Long-Term Posttreatment Evaluation of Rapid Palatal Expansion

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There has never been a question as to how the task of writing this paper was to be accomplished as the author has always taken a critical view of the common practice of some clinicians who write on a subject for a quarter of a century or longer and are constantly illustrating their material with new faces and cases. Since the only indisputable yardstick for measuring success in orthodontic treatment is the appearance and stability of the case a substantial time out of all retention, one can only suspect that the authors' reluctance to redemonstrate and update previously-used material is because the fine examples of the past years have eroded and tarnished to a degree that they would detract significantly from or even destroy his presentation and perhaps indict, or lend strong argument against, his original contentions.

In view of this author's obvious prejudices in this matter the only course in writing this paper would be to include previously published cases, preferably all of them.

Of the author's seven published articles on the subject of palatal expansion, four of them contained treated cases. Two of the publications came after 1970, therefore the cases presented do not qualify for long-term evaluation as some are still in retention. In articles published in 1961,[1] 1965,[2] and 1970,[3] a total of six cases of palatal expansion without subsequent mandibular surgery was presented. Recent records of these six cases will be shown in this paper to enable the reader to evaluate the effectiveness of the technique.

In addition to the above six, extensive use has been made of four additional cases in the past 20 years when I have been discussing the subject of dentofacial orthopedics. Recent records of these four cases will also be offered for perusal and evaluation. The ten cases have been from 6 to 14 years without upper retainers and from 4.5 to 12 years without lower fixed lingual retainers.

Throughout the paper the reader will have the opportunity to evaluate long-term orthopedic stability in both anteroposterior and vertical dimensions. Further, one will be able to evaluate the stability of dental overbite correction, made by impeding eruption of or by depressing incisors, rather than the common practice of erupting posterior teeth. Finally, and perhaps most importantly, there will be ample opportunity to judge the effect of long-term fixed lower retention.

In several thousand cases put into retention, I have rarely, if ever, removed a lower fixed lingual retainer in less than six years, with the usual lower retention time being approximately six to eight years, the rationale being that, if cellularly speaking man is a new body every seven years, all those taut Sharpey's fibers should now be comfortably relaxed. Third molars should have erupted, be poised for good eruption or have been removed. Probably most significant, ramal growth should have ceased. In addition, incisors should have achieved a homeostasis with alveolar and perio-

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dontal structures, forces of occlusion, and existing muscular forces.

The ten cases have been evaluated for stability of the orthopedic correction and of the orthodontic correction. With regard to the former the following questions were asked:

1. Was gained apical base dimension stable?
2. Was increased nasal cavity width stable?
3. Were anteroposterior and vertical corrections stable?

And with regard to the latter:

1. Were the three dimensional changes in denture correction stable?
2. And, somewhat subjectively, could similar results have been achieved without rapid palatal expansion?

Unquestionably, the salient factor in treatment planning is an accurate diagnosis. Analyses that are denture oriented are not appropriate in present-day diagnosis. Just as a good clinician assesses denture characteristics in all three planes of space, so must one examine skeletal patterns in three planes of space; frequently influence in another plane is also indicated, while many cases will require correction in all three planes.

An anteroposterior skeletal abnormality may require inhibition or expansion of the maxillary growth potential. Both are readily accomplished in the growing child. If the anteroposterior dysplasia exists in the mandible, modification is far more difficult. A mandible that is grossly deficient or overdeveloped is manageable only with surgery. However, if the circumstances of overdevelopment are moderate, it is frequently possible to lessen the effective mandibular length by producing a negative downward and backward rotation of the mandible.

Skeletal anomalies in the vertical plane are characterized by the heavy muscled hyperdivergent or deepbite case and the poorly muscled hypodivergent or openbite case. The former is benefited by employing palatal expansion to loosen the maxilla and then torquing the loose maxilla down in back, concomitantly causing the mandible to rotate downward and backward thus achieving the desired skeletal bite opening.

In the skeletal openbite case it is not always necessary to do palatal expansion. Likewise, skeletal openbite is no contraindication to palatal expansion, since the additional skeletal bite opening induced by the technique can be resisted by the application of a vertical pull chin cup following suture opening. With continued wear of the chin cup the vertical condition existing before palatal expansion can be greatly improved.

If the skeletal discrepancy is in the transverse dimension of the jaws and denture bases, the most obvious orthopedic solution is found in the rapid palatal expansion procedure. Regardless of the specific findings of the diagnostic processes, a definitive remedial measure must be applied to correct each of the dysplastic factors, skeletal as well as dental.

In dentofacial orthopedics the width factor seems to be the most important, since with facial growth the width dimension changes the least; it also stops growing the earliest. Before the advent of rapid palatal expansion these conditions placed some impossible demands on the clinician. Dealing with the width dimension is a necessary prerequisite to other orthopedic influences, for example, protracting the loosened maxilla to increase maxillary convexity and tipping the partial disarticulated maxilla to increase the vertical dimension. Finally, it is possible to ignore the skeletal anteroposterior and vertical dimensions and still ob-

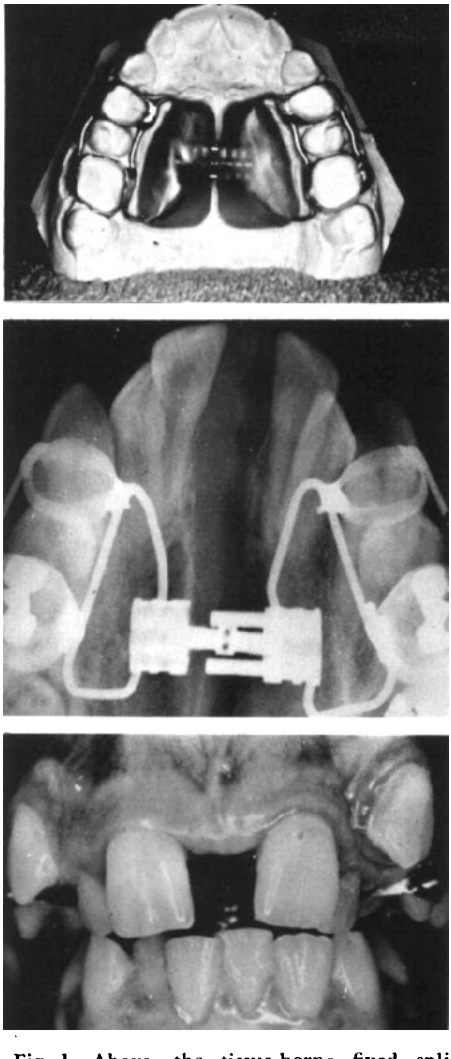

Fig. 1 Above, the tissue-borne fixed split acrylic maxillary palatal expansion appliance. Center, occlusal radiograph of a successful suture opening. Note the opening is essentially parallel anteroposteriorly. Below, this intraoral photograph shows an 11.5 mm void between the central incisors. The photograph was taken the day the palatal appliance was stabilized.

tain a satisfactory and stable dental occlusion, albeit a poor skeletal result. However, to attempt to correct a skeletal deficiency in the transverse dimension by merely moving teeth is invariably doomed to certain relapse. It is for all these reasons that I consider the width dimension to be the most significant.

The palatal expansion appliance and technique was used on all cases initially. Some had additional orthopedic appliances for continued orthopedic influence in other planes of space following suture opening. In Figure 1 is seen the rapid palatal expansion appliance used in the treatment of the ten cases to be detailed and the effects of this appliance. Note the essentially parallel opening of the midpalatal suture and how upright the buccal segments are when a maximum anchorage appliance is utilized.

The vertical pull chin cup (Fig. 2) is used on the skeletal openbite case whether or not palatal expansion is employed. Note the beautiful control over the vertical dimension in this case. Notice the closing of the Y axis and flattening of the mandibular plane (Fig. 2—below).

Figure 3 depicts the appliance system used to increase the vertical dimension. Class III elastics with two to three pounds of force per side tip the loosened maxilla down in back to get negative mandibular rotation and thus increase lower face height and lessen effective mandibular length. Consider the favorable effect this has on the deepbite Class III case demonstrated in Figure 3—below.

Pictured in Figure 4 is the protraction chin cup, a device used to protract the loosened maxilla in as nearly a horizontal fashion as possible to increase midface convexity. As seen in the tracing in Figure 3—below, the maxilla protracted 3 mm in three months. The profile change in Figure 4—below is due mostly to the three months of protraction. The elastic force to each side should be in the two to three pound range.

To lessen the anteroposterior position of the maxilla following rapid palatal expansion, Kloehn cervical

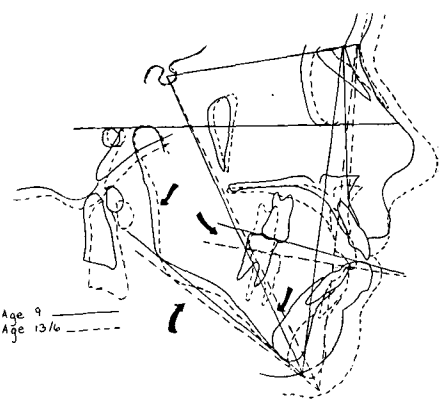

Fig. 2 Above, the vertical pull chin cup. This device is capable of exerting up to six pounds of force per side. As such it is capable of causing depression of upper and lower buccal teeth. A force of this magnitude can prevent the descent of the maxilla. It is further possible to move the maxilla upward and forward and finally mandibular directional growth can be altered.

Below, before and after tracings of a skeletal hypodivergent type. With prolonged application of a vertical pull chin cup and a high force Kloehn cervical gear the vertical and anteroposterior skeletal relationship improved. The mandibular plane and Y axis closed, the occlusal plane flattened and a change in mandibular morphology is obvious.

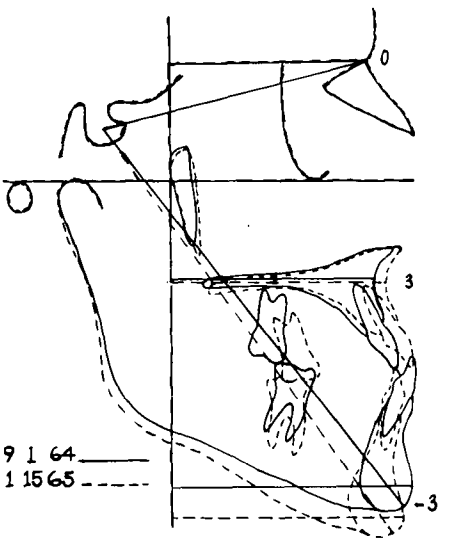

Fig. 3 Vigorous Class III elastics are worn to tip the loosened maxilla immediately following stabilization of the palatal expansion appliance.

The tracings represent the effect produced on a Class III skeletal pattern subjected to heavy intraoral Class III elastics and intra-extraoral horizontal protraction elastics worn to a protraction chin cup. These changes were produced in three months time. Facial height was increased by 5 mm and convexity was changed by 6 mm as a result of the maxilla moving forward 3 mm and the 3 mm negative mandibular rotation.

gear is the appliance of choice. The maxilla has been unitized by the expansion appliance and can thus be moved backward and downward as a unit. If the vertical dimension of the patient will not tolerate the downward movement of the maxilla, then a vertical pull chin cup is added to control the vertical dimension (Fig. 5).

The author recognizes six indications for rapid palatal expansion:

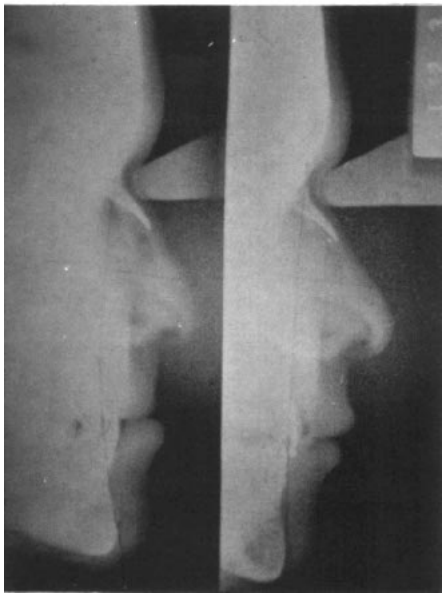

Fig. 4 The protraction chin cup, a device which gains anchorage from the chin to protract the loosened maxilla in a relatively horizontal fashion.

Profile changes of this magnitude are frequently achieved with palatal expansion. However if they are to be maintained it is necessary to continue a protracting force to the unitized maxilla while the hafting sutures reorganize. In the absence of a protraction force the displaced maxilla tends to return to the pretreatment anteroposterior position.

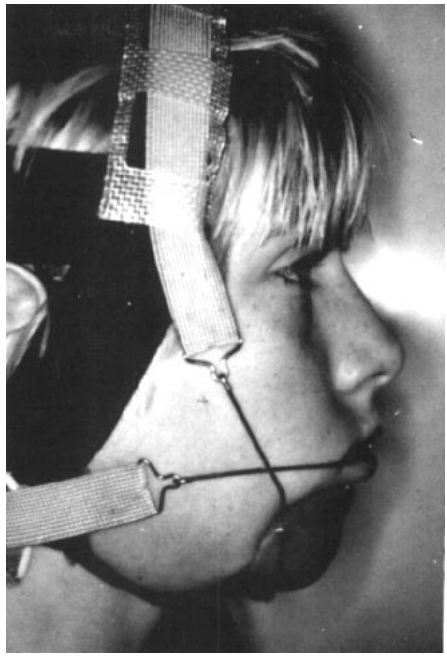

Fig. 5

1. Cases of real and relative maxillary deficiency—A real deficiency is characterized by compression of the maxilla, when compared with the rest of the facial bones and the mandible; the maxilla is definitely undersized. A relative deficiency exists when the maxilla appears to be of normal size when compared with adjacent craniofacial bones but the mandible is mildly or even moderately oversized.

2. Cases of nasal stenosis—They are usually characterized by full-time mouth breathing and a constricted nasal aperture with the conchae literally compressed against the septum.

3. All types of Class III cases—These would include, of course, the pseudo Class III, the dental Class III, and the surgical Class III. Consider, that in approximately three weeks time the buccal crossbite is corrected in virtually all types of Class III and the anterior crossbite is improved. Thus the denture base relationship is greatly improved.

4. The mature cleft palate patient—The procedure is not of particular advantage in the young cleft palate case since it is very easy to expand the lateral masses by less complex methods.

5. Anteroposterior maxillary deficiency cases—These are cases with negative ANB angles, a negative point A to facial plane, or negative Wit analysis which could benefit from maxillary protraction. A prerequisite to such activity would be rapid palatal expansion to loosen the maxilla to facilitate protraction.

6. Selected arch length problems in a mature good morphogenetic skeletal pattern—Given 14.5 to 16 year old patients with fine skeletal patterns there is usually considerable difficulty encountered with extraction of first or even second premolars as the profile is invariably flattened.

In both the 1961 and 1965 publications, studies of the author and others[4,5,6] demonstrated total stability of the increased nasal cavity and apical base width.

In the ten cases in this present study the average increase in apical base width was 9 mm and nasal cavity width 4.5 mm. All cases were without upper retention for 6 to 14 years when recently examined. None of the patients lost any of the nasal cavity or apical base width attained during the palatal expansion procedure. Two cases showed a slight decrease in maxillary dental arch width while two showed a slight increase in maxillary dental arch width following retention. The remaining six cases showed no demonstrable difference in the width of the maxillary dental arch at retention and in recent postretention records.

To control the number of illustrations and not reproduce previously published material, for the most part only photographs of the models will be presented for the six previously-published cases. The reader is referred to prior publications for comprehensive records.

Case 1860 has been used as a teaching case for 13 years and when published in 1970[3] was still in retention. This Class III case had a deficiency in skeletal width, height, and anteroposterior relationships of the jaws and denture bases. Therefore, palatal expansion would be needed to correct the width deficiency factor. The maxilla thus loosened could be protracted to alleviate the anteroposterior variant. Tipping the maxilla down posteriorly would cause negative mandibular rotation and thus increase the vertical.

Tracings in Figure 6—above of before and after palatal expansion on this 9.5 year old male demonstrate a 2.5 mm downward and a 3.5 mm forward movement of the maxilla with increased lower face height and less effective mandibular length due to the negative mandibular rotation as pogonion went back 3.5 mm. For this case all these factors were very good. They contributed to the profile change which was characterized by a mild Class III profile changing to an ideal Class I profile. To keep the maxilla forward it is necessary to protract it for a period of approximately six months while maxillocranial sutures reorganize. If effective midpalatal suture opening is achieved, the maxilla will also be displaced downward and forward with an effect that can literally be considered immediate growth as the other maxillocranial sutures disengage. As these unstable articulations begin to reorganize, the pull of the viscera, muscles, connective tissue, etc. would cause the maxilla to move up and backward again toward its original anteroposterior and vertical position. Therefore, if the maxillary displacement is desir-

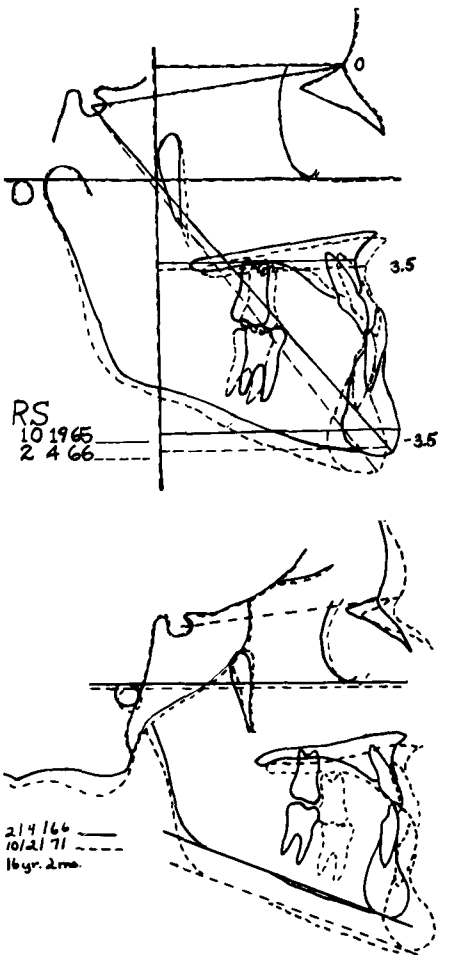

Fig. 6 Above, tracings showing the effect of an 18 day rapid palatal expansion procedure on a 9.5 year old male. Below, tracings showing the skeletal bite opening effect appears to be quite stable 5.5 years later.

able, one must protract during this period of suture reorganization to insure permanency of the new maxillary position. The appliance of choice to accomplish this is the protraction chin cup seen in Figure 4. In cases where ideal suture disarticulation occurs, one can readily see and measure from headplates an increase in the width of the pterygomaxillary fissure. Another finding of significance was the reaffirmation of the apparent fact that the skeletal deepbite Class III type has an excessive freeway space and will thus tolerate the skeletal bite opening.

The tracings in Figure 6 demonstrate this clearly. Observe the skeletal bite opening. In Figure 6—below note that 5.5 years later the skeletal bite opening has held as it will in the Class III type, not so however, in Class I and Class II. Note further how this moderate skeletal Class III, when treated to a skeletal Class I, continued to grow as Class I. This is not necessarily always true for Class III. However, when the Class II skeletal pattern is changed to a Class I, it will always remain as such.

One can appreciate the excellent change in skeletal pattern in the Class III case. The face is better due to increased midface convexity, increased lower face height, and lessened effective mandibular length.

Figure 7 shows the models of the case before treatment and recent models at age 22. They were made eight years after removal of the upper retainer and five years off the lower fixed lingual. A comparison of the upper dental arches shows that they have maintained their correction. Figure 7H—gives the comparison between the retention model and the eight years out of retention model. Measuring across paired teeth showed there was absolutely no change in dimension.

Case 834 was a 9.5 year old female with a relative maxillary deficiency and a pseudo Class III malocclusion. The case was published in 1965.[2] In one month, as a result of rapid palatal expansion, the anterior crossbite and buccal crossbite were corrected. The maxilla moved downward 2.5 mm and forward 2 mm with expected concomitant negative mandibular rotation. Because of the relatively ideal lower arch, this was the only treat-

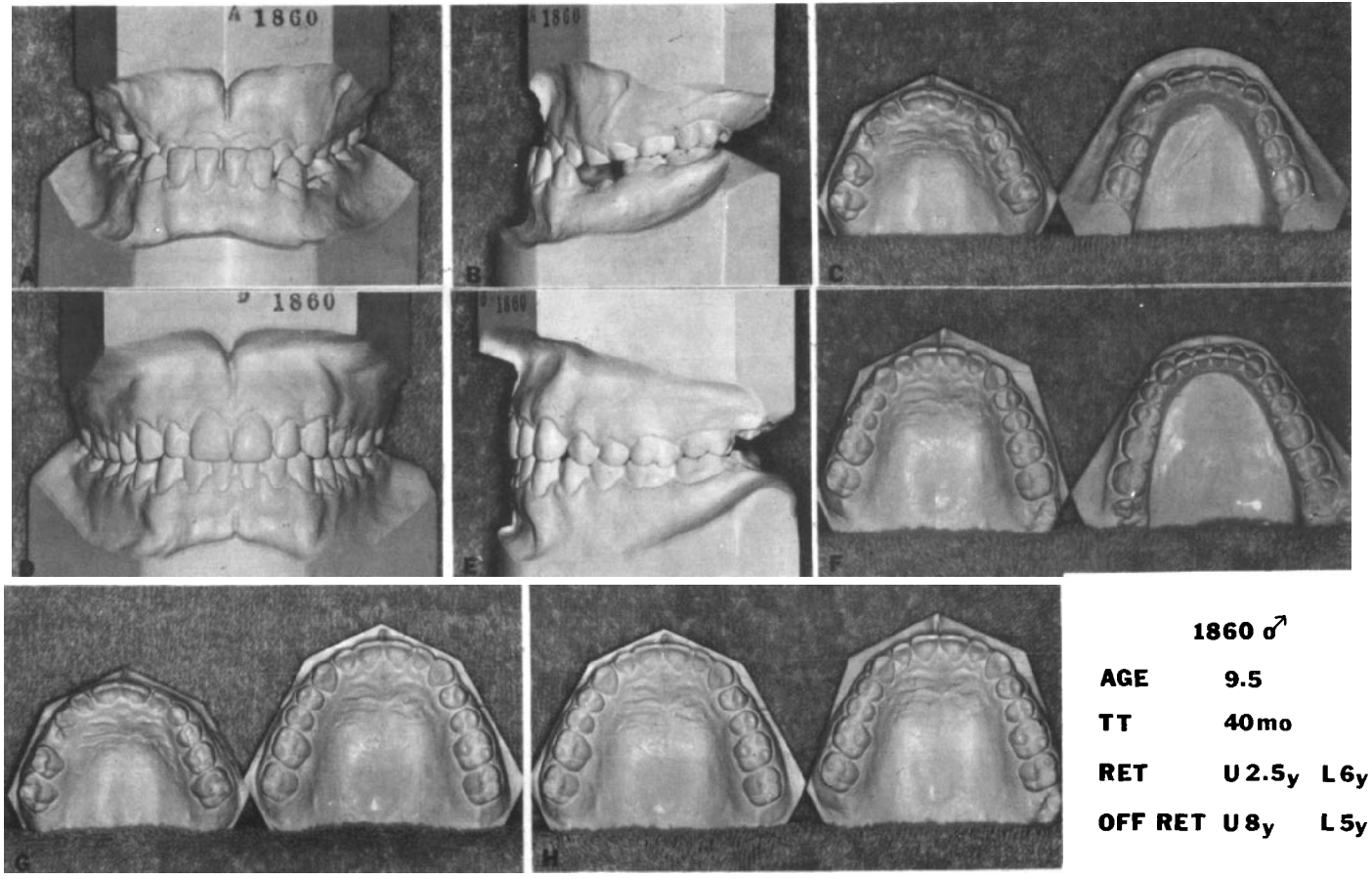

Fig. 7

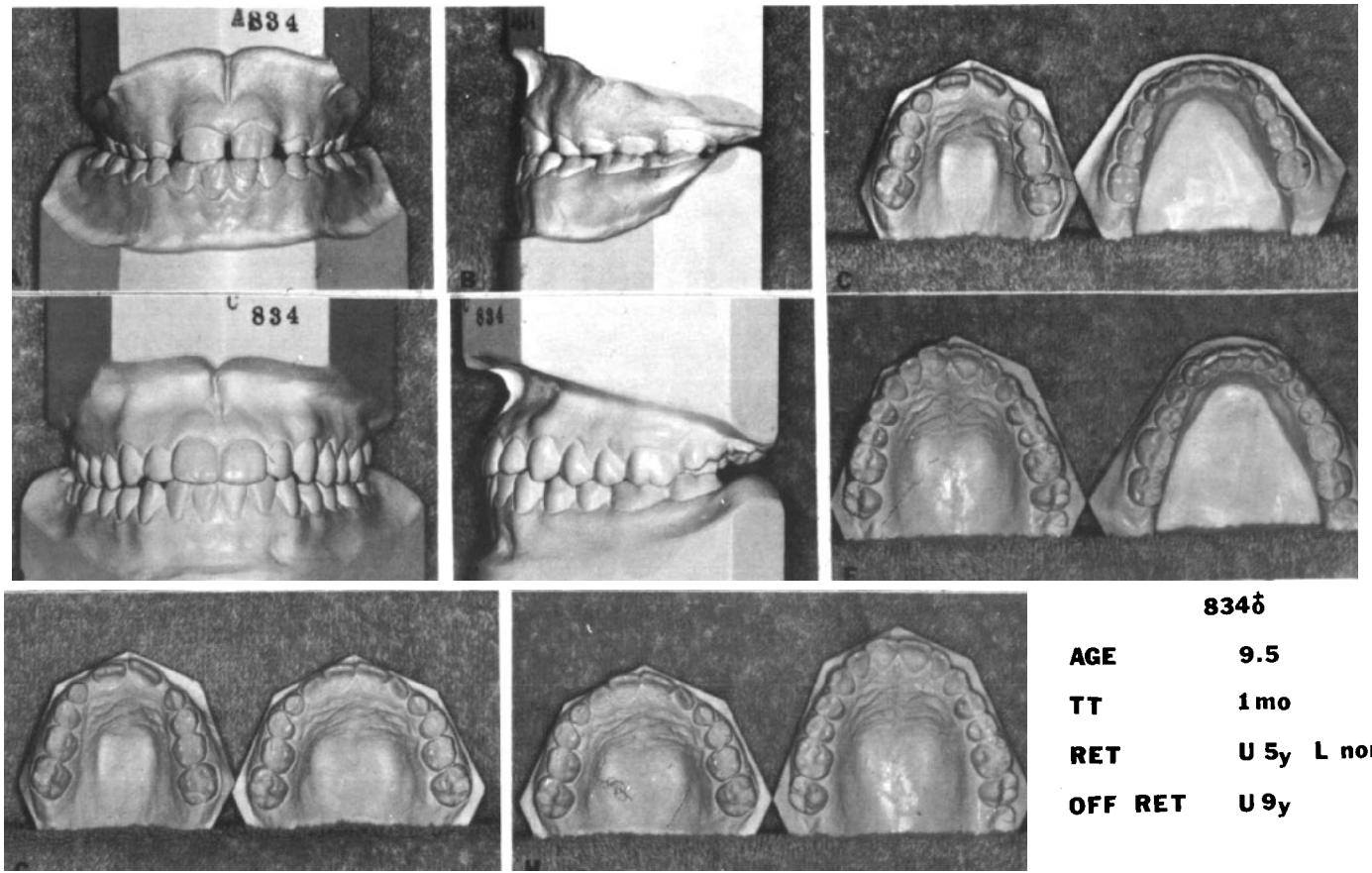

Fig. 8

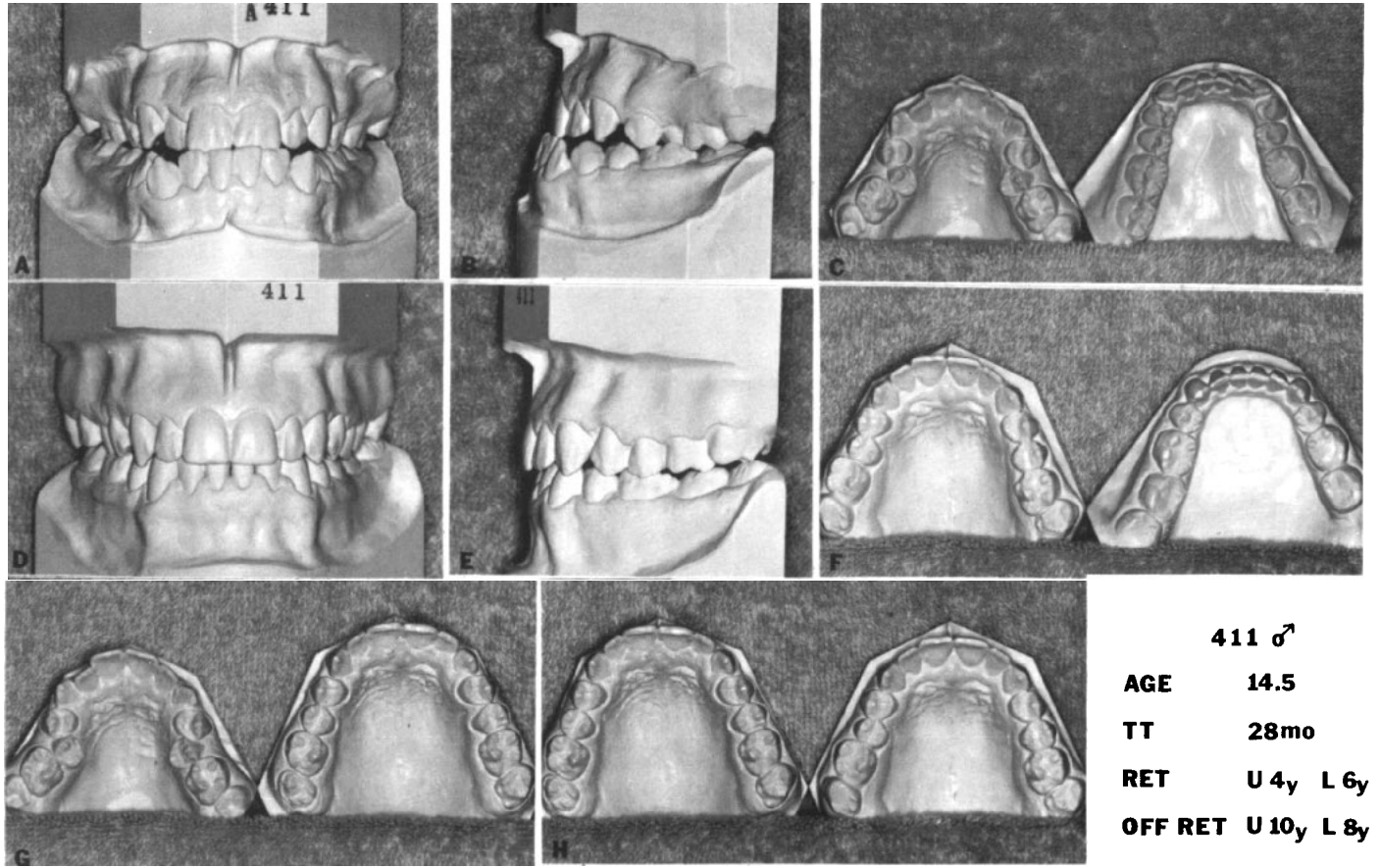

Fig. 9

ment given this child. There was no retention in the lower and an upper acrylic palate without any wires was the only retention in the upper. She has been off the upper retainer for 10 years. A comparison of models in Figure 8 shows stability of the case that is noteworthy considering that the total active treatment was one month of rapid palatal expansion. This is a completely different maxillary dental arch (Figs. 8f and g).

Case 411, a 14.5 year old male, was published in the 1965 article. His facial appearance prior to treatment was moderately suggestive of Class III. He had a moderate skeletal openbite, a maxillary deficiency in the width and the anteroposterior dimension, and a mandibular prognathism. Thus treatment in all three planes of space was needed. He therefore received rapid palatal expansion, maxillary protraction, and vertical control with a vertical pull chin cup, in that order. His facial appearance was suggestive of mandibular prognathism.

The denture pattern (Fig. 9) was unmistakably Class III, three quarters of the maxillary arch being contained within the mandibular arch. In view of the lower arch length problem, lower first premolars were removed. Extraction was vetoed in the upper arch as it would be incongruous with the concept of maximum development for that arch. I cannot recall removing premolars in an upper arch on a rapid palatal expansion case.

The recent models in Figure 9 demonstrate that his case has maintained beautifully. Note how the lower incisor alignment has held as has the width of the maxillary arch. He wore an upper Hawley type retainer for four years and in the final record was without it for 10 years. He had on a lower fixed lingual for six years; these most recent models are eight years free of retention.

The patient's facial appearance is that of an ideal Class I skeletal type as a consequence of the improved denture base relationship. Note in the lateral view how the models do not have the typical appearance of a treated Class III malocclusion. In the typical Class III dental correction as distinct from a skeletal correction, the maxillary base is retruded and the incisors are excessively labially tipped while the mandibular base is protruded and the incisors show marked lingual inclination.

The cephalometrics of this case are of interest. The patient had a skeletal openbite tendency. With palatal expansion the skeletal bite opening became worse. Vigorous intraoral Class III elastics were unwisely used to protract the maxilla. Unfortunately, the elastics also tipped the maxilla down in back. A better method of protraction would be the use of a protraction chin cup as in Figure 4.

Thus three factors tended to worsen the skeletal pattern: 1) the divergent growth vector intrinsic in the pattern, 2) the palatal expansion procedure and 3) the tipping effect of the Class III elastics. Fortunately, there was a large positive factor in the treatment, as a vertical pull chin cup was used to control the vertical dimension.

The compared tracings in Figure 10 show how the three negative aspects of this case were overcome by the vertical control force of a vertical pull chin cup. Note how the occlusal plane flattened, how the mandibular plane closed, as did the Y axis. It would have been folly to deny this case rapid palatal expansion because some individuals with little experience with such cases pontificate that the procedure is contraindicated in the skele-

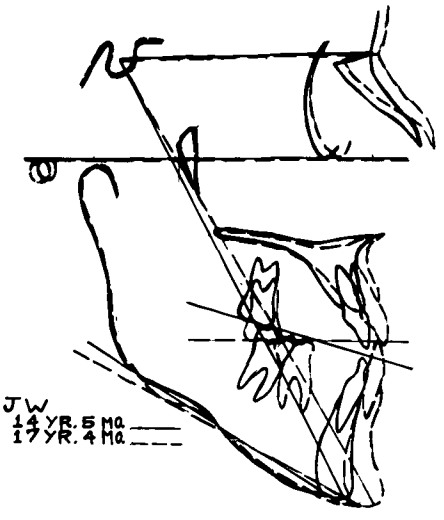

Fig. 10 This Class III skeletal openbite case benefited significantly from the vertical control of the vertical pull chin cup. No intraoral vertical elastics were used at any time during the treatment.

tal openbites. Certainly the hazard is recognized but is easily counteracted with chin cup wear subsequent to expansion.

It is ridiculous to limit the indications of rapid palatal expansion because of one's own limitations in thinking, understanding, or use of the technique. I would agree that expansion appears to be more favorable in Class III deepbite cases as only desirable things happen to such a case. However, due to the overriding importance of the transverse dimension, in my opinion, any case that exhibits a need for maxillary base width or maxillary base manipulation dependent on loosening the base needs and should have rapid palatal expansion. The occurrence of undesirable effects in other dimensions should be anticipated and dealt with in the treatment planning.

Therefore, rapid palatal expansion in a skeletal openbite patient is not a contraindication as can be seen in (Fig. 10). Such a case can be more

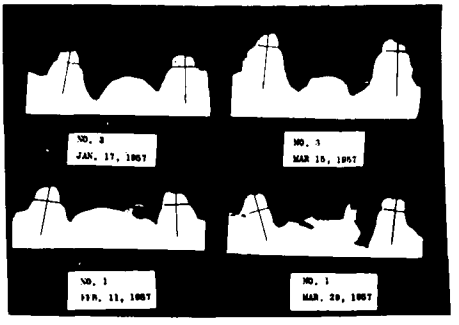

Fig. 11 Demonstrated are sections through the mandibular third premolars of an experimental animal above and a control animal below.

than adequately controlled with a vertical pull chin cup and the total pattern vastly improved. The question is suggested, "is it better to avoid correction of the transverse dimension or attempt it by expansion of the dental arch and thus invite almost certain relapse?"

The author has little quarrel with those who contend that excessive dental expansion across the upper and lower canines is a questionable practice and frequently destined to relapse. It was noted in the 1958[7] pig study that mandibular buccal teeth uprighted and expanded in response to changes induced by rapid palatal expansion. Figure 11 illustrates sectional mandibular casts; cuts were made through the third premolars of an experimental and a control animal. The experimental animal had been subjected to rapid palatal expansion and in about 6 weeks time there was a dramatic change in the axial inclination of the mandibular buccal teeth. It was speculated at the time that this was a consequence of the altered forces of occlusion and muscle balance with buccal tension diminishing and lingual pressure increasing.

The thickness of the expansion appliance caused the tongue to be displaced totally into the confines of the

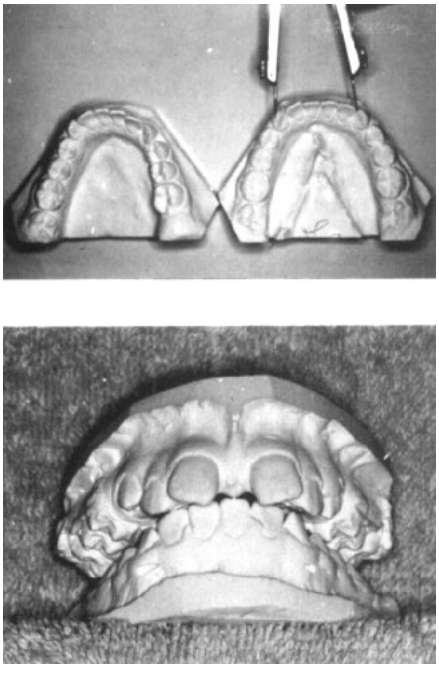

Fig. 12 Above is the striking increase in width of the lower dental arch, in this instance 3 mm at the canines. Below, a model showing the occlusal relationship at stabilization of the expansion appliance.

mandibular arch; concurrently as the maxillae separated, the attached buccinator muscles also moved laterally away from the mandibular buccal teeth, hence the uprighting and expansion of the buccal teeth.

Twenty-five years later I have seen nothing clinically to cause an alteration of opinion regarding human response. Whereas dental expansion in the lower arch may be a liability when used in conjunction with a successful rapid palatal expansion, it is good treatment if indicated, and stable beyond the belief of the uninitiated.

Figure 12—above is the most amazing example the author has ever witnessed of induced expansion in the untreated lower arch as a consequence of the altered muscle activity and occlusal balance attendant to rapid palatal expansion. The time difference between the two models is one year. The case had had only rapid palatal expansion to date; it demonstrates an increase of 3 mm in intercanine width, there was an increase of 4.5 mm at the first premolars and, incredibly, there were 7 and 6 mm increases at the second premolars and first molars, respectively.

Figure 12—below will be interesting to many readers as it shows the occlusal relationships of the dental arches following stabilization of the palatal expansion appliance. Despite the mandibular arch being completely contained by the maxillary arch, the above noted spectacular expansion took place in the mandibular arch in one year's time. A moment's reflection should dismiss any confusion as to how such a phenomenon could occur.

I wish to emphasize that good orthopedic technique demands that most, if not all, of the rapid palatal expansion cases should have the mandibular arch completely contained by the maxillary arch at the conclusion of the procedure.

One of the greatest errors made is that too often clinicians do not carry the expansion far enough. Ten millimeters should be considered minimum and 12 millimeters should be considered average expansion, as that increment of expansion due to alveolar bending, periodontal membrane compression, lateral tooth displacement, and tooth extrusion will most assuredly be lost. Therefore it is vital to have the maxillary buccal teeth in a markedly overtreated position immediately following palatal expansion. The occlusion seen in Figure 12 should exist only when the patient swallows, in other words, only a few minutes a day.

Man, like all animals, functions on only one dental segment at a time,

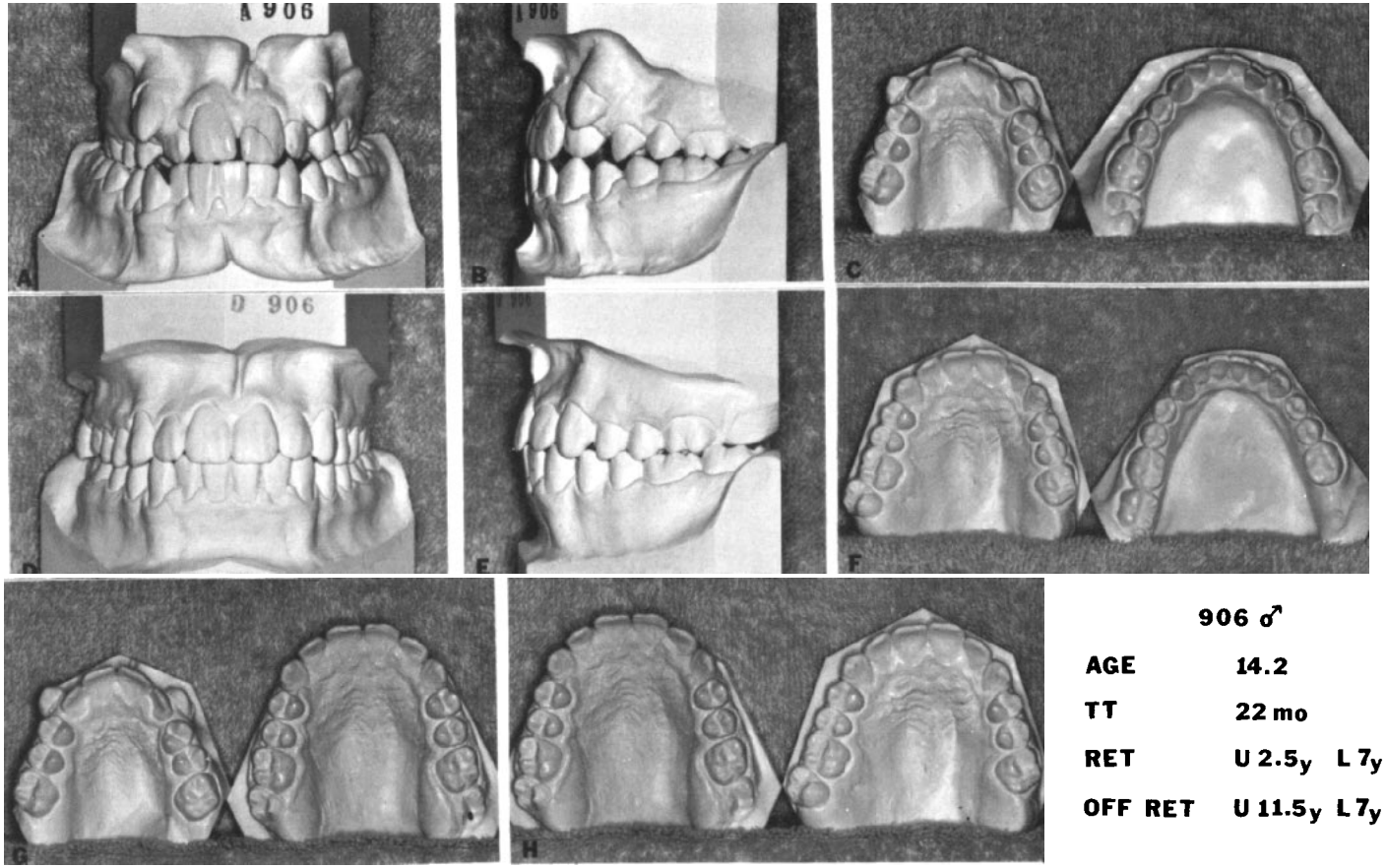

Fig. 13

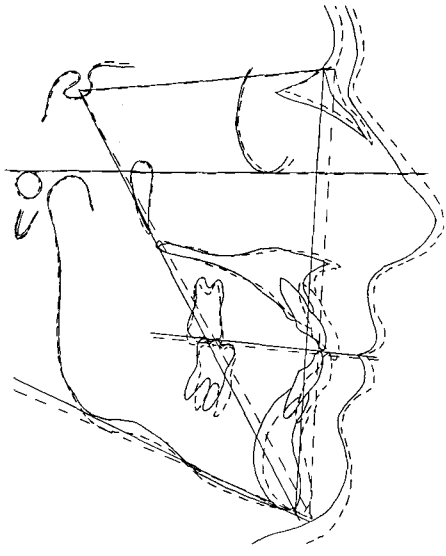

Fig. 14 Tracings of case 906 depicting less than expected growth for the age of the patient.

therefore patients treated in this manner shift the mandible to the individually preferred side during function. At most other times the teeth are separated in physiologic rest position; hence there should be no astonishment regarding the phenomenon recorded in Figure 12 if one remembers that the teeth have this relationship for only moments in a day.

Case 906 was published in 1965. The patient was 14 years two months old at the onset of treatment and was characterized by a severe maxillary deficiency in the transverse dimension. The most interesting aspects of this patient are to be seen in the models in Figure 13. Displayed is a comparison of starting models and models made recently at age 29. The patient was two and a half years on an upper Hawley retainer and six years on a lower fixed lingual. The latest models show his condition 11 years off the upper Hawley retainer and seven years off the lower retention. Maxillary width has actually increased in the postretention period (Fig. 13h).

Observe how obviously stable the lower incisors are (Fig. 13 F). The expansion across the canines was 4 mm and has remained absolutely stable during the seven year postretention period. For those who are thinking to themselves, "the patient must have been a fantastic grower," the tracing in Figure 14 is submitted to show, if anything, less than average growth for a boy between 14 and 16 years of age.

Another incident of lower canine stability following attempted palatal expansion seems of interest due to some rather significant variations from the preceding case. Case 500 was published in 1970[3] at that time six years out of all retention. The recent records were made 14 years following removal of the upper retainer and 12 years after discontinuing the lower lingual retainer (Fig. 15).

The patient was a male, 19 years of age at the start of treatment. After approximately one week of adjustment it became obvious that the midpalatal suture was not opening. The patient was instructed to turn the screw at a rate consistent with comfort; the expansion took place over a period of approximately three months. Since tissue borne appliances act high on the base, it was visualized that a high alveolar and apical base expansion took place rather than the low alveolar expansion which results when teeth are expanded by the use of conventional appliances.

It was recommended in the 1970 article that, in the older case where midpalatal suture opening is improbable, slow adjustment of the screw be used, that is, slow palatal expansion. It was noted that the tissue borne appliance acts not only against dental anchorage, but also against the

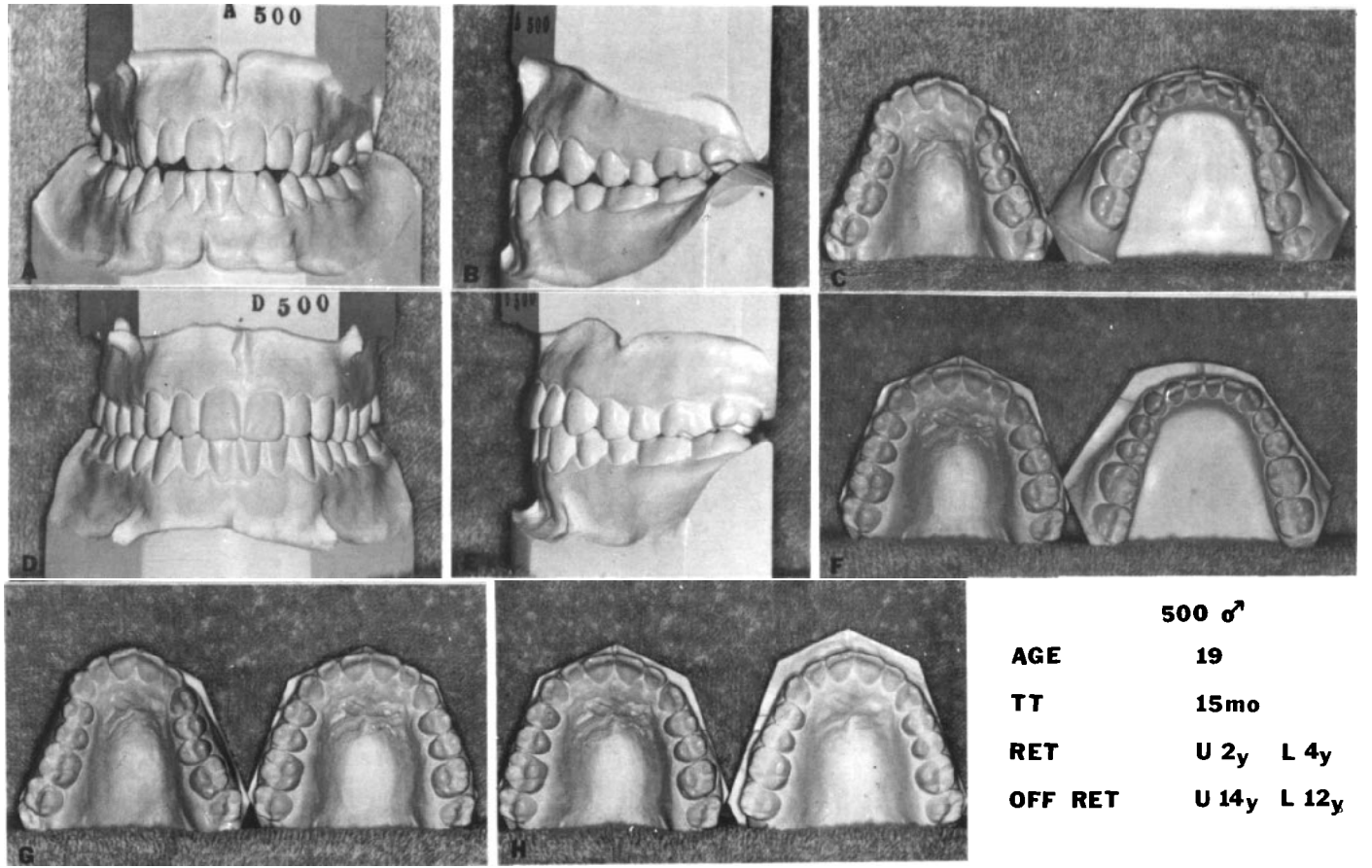

Fig. 15

inclined walls of the palatal vault, lingual alveolar plate, and deeper alveolar structures.

When examining plaster models of cases treated in this manner, it is difficult to distinguish them from those in which ideal suture opening occurred. The author speculates that the striking change in the morphology of the vault (Fig. 15 G) is again due to the superiority of the tissue borne appliance over the anchorage deficient, totally tooth-borne, palatal expansion appliance. The serendipity in this instance appears to be related to the body's defense mechanism in regard to compression of arteries.

The heavy forces delivered to the palatal vault by the acrylic buttons of the appliance tend to compress the palatine arteries. This in turn stimulates the connective tissue surrounding these vessels to differentiate into osteoclasts to remove underlying bone and thus protect the arteries from injury. In so doing the vault is hollowed out and a true apical base expansion is induced as in Figure 15.

This patient was a dental student during the time of his retention and was not in retention as long as I would have liked. Ideal retention would have been four years in the upper arch and six years or more in the lower. The patient had approximately half that much. Note in Figure 15 the bilateral crossbite and the obvious constriction of the maxillary dental arch and to some extent of the maxilla as well. This case was considered a borderline real or relative maxillary deficiency.

To reiterate, the D models were made just over 16 years after retention, about 12 years out of all retention. There has been a slight loss in maxillary dental arch width (Fig. 15 H). Note the excellent stability of the lower incisors in spite of the fact that the canines are 4 mm wider as can

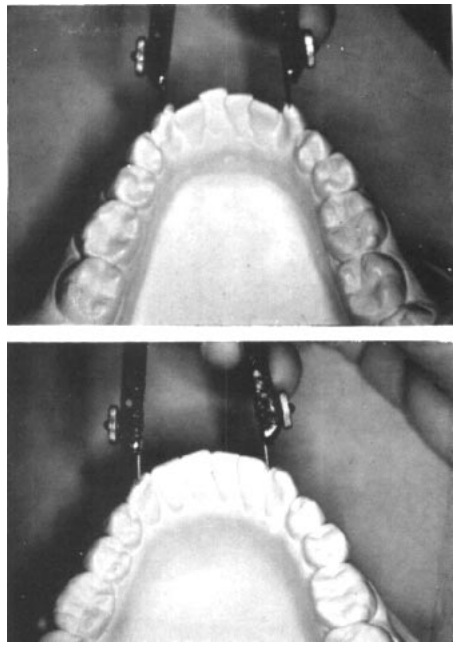

Fig. 16 The mandibular cast of case 500 before treatment (above) at age 19. Below, the cast after treatment, 16 years later and 12 years without lower retention.

be seen in Figure 16; this has held for 12 years. The patient was 19 years old at the onset of treatment.

Since this portion of the paper seems involved with lower arch stability, two other cases that were treated with lower arch stability as the primary objective will be examined. Both cases could have been treated without palatal expansion, but I would suspect to a far less satisfactory result. Neither case has been published.

The technique has proven to be of considerable value in treating selected arch length problems in mature, good pattern cases. Given a 14.5 to 16 year old male or female with an excellent skeletal pattern and a need for a few millimeters of arch length to relieve crowding, even removal of second premolars leads to a concave and exceedingly flat profile. Frequently there is difficulty in closing

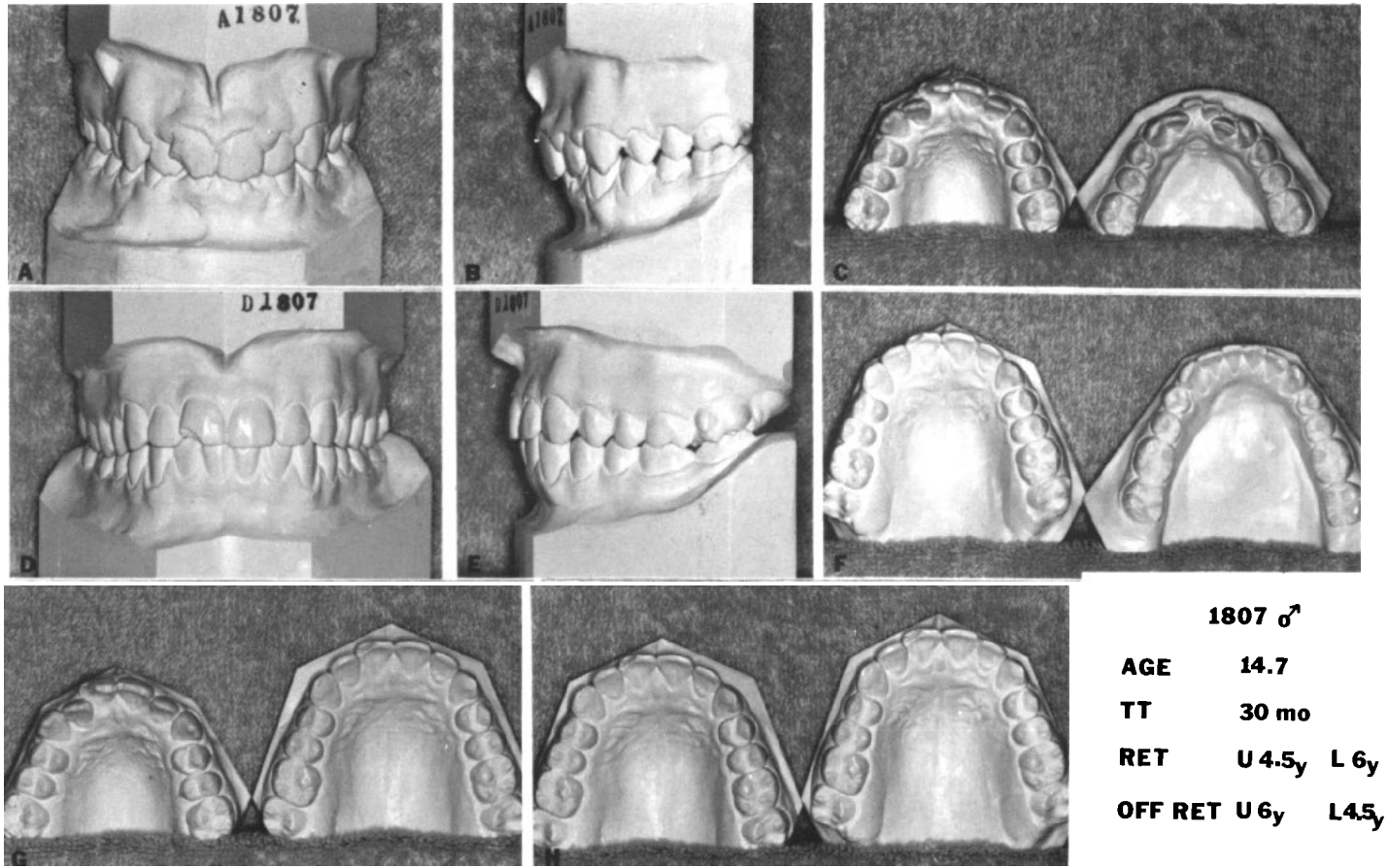

Fig. 17

the spaces and even greater difficulty in keeping them closed. Consider now the alternative of rapid palatal expansion. In a few days the maxillary dental arch length problem is solved. Having permanently widened the maxillary dental arch and apical base, it is now possible to upright and judiciously expand the mandibular teeth to give the few millimeters of arch length needed in the lower.

Case 1807 was a 14 year 9 month old male at the start of treatment. The models (Fig. 17) demonstrate a deep overbite with relatively good buccal tooth interdigitation. Both arches were inadequate as to length with the lower being markedly constricted at the canines.

Rapid palatal expansion was utilized to gain needed maxillary arch length and also to add the favorable effects of changing the forces of occlusion against the lower arch and to lessen the crushing effect of the buccinator muscle on the lower arch. These modified factors permitted permanent expansion across the canines and a relatively easy solution to a situation that would be hopelessly complicated by extractions. Extraction of even second premolars would have led to a very concave profile. It would be difficult to close spaces and to keep them closed and most certainly the anterior overbite would return. The patient was on an upper Hawley retainer for four years and a lower fixed lingual retainer for six years. The models made at age 28 show excellent stability (Fig. 17). The upper Hawley was removed six years ago, and the patient has been off the lower lingual for 4.5 years. Observe the stability of the overbite and lower incisor correction.

Tracings demonstrate relatively good growth of this Class I skeletal and dental type. Figure 18 shows an unchanged skeletal pattern and

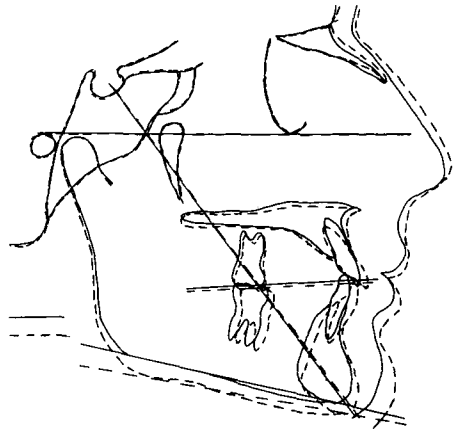

Fig. 18 Tracings of case 1807 demonstrate relatively good growth in this fine pattern case. First tracing at 14 years seven months and final at 28 years.

slightly more procumbent incisors. This has a favorable effect on such a strong profile. The lower incisors are ideally positioned at +2 millimeters to the APo plane as seen in the original Ricketts analysis.

Patient 2323 was a female age 15 years 5 months at the start of treatment. She was in maxillary retention for four years and six years with a lower fixed lingual retainer. The models in Figure 19 again demonstrate a moderate upper and lower arch length problem. Palatal expansion solved the situation in the maxilla and judicious expansion relieved it in the lower arch. The D models were made almost 19 years after the A models. The patient has been without the upper retainer for 12 years and the lower lingual for just over 9. There was a very slight loss of maxillary arch width. As in the preceding case if premolar tooth removal had been resorted to in the treatment of this girl, the iatrogenic consequences of a less than ideal dentolabial esthetics would have been of major concern.

The profile reproductions (Fig. 20)

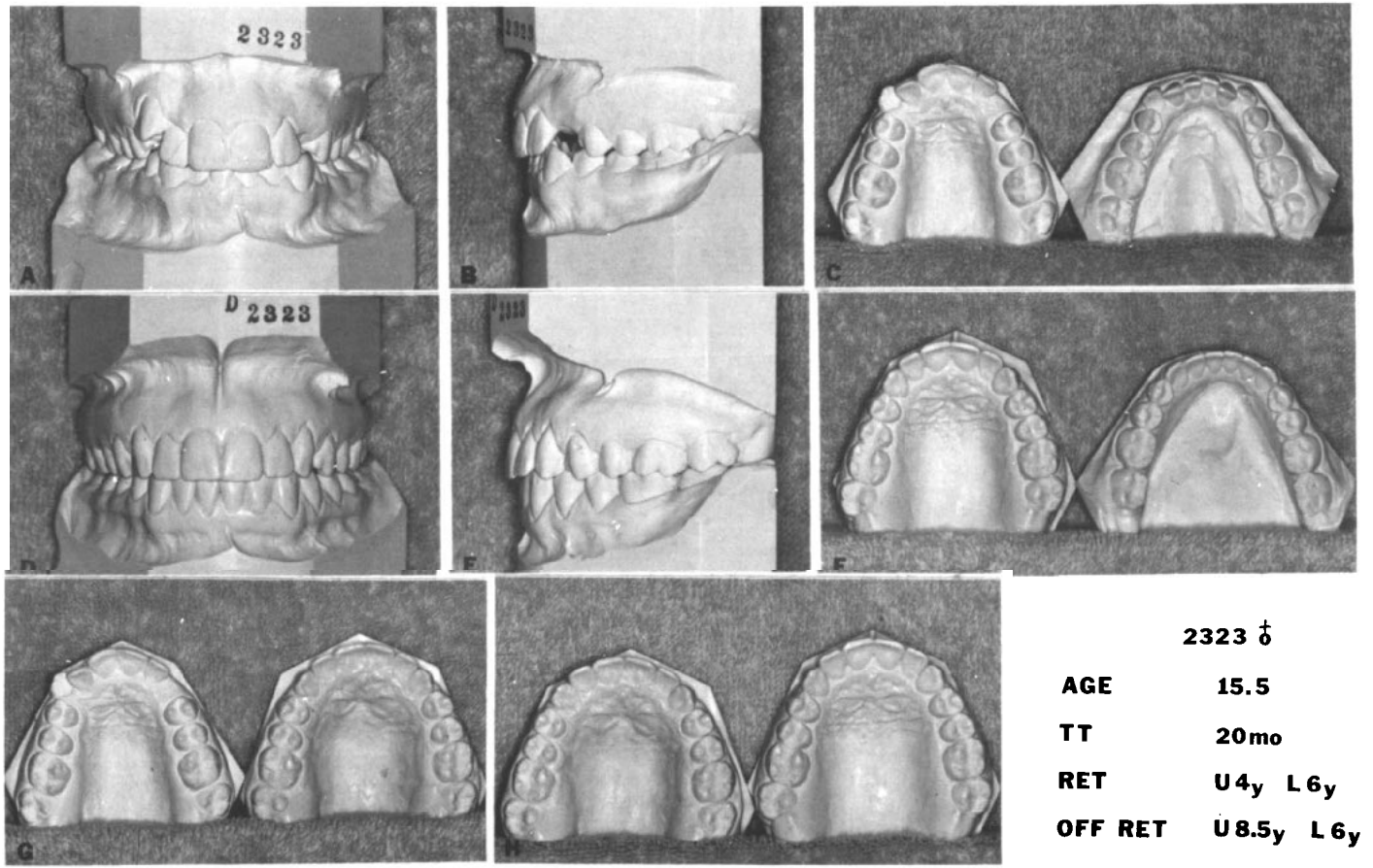
2323
A
B
C
D 2323
D
E
F
G
H
2323 ♀
AGE 15.5
TT 20mo
RET U4y L6y
OFF RET U8.5y L6y

Fig. 19

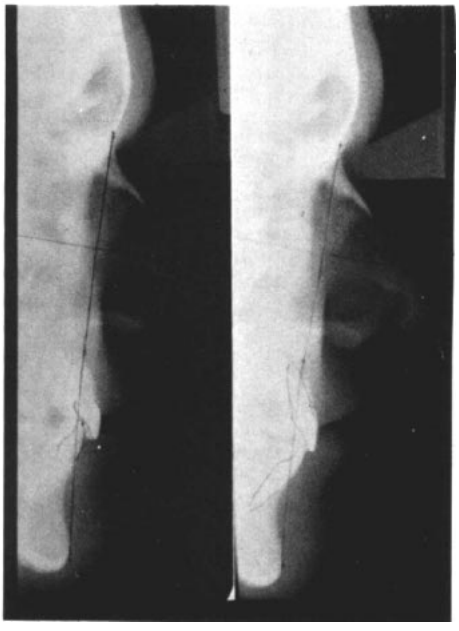

Fig. 20 The fine profile of case 2323 obviously has been preserved.

attest to the successful accomplishments of this esthetic objective while the models sustain the contention that mandibular intercanine width can be increased in the nongrower if the apical base of the maxillary complex is permanently widened.

I realize it is still too early to make a strong statement about case 1807 since he has been off lower retention for only 4.5 years, but I certainly can cite cases 500 and 2323 as indisputable evidence that intercanine expansion in the lower is absolutely stable even in the nongrower if three conditions are met: 1) concomitant maxillary apical base expansion, 2) intelligent use of anchorage in the orthodontic phase of treatment, and 3) long retention. To summarize the last two cases, stability is enviable and the profiles have maintained their excellence. Treatment has been vastly easier than the potentially hazardous extraction approach and the cases possess biologically healthier dentures than they probably would under other treatment circumstances.

The next case, 641, was a Class II, Division 1 mouth breather with considerable respiratory difficulty (Fig. 21). He had the classical maxillary compression and nasal stenosis. He thus met at least two requisites for rapid palatal expansion. This case was first published in 1961 and republished in 1970. In 1961 the question was asked, "Are we justified in worsening a Class II case temporarily to gain increased respiratory benefits?" The question was emphatically and positively answered in the 1970[3] article.

At the conclusion of the palatal expansion procedure it was observed that what seemed to be a moderate skeletodental Class II before palatal expansion was changed to a severe skeletodental Class II. The patient had much greater difficulty approximating the lips and the soft tissue profile was unfavorably altered.

The change of the profile was due to the forward displacement of the maxilla and the downward and backward clockwise rotation of the mandible.

It was therefore necessary to apply an orthopedic force to the maxillary complex. A fine vehicle to accomplish this end is to utilize the anchorage provided by the palatal expansion appliance. A horizontal force of approximately 32 to 48 ounces per side delivered by a Kloehn cervical gear is not only sufficient to inhibit maxillary growth but literally causes the entire maxilla to slide down and back on the undersurface of the cranial base. The hafting sutures of the maxilla are so oriented as to readily permit such a dislocation. For instance, in this case there was 4 mm less depth to the maxilla four years later than

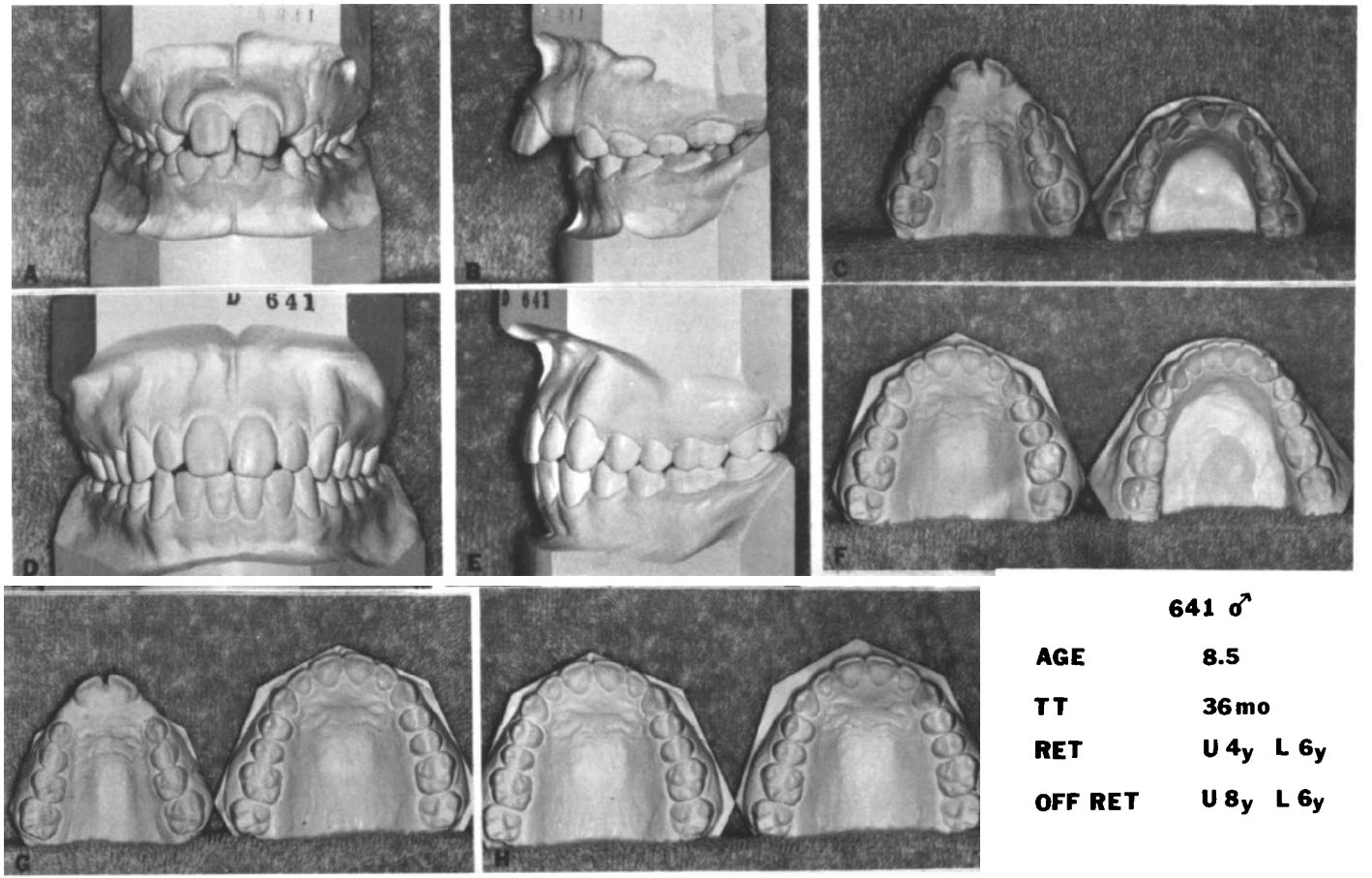
A
B
C
D 641
D
641
E
F
G
H
641 ♂
AGE 8.5
TT 36mo
RET U 4y L 6y
OFF RET U 8y L 6y

Fig. 21

there was at the start of treatment. This was truly anteroposterior dentofacial orthopedics.

Therefore, the temporary forward displacement of the maxilla can be easily controlled by the use of cervical gear subsequent to palatal expansion. Again it seems unreasonable to refuse palatal expansion to a Class II case if a width factor or respiratory factor requires it. It is relatively easy to control any deleterious effect palatal expansion may have on other planes of space while gaining the needed benefit in the transverse dimension.

The models in Figure 21 show us a Class II of formidable stature in view of the lower arch length problem. It is again obvious that the lower arch was expanded in accord with the very favorable maxillary changes.

One can readily see how the width of the lower arch has essentially been maintained. Note also in the comparison of the upper arches the same phenomenon. This case was in retention in the upper arch for four years and the lower arch for six years. At the time of the latest records the patient was eight years off the upper Hawley retainer and six years off the lower fixed retainer.

Case 1566 was a male selected some years ago for teaching purposes as he nicely exemplified the treatment of a maxillary deficiency in both width and anteroposterior dimensions. After correcting the transverse disparity the loosened and displaced maxilla might then be held forward or displaced still farther forward by the use of the protraction chin cup.

Treatment was started at age 12.5, recent model records were made at 26 years of age. The patient wore upper and lower retainers four and six years, respectively. He has been 6.5 years off the upper Hawley and 4.5 years off the lower lingual. The arches appear to have an excellent prognosis for stability as there has been absolutely no change in lateral dimension in either arch (Fig. 22).

The tracing in Figure 23 demonstrates the effect of rapid palatal expansion on the maxilla when the expansion screw is extended to the 10 to 12 mm range. It moved forward 3 mm as measured from the pterygoid root plane of Ricketts. The mandible concomitantly went through a negative rotation of 4 mm. Thus the skeletal overjet was changed by 7 mm. The skeletal bite opening in a strong Class I pattern like this would be virtually impossible to maintain. It will close again as the muscles of mastication assert dominance. Growth, palatal expansion, and maxillary protraction during the time of suture reorganization had the net effect of bringing the maxilla 5 mm forward. Since nasion came forward only 1 mm, there is obviously more than growth working on this maxilla.

The tracing in Figure 24 shows the outstanding growth which such a strong patterned case is destined to enjoy. All the growth recorded here came after age 14 was attained. Note how the mandibular plane closed as it invariably will in a strong patterned individual. Observe also that without any treatment the maxilla grew forward 3 mm while the growth at nasion was a tremendous 5 mm. With the expected positive mandibular rotation and excellent over-all growth pogonion advanced a significant 6.5 mm.

The last case, 1051, was a cleft palate case. When first seen, this 15 year old female had had 14 surgical procedures. This number was undoubtedly the result of the first surgical procedure, a Brophy operation at about six months of age. In a Brophy procedure the maxillae are compressed and two transmaxillary and two transpalatal wires are placed to make cer-

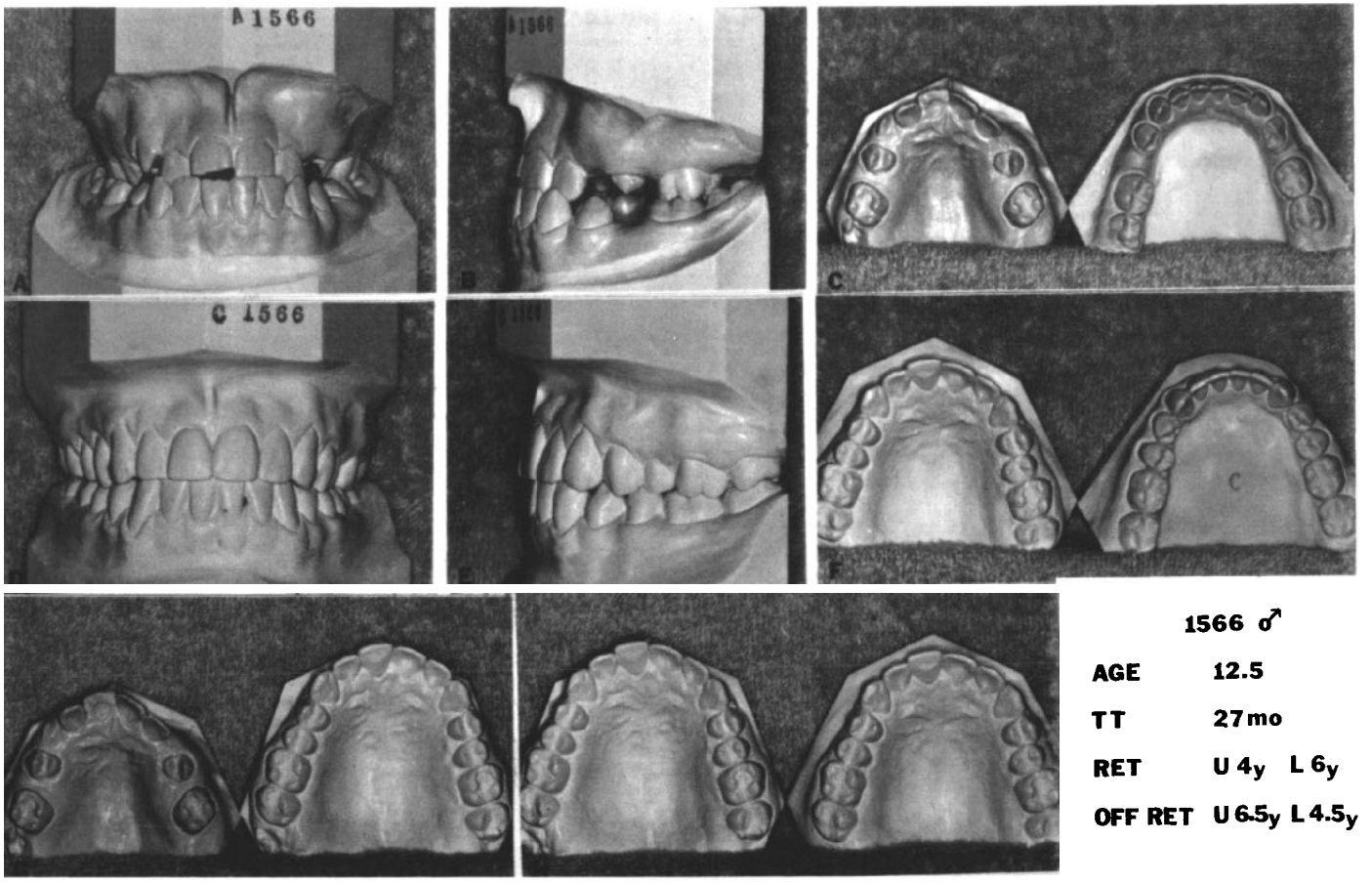

Fig. 22

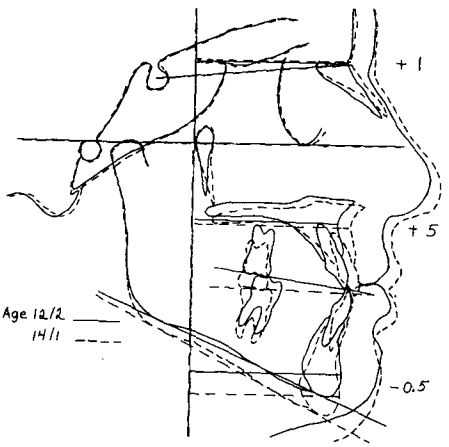

Fig. 23 Case 1566 demonstrating striking forward displacement of the maxilla as a result of rapid palatal expansion and subsequent protraction of the disarticulated maxilla.

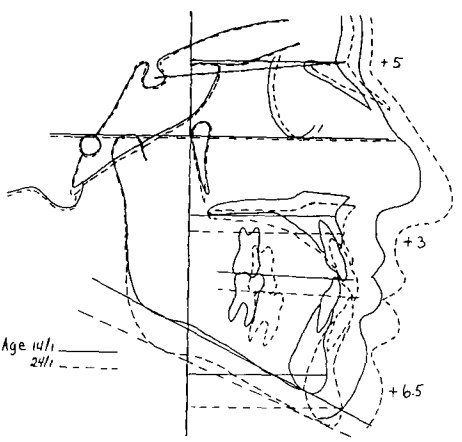

Fig. 24 Tracings of case 1566 illustrating the tremendous growth which many strong-patterned males enjoy. In this case much of the growth was postpubertal.

tain the maxillae do not come apart again. Such surgery also made certain that there would be no lateral growth and indirectly there would be attenuated vertical maxillary growth.

Note in the models in Figure 25 how the maxilla has literally been swallowed by the mandible. It was determined that a real maxillary deficiency existed in both width and anteroposterior and, of course, the vertical development was also deficient. As a consequence of her maturity and of numerous cleft palate repairs this case was a candidate for rapid palatal expansion treatment. Observe the growth force of the tuberosities (Fig. 25C); the surgically abused area shows poor development while the undisturbed tuberosity area shows amazing growth. Consider the attained result in treatment; it was gratifying to be able to overtreat the buccal segment to this extent. The upper dental arch is being permanently retained with a vitallium casting; the lower dental arch was held seven years with a fixed retainer. Looking at the recent models one can again see the stability of the arch. As noted, the upper arch will have lifetime retention in all probability. The lower retainer was discontinued six years prior to making the D models.

The tracing in Figure 26 shows little forward movement of the maxilla in response to the palatal expansion. Less than 2 mm of protraction occurred during the protraction phase of treatment. Whereas the lateral and anteroposterior skeletal corrections were good, the vertical response was outstanding. By design the mandible went through a tremendous negative rotation. Pogonion went back 9 mm, menton increased 18 mm in height. This was a completely different face due to the increase in lower face height, the lessening of effective mandibular length, and the 10 mm change in skeletal overjet. A 5 mm change in skeletal overjet resulted in a significant profile change. At the 10 mm level the change seems to border on the miraculous.

The profile change for the young lady is seen in Figure 27. Just perusing the head films attests to the fact that a tremendous alteration has occurred in the face. As was stated on

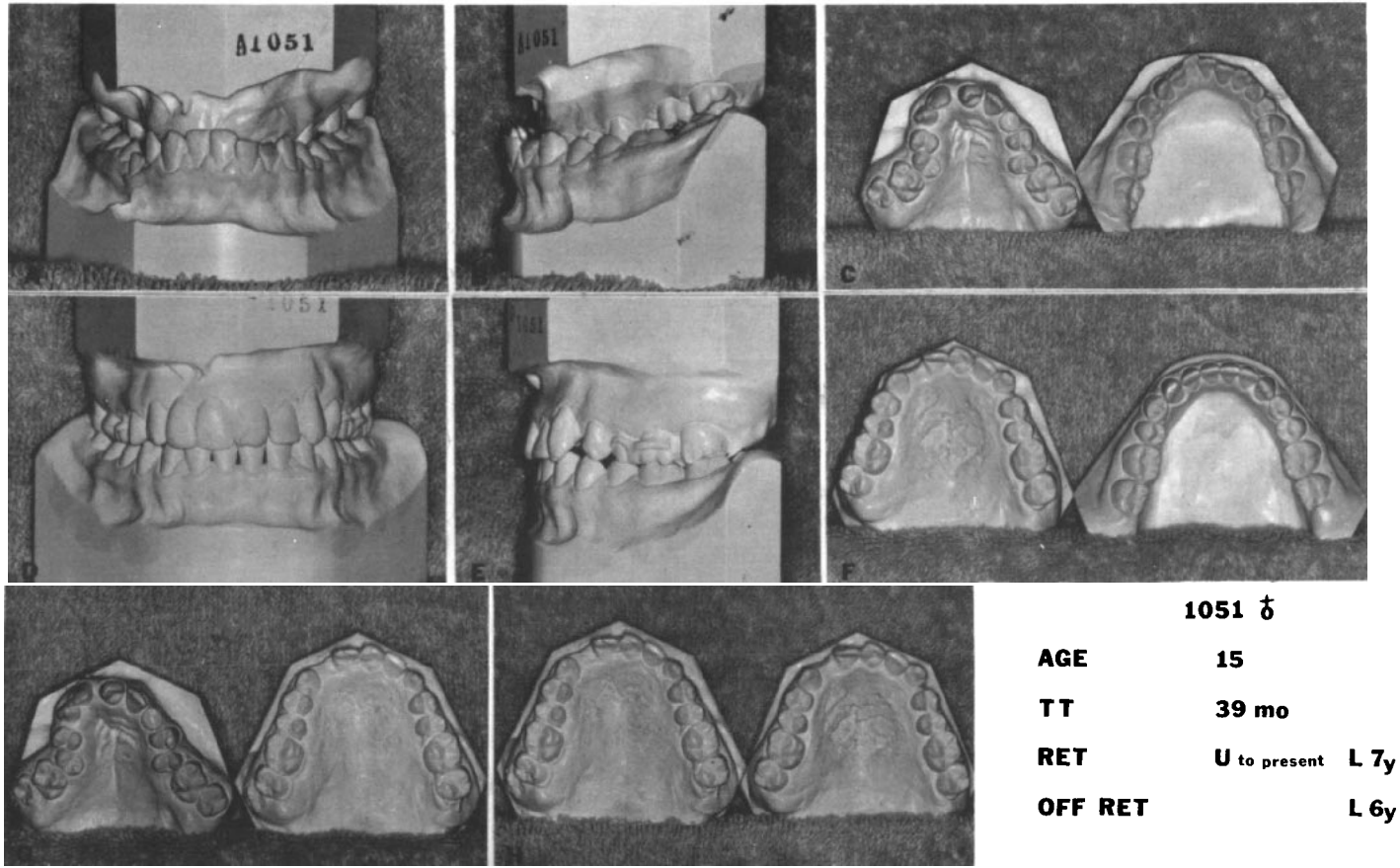

Fig. 25

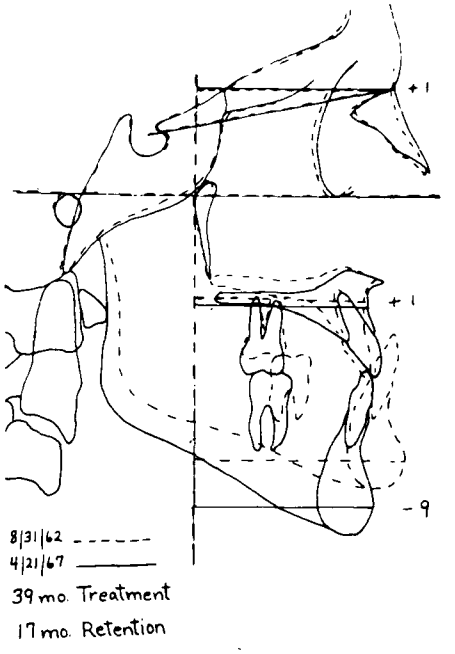

Fig. 26 These tracings show a marked increase in the vertical as a result of the text-detailed orthopedic treatment. This is another of the many instances where vertical increase is beneficial to our treatment objectives.

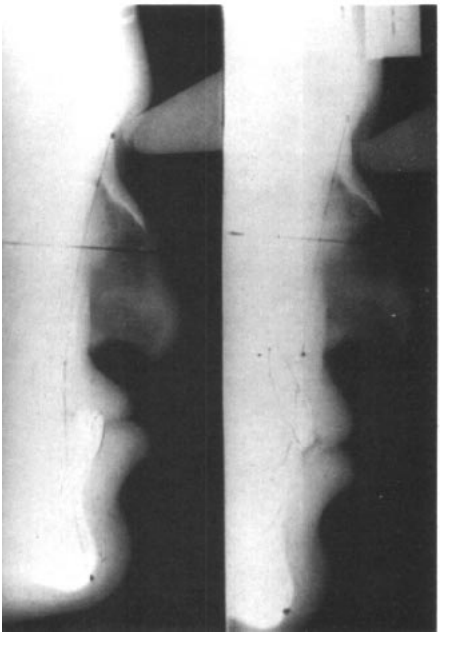

Fig. 27 Profiles of case 1501 before and after orthopedic and orthodontic treatment. There was approximately 17 years of time between the two exposures.

the first case (1860), the Class III skeletal type apparently has a very large freeway space and thus tolerates skeletal and dental bite openings. The same apparently holds true for such an iatrogenically created skeletal deepbite Class III case; notice how headplates made 12 years apart superimpose exactly (Fig. 28). The vertical skeletal correction is completely stable after 16 years.

Six published cases have been shown again. Except for the pseudo Class III case (834) these cases for the most part were severe to extreme and some literally untreatable by conventional orthodontic methods and all with a high expectation to relapse. The other four cases have been taken over the years from courses on the subject of dentofacial orthopedics. I have never been forced to eliminate a case from my teaching material because of relapse. Since I retain cases

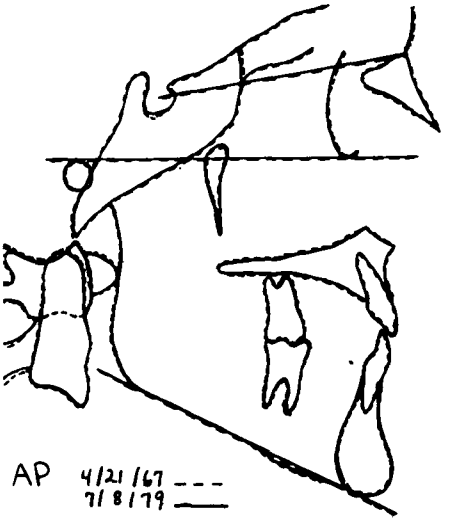

Fig. 28 Note that the skeletal bite opening achieved by orthopedically tipping the maxilla down in back is absolutely stable after 16 years of time.

for an extended period of time, most of the teaching material has been selected during treatment or early retention. There were additional cases published in the 1970[1] article but they were not palatal expansion cases.

This material represents a demonstration rarely seen in orthodontic history as far as method of case selection and stability of treated results. Demonstrated were: (1) totally stable 4 and 5 mm intercanine expansions in the lower arch many years out of retention, (2) upper buccal teeth expanded 9 to 12 mm with the expansion remaining absolutely stable. All cases showed complete stability of dental overbite correction, skeletal pattern correction as well as the dental correction. Every case was better skeletally following treatment than before.

The question is immediately suggested, "Is this uncommonly favorable stability due to the method of treatment or the method and length of retention following treatment?" In my opinion it is both. First a diagnosis was made to delineate skeletal and dental anomalies. Then a treatment plan was devised to correct each dysplastic factor. Correction of the transverse factor was never avoided because of some imagined contraindication; there are no contraindications to palatal expansion in a child of reasonable physical and mental health. I claim no personal wizardry and insist that these results are reproducible by any careful diagnostician and operator. After all, these cases were all treated by a rank beginner, as eight cases were initiated during my first three years of practice.

Much remains to be written, particularly in regard to the folly of minimal or no retention but that must await another essay. However, one more point should be made before concluding and it is in regard to treatment. An obvious key to the success of these cases was the rapid palatal expansion procedure and the appliance by which it was achieved. The most important consideration in any orthopedic appliance is gaining maximum leverage through maximum anchorage to produce a maximum orthopedic effect. The better one relates the denture bases, the greater will be the success of the treatment. An optimum or near optimum denture base relationship produces dental arches with similar favorable relationship and, perhaps even more importantly, the most favorable muscle balance for the individual. Therefore any appliance mutation that weakens or destroys anchorage is totally unacceptable to anyone with even casual understanding of dentofacial orthopedics. The use of an all wire framework appliance in deference to a tissue borne appliance is very limited because of the tremendous compromise of anchorage.

With a tissue borne appliance the acrylic masses are confined to the rather ischemic tissue which lies between the first premolars and the first molars. In use the acrylic buttons bear against the inclined walls of the palatal vault and lingual alveolar plate.

When a fixed acrylic palatal appliance with dental anchorage reinforced on both buccal and lingual sides is used, an optimal in anchorage units is achieved. The resistance units are the inclined walls of the palatal vault, the buccal alveolar process, the posterior teeth and the periodontal structures.

While the all-wire framework appliance might be moderately efficient in a mixed dentition case or in a young full dentition case, it must still be considered distinctly inferior to an appliance which gains additional anchorage by action on the base itself. The all-wire framework appliance is unquestionably inferior to the base

borne appliance in older patients because of the resistance of these patients to midpalatal suture opening. It is very possible that abutment teeth can be made to perforate the buccal plate with such an anchorage deficient appliance.

The greatest disadvantage to the all-wire framework appliance must occur during the retention period, while the teeth are supported in their expanded state by the appliance. Thorne[6] noted that cases retained less than two months demonstrated considerable relapse. Zimring and Isaacson[8] have demonstrated that forces tending to collapse the maxillary expansion exist for approximately six weeks.

Let us consider the fact that the teeth are maintained in their expanded state by the tooth borne appliance, while for a period of six to eight weeks forces are compressing the expanded maxillae. Considering the physiology of tooth movement, such a system of force and resistance can only result in considerable relapse of the attained nasal cavity and apical base width. The pressures on the maxillae would be directed in part to the buccal surfaces of the roots of the maxillary buccal teeth. The result would be resorption of buccal alveolar bone with attendant medial movement of the maxillae.

If the maxillary base is stable and an expanding force is directed to the buccal teeth, most would agree that the teeth will move laterally through the bone.

If we reverse the situation and stabilize the teeth in unstable, separated maxillae and there exists a force to the maxillae that would move them toward each other, we can figuratively see the maxillae moving through the stabilized teeth.

It is beyond the scope of this essay to discuss other abuses of the palatal expansion technique, but it should not be condemned because some use it improperly, nor am I prepared to defend all methods of palatal expansion. I personally feel strongly only about the method I have presented in this and previous publications during the past 20 years.

Rapid palatal expansion procedure is here to stay. The few critics of the technique are, for the most part, poorly informed or have never attempted the procedure as the objections they raise to it and the so-called evidence they present against its use sometimes approach the ridiculous; it is obvious some are barely conversant with the subject. The technique is biologically and biomechanically sound and the untold number of cases treated better with it than without it, is all the convincing your essayist needs.

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