The Treatment Of Maxillary Deficiency By Opening The Midpalatal Suture

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Opening the midpalatal suture or palate expansion to gain maxillary arch width is by no means a new European form of dentofacial orthopedics. As a matter of fact, the procedure probably originated in this country with Angell[1] in 1860. The operation was reported and discussed frequently in the early dental, orthodontic and rhinologic literature by its proponents: Goddard (1893), G. V. Black (1893), Monson (1898), G. V. I. Brown (1903), Ottolengui (1904), N. M. Black (1909), Landsberger (1910), Willis (1911), Wright (1912), Barnes (1912), Hawley (1912), Pullen (1912), and others.

Opponents to the procedure believed that it was either anatomically impossible or, if possible, too dangerous to be used. Among these antagonists were McQuillen (1860), Farrar (1888), Cryer (1913), Federspiel (1914), Kemple (1914), and Stanton (1914).

Those who remained indifferent to the procedure, notably Angle,[2] Case,[12] Ketcham,[25] and Dewey,[15] were responsible for its discontinuance in this country. These very influential men believed they could gain all the benefits inherent to palate expansion by conventional expansion of the buccal teeth without the possible risks involved in such a seemingly drastic procedure. This was merely another example of the hold which the functional concept of development had on orthodontics from 1910 until the cephalometric appraisal of treated cases by the Illinois staff[7] in 1938.

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European orthodontists, on the other hand, continued the use of the operation and have reported on it through the years: Babcock (1911), Schroeder-Bensler (1913), Huet (1926), Mesnard (1929), Derichsweiler (1953), Korkhaus (1953), Krebs (1958), Thorne (1960), and others.

Korkhaus[27] probably is responsible for reintroducing the procedure to this country while visiting the department of orthodontics at the University of Illinois in 1956. His remarkable cephalometric records of cases treated by palate expansion aroused the curiosity of Allan G. Brodie and the author. Using the pig as the experimental animal, a study[19] of the procedure was undertaken. The salient findings of this study were that: (1) The procedure was apparently pain free. (2) The midpalatal suture offered very little resistance to spreading. Suture openings of 15 mm in two weeks time were recorded. (3) The mandibular teeth, without treatment, uprighted or expanded probably in response to altered forces of occlusion and change in muscle balance. (4) Internasal width was increased. Changes up to 7 mm were recorded.

In 1961[20] the author reported a study based on his management of forty-five patients treated initially by opening the midpalatal suture. Some of the observations made in that paper will be expanded in this report.

Palate expansion is most encouraging in answering some of orthodontics' severest challenges. Among these are the Class III case, treatable without surgery; the cases of real and relative

maxillary deficiency; the cases of nasal stenosis with characteristic mouth breathing; and the mature cleft palate patient. Three cases which derive great benefits from suture opening will be discussed in this article.

Excepting a few mixed dentition cases, palate expansion is by no means the complete treatment of any case. However, cases that would ordinarily be considered among the most difficult become relatively routine problems after suture opening. For example, marked crossbites, whether unilateral or bilateral, are corrected in days rather than months or even years.

Differentiation between *real* and relative maxillary deficiency seems in order. A *relative* maxillary deficiency occurs when the maxilla is of expected size compared with the upper face and cranium, but the mandible is too large when compared with these structures. This mandibular discrepancy is usually in width in Class I and Class II cases, and in both width and length in Class III cases. When considering treatment of such problems, the orthodontist is confronted with the dilemma of expanding the maxillary dental arch and constricting the mandibular dental arch. Labial and buccal musculature rarely permit permanent lateral tipping of maxillary teeth, and the tongue rarely tolerates the confining aspects of contracting the mandibular dental arch. The most desirable method of treatment would be to correct the disparity in denture base width rather than in dental arch width.

Any thoughts directed toward changing the mandibular apical or denture base would necessarily be of a radical nature involving open surgery such as removing a piece of bone from the symphysis, then compressing and wiring the lateral halves. The mandible by nature of its function, anatomy, and position is obviously the more immutable of the two jaws.

Except for functional similarity in mastication, the nature of the two jaws is very different. The maxilla plays an important part in respiration; it is hollowed by sinuses and delicate in nature to permit the passage and warming of air and the balancing of air pressures.

The mandible, on the other hand, must stand alone. It has no rigid support or hafting to the cranial bones. It has as its main functions posture and mastication. Both require this bone to be of rigid construction. Thus, the mandibular base is not influenced by tooth movement; nor for that matter, is the maxillary base. Since it is composed of two distinct bones joined at the midpalatal and intermaxillary suture, the maxilla permits orthopedic influence of the denture base.

Notwithstanding the fact that the discrepancy is mandibular, but cognizant of the stability of the mandibular denture base, the orthodontist is forced to treat the maxillary denture base. It is relatively simple to move the two maxillae laterally to widen the apical base.

A *real* maxillary deficiency is characterized by compression of the maxilla with constriction of the buccal tooth segments. These teeth may be upright over the base, but are most often inclined buccally or labially as if reaching to occlude with mandibular teeth. The anterior teeth may or may not be in crossbite depending on the classification of the case and the influence of the musculature. Arch length is deficient in virtually all cases with the possible exception of some Class II cases with severe overjet. If one analyzes arch length compared with denture base mass, then virtually all real maxillary deficiency cases are also arch length problems.

These real deficiency cases have been treated by expansion of the buccal segments even when teeth were already in

positions of marked buccal inclination. It has been found impossible to maintain these corrections following treatment without lifetime retention or, for that matter, even to attain correct axial inclination of these teeth during such treatment.

By moving the maxillae apart with palate expansion, it is possible to position the maxillary denture base in harmony with the mandibular denture base. When this is done, the occlusal relationship of the upper buccal teeth will be buccal to the lower buccal segments. The overtreatment of buccal occlusion makes allowance for bending which occurs in the alveolar processes as a result of the expansion force and the subsequent intended uprighting of the maxillary buccal teeth. Therefore, to stop short in the splitting procedure and merely correct dental relationships rather than denture base relationships fails to take full advantage of the benefits peculiar to the technique.

As the midpalatal suture opens, the central incisors begin to separate without any direct force from the appliance. The following figures pertain to the same patient: Figure 1 is the frontal headplate of the patient three weeks after beginning palatal expansion. Note the gap between the central incisors extends superiorly into the nasal cavity. The suture opening has been shown to be triangular in character with the greatest width at prosthion and the least near the apex of the nasal cavity. In Figure 1 the gap at prosthion is 8 mm, between the separated palatine processes it is 5.5 mm. Figure 2A is an intraoral photograph of the patient before suture opening. Figure 2B is the patient after suture opening three weeks later. Note the buccal overcorrection. Figure 2C demonstrates the rapid mesial movement of the incisors during the time the appliance is stabilized to allow palatal healing to occur. The photograph was taken at the time the

Fig. 1 Frontal headplate of an 11 year old male made after opening the midpalatal suture.

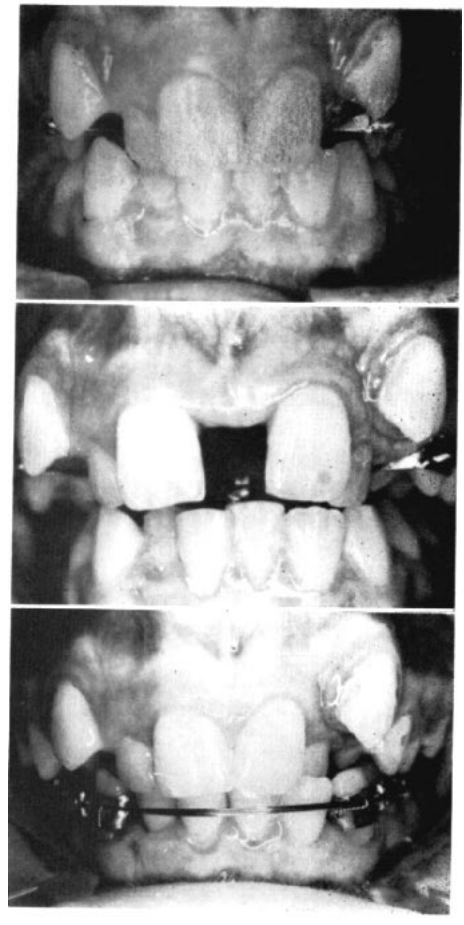

Fig. 2 Intraoral photographs taken at appliance placement (A), stabilization (B), and removal (C).

appliance was removed, fifteen weeks after that in the previous figure. No bands had been placed on the central incisors.

The reaction of the central incisors is indicative of the presence of transeptal fibers. Opening the intermaxillary sutures stretches the fibers connecting the central incisors. These stretched fibers draw the crowns of the teeth together very rapidly. Patients experience a tenderness in these teeth even though they are usually out of occlusion and never acted upon directly by the appliance. Pressing the central incisors medially with finger pressure intensifies the type of pressure the patients feel on these teeth, while pushing the teeth laterally causes the patient to experience a different kind of pressure.

As the maxillae separate, the outer walls of the nasal cavity move laterally. Being attached to these walls, the concha retreat from the septum. The floor of the nose drops as the alveolar processes bend laterally and the free margins of the horizontal palatine processes move inferiorly. The total effect is an increase in intranasal capacity.

The mechanical widening of the nose makes nasal respiration a much easier function. In cases of nasal insufficiency this increased intranasal capacity can enable patients to respire freely, in some instances for the first time in their lives.

The defect created by opening the suture requires from sixty to ninety days to calcify completely. The suture is reformed and radiographically cannot be distinguished from an undisturbed suture. Figure 3 demonstrates complete healing of the defect and reformation of the median palatal suture after expansion to a space of eleven mm between the central incisors.

There are two distinct stages in palate expansion. They are the active adjustment of the screw and the passive retention to allow healing. These stages are mediated by stabilization of the

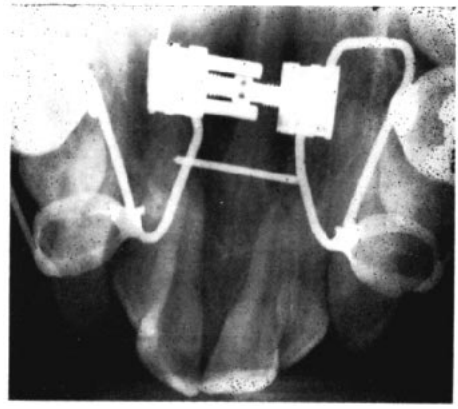

Fig. 3 Radiographs made after reformation of the suture.

appliance. The first stage ordinarily lasts from one to three weeks. Since growth is no factor, the cephalometric records taken before and after this first stage are very dramatic in showing maxillary changes as a result of treatment.

Models, photographs, and tracings of cephalometric headplates will be used to discuss the three cases to be presented.

Information sought in the cephalometric tracings will be concerned primarily with maxillary changes and their influence on the occlusion and the posture of the mandible.

Ricketts[37] suggested the pterygoid root plane (a plane tangent to the posterior margin of the pterygomaxillary fissure) as a base from which to make measurements in the maxilla. This plane is constructed tangent to the pterygomaxillary fissure, perpendicular to the Frankfort plane. Brodie[8,9] has shown that PTM fissure moves downward in a relatively straight line throughout growth. When opening the midpalatal suture, the change in the occlusion of the teeth usually results in an opening of the bite with associated disturbances in mandibular posture. Thus, measurements, whether they be

linear or angular, utilizing anterior facial planes are only suggestive of the maxillary changes.

Therefore, the relatively stable pterygoid root plane, which is a cranial plane, will be used as a basis for analyzing maxillary changes.

The first case is that of L. J., a female, age nine years seven months. The child has enjoyed apparently good physical development to date, and possesses a potential to continued good growth. Figure 4 shows frontal and lateral photographs and the patient's models.

The patient had a pseudo Class III malocclusion with the maxillary denture in a complete lingual crossbite to the mandibular denture. An arch length problem involving the eruption of the lateral incisors was present in the upper arch. Intraoral radiographs and the frontal headplate indicated the upper left lateral incisor was rotated approximately 70 to 90 degrees. Various cephalometric analyses indicated a good skeletal pattern to be present, as well as acceptably related denture bases and dental arches in the anteroposterior plane. However, these analyses do not deal with assessment of the pattern in width. While they do indicate good balance in the anteroposterior plane, these analyses fail to show that the basic problem in this case is a lack of correlation in the width of the maxillary and mandibular dental arches and denture bases. Further, the forces of occlusion lead to a lingual movement of the maxillary teeth, while mandibular buccal teeth upright. The result is a constriction of the maxillary dental arch and an overexpansion of the mandibular dental arch.

A series of three pretreatment lateral cephalometric headplates revealed that the tongue posture was habitually low. Thus, the tongue probably contributed to the discrepancy in arch width by encouraging mandibular arch development and failing to do the same for the maxillary arch.

The case was considered more of a relative maxillary deficiency than a real deficiency due to (1) the upright buccal segments and, (2) because these teeth could readily be moved distally and the central incisors moved forward to provide space for the blocked-out lateral incisors.

A maxillary split palate with expansion screw was secured to the first deciduous molars and first permanent molars. Twenty-five days later manipulation of the screw was discontinued; it had been opened 10 mm and the centrals separated 5 mm. The appliance was stabilized to prevent the screw from turning down during function.

Figure 5 depicts the change occurring in palatal width in the period of one hundred fifteen days allowed for reorganization of the suture. No other banding of teeth or treatment was given. A full acrylic palate is being worn in retention.

Models at this time reveal a bilateral Class I molar relationship and an acceptable buccal and anterior occlusion. Ample space is now available for the previously blocked-out upper lateral incisors and the upper left lateral incisor is now rotated about 10 degrees as opposed to its previous 70 to 90 degree rotation. No part of the appliance ever came in contact with teeth other than those in the buccal segments. As the central incisors were brought together by the pull of the transeptal fibers, space became available for the lateral incisors. The tension of these fibers may account in some part for the partial correction of the anterior rotations.

The buccal crossbite was corrected by the direct lateral movement of the maxillae. The anterior crossbite was corrected by the forward movement of the entire maxilla, a phenomenon that always seems to occur in palate

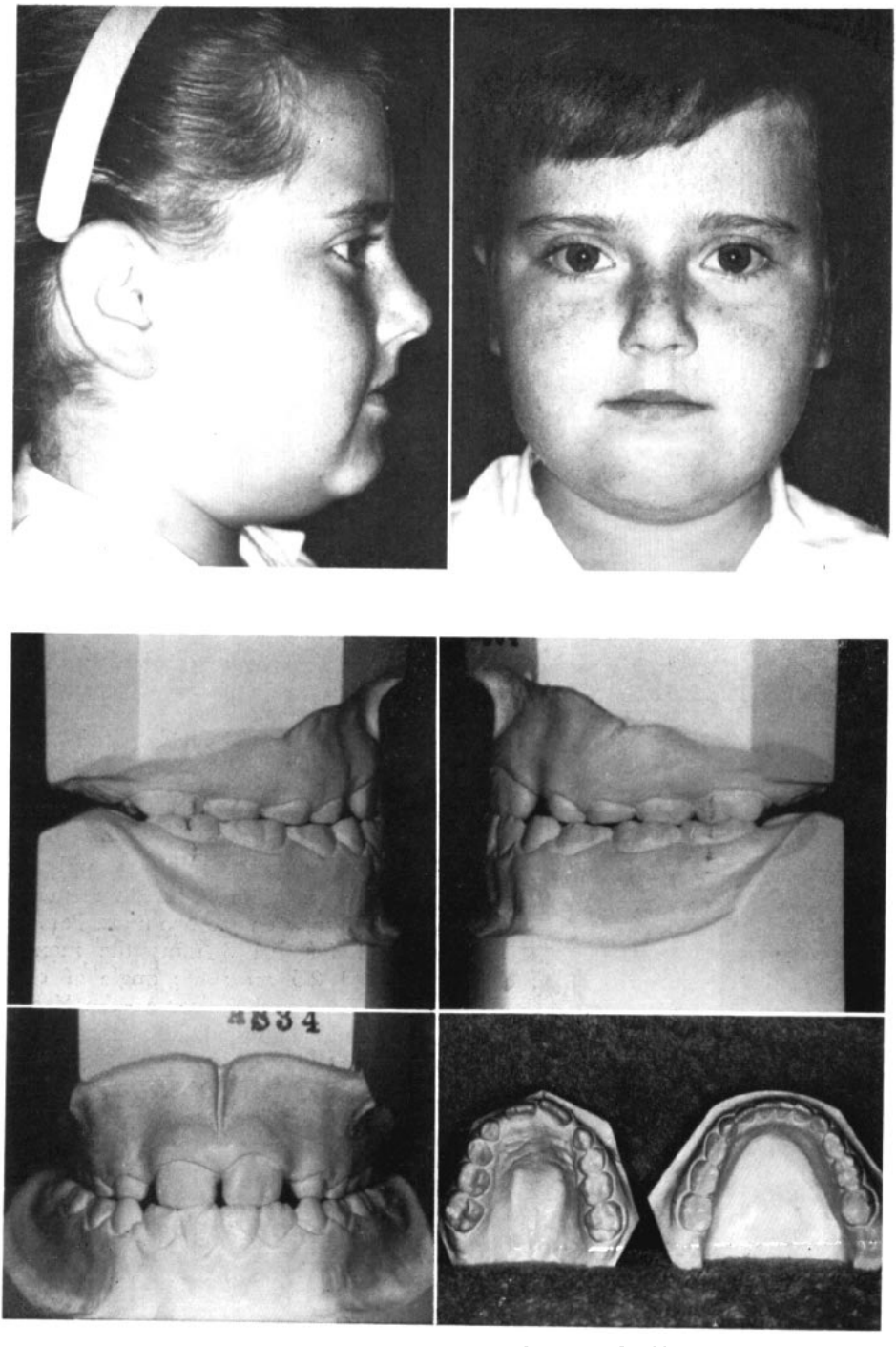

Fig. 4 Records of L. J., a 9 year old female with a pseudo Class III malocclusion.

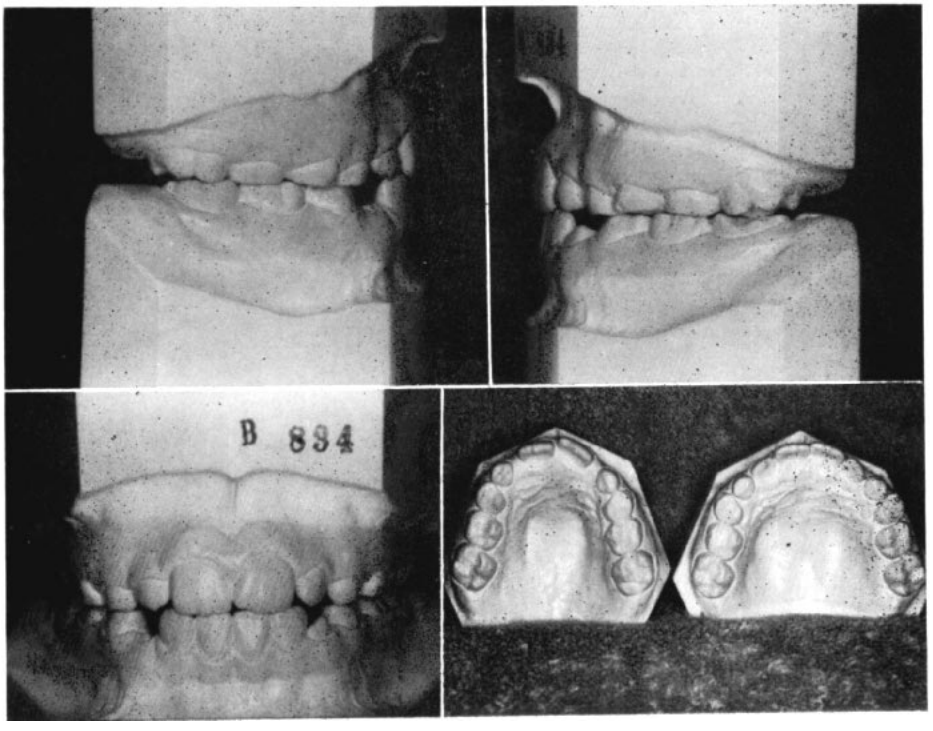

Fig. 5 Models of L. J. taken at the time the palatal appliance was removed. The central incisors which were separated 5 mm at stabilization have moved into contact.

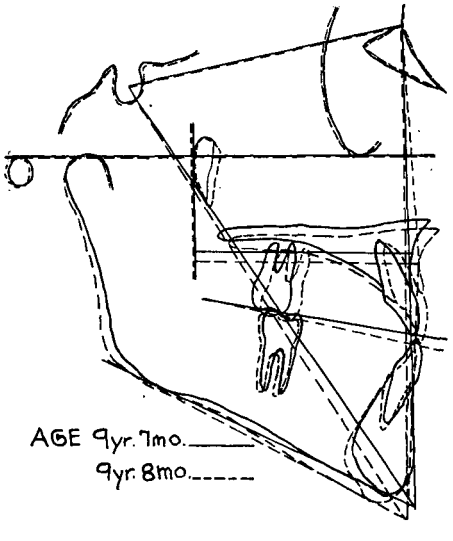

Fig. 6 Superimposed tracings of the patient at start of treatment and appliance stabilization.

expansion.

Figure 6 shows the tracings, superposed on SN at S, of headplates taken before treatment and at appliance stabilization. There was a three week interval between the two films. Point A moved forward 3 mm; the maxilla dropped 2.5 mm; the angle of convexity increased 6 degrees, the Y axis three, and the mandibular plane three; pogonion moved posteriorly 3 mm and the anterior root of PTM moved forward. It demonstrates the downward and forward movement of the maxilla. This is perhaps due to the disposition of the sutures and their anatomy. As Sicher[48] points out, the sutures between the maxilla and its important supporting bones are oriented in such a manner that growth at these sutures would result in a downward and forward movement of the maxilla. In the treatment,

as the maxillae are forced apart and these sutures begin to open, the force produces an effect similar to growth, so that the maxilla moves downward and forward. Most of these sutures are dentated. As they open and bones slide, these denticles which are up to 2 mm in length possibly bind in such a way as to hinder the return of the maxilla to its former position. The downward and forward movement of the maxilla causes certain obvious changes in occlusion such as opening the bite, the cant of the occlusal plane increasing as well as the mandibular plane angle.

The anterior migration of the maxilla in many instances corrects the anterior crossbite completely. If more anteroposterior correction is necessary, the loosened maxilla comes forward easily in response to the pull of vigorous Class III elastics.

Following removal of the split palate appliance, three lateral headplates disclosed another interesting finding; the previously low-positioned tongue had assumed normal posture. This may be due to the increased size of the palatal vault permitting the tongue to take a higher position, or the fact that the tongue has been trained to hold a loose fitting palatal retainer in place.

The case will be re-evaluated for a possible second phase of treatment during the eruption of the permanent dentition. The probability is excellent, however, that no further treatment will be necessary. If it is, it would certainly deal with minor problems.

This case, if permitted to remain untreated until the full dentition were erupted and then treated by orthodontic rather than orthopedic procedures, would be a formidable task and a case possibly requiring lifetime retention. Treated at this time by palate expansion, the resolution was relatively simple and the prognosis without prolonged retention very good.

The next case to be considered is that of J. W., a fourteen year, two month old male with a Class III malocclusion. His records before treatment are shown in Figure 7. The patient was well developed for his age and in good health except for a noticeable difficulty in nasal respiration.

His facial appearance was suggestive of mandibular prognathism. The denture pattern was unmistakably Class III. The skeletal pattern fortunately was less severe than the classic Class III pattern.

Three quarters of the maxillary dental arch was in lingual crossbite relationship to the mandibular dental arch; both arches were deficient in length. The maxilla bordered on being a real or relative deficiency.

The Downs, Ricketts, and Riedel analyses affirmed the moderate Class III skeletal pattern with relatively good prognosis for treatment if no mandibular growth spurt occurred in the future.

The denture bases with a minus 3.5 ANB angle were in a moderate Class III relationship and the lower denture was forward on its base, e.g., the lower central incisors were 5 mm anterior to the APo plane. They were also at a 20 degree inclination to the plane with crowding and inadequate arch length.

Treatment was planned to open the midpalatal suture to gain needed maxillary width. Then, by means of vigorous Class III elastics, bring the loosened maxilla forward while retracting lower anterior teeth, including cuspids, into the spaces provided by the removal of the two lower first bicuspids. Extraction in the upper arch was vetoed because the palate expansion would give necessary arch length, and it seemed desirable to develop this deficient maxillary arch as fully as possible.

Figure 8 shows the occlusal view of the before and after expansion models. There was a twelve day interval between the two.

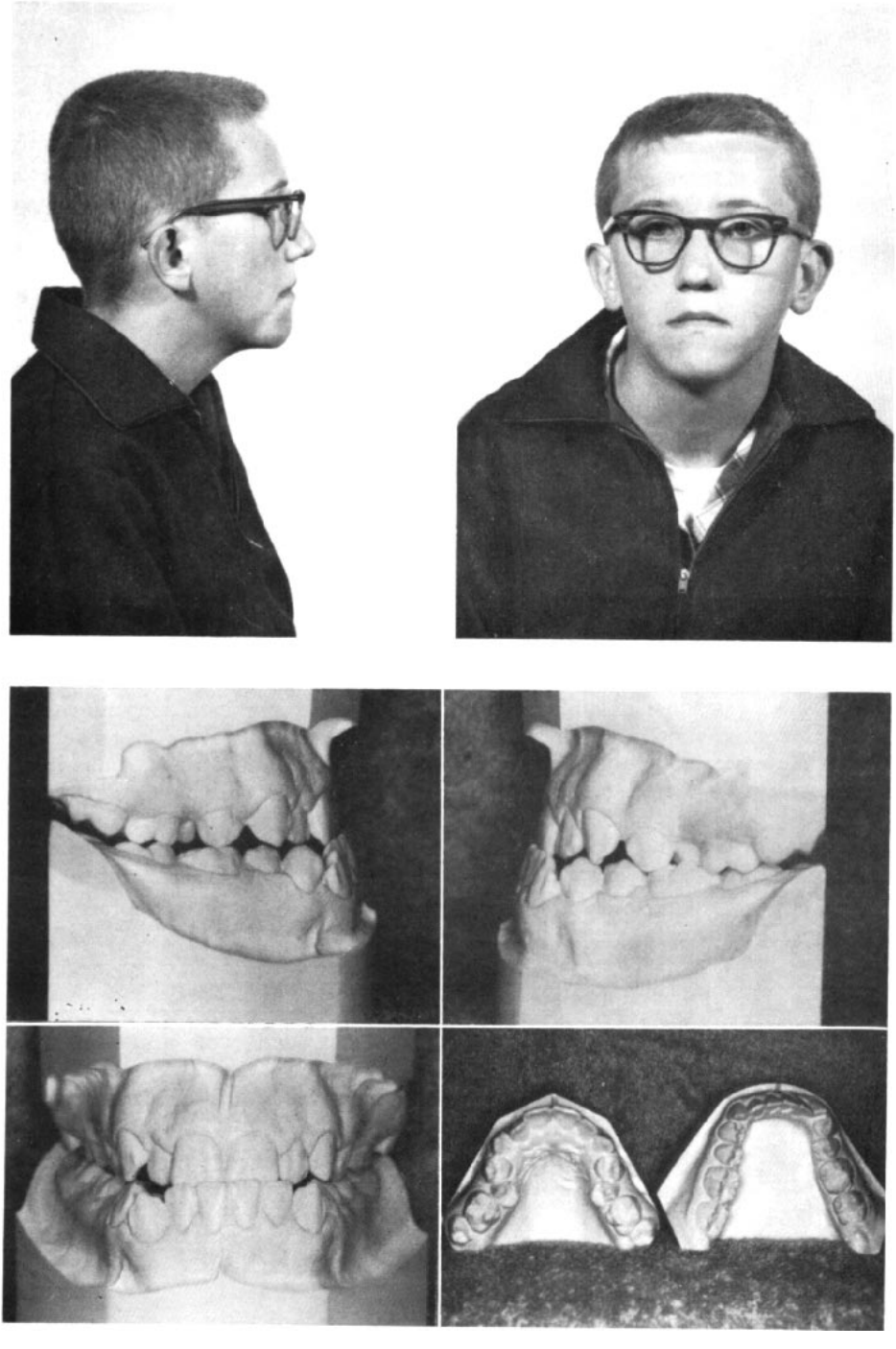

Fig. 7

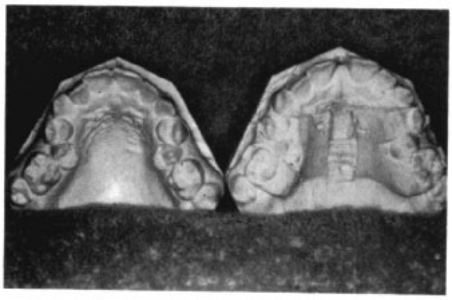

Fig. 8 Occlusal models made before palate expansion and at stabilization of the appliance 12 days later.

The screw was opened 7 mm and the diastema between the central incisor was 5 mm. The palate appliance was stabilized and allowed to remain as a retainer for 127 days. The bilateral buccal crossbite was over-corrected after the twelve days. The anterior crossbite became an end-to-end relationship as the maxilla characteristically moved forward.

Figure 9 demonstrates superimposed tracings of lateral headplates taken before treatment and at stabilization. The maxilla moved forward 2 mm as measured from the plane of the pterygoid root to point A. It also moved downward 2 mm. As a result of the forward positioning of the maxilla, the denture base relationship improved 2 degrees as measured by Riedel and 3.5 degrees as measured by Downs.

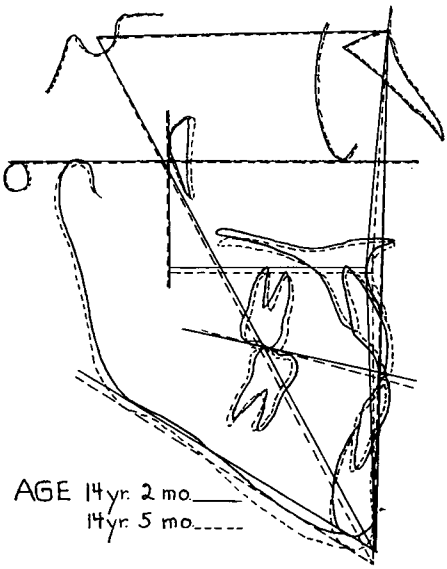

Fig. 9 Superimposed tracings of the patient at the start of treatment and at stabilization.

The change in the posture of the maxilla, coupled with the disturbance in occlusion, caused a temporary opening of the bite with corresponding increases in cant of occlusal plane and mandibular plane angle. The tracings indicate that the mandible was displaced posteriorly as well as being depressed anteriorly.

A subsequent headplate and tracing made at the removal of the palatal appliance indicated the posterior displacement of the mandible was temporary as it moved forward to its former position.

During the time the palatal appliance was worn as a retainer, the cuspids and incisors were retracted in the lower arch. After removal of the palatal appliance, an edgewise appliance was placed. Conventional treatment lasted twenty-four months. Records after treatment are seen in Figure 10.

The models do not have the typical appearance of a treated Class III case. Due to the forward displacement of the maxilla, it required less tipping of incisors to complete correction of the anterior crossbite. Therefore, the usual extreme lingual inclination of the lower incisors and labial inclination of the upper incisors was avoided. The occlusal view of the models demonstrates the change in maxillary width and development.

A finer buccal occlusion might have been achieved with four bicuspid extraction; however, this could have led to excessive flattening of the lips and lack of maxillary arch development.

Figure 11 shows the superimposed

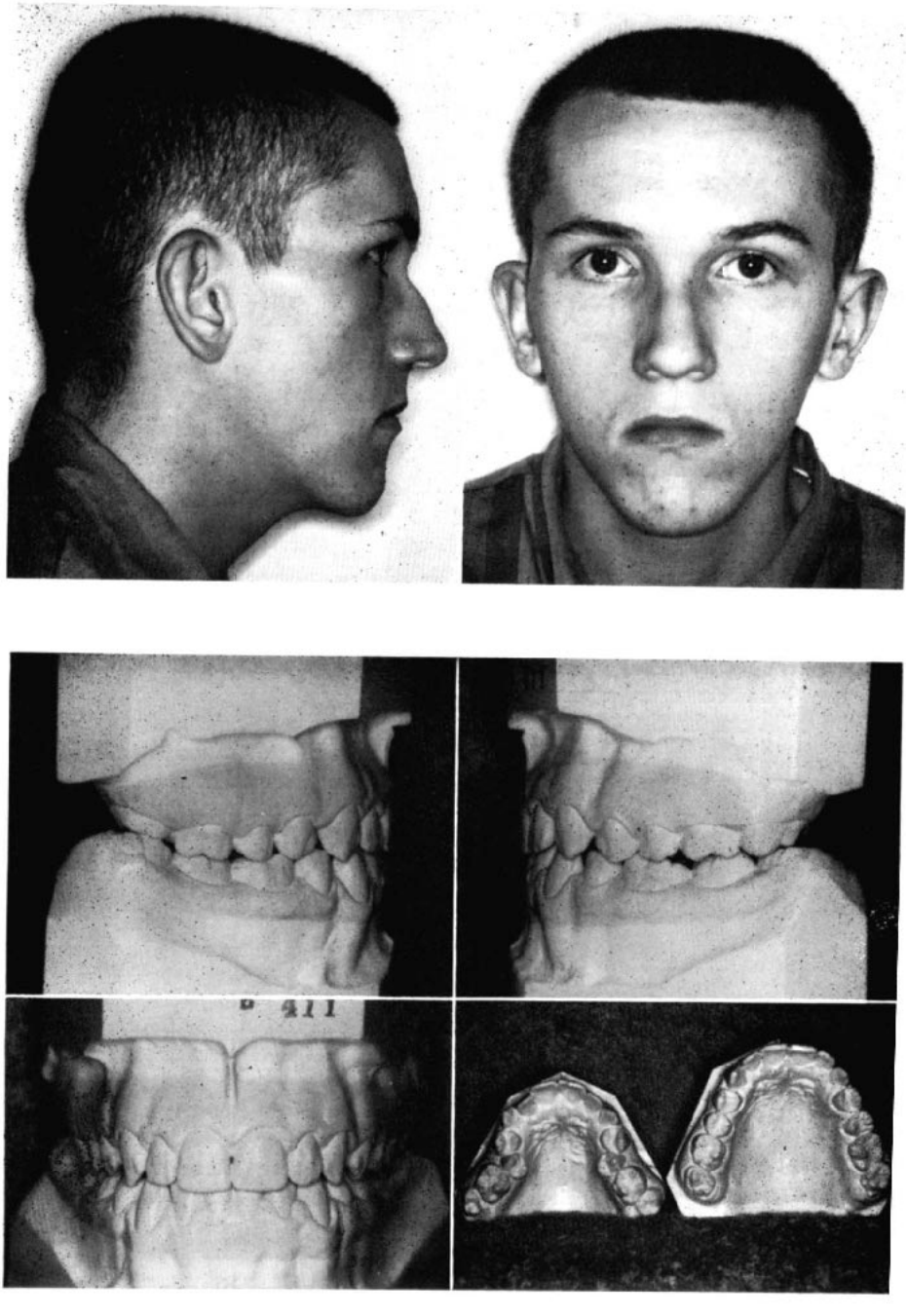

Fig. 10 Records taken within two weeks of band removal.

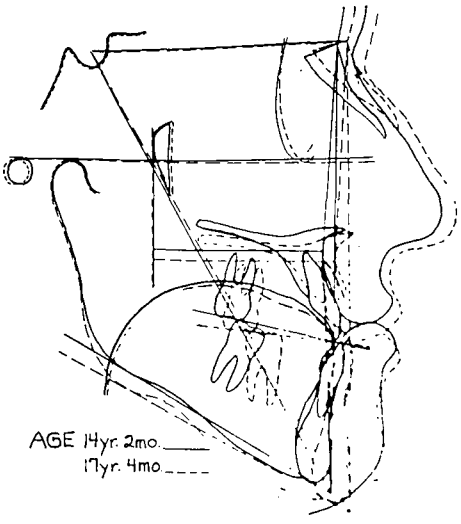

Fig. 11 Superimposed tracings of J. W. made prior to treatment and after 6 months of retention.

tracings of the headplates taken before treatment and six months after retention. It indicates that the bite opening caused during the palate expansion procedure was temporary. The occlusal plane and, perhaps, the entire maxilla were tipped downward in the back by the Class III elastic force.

The patient's tongue position remained at the level of the cervical region of the upper buccal teeth throughout the treatment and during early retention. Contrary to the findings in the first case, the treatment seemed to have no effect on tongue posture.

The parents have noted that the patient no longer mouth-breathes when awake, while the patient has often commented on the ease with which nasal respiration is now possible.

Figure 12 demonstrates the changes in nasal and maxillary widths over the period of treatment and six months' retention. The stability of these gains in maxillary apical base and nasal widths is apparent as the gained width has held for three years. Uprighting of the maxillary buccal teeth is shown by

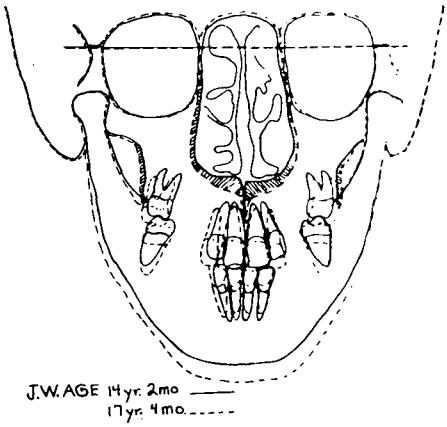

Fig. 12 Superimposed frontal tracings of J. W. The shaded areas indicate the increased size of the nasal cavity and maxilla.

the change in axial inclination of the second molars.

In over eighty cases treated to date by the author, the forward displacement of the maxilla has been of great interest. Class II or convex skeletal patterns are seemingly made worse by this phenomenon while conversely Class III or concave skeletal patterns are improved. Much change in the relationship of the maxilla and mandible has been noted during the expansion procedure and the succeeding healing period. Lateral cephalometric tracings used to analyze the anteroposterior movement of these bones have shown the maxilla to always move forward if midpalatal suture opening occurs. In Class II cases it tends to recover and move posteriorly again. In Class III and pseudo Class III cases the maxilla tends to stay forward. This is probably in response to the altered forces of occlusion since the anterior crossbite is wholly or partially corrected.

The mandible remains stable or moves either forward or backward during palate expansion and then remains stable or recovers its former posture partially or completely.

The final case, A. R., is that of a

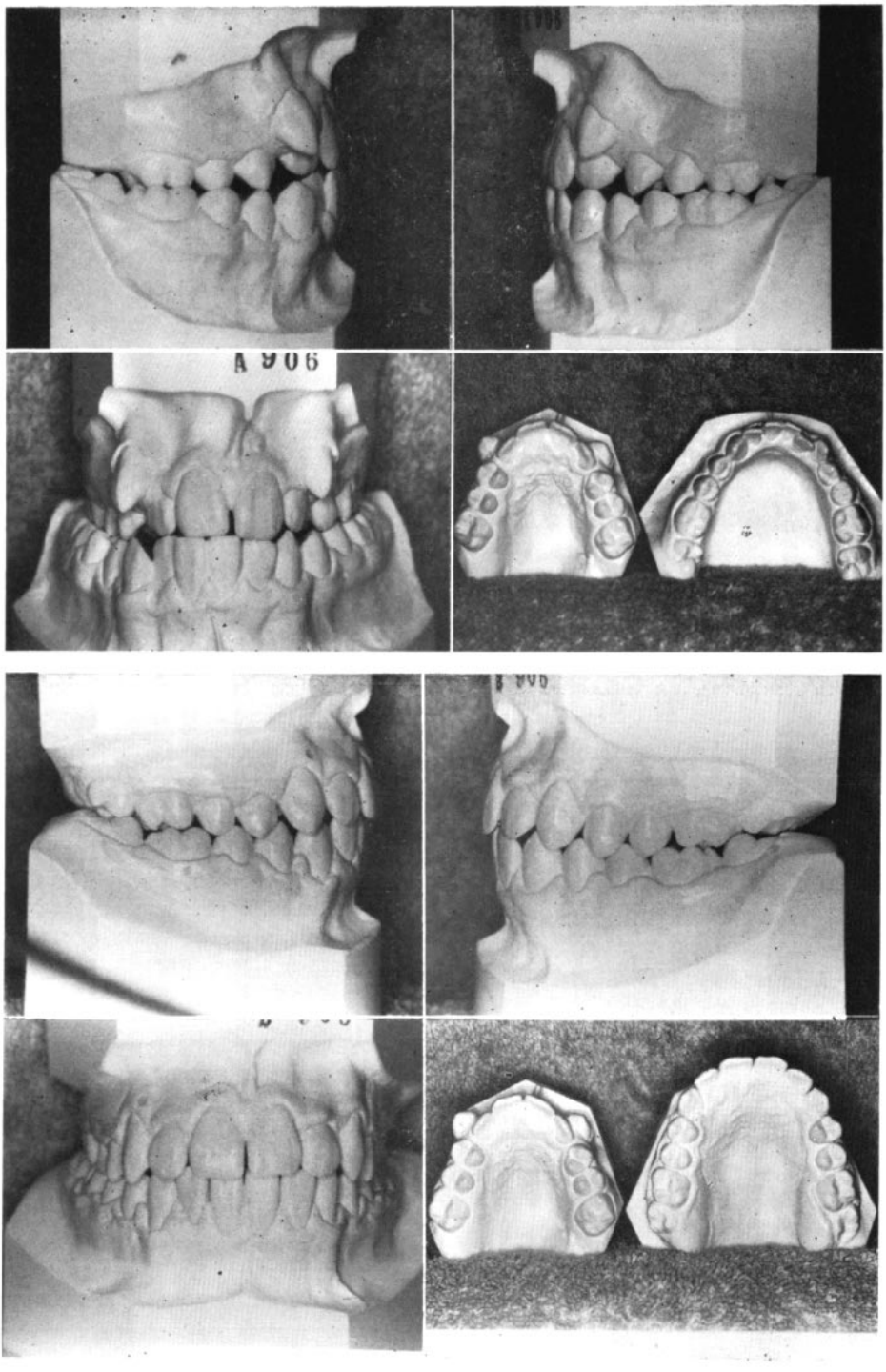

Fig. 13 Models of patient A. R.

fourteen year, one month old male characterized by a severe maxillary deficiency. The patient had a fair skeletal pattern according to the anteroposterior analyses. The denture bases were well related; however, the maxillary denture base lacked development, particularly in width.

Figure 13 shows the before and after treatment models. The malocclusion was a Class I with high labial, completely blocked-out upper cuspids and a bilateral crossbite. The buccal occlusion was extremely inadequate and incisors met in an end to end bite. A 4 mm midline discrepancy and a more severe crossbite on the right side suggested a lateral mandibular displacement to that side.

The patient had extensive surgery two years previous to orthodontic treatment for a detached retina. No trauma to the head could be tolerated. Therefore, great care was taken throughout treatment. A consultation concerning the treatment plan and procedures of treatment was held with the patient's attending opthalmologist.

This case was considered a real maxillary deficiency since the entire maxilla was undeveloped in relation to the mandible, particularly in the correlation of width of the two bones. The dentures, of course, reflected this relationship.

Maximum opening of the midpalatal suture was planned to give as much maxillary arch width and length as possible. The right to remove four first bicuspids was reserved depending on how much new arch length would be achieved by opening the midpalatal suture.

Figure 14 demonstrates the occlusal views of models at the start of the treatment and nineteen days later after suture opening. The screw was extended 9 mm. The diastema between the central incisors was 4 mm. The difference between these two values is apparently

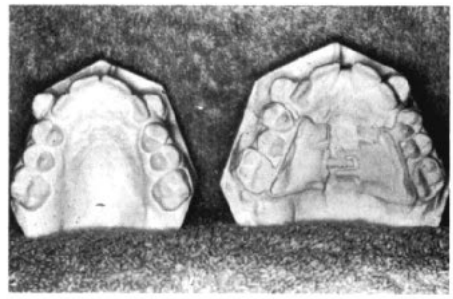

Fig. 14 Occlusal models made before and after palate expansion ten days later.

due to the two phenomena noted earlier; namely, the bending of the alveolar processes and the rapid mesial movement of the central incisors through the action of decussating transeptal fibers. This mesial movement of the central incisors seemingly starts with the first turn of the palatal screw. The palatal appliance was stabilized and used in retention for ninety-three days.

The superimposed tracings of the before and postpalatal expansion tracings revealed the maxilla was rotated about ANS, that is, PNS dropped posteriorly and the tip of the upper incisor and Pt. A moved forward and upward slightly. This, of course, also resulted in the occlusal plane being tipped down in back. The pterygoid root remained stable, while the anterior margin moved forward slightly with the rotation of the maxilla.

The entire mandible was translated forward and downward along the Y axis. This action is likely due to alterations in the forces of occlusion and neuromuscular patterns. The mandibular plane became more obtuse while the "Y" axis opened. The condyle was displaced forward. The bite was opened about 2 mm.

Tracings of headplates made at stabilization of the palatal appliance and its removal three months later demonstrated that both the maxilla and mandible moved posteriorly about the

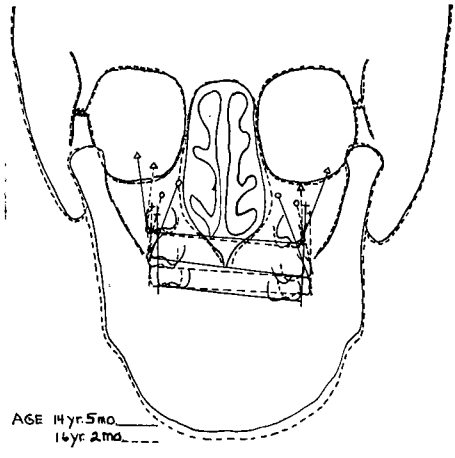

Fig. 15 Superimposed tracings of frontal headplates made before and after all active treatment.

same amount they were displaced forward by the expansion technique.

After opening the midpalatal suture, the maxillary arch length was critical to the extent of one cuspid being blocked out. Since this much space can readily be gained with good patient cooperation and heavy extraoral cervical force, it was decided to treat the remaining malocclusion conservatively. Full edgewise appliances with Kloehn type cervical bow were employed for a period of twenty-two months. The finished models are illustrated in Figure 13. Impressions for the model were taken at the time the appliances were removed. The maxillary buccal teeth are upright over supporting bone and settling into an acceptable Class I occlusion.

Figure 15 is the superimposed tracing of frontal headplates made at the start of treatment and at retention. The first molars have maintained virtually the same long axes they possessed at the start of treatment. The second molars are more upright following treatment. The behavior of the unerupted third molars is of interest. These teeth had a decided lingual inclination at age fourteen years and, though still unerupted, a definite buccal inclination at age sixteen years.

Had the maxillary teeth been advanced and expanded into occlusion with mandibular teeth by conventional means, a procedure necessary even with removal of bicuspids, they would necessarily be markedly tipped to the buccal. It would have been virtually impossible to gain the axial inclination demonstrated in the finished models without risk of moving roots through the labial plate. Indeed, the suggestion has often been made in regard to maxillary deficiency cases that the buccal crossbites be left uncorrected as relapse to this relationship is inevitable.

The tracings of the lateral headplates made before and after treatment (Figure 16) indicate that the bite opening caused by the expansion procedure was only temporary. It also appears that upper and lower first molars were held in space while the jaws and face grew forward about 3 mm at nasion and 2 mm at Pt. A, Pt. B and pogonion. The pretreatment low tongue position has apparently maintained itself in spite

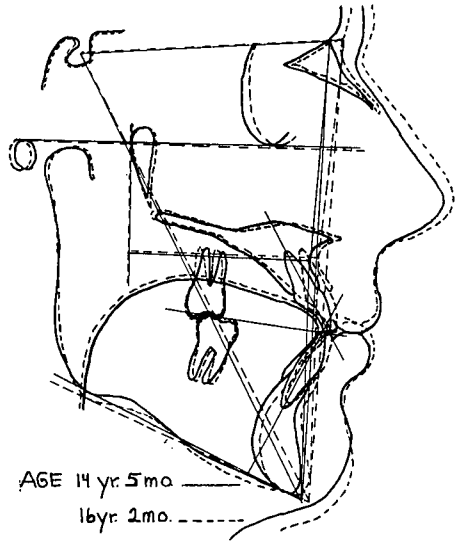

Fig. 16 Superimposed tracings of lateral headplates made before and after active treatment.

of the marked increase in maxillary width.

The principle of light continuous force for rapid tooth movement appears to be well established. But to use light forces with appliances having orthopedic potential such as the Kloehn-type face bow with cervical traction and the fixed split acrylic palate with expansion screw fails to take full advantage of the potential of these appliances. Since it is difficult to distinguish between growth and treatment changes, no positive proof for posterior movement of the entire maxilla using heavy cervical force has been presented to date. However, Moore[34] suggests, and Ricketts[38] is explicit, that orthopedic reduction of the maxilla occurs with cervical traction force measured in pounds rather than ounces. The unyielding force delivered by an expansion screw in a fixed appliance must also be calculated in pounds.

The magnitude of the force would seem to operate against the use of removable split appliances regardless of the method of clasping to the teeth.

The anatomic palate is usually V-shaped in cases with need for suture opening; thus, as the acrylic masses of the split palatal appliance move laterally, the inclined planes of the palatal vault would operate to force the appliance occlusally.

Using a removable appliance would thus generate a displacing force long before sufficient force has been built up to cause the maxillae to separate. Conversely, when the appliance is fixed to the teeth, the force required to move teeth occlusally is greater than the force needed to cause the palate to split. The teeth prevent displacement of the appliance and along with the palatal and alveolar bone they bear a horizontal force from the appliance. This force is directly related to the spreading of the maxillae.

In order to widen the maxillary dental arch with a removable split palate appliance, the screw is opened gradually to prevent appliance displacement. This necessarily leads to a lateral tipping of the buccal teeth with the accompanying remodeling of alveolar bone.

The study[19] of an unyielding lateral force delivered to the teeth and alveolar bone of pigs showed that the alveolar process bent and the palatal shelves dropped occlusally. The dropping of the palatal shelves could account in part for the straightening of a deviated nasal septum of which Korkhaus[28] speaks and demonstrates radiographically.

The fact that the opening of the suture requires from one to three weeks depending on the amount of opening desired precludes the possibility of much tooth movement. Whereas, if the procedure were to take many months or even years, then most of the gain in width would necessarily be due to the expansion of the dental arch by the lateral movement of the teeth.

Before attempting to split the hard palate, certain precautions are necessary. The clinician should be thoroughly familiar with the anatomy and physiology of the structures and systems his treatment is affecting.

Great attention should be given to appliance construction, particularly in beveling edges and rounding corners of the acrylic parts that will bear against palatal tissue.

Theoretically, the midpalatal suture can be opened as long as it remains patent. Hrdlicka[22] has demonstrated patency of the suture at age fifty in the Eskimo.

In the eighty cases previously mentioned, eight were over twenty years of age. The suture apparently failed to open in two cases, ages seventeen and nineteen respectively.

Both patients were males. They began experiencing pain after approximately one week of appliance adjust-

ment. There was no sign of a diastema at the central incisors. In both cases the screw was turned down until there was a remission of the pain. After a week's rest, the screw was expanded very slowly over a four month period of time to get alveolar remodeling and lateral tooth movement.

The procedure is pain free except for momentary pressure experienced when the screw is extended. Consequently, pain is pathognomonic of tissue irritation caused by careless appliance construction or failure of the suture to open.

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