impacted as well as partially impacted lower third molars can cause crowding of the lower anterior teeth as well as buccal teeth by increasing the Anterior Component of Force at the time of their eruption.

Concerning the matter of the Anterior Component of Force becoming excessive coincident to the eruption of the lower third molars, and occasionally the upper third molars also, the discussion in the literature seems to be that in children who have grown normally according to the Broadbent-Bolton standards there is no increase of the Anterior Component of Force at the time of eruption of the third molars; with this statement I can agree. Further, Dr. Broadbent illustrates that in children whose growth pattern of the mandible is not "normal" the lower third molar becomes impacted or fails to erupt into the mouth.

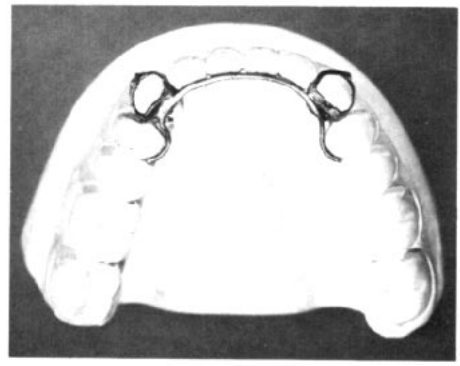

Fig. 4

In patients with poor growth patterns such as this, and in those where there has not been sufficient growth in the mandible for the third molar to erect itself, the Anterior Component of Force does seem to become excessive at the time the third molar begins to erupt into the mouth.

In order to prevent crowding of teeth at this time of eruption of third molars, the lower cuspid-to-cuspid retainer is most effectual if made correctly and placed within twenty-four hours after removal of appliances, Figure 4. The lingual bar should rest on the lingual of the lower lateral and central incisors at the junction of the middle and incisal one-third to press against the flat lingual surface of the incisors and thus prevent rotation or permit ligatures to rerotate the incisor against the retainer bar using the 'U' shaped tie. It also should extend posteriorly to the lingual of the adjacent premolars to prevent their buckling lingually, and to give something to which to ligate the

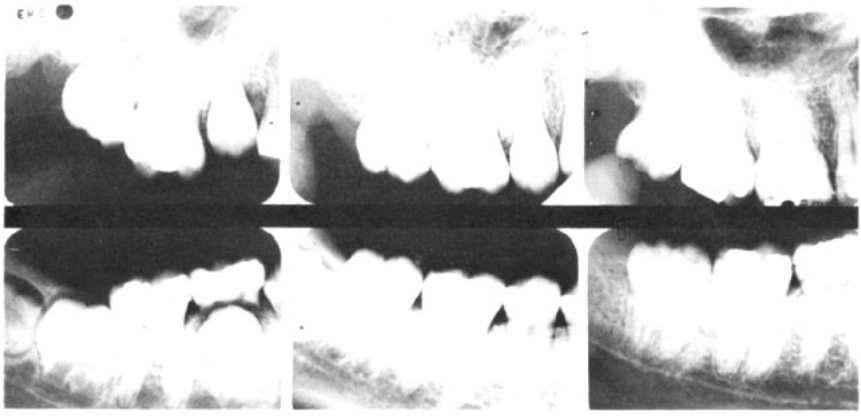

Fig. 5

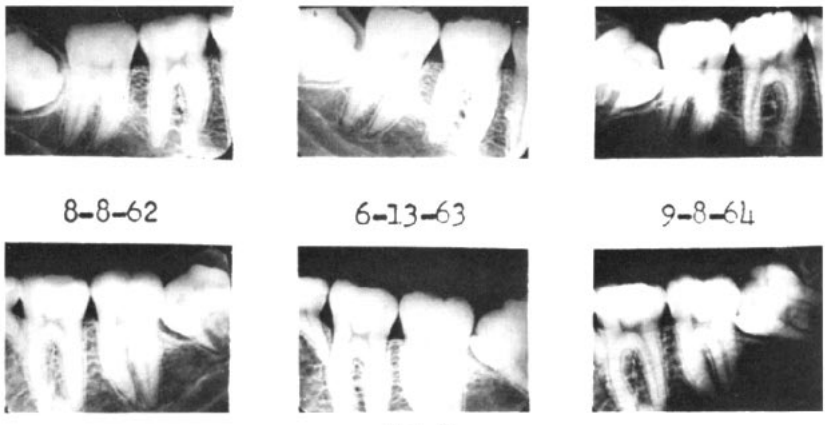

Fig. 6

bicuspid lingually if it should tend to move buccally. This is worn until the lower third molars are fully erupted or extracted.

Beginning at the age of fifteen years or earlier for children whose other teeth erupted prematurely, dental roentgenograms of the third molars are taken annually, Figure 5, to determine the eruptive inclination changes, as related to the occlusal plane, which occur as the child continues to grow. If the axial inclination of the lower third molar does not follow the gradual erecting procedure but begins to turn horizontally, Figure 6, this is the indication that the third molar should be extracted soon, before it increases the Anterior Component of Force sufficiently to crowd the other teeth.

Usually in patients who lack only slightly sufficient mandibular growth the lower third molar inclination follows the "normal" inclination pattern, but simultaneously increases the Anterior Component of Force, as it attempts to push the second molar out of its way in order to gain sufficient eruptive space. This causes the teeth to crowd, i.e., (1) the lower second molar roots to tip mesially, Figure 7, and the crown to tip distally; (2) the lower second molar or second premolar to tip buccally or lingually out of oc-

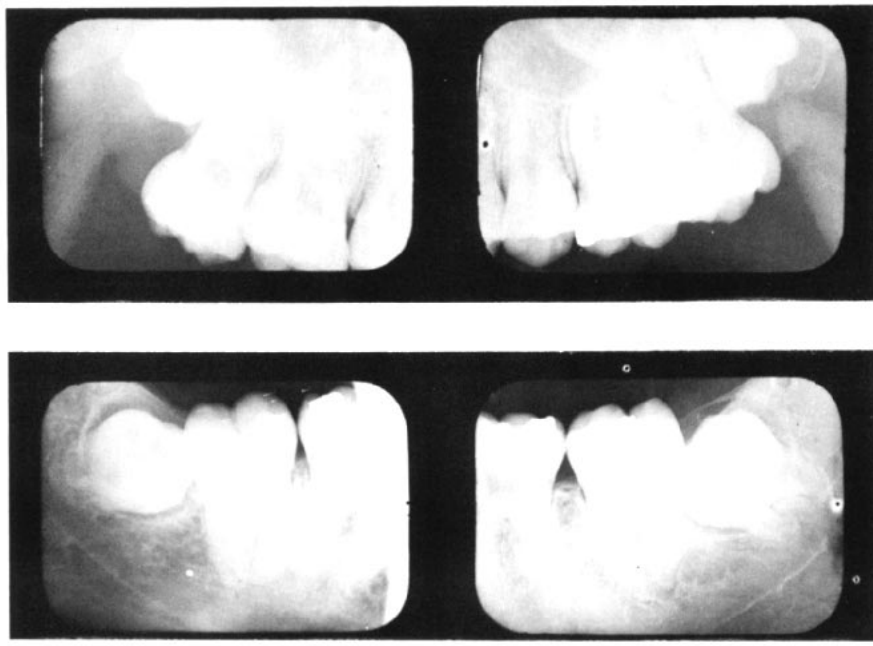

Fig. 7

clusion; (3) the lower first molar to tip buccally out of occlusion; (4) the lower first premolar to tip buccally away from the lingual extension of the cuspid-to-cuspid retainer, or to "duck", that is, the crown to tip mesially. Meanwhile the lower anterior teeth are kept nicely aligned by the cuspid-to-cuspid retainer. If any of these signs appear, the offending lower third molar should be extracted; after extraction this crowding usually stops immediately but rarely corrects itself. This can and does occur unilaterally frequently, while the lower third molar on the opposite side may continue its eruption into occlusion normally without any crowding.

Not infrequently the inclination of the erupting upper third molar is in an anterior direction instead of the normal posterior direction.. When the inclination is anteriorly it may: (1) tip the upper second molar root mesially, Figures 7 and 8, causing the crown to tip distally; (2) without tipping the second molar root, increase the Anterior Component of Force sufficiently to produce crowding which usually occurs as a "popping" or rotation of an upper lateral incisor; or (3) force the upper dentition forward into a Class II relation. If any of these changes occur, then the offending upper third molar should be extracted; not infrequently the offending molar is on the opposite side from the "popped" upper lateral incisor or other tooth. A Hawley plate employing a spring on the labial bar or additional acrylic on the lingual to correct the tipped or rotated lateral incisor may restore the alignment of the upper incisors; if worn continuously, before the upper third molars are extracted or erupted, the Hawley plate may prevent this crowding of the incisors.

The question of routine extractions of all third molars arises occasionally. It was a common practice about 1930 to 1940 but was abandoned about 1945 because of surgical difficulties when attempted before root formation had be-

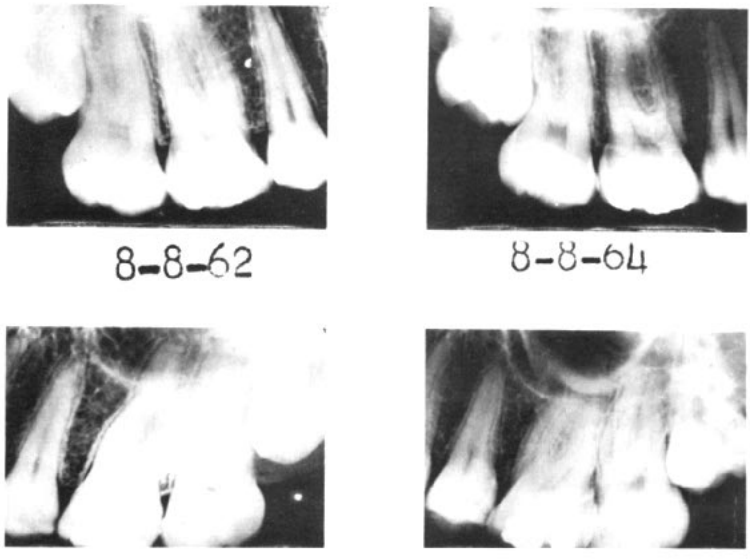

Fig. 8

gun, and also the frequent harm it produced for the patient. Reference to the oral surgery literature of this period explains the undesirable sequelae. However, when third molars must be sacrificed, it is preferable to have it done before the patient becomes an adult so that complete healing will occur along the distal root of the second molar to prevent "pocket" formation.

According to Davis,[8] "To find at the adult stage of life that impacted teeth are present and must be removed under adverse conditions is an indictment of our previous attention to this patient." This applies to orthodontists as well as general practitioners. Fry said,[9] "Nowadays when children are placed in the hands of a dentist for advice and attention regarding their teeth, surely it is his duty not only to take care of the immediate needs, but also to consider the probable future conditions. Can it be said that this duty has been well performed if it should be necessary for the patients, on reaching a more mature age, to undergo a complicated and difficult surgical operation for the removal of impacted wisdom teeth." This certainly applies to the orthodontist who has been entrusted by the pedodontist or general practitioner with the occlusion problems of a child.

Thus, with the intelligent use of retention appliances, and by the careful comparison of annual third molar dental roentgenograms to determine the necessity and most advantageous time to the patient for extraction of third molars, it is possible to have one's patients become adults with nicely aligned and functioning anterior teeth or at least only minor irregularity of the buccal and/or posterior teeth — the price of insufficient growth to accommodate the third molars, or ectopic eruptive direction of the third molars.

Strangely enough, with all of our knowledge of muscle function and training, of growth and development, together with the present extensive use of cephalograms and their analyses, many orthodontists seem to believe that, as soon as the child's teeth are placed into normal occlusion, the child will immediately begin to grow normally, to function normally, to use his mimetic and masticatory muscles nor-

mally, when in truth the orthodontist has done little, if anything, to counteract or to teach the patient to overcome those etiologic factors which caused the original malocclusion. Then the orthodontist is horrified to see his nicely treated case begin to fail! We must not forget that many of the original causes of malocclusion are still present following treatment and that it is during the retention period: (1) when the retaining of the muscle patterns must continue; (2) when the maxillary - mandibular growth discrepancies must continue to be counteracted by extraoral force; (3) when the changing anterior components of force must be eliminated by extraction or counterbalanced; (4) and when the new manner of masticatory function established by orthodontic treatment must be practiced and maintained. Thus retention actually constitutes a continuing effort to eliminate the etiologic factors which caused the original malocclusion.

Frequently toward the end, and occasionally at the start of orthodontic treatment, it is advisable to lightly stone the surfaces of the cusps of newly erupted teeth to contour them to correspond to the normal wear of adjacent teeth produced by function. Otherwise any premature contacts should be eliminated by tooth movement during treatment.

Several months after the appliances have been removed, the spaces between the teeth due to bands will have closed, the crowns of the teeth will have become settled into the functional occlusion peculiar to that child and the roots of the teeth will have changed their axial inclinations to support their crowns in these new positions. At this time there may be a cusp or fossa which will need minimal grinding to remove it from premature contact; the danger is mostly in removing too much tooth structure which may be required in a year or so as the child continues to grow and his dental relations continue to change. This minimal occlusal equilibration is nothing like the occlusal grinding applied to the stable dentitions of adults, because the occlusal relations of the cusps and fossae of the growing child are in a state of flux due to the continued eruption of the teeth, the continued lengthening of the mandible and/or the maxilla, the consequent change in the occlusal plane, and especially the shifting of contacts which usually occurs with the increased Anterior Component of Force as the third molars erupt, or try to erupt. A most satisfactory procedure for occlusal equilibration has been effectively explained by Heimlich;[12] this procedure is explicitly for the orthodontist and his orthodontic patients.

Rotations and their retention present a peculiar situation. As so aptly described in the literature, rotated teeth must be retained until the tissues cease to try to rerotate them. Clinically, bands and spurs are routinely continued for a year after removal of the appliances; then, if necessary, a Hawley plate is worn to prevent the upper incisors from rotating again. The lower cuspid-to-cuspid retainer with extensions to lower first premolars cares for the lower anterior rotations; occasionally the lower incisors must be ligated to this lingual bar to prevent recurrent rotation. Reitan has shown microscopically that after 242 days only the apical and middle periodontal fibers in dogs and recently, in humans, have reoriented themselves following rotation; the free gingival fibers still are stretched and tending to rotate the tooth to its original position.

As a result of clinical experience this hypothesis seems proper and seems to be substantiated by Reitan: the increase in nasal floor-mandibular border distance permits eruption of the teeth; along with this eruption the rapidly-forming, stretched gingival fibers be-

come embedded in the newly-forming alveolar crest; the newly-formed gingival fibers develop in the corrected position of the tooth and rotation relapse is then eliminated. Clinically, this seems to occur within one year in children in the early teens. Sometimes this requires two or three years following treatment in older children. When growth has ceased, as in adults, relapse of rotation has been prevented by fastening the adjacent teeth together with a small inlay joining the two teeth physically.

In conclusion, it is evident that satisfactory retention of a malocclusion is even more of a challenge than its original correction during treatment. Retention, when successful, is most exhilarating; yet occasionally when it fails it becomes most frustrating because it demonstrates so visibly either our impotency to alter Nature's pattern when she wishes it to remain, or else our own lack of ability or lack of knowledge.

Retention requires time, yet complete retention care of one's patients to adulthood is a professional obligation of all orthodontists. Are we not professional people: educated, licensed by law, and personally pledged to help patients attain the utmost in orthodontic care? And what it this utmost in orthodontic care? It is not only the treatment of the patient's malocclusion, but also the continuous effort of the orthodontist to prevent, by every means at his disposal, the relapse of this patient's treatment during the remainder of the growth period. Thus eventually, the patient as an adult, is entitled to a nicely functioning, stable occlusion with an esthetic appearance as pleasing as is orthodontically possible.

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