Vertical Control in Treatment of Patients Having Backward-Rotational Growth Tendencies

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Much has been written the last few years describing the patient with a steep mandible, hypodivergent face, tall lower face, or the backward rotater. This type of orthodontic situation has continued to be one of the most difficult problems for the clinician to treat successfully. A backward growth rotation of the mandible usually results in an increase in the anterior face height, a more posterior position for the chin, and an open bite may develop (Fig. 1). Such rotation occurs when anterior structures grow more than posterior structures (the alveolar process height increase exceeds that of the condylar vertical increase) or when the cranial base flattens and results in a more superiorly positioned fossa. A forward rotating mandible typically has a growth rotation which gives rise to a deep bite and a forward positioning of the chin (Fig. 2).

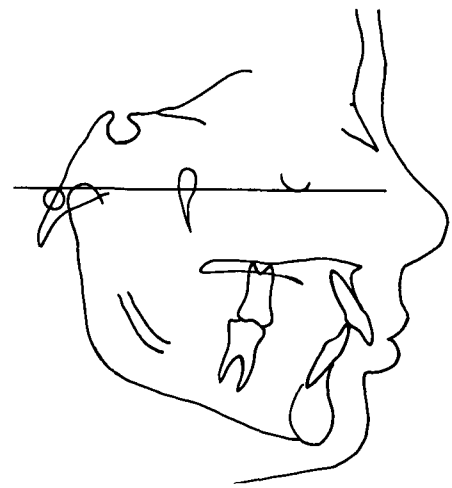

Fig. 1 Forward rotater.

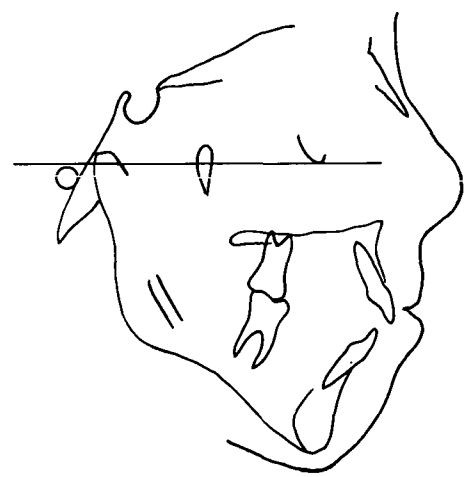

Fig. 2 Backward rotater.

Björk[3] has contributed significant information of growth rotations of the mandible. There is a definite advantage in treatment to predict what type of growth rotation one is dealing with and then to plan treatment specifically for that pattern.

Björk described a structural method of predicting significant growth rotation from a single cephalogram. The principle is to recognize seven specific structural features that develop as a result of remodeling in a particular type of mandibular growth rotation (Table I). This method is based on information gained from implant studies of the remodeling process of the mandible during growth. A determination or prediction is helpful in treatment planning to decide when extrusive or intrusive posterior forces are necessary or when some environmental factors must be changed.

Not all seven signs will be present in any one individual but the greater the number present, the more reliable will be the prediction.

Given at the January, 1977 meeting of the Midwestern Component of the Angle Society.

TABLE I

	Forward (Fig. 1) Rotater	Backward (Fig. 2) Rotater
I. Inclination of the condylar head	Curves forward	Straight or slopes up and back
II. Curvature of the mandibular canal	Curved	Straight
III. Shape of the mandibular lower border	Curved downward	Notched
IV. Inclination of the symphysis (Anterior aspect just below "B" point)	Slopes backward	Slopes forward
V. Interincisal angle	Vertical or obtuse	Acute
VI. Interpremolar or intermolar angles	Vertical or obtuse	Acute
VII. Anterior lower face height	Short	Tall

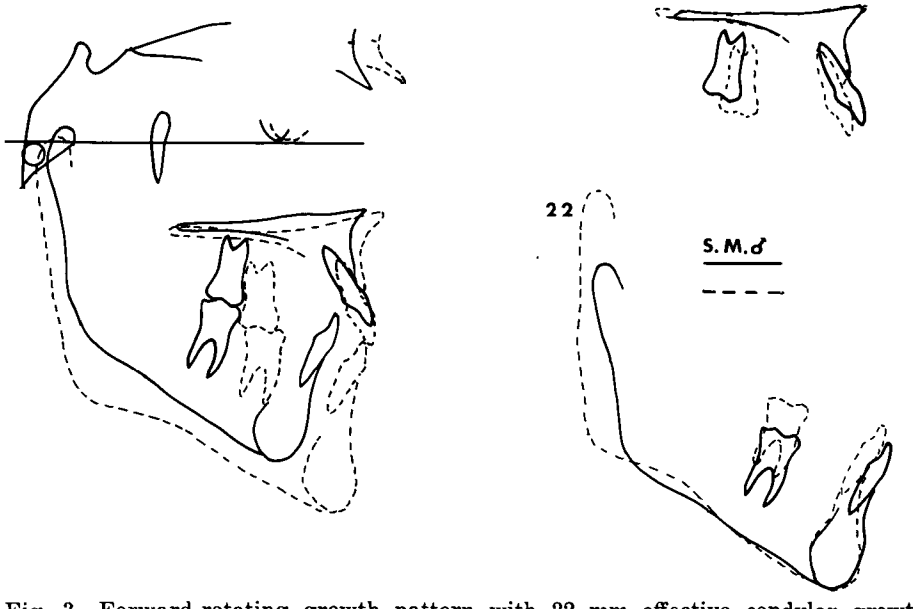

Fig. 3 Forward-rotating growth pattern with 22 mm effective condylar growth during treatment. Note the forward curvature of the condylar head.

Four treated cases are presented to illustrate two different types of growth rotation and to consider the additional effects of treatment. Figure 3 is of a forward rotating pattern with an extreme amount of mandibular growth. This patient exhibited an effective condylar growth measurement of 22 mm using the measurement technique suggested by Creekmore.[5] Five of Björk's structural signs were indicative of a forward rotating pattern. Even though there was some treatment extrusion of the posterior teeth as well as some vertical development, the condylar growth was so great that a significant increase in the forward position of the chin occurred. Treatment of a patient with this amount and direction of growth should respond well with conventional treatment methods.

The following three cases are all potential backward rotaters having similar amounts of effective condylar growth. Figure 4 illustrates a backward rotating pattern treated with excellent control of maxillary forces but showing tremendous treatment extrusion of the lower posterior teeth. This patient had a mouth breathing habit associated with

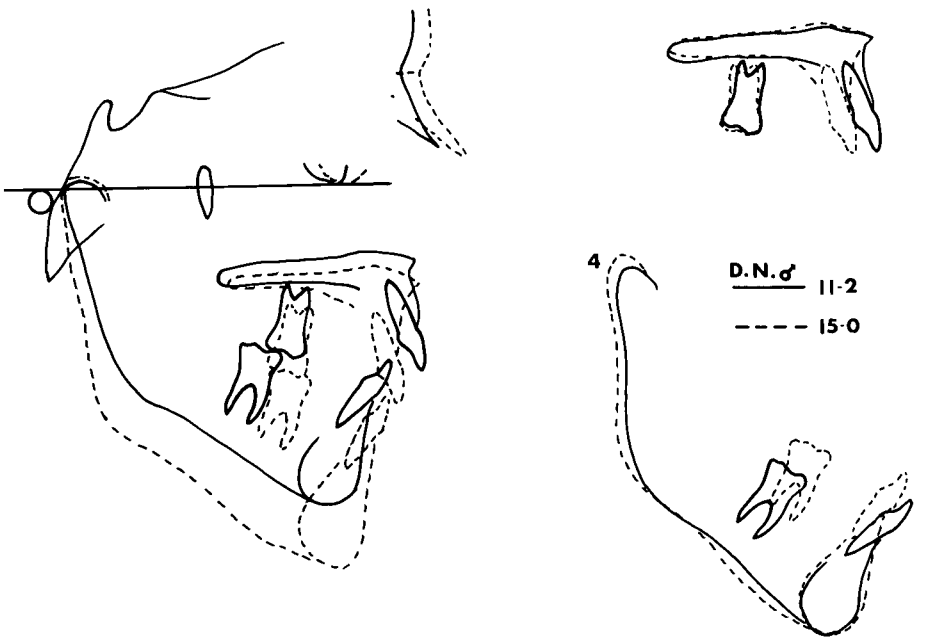

Fig. 4 A backward-rotating growth pattern treated with good control of the maxillary posterior teeth and illustrating a significant amount of lower molar height increase associated with a mouth breathing habit. There were no intrusive forces used for the lower posterior teeth.

his allergies. This makes it appear that a great deal of vertical growth resulted in the mandible. Observe there was 4 mm of effective condylar growth.

Figure 5 illustrates a backward rotating type of case treated without any attempt to retard treatment extrusion of the posterior teeth in either arch. There was a 4 mm effective condylar growth recorded, and a significant increase in the vertical height of the lower face occurred with the accompanying downward and backward positioning of the chin. Figure 6 represents another patient with a potential backward rotating pattern treated with intrusive forces to both the maxillary and mandibular posterior teeth. These forces were derived from an occipital type maxillary headgear and a light (6 oz.) lower cervical headgear attached to the lower first molars with a force directed through the center of resistance of the mandibular arch.[12] This patient had an effective condylar growth of 6 mm. Compare the chin positions and vertical height increases in similar patterns with differing treatment methods in Figures 4, 5, and 6.

Several researchers have studied vertical relations of the jaws as related to anterior-posterior jaw positions and the anterior facial height. Schudy[17] suggested that these factors merit consideration: 1) maxillary alveolar height, 2) change in fossa position (cranial base bending), 3) nasal septum maxillary corpus growth, and 4) mandibular alveolar height.

Of these factors, orthodontic treatment can influence the maxillary and mandibular alveolar processes to the largest extent. The control of the maxillary alveolar height has been researched, demonstrated, and discussed by several authors.[1,12,18] It seems apparent that in a backward rotating case the occipital type headgears are effec-

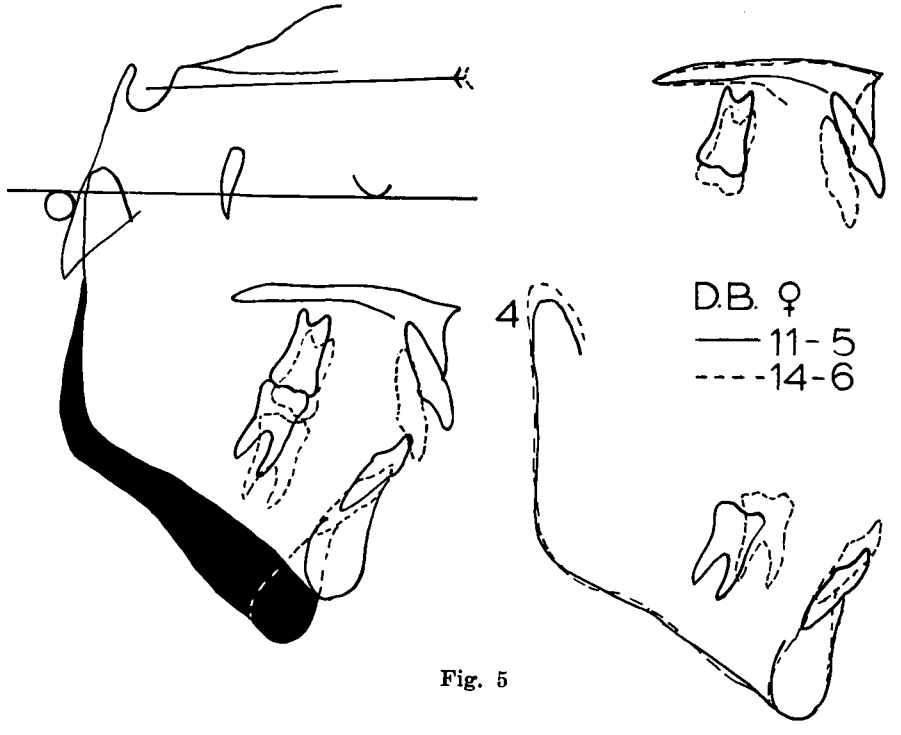

Fig. 5

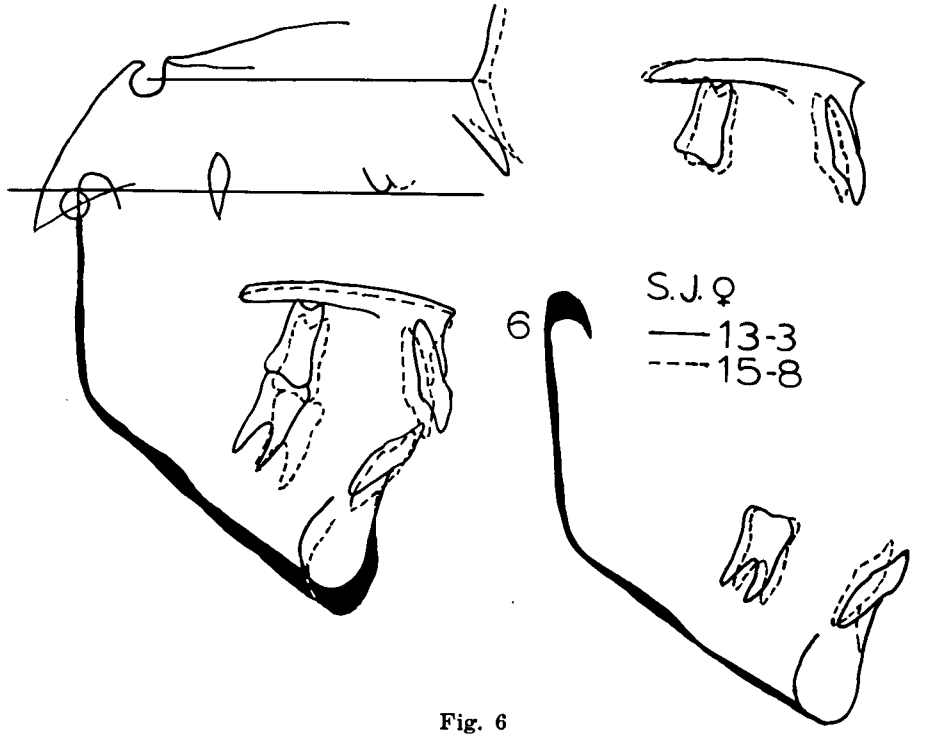

Fig. 6

TABLE II

Average height increase measured from the mandibular plane (mm)

I. Untreated controls during orthodontic age—30 months[5,15]	1.5
II. Nonextraction treatment[5]	2.2
III. Nonextraction, anchorage preparation[6]	2.6
IV. Extraction cases[13]	3.2
V. Extraction cases, anchorage preparation[6]	3.5
VI. Extraction cases, lower headgear patients[13]	1.9
VII. Extraction cases, sliding jigs to lower molars[13]	1.5

tive in preventing a significant increase in the maxillary posterior alveolar height.

Control of the mandibular alveolar height is frequently at least as important as the maxillary alveolar height especially in patients with mouth breathing tendencies.[13,17] The lower molar height measured to the mandibular plane in patients with steep mandibles is 31.2 mm (S.D. 2.7).[11] Elevation of the lower molars can be a contributing factor in backward rotation of the mandible in a patient with these tendencies. If we summarize the information from different studies of lower molar height increases, some trends are apparent (Table II).

It appears that intrusive types of forces are able to reduce the amount of lower molar height increases to a level very close to what would occur with normal growth. Significantly, these patients were not divided into backward or forward rotational tendencies and so presumably these groups would be mixed, but since forward rotaters are much more common one would expect them to predominate.

In treatment of growing patients with backward rotational tendencies, the following approach has been helpful. If the case requires extractions, the four first premolars are removed just after they erupt. A vertical-pull chin cup

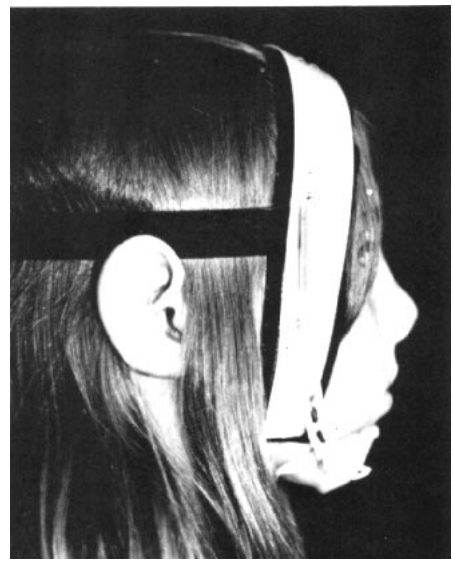

Fig. 7 Patient wearing a vertical-pull chin cup illustrating a desirable force direction.

is worn by the patient while waiting for the remaining teeth to erupt. The patient is requested to wear the chin cup at least 12 hours a day (Fig. 7). The force used is a minimum of 16 ounces on each side and the direction of pull is as far forward as possible. Table III presents the measurements of twenty backward-rotating growing patients treated in this way prior to placement of appliances. Figure 8 shows the distribution of the mandibular plane angles and their changes.

The anterior open bites were all closed prior to the placement of appliances (Figs. 9 and 10). The lower molars slightly increased in vertical height to a + .21 mm mean (range —1 mm to + 1 mm) when measured to the mandibular plane and were slightly intruded, —.21 mm (range —1 mm to + 1 mm) when measured by Björk's method. He has suggested, in lieu of metallic implants, superimposing the tip of the chin and the following three internal structures: 1) the inner cortical

TABLE III

Mandibular Plane Angle Changes Measured To Sella-Nasion Following Four First Premolar Extractions And Vertical Pull Chin Cup Therapy

Group	Age (Years)	Time Worn (Months)	GoGn-Sn Before	GoGn-Sn After	Differences
Twenty Patients	11.5 years Mean	9.4 Mean	41-9° Mean	38.0° Mean	3.9 Mean
11 Females	S.D. 1.20	S.D. 4.123	S.D. 3.406	S.D. 3.271	S.D. 1.425
9 Males	Range 9.0 to 13.5	Range 5 to 18	Range 37° to 48°	Range 35° to 46°	Range 1° to 6°

S.E. of the Differences .319
T value = 9.09

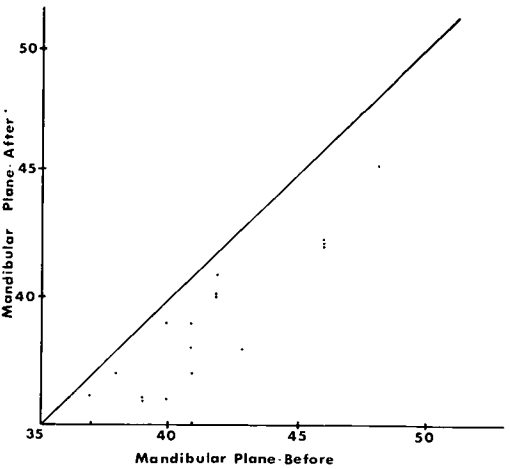

Fig. 8

Fig. 9 Frontal view of a patient with a 46° mandibular plane angle before treatment.

Fig. 10 Frontal view of the patient shown in Figure 9 following the extraction of first premolars and thirteen months of vertical-pull chin cup wear prior to the placement of appliances. The mandibular plane closed from 46° to 42°.

structure of the inferior border of the symphysis, 2) detailed structures from the mandibular canal, and 3) the lower contour of the third molar germ from the time mineralization of the crown is visible until the roots begin to form.

Full appliances are placed when all the teeth have erupted. The chin cup is continued throughout treatment and may be necessary until growth ceases. It is very important that the patient is growing; when a few nongrowing patients were treated in a similar manner, no mandibular closure occurred. During treatment, extrusive types of forces such as intermaxillary elastics and extrusive types of headgear forces should be avoided so the patient doesn't lose the closure previously attained. It is a significant advantage in treatment to have the open bite closed prior to the placement of appliances. Overbite correction is often accomplished with the least posterior extrusion when treated by incisor intrusion as presented by Burstone[4] rather than by continuous arch mechanics. Isaacson[11] has shown that many of these patients have incisors that are already over erupted and that it is much better to close the open bite without any further extrusion of the incisors as one would get by the use of anterior vertical elastics.

There may be several explanations for the closure of the mandible reported here.

1. After the premolars are extracted there is some mesial drift of the posterior teeth (out of the wedge) and this permits the mandible to hinge closed.

2. It is possible that the forces generated by the vertical-pull chin cup affect the growth at the pressure sensitive growth sites of the membranous bones.[8,9]

3. There may be retardation of eruption of the posterior teeth because of the forces from the vertical-pull chin cup acting at the periodontal membrane. Harvold[10] has stated that intrusion occurs best with continuous forces and that intermittent force may retard eruption of the teeth.

4. There may be some effect on the prechrondroblastic layer of the condyle from the pressure of the chin cup and from the fulcruming at the molars. Petrovic[14] and his workers have reported on this as well as Graber.[7] The mandibular body and ramus have a different shape in several of the long-term patients following full orthodontic treatment (Fig. 11).

The role and influence that prolonged mouth breathing and tongue thrust habits have on the development of the face are not clearly understood at this time. It does seem that both mouth breathing and tongue thrusting do occasionally need corrective therapy even though many may be self-corrective eventually. Clinically, the growing patients having either one or both of these habits have a tendency to markedly increase their alveolar heights during orthodontic treatment. Intrusive forces to the buccal segments can be helpful in preventing this unwanted lower facial height increase.[13] Either maxillary and/or mandibular headgears, jigs, vertical-pull chin cups, or mandibular bite blocks may prove to be helpful.

Another late mixed dentition alternative that can be considered for a patient with an anterior open bite and backward rotational growth tendency is to place an intrusive occipital headgear attached to the upper first molars. This should be used in conjunction with an upper lingual arch to prevent "molar roll out." When the upper first molars are out of occlusion two or three millimeters, then removal of the remaining deciduous teeth may permit the hinging of the mandible closed (Figs. 12 and 13). Stability may depend on whether or not the usual accompanying tongue thrust

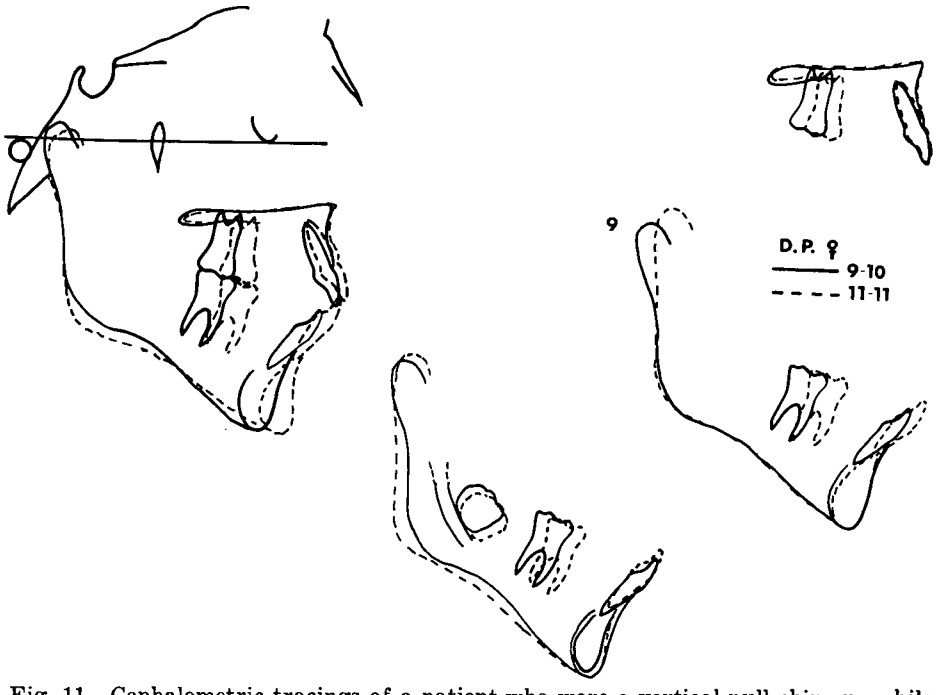

Fig. 11 Cephalometric tracings of a patient who wore a vertical-pull chin cup while waiting for teeth to erupt and also during appliance therapy. The mandibular plane closed from 46° to 42° before appliances and changed to 40° by the time appliances were removed. Notice the center mandibular tracings are superimposed on internal structures and the mandibular tracings on the right are superimposed on the symphysis and the lower mandibular border.

was adaptive or causative. The stability following this procedure shown in Figures 11 and 12 has been excellent.

For the nongrowing patient who had a backward rotational pattern during growth, there are several alternative plans one might consider although the extrusive tendency seems to diminish after growth ceases. An upper first premolar extraction treatment using an occipital type of headgear can be successful. Whenever possible, not banding the lower arch prevents any treatment extrusion from aggravating the problem. A fixed lower retainer is highly desirable to prevent lower crowding from developing. If it is necessary to extract teeth in the lower arch and to place a lower appliance, the use of a vertical-pull chin cup or some other method of obtaining intrusive forces could be helpful in minimizing treatment extrusion. The chin cup or lower cervical headgear might also be considered as a useful adjunct when Class II elastics are found necessary to complete treatment and when the clinician is concerned about the extrusive component of the Class II elastics.

There are several surgical-orthodontic procedures that hold promise in the treatment of relatively severe backward rotaters who have completed their growth.

There is an increasing awareness of the importance of vertical dimension in orthodontics at this time. When treated cases are evaluated, attention should be carefully spent on evaluation of any decreased or increased lower facial height. As orthodontists become more proficient in handling this dimension,

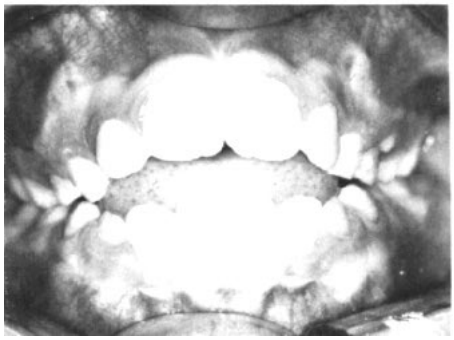

Fig. 12 Frontal view of a patient with an anterior open bite before upper molar intrusion.

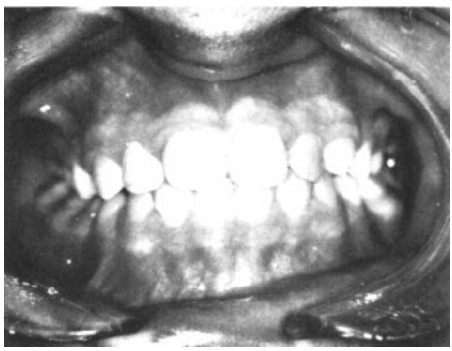

Fig. 13 Frontal view of patient shown in Figure 11 following upper molar intrusion and removal of the remaining deciduous teeth that permitted the mandible to hinge to a more closed position.

the facial esthetics and possibly the future dental health of the treated patient will improve greatly.

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