Clinical Management And Supportive Rationale In Early Orthodontic Therapy

J. Rodney Mathews, *A.B., M.A., D.D.S.*
Berkeley, California

Orthodontic therapy, not unlike that seen in other health fields, is subject to extreme shifts and even fads. The basic underlying theme of prevention so characteristic to modern medicine and dentistry was set aside in a large segment of orthodontic practice in past years in favor of a philosophy of so-called watchful waiting. This type of thinking held the results of deciduous and mixed dentition treatment to be of questionable value in terms of total gain for the patient. On the other hand, incipiencies of Class III malocclusion and presence of anterior and posterior crossbites seem to have always found an acceptance for immediate treatment as soon as presented to the orthodontist. These latter categories represent a relatively small segment of the total incipiencies of malocclusion. We might ask ourselves the reasons why most orthodontists preferred (and indeed some still prefer) to watch a malocclusion develop before instituting corrective therapy. Broadly speaking, the answer is simple. Most cases required additional treatment in the early permanent dentition or had collapsed or progressed beyond the earlier malocclusion as a result of untoward tooth movement and mandibular positioning. This discouraging state of affairs has been improving to the extent that early treatment (this usually means the mixed dentition) is being reported with increasing frequency in the current literature. The picture of malocclusion is still the same, the appliances are essentially the same, and we still know that it is preferable to prevent malocclusion rather than treat a full-blown dentofacial anomaly. Obviously, we are undergoing change in treatment timing.

Read before the Northern California component of the Angle Society, May, 1959.

I like to think that our treatment efforts are being directed more and more along a line that takes active cognizance of the fact that the dental apparatus and its supporting tissues are truly dynamic structures subject to the same rules applying to all body tissues. All too often we follow one authority or another in blind fashion in total ignorance of the validity of rationale that had led him into some particular series of mechanical maneuvers. Some of their statements taken in part and applied to clinical thinking have led to stereotyped practice procedures which are faulty to say the least. All too often these alleged "philosophies of treatment" treat the teeth as if they were inanimate objects in an equally inanimate supporting structure. We are still prone to stand in admiration of the orthodontist who is able to effect tooth movement over considerable distance in beautifully controlled fashion and pay little or no attention to work in which an incipient malocclusion was intercepted and prevented with minimal appliance therapy. In truth, as members of a health profession, we should be ashamed that malocclusion is allowed to progress to a place where heroics become necessary.

As the title indicates, the present paper is concerned with the clinical management of early malocclusion. Representative, and I hope illustrative, cases will be presented in support of the rationale which underlies my thinking in treatment therapy. I make no apology in stating my continuing effort to correlate my orthodontic mechanics with tissue biology and physiology. The orthodontic literature is replete with mechanics of the variety advocating rectangular wire adjustments of the "thickness of a thin dime," applying forces to a single tooth far beyond tissue tolerance, reciprocal forces which the operator hopes will not act in reciprocal fashion, and mechanotherapy which is dignified by cephalometry and ignores the theme of endless variation in facial morphology.

On the other hand, our literature and that of ancillary fields have supplied us with the fruits of excellent research which the orthodontist may use and apply to his treatment mechanics; work serving as guideposts telling us over and over that we are dealing with a biological structure. The obvious corollary is that movement of teeth and the resultant correction of dentofacial anomaly will be more satisfactory if we treat both soft and hard tissue with care and respect for their physiologic integrity.

The overwhelming bulk of research evidence points very clearly to a genetic origin for most malocclusions. Figure I shows the pretreatment photographs of a mother and her daughter, both presenting with Class II malocclusions and lacking in lower face height. One would expect a more favorable treatment result with the daughter in whom facial growth has not been completed. This is borne out in the posttreatment photographs. As clinicians, we are forced to deal with whatever nature has endowed the patient in the way of inherited dentofacial characteristics. We are all products of the inheritance upon which is superimposed the sum total of intra and extrauterine environment. It is unfortunate that Brodie's serial growth

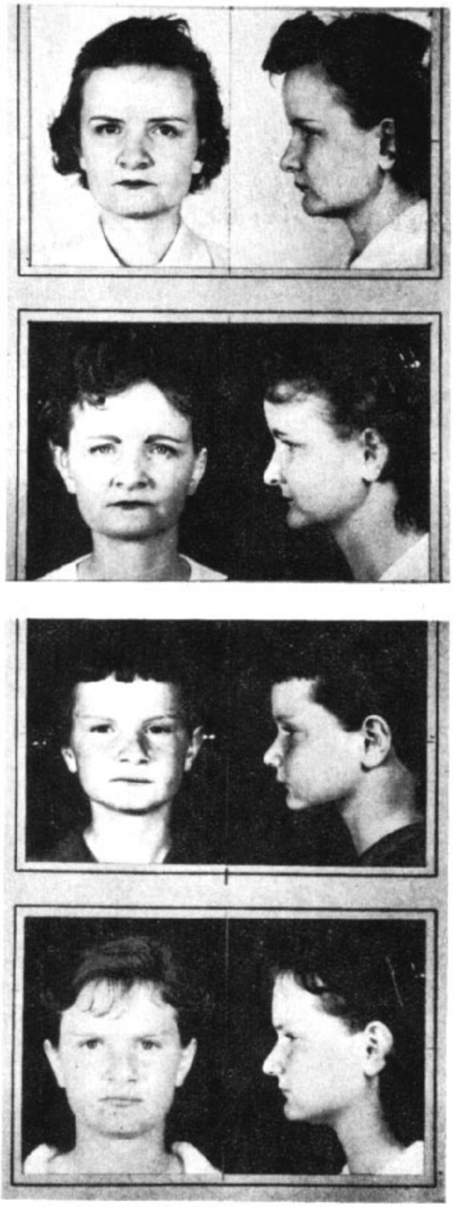

Fig. 1 Beginning and posttreatment photographs of a mother and daughter showing marked similarity in dentofacial complex. Note the greater degree of facial improvement in the daughter over that gained for the mother.

study was interpreted widely to mean that once the morphogenetic facial pattern was established nothing could be done about it. The mean and other statistical values of central tendency have their place as they did in Brodie's work and will continue to serve us well, but not if their significance is poorly understood. All too often we stand in blind obeisance before the throne of the "average value," applying it to the single individual. Stating it more exactly, we try to fit the single individual to the average value which somewhere along the line has also become the standard of excellence. Dewel[1] is quite cognizant of the problem in terms of facial esthetics by taking issue with those who would standardize the profile by geometry applied to the dental apparatus. He states "It is possible that the straight profile has been overemphasized in our current concept of pleasing facial contours and that this has led to premature serial extraction as a pretreatment requirement. Yet there was a time when this convex facial type was considered to be the essence of beauty. Even casual study of the paintings of the great Renaissance artists shows that they favored models with slightly recessive chins and foreheads that tapered backward as well as upward. The most famous example of this concept in beauty is, of course, the Mona Lisa. In a previous age, the prominent Roman nose and the Greek profile were considered a mark of distinction, yet they also could be in harmony with other facial structures. Hence, our current craving for a straight profile and a strong, aggressive mandible is not necessarily the ultimate in attractive facial contours. There are other forms of beauty and we would be in error if we had only one concept of pleasing balance and proportion in the human profile."

We may think of the general term, environment, to encompass everything above and beyond our inheritance. This latter package is most assuredly subject to a multitude of factors which can and which may well alter the morphologic pattern for better or for worse. The school of thought which held malocclusion to be almost wholly of environmental origin has been forced to give way. For example, we no longer read of the childhood diseases and finger sucking as prime movers in the etiology of malocclusion. This is not to say that these and similar environmental experiences are without effect on the developing occlusion, but rather that their effects are largely secondary in nature. It is part of our job to intercept and provide an environmental climate for the dental apparatus which will favor coordinated growth and development in order to realize the full inherited potential of the individual. We can make clinical use of the old adage, "as the twig is bent, so grows the tree." The clinical problem centers about deciding just when to try bending the twig. The obvious answer would appear to be as soon as we are able to decide that the growing structure is headed for trouble. Figure 2 (left) shows the models of a child five years of age presenting with a marked Class II deciduous malocclusion and serious incipient arch length deficiencies. Treatment was declined upon the advice of friends who questioned the need to "straighten baby teeth." Figure 2 (right) shows the models of the same patient at age eleven when he presented again for treatment. Early reduction of the Class II molar relation followed by supervised serial extraction would have prevented the gross malocclusion. Ultimately, our treatment procedure must rise to the occasion, for prevention of malocclusion is our only hope in the face of a rising tide of population and demand for service which

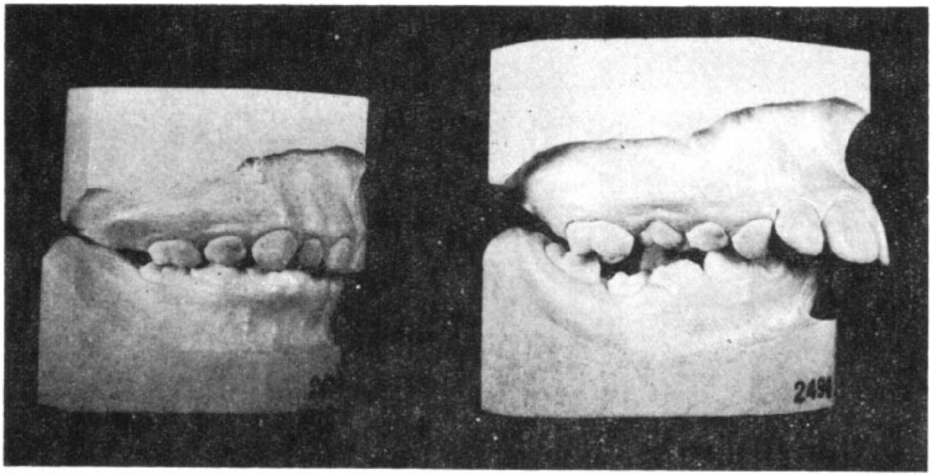

Fig. 2 Left, models of a patient at age five years with a Class II malocclusion and arch length deficiency. Right, the same patient at age eleven years. Treatment had been declined at the earlier age.

we cannot possibly otherwise meet.

It does not serve us very well to remark simply that growth is the orthodontist's greatest ally. We must try to time our treatment efforts to make maximum use of the phenomenon. It follows that the serious student of orthodontics should also be a student of growth and development. Herein lies the background material to make us truly conscious of the dental apparatus as part of a dynamic biologic system. The appositional nature of bone growth has been demonstrated in conclusive fashion. The nature of mandibular growth in particular is of considerable importance in treatment planning. Like Dewel, I consider the mandibular arch to be the limiting factor, almost without exception, in treatment planning when the possibility of extraction of permanent teeth is in prospect. I place considerable reliance on the oft-repeated work which demonstrates that we cannot expect an increase in intercanine mandibular width of any consequence after the approximate age of six to seven years. By this time, generalized growth of the mandible is said to have all but ceased, and subsequently we may look to the well-known mandibular growth sites for increase in size of the structure. Stability of intercanine width serves as a useful clinical tool, but like everything else in a biologic system is only approximately true. Likewise, we are all well aware of the fact that some individuals can tolerate orthodontic expansion of the intercanine width. Were this not so, the nonextraction therapies would be wholly unsuccessful in what we judge to be clear-cut extraction cases. However, in the main, persons with normal tone of the oral musculature must be considered candidates for extraction if they lack room for the mandibular teeth within their given arcs. In my estimation, it is wishful thinking to mechanically expand the lower arch to make room for all the teeth during and subsequent to the mixed dentition and expect a stable result. I feel it to be equally futile to place a cuspid to cuspid retainer to establish this new expanded dimension. On the other hand, I do not plan serial extraction for a given case, solely on the basis of measurement, if the arch length de-

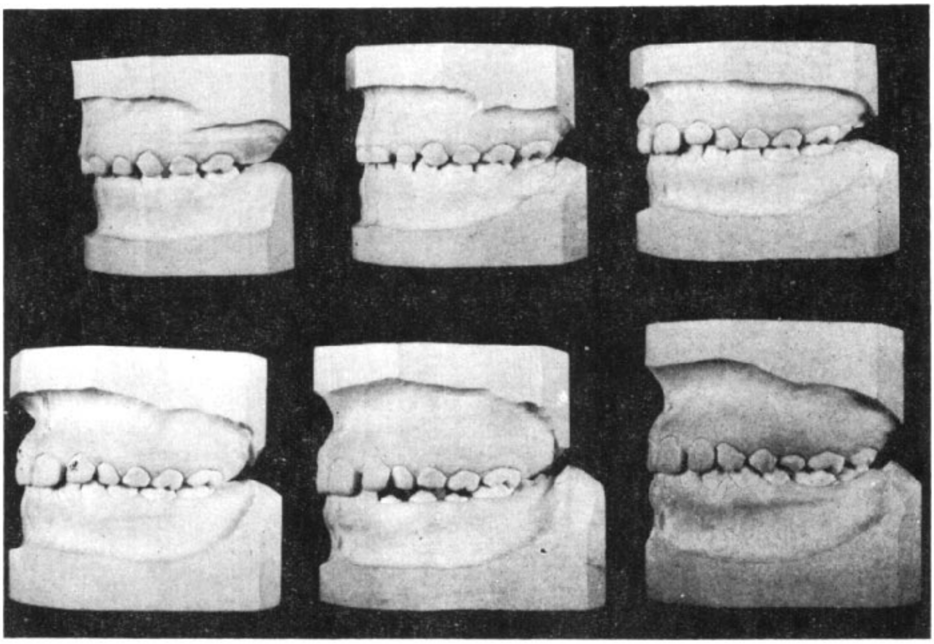

Fig. 3 Serial models of one of untreated identical triplets showing the molar adjustment from the end-on position to the adult cusp and groove relation prior to the loss of the deciduous molars and cuspids.

ficiency is not clear cut. I purposely avoid defining this deficiency in millimeters for myself since such arbitrary rules fail to take into consideration the factors of individual variation. The final decision must rest with the clinician. The clinical ramifications derived from cuspid width stability are several. There would be no point to early extraction of lower deciduous cuspids to make room for the lower four incisors if they are already well up on the ridge in rotated positions, for in so doing we "rob Peter to pay Paul" for space which will not be increased through subsequent intercanine growth. I hasten to add that early bilateral extraction of deciduous cuspids is most certainly indicated where the lower centrals are being forced labially, off the ridge, by the lingually erupting laterals. In so doing, we are setting the stage for serial extraction, but there would appear to be no other choice.

Cessation of generalized mandibular growth has supplied the backdrop for lower arch length calculation as described by Nance[2], Carey[3] and others, in evaluating the available space on the ridge of alveolar bone mesial to the six year molar. The decrease in arch length upon change from the mixed to the permanent dentition is unchallenged. The customary interpretation of physiologic mesial component of force in closing the ranks, so to speak, is open to question. In cases where the first molars have erupted into end-on position, it is commonly supposed that the final adult cusp and groove relation of these teeth is accomplished by differential mesial migration upon the loss of the deciduous molars. The models shown in Figure 3 made in a serial study of identical twin children demonstrate that this is not necessarily the case. One may adjust differentially from end-on position of the first molars

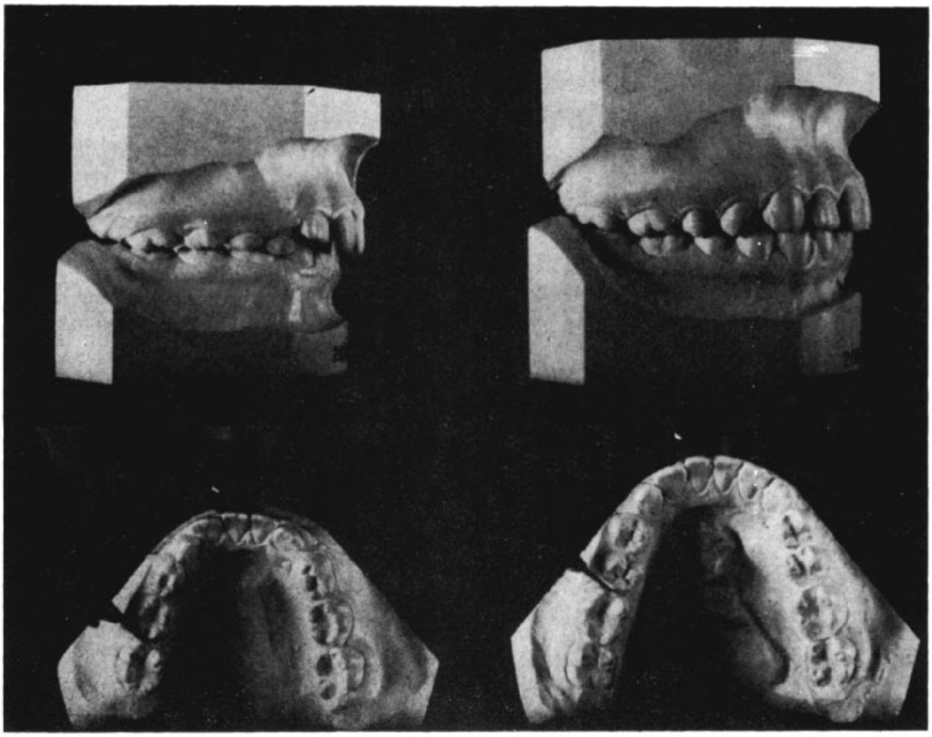

Fig. 4 Beginning and final models for patient, J.C. Note the crowding in the incisal segment prior to treatment. Dividers set at constant length demonstrate maintenance of arch length from the mesial of the first molar to the mesial-incisal edge of the central incisor following the loss of the deciduous teeth.

to the adult cusp and groove relation prior to the loss of the deciduous cuspids and molars. Likewise, there is no physiologic reason why the lower first molar *must* come forward upon loss of the deciduous molars. Regardless of what is said, there is no magic position for this tooth to move on the average of 1.7 millimeters mesially any more than there is a requisite predetermined position for any other tooth. If good cusp and groove relation of the first molars is established and proper holding mechanics maintained, there is no reason why use cannot be made of lower arch space which will otherwise be irreparably lost. Personally, I feel that lingual arches are poor mechanisms for the maintenance of anteroposterior tooth to ridge relation. The long lever arch from the molars to the lingual of the incisors lacks inherent stability and tissue support. On the other hand, they are helpful in the maintenance of arch length at the possible expense of forward migration of the entire mandibular denture in relation to supporting bone. The removable Hawley retainer, although subject to loss and breakage, offers a maximum of retention in terms of total surface application. It has the additional advantage of preventing the extrusion of opposing teeth in cases where premature extractions have been necessary.

Figure 4 shows the models of patient J. C., demonstrating arch length preservation for a full complement of teeth in a case which would otherwise offer no solution short of extraction.

Fig. 5 Beginning and final photographs of patient, J.C.

The patient presented with a Class II malocclusion and a calculated lower arch length deficiency of five mm. The malocclusion was reduced with upper arch banding and occipital traction. Mandibular arch length was stabilized with a removable retainer during the time the deciduous molars were being shed. Bands were then placed on the lower molars, bicuspids and cuspids, and space closure effected by distal movement of the bicuspids. Figure 5 illustrates beginning and final photographs. Before and after tracings (Fig. 6) superimposed on SN and registered on S as are all full tracings in this paper, show the overall facial growth and development over a span of four and one-third years, the Class II relation having been corrected during the first twelve months of this period. The tracings (Fig. 7) superimposed on the lower mandibular border and chin point depict increased vertical alveolar growth with no apparent forward migration of the first molars and incisors upon change from the mixed to the permanent dentition.

I have asked myself in the past, "Might we not set up a better environmental climate for the development of adequate intercanine width in children prior to the cessation of generalized mandibular growth in cases where the clinical prognosis is poor?" It has become increasingly apparent to me that the early closebite is perhaps the greatest single environmental stumbling block in the development of the dentition. We are all aware of the difficulties imposed by closebites in the mixed and permanent dentitions. For the most part, the bragging cases shown at meetings tend to return to the closebite relation when retention is discontinued. One solution is indefinite retention to which some orthodontists subscribe.

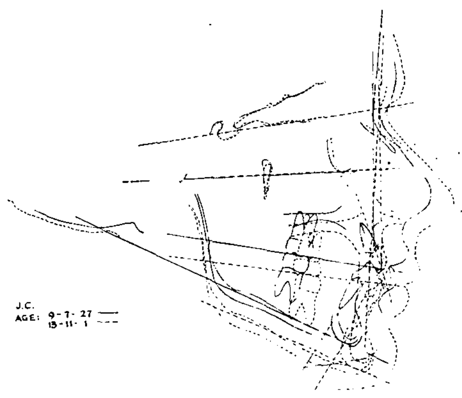

Fig. 6 Tracing of patient J.C. superimposed on the cranial base showing the overall results of treatment and concomitant growth.

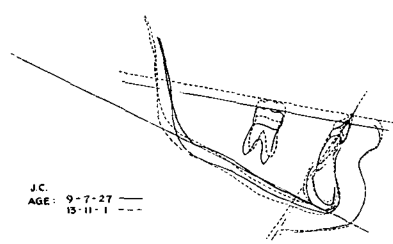

Fig. 7 Tracing of patient J.C. superimposed on the chin point and the lower border of the mandible showing anteroposterior stability of the first molar and incisor.

Until I see evidence to the contrary, I shall continue believing that development of proper overbite relation in closebite cases is best aided by initiation of orthodontic guidance therapy during the deciduous dentition years. For the record, I would like to reiterate my belief that, within the limits imposed by the growth potential, it is possible to modify favorably potential arch length deficiency during the deciduous dentition in cases presenting with favorable anteroposterior tooth relation coupled with deficient vertical relation. By definition, this is the deciduous Class I case with a closebite and potential lower arch length deficiency.[4]

One of the premises upon which I base treatment planning is that intraoral anchorage in the true sense of the word does not exist. I am well aware of the lengthy discussions in this respect to be found in the literature directed to the contrary.[5] I do not mean to say, for example, that I do not use Class II elastics in spite of the fact that they are said to be dirty words in my presence. My point is simple. Anchor teeth, other than ankylosed teeth, don't know enough to stay still when subjected to pressure of sufficient magnitude to disturb their existing equilibrium. Thus, a little Class II rubber mechanics may be a fine thing, but if I pit many teeth against a single tooth, I expect relative stability of the so-called anchorage units and nothing more. If I use push coil springs, pull coil springs, closing loops, or whatever in the mouth, I expect them to be reciprocal in action. As far as I am concerned, anchorage units, whether they be tipped back or upright, disturbed or undisturbed, will move reciprocally. I cannot help but agree with the research findings of Whitman[6] who was quite unable to demonstrate retrabeculation of bone at approximately right angles to the long axes of teeth subjected to orthodontic pressures. This phenomenon, according to the general principles of Wolff's Law, is said to occur as the result of force application to the tooth as Nature's way of setting up a temporary block or barricade to movement. In the final analysis, intraoral anchorage becomes a relative matter and a question of degree in which the orthodontist must decide whether he is willing to pay the price in terms of untoward movement of the tooth or teeth.

It becomes apparent with this rationale that banding of the lower arch in deciduous and in mixed dentition cases would be the exception rather than the rule. Mechanotherapy in the aforementioned age brackets, for the most part, involves the maxillary arch directly and the lower arch indirectly as it is influenced by a bite plane and the tongue. Figure 8 demonstrates the favorable development of the lower arch in a deciduous case in which there was a Class II relation with the maxillary posterior segments in complete buccal relation to the lowers. There was no appliance used on the lower arch. None of the permanent teeth have been banded.

Development of the cephalometer has made possible the analysis of tooth movement which was heretofore quite out of the question. There are no physiologic reasons why normal teeth subject to orthodontic pressures cannot be induced to move in any desired direction. In spite of the fact that the profession has had the cephalometer for a quarter of a century, it is only recently that some researchers have finally admitted that maxillary teeth can be moved bodily toward the distal and that teeth are intruded as well as extruded in certain levelling mechanics.

We are well aware that tooth movement is only possible because of the cellular elements in relation to the connective tissue of the periodontal membrane. Since cellular activity depends

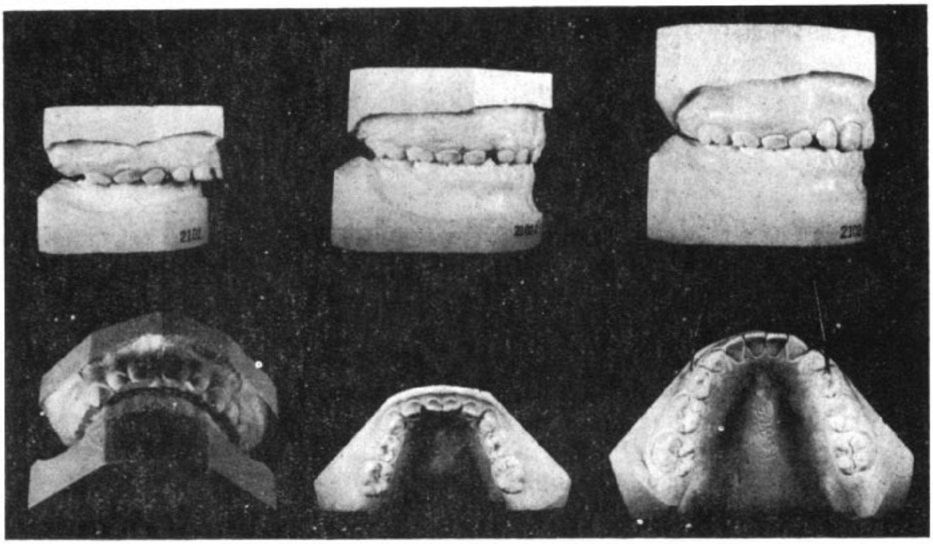

Fig. 8 Models of patient S.B. treated in the deciduous dentition. Fully banded upper arch in conjunction with occipital traction and maxillary bite plane. No appliance used on the lower arch. Increase in mandibular arch width is shown with dividers.

on the availability of local blood supply, it follows that extrusion is the easiest movement, followed by tipping, rotation, bodily movement and intrusion, in order of increasing difficulty. Clinical movement of teeth is accomplished in spite of force applications which show little or no understanding and regard for the integrity of the supporting tissues. This is true, thanks to repair, which is again the product of cellular activity and concomitant blood supply, in the undermining and removal of necrotic tissues which resulted from the initial orthodontic insult. Excessive force application has been characterized in some quarters by such terminology as "vigorous" and "positive." This is supposed to accomplish all manner of things ranging from faster completion of the case to stimulation of the growth of bone. At a meeting in 1958 Dr. Alton Moore reported the results of a statistical comparison between a series of Dr. Charles Tweed's cases and a comparable series of treated cases in which Tweed mechanics were not employed. He was unable to demonstrate the oft discussed stimulation of mandibular growth supposedly resulting from Dr. Tweed's mechanics. I still find myself in the same position that I held some four years ago in a paper before the P. C. S. O. in Seattle, at which time I stated in part . . . "the burden of proof for stimulation of bone growth by orthodontic mechanics (other than that normally expressed in vertical alveolar dimension) rests with those making the claim." Generalized stimulation of bone growth has been demonstrated in man following the injection of growth hormone in children. To the best of my knowledge, no one has yet succeeded in demonstrating differential stimulation of bone growth in man, i. e., inducing a single growth site to activity while other sites remain quiescent. As a matter of fact, we do not understand the genetic mechanism underlying differential growth rates and amounts in any organism.

It is beyond the scope of this paper to deal with the details of force application in tooth movement. However, among the more recent works are the papers by Reitan[7] and Storey and Smith.[8] These papers point up once again that force application should be within the realm of physiologic reality. Every operator likes to think he treats the tissues with due respect, but few have any real idea of the forces being used clinically in terms of grams per square centimeter of root surface involved. Doctor Frederick Noyes once made a statement to the orthodontic profession which should be more widely known and appreciated. "It is very difficult for the orthodontist to understand that force does not move teeth, but rather should be only of sufficient magnitude to stimulate the production of cellular elements which are responsible for tooth movement." Exacting control of maximum numbers of teeth in an arch is possible to a greater degree with the edgewise appliance than with any other. Forces of four or five hundred grams are easily applied to a single tooth. This is easily demonstrated, for example, in the ordinary activation of a vertical loop in a rectangular sectional arch. In my estimation, the best clinical yardstick in deciding force application was laid down by Oppenheim. He warned against soreness of teeth, looseness of teeth, and blanching of the soft tissues upon adjustment of the mechanism. I think that we can agree that orthodontic movement of teeth should be an almost painless affair. I do not use the customary .016 initial round levelling wire in a fully banded arch as I was taught in school. Smaller sizes, ranging from .012 to .014 will accomplish the same thing in what appears to me to be less time (if that be so important) and with much less discomfort to the patient. It might be in order to comment on the relatively new levelling arch wire consisting of a bundle of four .010 round steel wires. This wire obviously has greater resiliency than a single wire of comparable cross section. However, the operator should not be deluded into thinking that such an arch wire exerts less force and is therefore more gentle than, for example, a .016 wire. Table I shows the results of a simple typodont setup in which a series of archwires were subjected to a 1.0 mm deflection over an 18 mm span. This represented the midpoint between the typodont first molar and the first bicuspid. Accordingly, the scales measured the force in grams which would have been exerted on the second bicuspid and reciprocally on the first bicuspid and first molar. There was a measured force of 100 grams with the .012 round steel arch; 400 grams with the .016 arch; 475 grams with the bundle arch (four .010 wires); and about 1900 grams with the .021 x .025 arch. In this crude experiment, even the very lightest archwire exerted a force beyond physiologic limits. We should not excuse ourselves in excessive force application merely because we seem to get away with it. Rather, I think, we should try to do something about it.

Table I

COMPARATIVE TENSIONS EXERTED BY ARCHWIRES UPON ONE MILLIMETER DEFLECTION OVER AN EIGHTEEN MILLIMETER SPAN

(stainless steel)

.012 rd.	100 gms. (3½ oz.)
.016 rd.	400 gms. (14 oz.)
Quadruple .010 rd.	475 gms. (16 oz.)
.021 x .025	1900 gms. (4 lbs.)

Analysis of tooth movement with cephalometric films is not as simple as some would have us believe. The great difficulty lies in deciding the method of superimposition of the second tracing since the variables of mechanical error

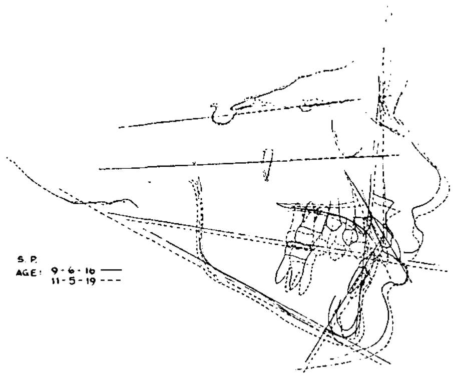

Fig. 9 Patient S.P. treated in the mixed dentition with occipital traction against a fully banded upper arch. No appliance used in the lower arch. Note the distal movement of the unerupted cuspid and bicuspid during treatment. Bodily movement of the first molar is quite evident.

and structural growth have intervened. It is possible to arrive at various answers depending upon how the second registration is made. This point is especially well made by Krogman and Sassouni[9] in a comparative study of various methods of cephalometric analysis applied to a single case. We need more information regarding the location of surface deposition of new bone in the growing facial structure. The work of Bjork[10] using small metal implants in the facial skeleton of children to provide reference points for superimposition of tracings may well alter certain of our current methodology in this respect.

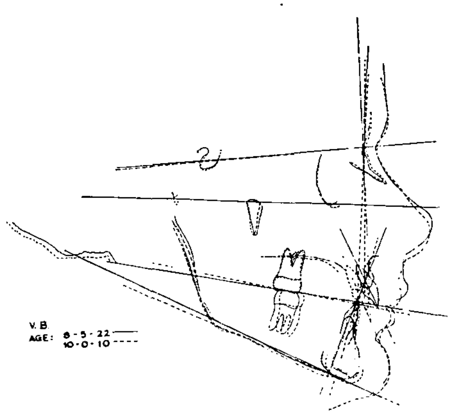

Fig. 10 Cephalometric tracings for patient V.B. demonstrating the correction of a Class II malocclusion by full maxillary arch banding and occipital traction. Molar correction in this case was effected by mandibular growth. Lingual bodily movement of the maxillary incisors is clearly shown.

Tooth movement is accomplished with considerable rapidity in certain cases before appreciable growth has intervened. Analysis of tooth movement is easy in these cases and is more so in adult cases where facial growth is no longer a variable. Figure 9 shows the cephalometric tracings for patient, S. P., in which the distal bodily movement of maxillary molars and incisors through the medium of occipital traction is demonstrated in conclusive fashion. This should not be construed to mean that this is the one and only way in which Class II malocclusion is reduced in my hands, for most certainly some cases are corrected as the result of tooth movement, jaw movement and resultant growth direction of the facial complex. Figure 10 illustrates the cephalometric tracings for patient V. B. in which a Class II malocclusion was treated with full maxillary arch banding and occipital traction. No appliance was used in the lower arch. The tracings superimposed on SN and registered on S depict an elapsed time of approximately ninteen months. Molar correction in this case was effected by marked forward growth of the mandible. However, lingual bodily movement of the flared maxillary incisors is quite evident.

Figure 11 of patient B. S. shows the tracings of a Class II case in which full banding of the maxillary dentition and occipital traction was employed over a period of ten months. The tracings, superimposed on SN and registered on S, show essentially no growth of the anterior cranial base while growth of

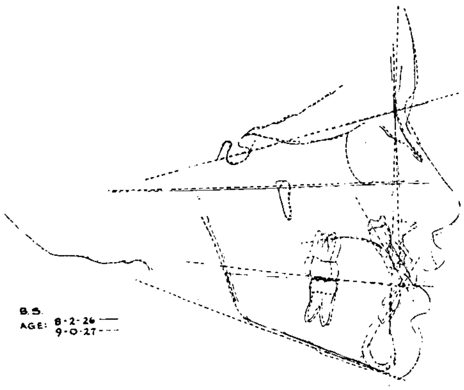

Fig. 11 Tracings of patient B.S. showing correction of a Class II malocclusion by posterior movement of the maxillary denture. Growth of the facial skeleton has been negligible during the treatment period of ten months.

the facial skeleton has been negligible over this short period of time. Correction of the malocclusion in this case was obtained almost wholly by distal movement of the maxillary teeth. Forward growth of the mandible has played a minor role in this case.

Figure 12 presents the tracings for patient S. G. demonstrating again the reduction of a Class II malocclusion with occipital traction against a fully banded upper arch. No appliance was used in the lower arch. The tracings are superimposed on SN and registered on S. The maxillary incisor has been retracted bodily while the first molar is in the same anteroposterior position. Molar correction in this case was gained by marked downward and forward mandibular growth.

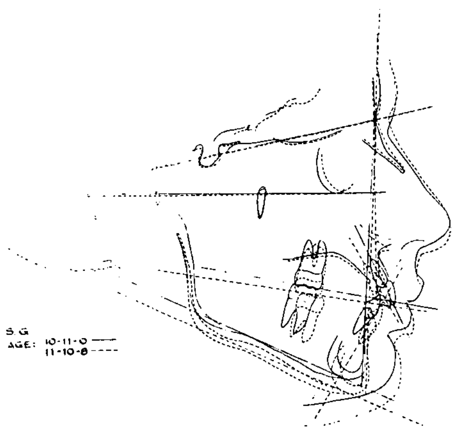

Fig. 12 Tracings of patient S.G. in which correction of the Class II relation was obtained by marked downward and forward mandibular growth. Lingual bodily movement of the maxillary incisors is seen.

It has been said that movement of deciduous teeth does not affect the permanent tooth buds underlying them.[11] The work of Breitner[12] on the orthodontic movement of the deciduous dentition in monkeys some nineteen years ago suggested quite the contrary. It would be most difficult to imagine how the tooth germ of an unerupted bicuspid, for example, forming and nestled between the roots of the deciduous molar could not be influenced by movement of the overlying tooth. Likewise, the unerupted maxillary cuspids and incisors should come under the restrictive influence of the oral musculature as the posterior teeth are taken distally. I assiduously avoid distal tipping of deciduous molars for the very reason that in so doing there will be a varying mesial root tipping and unfavorable mesial movement of the permanent tooth bud with it. Reference to the tracings in Figure 9 shows the favorable distal movement of the maxillary bicuspids and cuspids during mixed dentition treatment, the deciduous molars having been shed subsequent to band removal. The clinical results of carrying the deciduous molars and first molars distally in bodily fashion with little or no tipping has been most gratifying.

Words of warning have been sounded regarding root resorption and root-end deflection if the maxillary incisors are banded prior to the near completion of root closure. From a purely mechanical point of view, it would seem likely that a comparatively delicate structure such as Hertwig's sheath would be deflected when subjected to pressure. Similarly, it is not too difficult to find maxillary laterals with curved root tips although this is seldom seen in central incisors. The partially formed root-end possesses a comparatively great blood supply which, in turn, provides the cellular elements requisite to bone removal upon the initiation of tooth movement. I have yet to see a case in which I felt there was root damage as the result of tooth movement prior to root closure. I realize this point can be argued since one can only estimate the probable root length from the outline of the partially formed structure. One finds varying degrees of root resorption following tooth movement in older children and it is almost axiomatic to say that we may count on root resorption of maxillary incisors in adult treatment.

The typical mixed dentition treatment of a Class II malocclusion presenting with a clinically good lower arch will require banding of all available maxillary teeth. Obviously, this will vary, depending on the age and teeth present in the maxillary arch. My basic objective in all so-called early treatment is correct interdigitation of posterior teeth with the concomitant maintenance of a flat occlusal plane in the maxillary arch. The rationale for a flat occlusal plane in the upper arch will be considered later. It will not matter to me whether or not the patient has adequate or insufficient mandibular arch length to accommodate the permanent dentition. The primary aim is the same in both instances, namely, establishment of normal cusp and groove interdigitation of the posterior teeth, thereby setting the stage for correct anteroposterior relation of the succeeding molars and bicuspids. This invariably means extraoral traction against the maxillary teeth and strict avoidance of mesial forces bearing against the mandibular arch.

Those employing the ribbon arch mechanism must treat the deciduous dentition prior to the near exfoliation of the deciduous maxillary incisors and must postpone early mixed dentition treatment until the maxillary incisors have erupted. If one believes that the unerupted maxillary incisors and the supporting premaxillary base are not influenced by distal movement of the deciduous cuspids and posterior teeth, there is good clinical reason for avoiding treatment during the five to seven and one-half year age range. However, one must admit that these are favorable years for treatment if the use of extraoral traction is in prospect. Clinically, I find it quite feasible and realistic to undertake treatment during this age period with the edgewise mechanism. The maxillary deciduous cuspids and all available teeth posterior to them are banded. Occipital traction is used against the cuspids by means of free-sliding headcap hooks which carry the deciduous cuspids and posterior teeth into normal relation along the archwire much like sliding beads on a string. Obviously, every effort is made to avoid distal tipping in order to encourage mass bodily movement. The rectangular archwire rests in proximity to the anterior alveolar process but does not bear on it directly. The process and unerupted incisors are encouraged to retreat, as it were, as the lip exerts its restricting influence. Self-correction in this area is more marked if reduction of thè Class II relation is undertaken while the permanent incisors are completely unerupted and if lip control has not been lost by extreme protrusion of the supporting bony process. By the same token, there is every reason to wait for complete eruption of the two centrals before banding if these two teeth have already started to erupt when the patient presents. When the centrals are incorporated into the arch system, headcap hooks are soldered to the archwire and mass movement of the entire maxillary denture is undertaken. It is of prime importance to preserve arch length with stops mesial to the molar tubes to prevent differential movement of the centrals into the eruptive path of laterals or permanent cuspids as the case may be. In cases where the permanent centrals are part of the arch system and the laterals lack room for eruption, I use sliding hooks against the deciduous cuspids, carrying them and the posterior teeth back until space is created for the laterals. Thereupon, the headcap hooks are soldered to the archwire and arch length is preserved by molar stops.

For those using the edgewise mechanism who have never undertaken mass movement of the maxillary denture with occipital traction, it is in order to mention a few details with respect to management of the archwire. I invariably use an .021 x .025 steel archwire with headcap hooks in the cuspid-lateral interspaces. As mentioned before, these hooks may be soldered to the archwire or free sliding as indicated. Active labial crown torque is incorporated in the incisor area of the archwire irrespective of the existing inclination of these teeth. The posterior segments are torqued slightly to the lingual in order to counteract the tendency for the molars to tip buccally. The cuspid areas of the archwire are kept flat, maintaining the desired intercuspid width and labiolingual inclination. I attempt to maintain the arch in a flat plane at all times, dictated in part by the band levels on the teeth. As traction is brought to bear on the arch, there is a tendency for the maxillary incisors to develop spacing and tip lingually as the buccal segments tend to tip buccally and expand. These untoward actions must be checked and compensating bends in the archwire reinforced each time it is removed. In addition, I find it advisable to incorporate slight mesial bends for the laterals so that upon completion of treatment, these teeth will have a slight mesial crown inclination. I generally figure-eight the four incisors as an added precaution. I consider it an error to gather the spaces between upper incisors at the beginning of treatment by tying back a round wire. In so doing, there is a varied degree of undesirable forward motion of the incisor apices. Correspondingly, it is difficult to correct the axial inclination of incisors toward the close of treatment if they have been tipped lingually previously. On the other hand, by careful maintenance of incisal axial inclination during treatment, one may finish the final closure of anterior space with a small round arch without detriment to incisor esthetics.

Many different designs of occipital headgears have been concocted in an effort to make them more presentable. I still use the familiar Johnson[13] headgear made of rug binding. They are probably the worst looking of the lot and are real headshrinkers if they are laundered. Nevertheless, they have the virtue of staying in place and permit unilateral traction if it is indicated. Likewise, I still use the Terwilliger hooks which permit directional tension adjustment. Theoretically, the patient returns the hooks for sterilization and re-use.

I would like to take time at this juncture to point out what I consider to be objections to the so-called Kloehn approach to Class II treatment which conventionally involves banding upper first molars and directing the maxillary denture distally by cervical traction delivered directly to the molars by means of a removable face bow. In essence, the banding of first molars and use of cervical traction on these teeth makes use of the fact that the dental arch is bound together, so to speak, by a connective tissue band of transseptal fibers. This, coupled with favorable restrictive influence from the oral musculature makes possible the reduction of the malocclusion. Integrity of the transseptal tissue is lost whenever space is opened mesial to the banded molars. The patient is asked to wear extraoral traction but the incisor teeth are not being controlled axially. The resultant cervical force being applied to the molars is somewhere below the level of the maxillary occlusal plane while the level of the occlusal plane, itself, is not under control. Cervical gear, on the average, rests at the level of the third cervical vertebra. Since the occlusal plane is almost invariably above the level of the neck gear, and since no one has repealed the law about pulling one's self up by his boot straps, the resultant force must lie somewhere in between. I have no quarrel with those using this approach to treatment. Rather, I feel it preferable to control as many teeth as possible, especially when the patient is forced to wear extraoral traction.

I have had the privilege during the past year to see some spectacular clinical examples of treatment of Class II, Division I malocclusion using a modified Kloehn-type appliance. The headfilms showed interesting downward tipping changes in the posterior palatal area accompanying treatment. This minimal appliance therapy may well be indicated in selected Class II, Division I cases with the maxillary incisor apices well back under supporting bone and with relatively flat maxillary occlusal planes. The significance of the palatal changes must await future assessment. Minimization of angular changes in the occlusal plane may be significant when one remembers the considerable research indicating the instability of this type of dislocation. It is not my purpose to deprecate cervical traction, per se, for I use it routinely in both Class I and Class II cases against a fully banded upper arch in openbite cases where controlled downward and backward movement of the maxillary incisors is indicated.

The bulk of Class II malocclusion is characterized by a closebite. In reduction of the malocclusion, one is faced with this and the related problem of vertical dimension. A fully banded maxillary denture which has been levelled by various archwires, with the posterior teeth in upright position and the marginal ridges in good relation, sets the stage for bite opening which is simple and effective. In these so-called upper arch headgear cases, a flat maxillary bite plane placed upon band removal is generally successful in effecting bite opening through differential eruption of the lower posterior teeth. This is easily demonstrated by headfilms in which the mandibular incisors are seen to maintain their existing vertical height while the posterior teeth erupt into occlusion. However, the time lapse is sufficient in some cases that the corrected molar interdigitation is lost before the posterior teeth are again in occlusion with the plane in place. I began using a flat maxillary bite plane in conjunction with upper headgear treatment at least three years ago as the result of failure of certain Class II cases to maintain the corrected anteroposterior tooth relation following band removal while waiting for the lower posterior teeth to erupt into occlusion. I have been asked repeatedly if distal en masse movement of maxillary teeth is not prevented by the bite plane in situ. Actually, teeth are not prevented from moving distally with palatal coverage in place any more than they are prevented from moving mesially when Class III force is applied against the upper arch with palatal coverage in place. Were this not so, there would be no need to "back up" the upper arch in cases where anchorage is being set up in the lower arch. However, I generally do not use the bite plane in these upper arch headcap cases until the posterior teeth are about in edge to edge relation. The case looks worse when the bite plane is inserted since the jaw is opened a few millimeters and chin point is down and back of its previous position. I continue the headcap to the upper denture until the desired vertical and anteroposterior relation is achieved. Retention, upon band removal, becomes a matter of maintenance of the established tooth and jaw relation. I find myself with a variable degree of success in the maintenance of the desired vertical relation when the case is out of retention not only in the mixed dentition but in the permanent as well.

In over one hundred Class II cases treated with occipital traction in the mixed and deciduous dentition, I have never impacted an upper molar. I cannot help but attribute this, in part, to plain good fortune but also to the fact that distal tipping of molars is minimized during treatment. Therefore, I do not have to count on their spontaneous uprighting following treatment. However, I have seen second molars erupt in buccal version more than once as the probable result of Class II headcap mechanics. Fortunately, these second molars can be guided into correct buccolingual alignment with clasp wires extending from the retainer. Similarly, I have never cut off the root of a maxillary lateral during the reduction of Class II malocclusion. This, I believe, is due to the maintenance of arch length coupled with the fact that the high, unerupted cuspid is favorably influenced in its eruptive path. Clinically, the cuspids erupt later into good anteroposterior relation. In treated cases possessing extreme protrusion, the newly erupted cuspid may require distal tipping with a suitable retainer clasp wire. Additional banding treatment is needed on occasion.

In June 1950, about a year after graduation from dental school I first began upper headcap treatment of Class II malocclusion, on a limited basis, in mixed dentitions with clinically good lower arches. Teaching at that time held that both arches must be banded in order to maintain coordination or synchronization.

Seventy-three of my completed upper arch headgear cases had sufficiently completed records to warrant analysis. Bands were worn in these cases for a calculated mean of thirteen months. However, the treatment time ranged from three to thirty months. Obviously, this extreme range reflected patient level of cooperation as well as the difficulty of the case. I am assuming that my orthodontic competence was more or less constant, irrespective of what the level may have been. Forty-two of the seventy-three completed cases were selected on the basis of above average cooperation with respect to headcap wear. In collecting the new sample, a conscious effort was made to disregard total treatment time for any given case. The forty-two cases required a total of 473 months of treatment for an arithmetic mean or average of 11.3 months per case. Treatment time ranged from three to twenty-one months in this new sample. Even without detailed analysis it becomes evident that the average may not have a great deal of significance. For this reason, the mode, or most common treatment time might be of value. Accordingly, treatment times were grouped as shown in Table II. It is im-

Table II

DISTRIBUTION OF TREATMENT TIME FOR 42 LATE DECIDUOUS AND EARLY MIXED DENTITIONS

No. Cases	Months	No. Cases	Months
1	3	3	12
1	4	1	13
1	5	1	14
2	6	0	15
5	7	1	16
5	8	4	17
3	9	3	18
3	10	1	19
4	11	2	20
		1	21

Average treatment time = 11.3 mo.

mediately apparent that neither the mode nor the mean is of significance in terms of the projected treatment time for any given single individual. The many uncontrolled variables dictate the random distribution of treatment months. I see no harm in telling one's self that the average treatment time is 11.3 months as long as one doesn't take it to heart. It is unrealistic to apply the average value to the single individual here or elsewhere in treatment planning or analysis.

Retreatment was necessary in four of the forty-two cases due to loss of the corrective buccal relation. Two of the four cases were identical twins who were treated in identical fashion and collapsed the same way. These children had very flat occlusal anatomy in the first molars which I suspect was responsible for the failure of the teeth to lock in good relation. Retreatment was successful at the time the bicuspids were erupting. I have no explanation for the return to Class II in the third case. The fourth case returned to Class II molar relation on one side only. Both of these latter cases have been retreated without incident and are out of retention.

I do not want to give the impression that my mixed dentition cases require additional treatment at the level of four out of forty-two or roughly eight per cent. Actually, a great many of my mixed dentition cases require subsequent treatment but not because of failure in my primary treatment objective. This, it will be recalled, is the establishment of normal molar relation. Corrected vertical relation will have been obtained with the bite plane. If the patient has a clinically good lower arch and no dental anomalies, I expect the reduction of Class II malocclusion to be a one shot affair. Actually, the parents are told in writing that additional banding treatment may or may not be indicated, irrespective of my personal feelings in any given case to the contrary.

Potential four bicuspid extraction cases presenting with a Class II malocclusion are treated early in order to establish correct anteroposterior relation of the buccal teeth at a time when the child is most amenable to extraoral traction therapy. Serial extraction of deciduous and permanent teeth is initiated and carried on from this point. The patient wears a flat maxillary bite plane intermittently during the intervening years until secondary full banding treatment is indicated. The bite plane is a valuable adjunct to maintain vertical dimension, prevent serious distal tipping of the lower incisor segment and helpful in guiding the teeth into good interdigitation. Secondary banding treatment then becomes a relatively simple matter of tooth alignment and completion of space closure. The need for extraoral traction at this stage is minimized or eliminated.

The treatment findings in the present series of cases are quite different from those reported in 1954 by Graber[14] in a more or less comparable group of one hundred patients. The shortcomings reported in his mixed dentition treatment results made no mention of the mechanical deficiencies in his appliance therapy. With only two molar teeth banded and cervical traction employed, he pointed out the following:

1. Lack of control of axial inclination of incisors.

2. A low level of success in distal bodily movement of molars.

3. Poor success in control of vertical dimension.

4. Temporary impaction of upper molars in some cases.

5. Successes associated mainly with pubertal growth spurts.

I go out of my way to mention the shortcomings of the method that Graber was using at that time because, in the first place, I have had no serious difficulties in these areas. But secondly, and more important, Graber's treatment difficulties were directly assignable to appliance inadequacies, a fact which he apparently failed to recognize and report. In generalizing, one must be quite certain that it is being done from a broad base and not from a limited point of view; in this case, an appliance incapable of doing the things being asked of it. The basic idea of retracting the protrusive maxillary denture is every bit as good as it was when Angle reported it in 1887.

Summary

This paper has been an attempt to describe my methods in handling malocclusion in the deciduous and early mixed dentition. There are no world-shaking conclusions to be drawn. The underlying theme is prevention, for malocclusion can only become worse and more difficult if left untreated until later years. One may disagree entirely with the various rationales which underlie the treatment procedures described. I have been in research long enough to have learned that there must be error on both sides where more than one school of thought exists regarding a given problem. Time will be the final judge.

The Medical Center

Bibliography

1. Dewel, B. F.: Serial Extraction in Orthodontic Treatment, *Am. J. Ortho.* 45: 421-55, June 1959.
2. Nance, H.: Limitation of Orthodontic Treatment. (I) Mixed Dentition Diagnosis and Treatment, *Am. J. Ortho.* 33: 177-233, 1947.
3. Carey, C.: Linear Arch Dimension and Tooth Size, *Am. J. Ortho.* 35: 762-775, 1949.
4. Mathews, J. R.: Maxillary Bite Plane Application in Class I Deciduous Occlusion, *Am. J. Ortho.* 45: 721-737, October 1959.
5. Renfroe, E.: The Factor of Stabilization in Anchorage, *Am. J. Ortho.* 42: 883-897, December 1956.
6. Whitman, C. L.: Reaction of Bone and Tissues in Living Subjects Employing the Edgewise Mechanism, *Tweed Seminar*, Havana, Cuba, 1955.
7. Reitan, K.: Some Factors Determining the Evaluation of Forces in Orthodontics, *Am. J. Ortho.* 43: 32-45, 1957.
8. Smith, R. and Storey, E.: The Importance of Force in Orthodontics: The Design of Cuspid Retraction Springs, *Australian J.* of *Dent.* 56: 291-304, December 1952.
   Force in Orthodontics and its Relation to Tooth Movement, *Australian J.* of *Dent.* 56 (1): 11-18, Feb. 1952.
9. Krogman, W. and Sassouni, V.: A Syllabus in Roentgenographic Cephalometry, Graduate School of Medicine, *Univ.* of *Pennsylvania and Philadelphia Center* for *Research* in *Child Growth.* Phila., 1957.
10. Bjork, A.: Facial Growth in Man, Studied with the Aid of Metallic Implants, *Acta Odont. Scand.* 13: 9-24, 1955.
11. Hahn, G.: Treatment in the Deciduous Dentition, *Am. J. Ortho.* 43: 255-261, 1955.
12. Breitner, C., Influence of Moving Deciduous Teeth on the Permanent Successors, *Am. J. Ortho.* and *Oral Surg.* 26: 1152, 1940.
13. Johnson, E.: Application of Occipital Anchorage, *Am. J. Ortho.* and *Oral Surg.* 29: 638-647, Nov. 1943.
14. Graber, T.: Extraoral Force-Facts and Fallacies, *Am. J. Ortho.* 41: 490-505, July 1955.