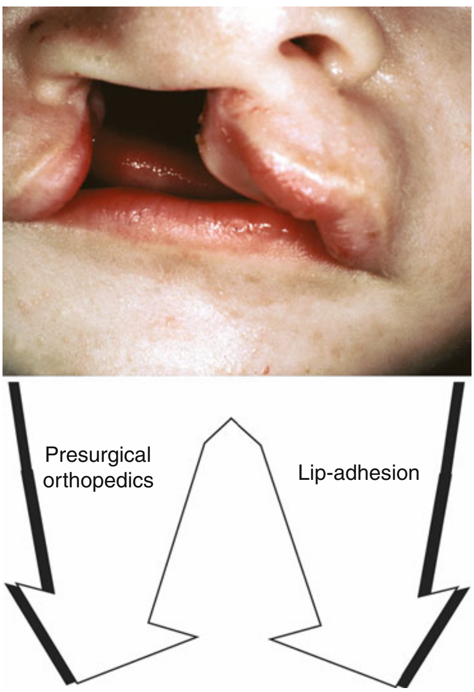
Complete Unilateral Cleft of the Lip and Palate

6

Samuel Berkowitz



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As previously described (Pruzansky 1955), in complete unilateral and bilateral clefts of the lip and palate, after the lip is united, the overexpanded palatal segments move together, reducing the cleft width along its entire posterior length. Subtelny (1955), using laminographs, has shown that newborns with complete clefts of the lip and palate have wider than normal pharyngeal widths and the perpendicular plates of the sphenoids are distorted in their relationship. Aduss and Pruzansky (1967) have demonstrated that, in complete unilateral cleft lip and palate, any one of three arch forms can result after the lip is repaired (Fig. 6.1):

1. The alveolar segments can move into end-to-end contact, producing a symmetrical arch form.
2. The alveolar segments can overlap, producing what is erroneously known as a "collapsed" arch form.
3. The alveolar segments can move closer together but not make contact. This occurs because of an inhibiting factor of the inferior turbinate on the cleft side, making contact with the distorted bulge of the nasal septum.

In a series of 58 patients who had no presurgical orthopedics or primary bone grafting, Aduss and Pruzansky (1967) found that approximately 43 % had overlap of the alveolar processes (mistakenly called collapsed arch). Among these patients, crossbites of the canine and first deciduous molar were the most common finding at 5 years of age. There were no anterior crossbites. Other investigators have reported similar results (Bergland 1973;

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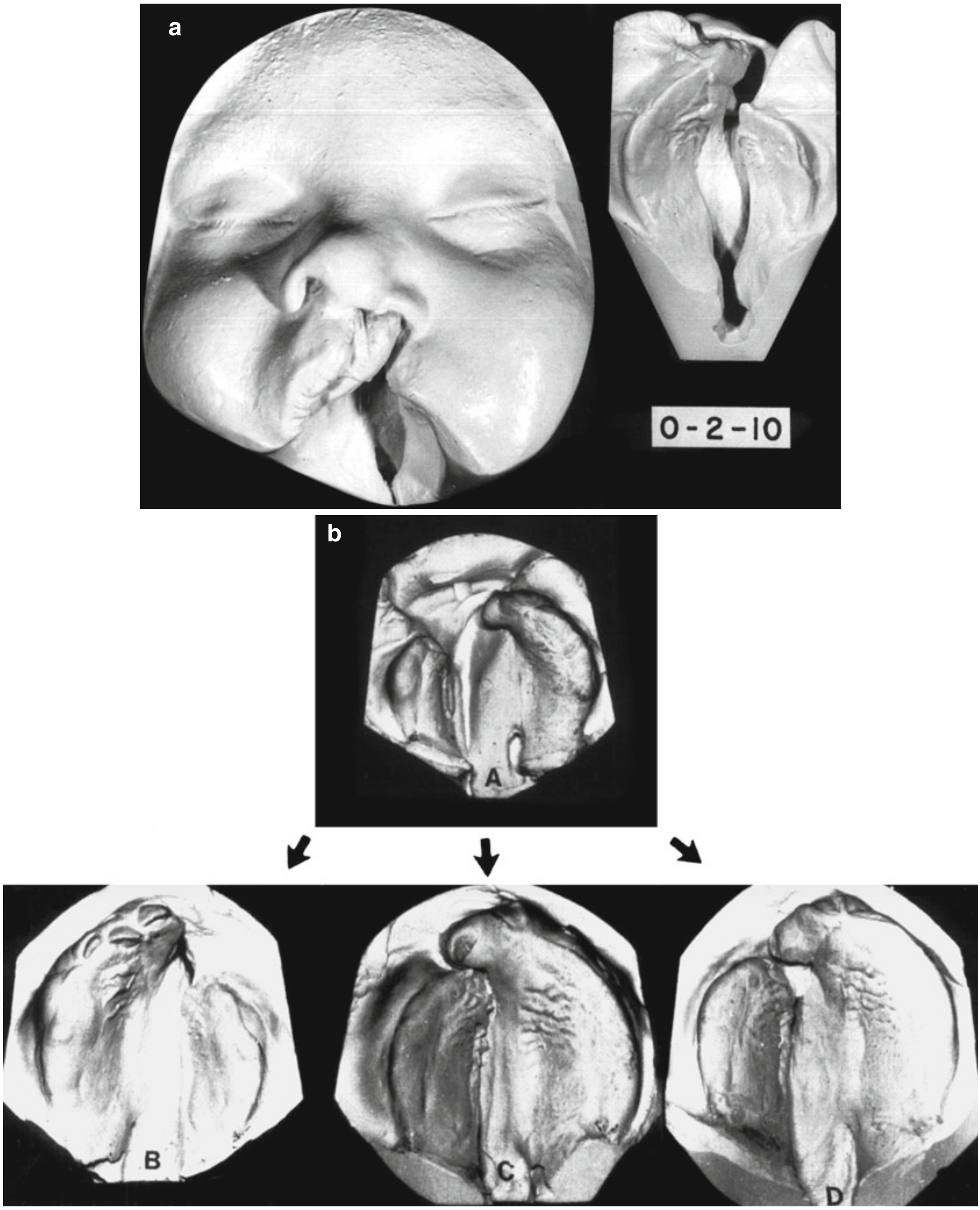

Fig. 6.1 (**a**) CUCLP. Facial and palatal casts. (**b**) Complete unilateral cleft lip and palate (CUCLP) before (*A*) and after (*B*) lip surgery. With the establishment of muscle continuity, the lesser segment moves medially, while the premaxillary portion of the larger segment moves medio-inferiorly, both acting to reduce the cleft width. Any of the following segmental relationships can result. (*B*) No contact between segments. The inferior turbinate on the cleft side makes premature contact with the bowed nasal septum. (*C*) The premaxillary portion of the larger segment overlaps the smaller segment. (*D*) The segments form a butt joint showing good approximation. Pruzansky and Aduss have shown that there is no correlation between the original cleft width and the resultant arch form. Wider clefts seemed to demonstrate less of a tendency toward collapse than did the narrower clefts (Aduss and Pruzansky 1967)

Bergland and Sidhu 1974). Berkowitz (1985), in a serial study of 36 cases with complete unilateral clefts of the lip and palate in which the lip had been united between the ages of 3 and 5 months and the palatal cleft closed between 18 and 24 months using a von Langenbeck with modified vomer flap without neonatal maxillary orthopedics, showed that 5 of the 36 cases had a complete buccal crossbite which was corrected within 6–10 months with fixed palatal expanders. Cuspid crossbite was the most frequent occurrence and was due to angular palatal rotation as well as to ectopic eruption of the deciduous cuspids. The cleft and noncleft segments were in either a class I or class II occlusal relationship. In no instance were any of the segments in a class III relationship.

This confirms Berkowitz's belief that the cleft palatal segment is not retropositioned within the skull relative to the mandible and that the maxillary-mandibular relationship is similar to that seen in the noncleft population. Whether the maxilla and mandible are both posteriorly positioned within skull has not been determined, and others (Semb 1991; Ross 1987a, b, c) have found this to be the case. Therefore, the palatal segments do not need to be brought forward by the use of neonatal protraction forces as Latham (1980) and his mentor McNeil (1950) have suggested. There are, however, some cases when, because of an unfavorable facial growth pattern coupled with a retruded maxilla relative to the anterior cranial bases, orthopedic protraction forces will be beneficial in the mixed (transitional) and permanent dentition.

According to Aduss and Pruzansky (1967), four factors govern arch form:

1. The size and shape of the alveolar process adjacent to the cleft. A bulbous and fully toothed alveolar process acts as an impediment to the collapse of the arch, whereas a thinly formed and dentally impoverished alveolar process leads to the overlapping of segments.
2. The size and shape of the inferior turbinate on the side of the cleft. A thick, rounded, well-modeled inferior turbinate can block excessive medial movement of the palatal segments.
3. The size and geometrical inclination of the nasal septum. A highly inclined septum with a contiguous bulbous turbinate will affect the movement of the palate and its final position.
4. The size and shape of the palatal shelves. Shelves of disproportionate size are more prone to overlap. One can certainly visualize that a long noncleft segment coupled with a short cleft segment will end up with the premaxillary portion overlapping the short cleft palate segment.

6.1 Facial Characteristics

Aduss (1971) in 1971 examined 50 males and 21 females with UCLP; their age range was between 4 and 14 years. He described craniofacial growth in the male cleft group as essentially equivalent to the female cleft group. He found that the gonial angle for the cleft patients was consistently larger than the noncleft group and the mandible appeared to be more retrognathic. He concluded that the craniofacial complex in the cleft sample tended to grow in a similar manner to that reported for the noncleft populations. The results of his study, based on a conservative method of surgery, negate the conclusions reached at the time regarding the deleterious effects of surgery on the growth of midface.

Hayashi et al. (1976) studied craniofacial growth in unilateral complete clefts using lateral cephalograms of 135 males and 120 females with an age range of 4–18 years. Control subjects included 120 noncleft males and 120 noncleft females of similar age to the cleft subjects. They concluded that the cleft group differed from the control group in several major respects: (1) Their overall growth trend showed a more downward or vertical direction; (2) the cranial base angle was more flattened; (3) the maxilla was smaller and was located in a more posterior and upward position; (4) ramal height was shorter, the gonial angle was more obtuse, and mandible was generally retrognathic; (5) upper face height was smaller and lower face height was greater; (6) underdevelopment in both the maxilla and the mandible was more pronounced in cleft females than in cleft males.

Smahel and Mullerova (1986), in 1986, studied 30 boys with UCLP prior to palatoplasty using cephalometry. A comparison with 27 normal individuals matched in age showed that most basic deviations of the craniofacial configuration recorded in adults developed at an early age, often prior to palatoplasty, i.e., reduced height of the upper anterior face, maxillary dentoalveolar retroclination, displacement of the upper jaw backwards, widening of some components of the maxillary complex, and a shortening of the mandibular body and ramus. Only the length of the upper jaw was not reduced. The shortening of maxillary dimension occurred postoperatively at a more mature age.

Later on 1992, Smahel et al. (1992) presented another study of craniofacial morphology in UCLP in 58 adult males. The results showed a shortening of maxillary depth, reduction of the upper face height, increased lower anterior facial height, and mandibular changes resulting from growth deficiency that consisted of shortening of the body and ramus, obtuse gonial angle, steep mandibular plane, and retrognathia.

Again in 1992, Smahel et al. (1992) studied growth and development of the face in UCLP during prepubertal and pubertal periods. He concluded that there were no definitive differences in the growth rate between the pre- and postpubertal periods. Therefore, the worsening of overjet during puberty could be due to the depletion of the compensation and adaptation after the previous orthodontic treatment rather than to the enhanced growth rate. In addition, he found that during the prepubertal period, the lower jaw showed a very slight posterior rotation, while during puberty, an anterior growth rotation was present. A marked retrusion of the maxilla developed already in the prepubertal period. During both periods, there occurred an identical impairment of sagittal jaw relations and of the upper lip prominence, accompanied by a flattening of the facial profile and reduction of the nasolabial angle.

In 1996, Smahel and Mullerova (1996) reported a longitudinal study regarding postpubertal growth and development of the face in UCLP as compared to the pubertal period. The data showed that in boys, facial growth persists after the age of 15 years and maxillary growth attains almost half the values recorded in the period of puberty, while mandibular growth attains almost the same values as during puberty. In girls, the growth is almost terminated except for the lower jaw, where it is still significant though several times slighter than during puberty. Due to the gender differences in the amount of postpubertal growth, developmental changes in facial configuration do not occur in girls during this period, while in boys, there is a further deterioration of maxillary protrusion, sagittal jaw relations, and flattening of the face.

In 1988, Hoswell and Levant (1988) reported another long-term follow-up of skeletal growth of UCLP subjects ranging in age from 8 to 18 years. Serial cephalographs taken every 2 years were utilized for determination of six cephalometric dimensions: anterior cranial base, upper and lower facial heights, posterior nasomaxillary height, maxillary horizontal length, and mandibular length. These were compared to published cephalometric standards of a noncleft group. All dimensions except mandibular length were smaller in the UCLP group. The horizontal maxillary length appeared to be most affected in UCLP. Mandibular length was not affected in the cleft group.

6.1.1 The Oslo Study

Because of the stable and long history of meticulous record keeping and protocols that characterizes the data acquisition of the Oslo team, the following studies on unilateral cleft lip and palate are presented to provide a unique perspective on treatment strategies and facial growth standards based on longitudinal data. The author does not follow the same surgical strategies as those of the Oslo team but recognizes that the differences are not significant enough to interfere with obtaining a successful long-term outcome.

Semb's (1991) 20-year serial cephalometric study taken from the Oslo Archives gathered during Bergland's leadership involved 76 males and 81 females (157 individuals) who did not have neonatal maxillary orthopedics. All of the children in the study had lip closure in infancy using a modified Le Mesurier or, after 1969, a Millard procedure. During the same operation, the nasal floor was closed using a one-layer vomer flap. The remaining posterior palatal cleft was closed between 4 and 5 years of age using a von Langenbeck palatoplasty. Secondary alveolar bone grafts from the iliac crest were placed at between 8 and 11 years of age. By 1974, all palate repairs were completed by 18 months of age. Superior-based pharyngeal flap surgery for velopharyngeal insufficiency was performed in about 20 % of the cases.

Compared with normal males and females, the pooled sample with unilateral cleft lip and palate showed (1) skeletal and soft tissue maxillary retrusion, (2) elongation of the anterior face (even though the upper face height was shorter), (3) a retrusive mandible, (4) reduction in posterior face height, and (5) a slight increase in the angle of the cranial base.

The pattern of growth also was different from that of noncleft individuals. Between 5 and 18 years of age, there was almost no increase in the length of the maxilla. There was a marked reduction in maxillary and mandibular prominence. Vertically, the excessive lower face angulations changed slightly.

6.1.2 Multicenter CUCLP Cephaloradiographic Study (Ross 1987a, b, c)

Ross's multicenter study involved data from 15 cleft palate centers around the world collected for the purpose of determining the effects of manipulative and surgical treatment on facial growth. A sample of 1,600 cephalometric radiographs of males with complete unilateral cleft lip and palate were traced, digitized, and analyzed in the Craniofacial Center of the Hospital for Sick Children. The seven series of studies considered virtually every aspect of treatment that might influence facial growth.

Ross concluded that the type of surgical repair used does not make an appreciable difference to facial growth. It appears, however, that there are differences that can only be explained on the assumption that some surgeons induce less growth inhibition than others. Variation of the timing of hard and soft palate repair within the first decade does not influence facial growth in the anteroposterior or vertical dimension. Ross admits that very early soft palate repair was not well represented in this study, and there is some suspicion that there might be untoward results.

Berkowitz et al. (2005) clinical findings suggest a different conclusion that, in most cases, early surgery (before 12 months) will have a negative effect on palatal growth in all three dimensions. It all depends on the size of the cleft defect relative to the area of the surrounding mucoperiosteum (see Chap. 7).

Ross's study did not include palatal surgery from 6 to 12 months. This study also reported that the resulting face is flat in profile and decreased in depth, with a vertical deficiency in the midface and vertical excess in the lower face. The mandibles in these faces characteristically are slightly shorter in total length so that the chin is retruded. The occlusion is more of a molar and incisor mesiocclusion in clefts with less overbite and overjet. The soft palate in this sample is appreciably more posterior. The mandibular plane angle is greater, possible due to the need for more interincisal space.

Ross further stated that the bony pharynx was unaffected by treatment and that the variation in midface development can be attributed to maxillary length rather than to maxillary position. He also noted that the mandible is not directly affected by treatment. Facial growth is intrinsically compromised by an underlying deficit, and surgery acts to further interfere with growth of the midface by inhibiting forward translation.

The best results appear to follow lip repair at 4–5 months with no repair of the alveolus. Early alveolar repair restricts its vertical growth and should be avoided in individuals with poor growth potential. This leads to deficient midfacial height and poor vertical height proportions, with more acute nasolabial angles. There is no evidence that periosteoplasty will cause similar results. Berkowitz et al. (2005) study conclusively shows that periosteoplasty inhibits midfacial development, especially that of the premaxilla (see Chap. 10).

Ross further states that the maxilla in the UCLP is not more posteriorly positioned to any appreciable extent, but it is much shorter in length. The repaired lip affects the basal maxilla more than the alveolar process. Vertical development of the posterior maxilla is more deficient than the anterior part. The mandible is shorter with a steeper mandibular plane angle.

Hard and soft palate surgical repair procedures provide the greatest potential for inhibiting the maxilla in length, forward translation, and posterior height.

Kwon's (1998) retrospective longitudinal study of the skeleto-facial growth in unilateral cleft lip and palate documented and evaluated the proportional craniofacial growth horizontally and vertically in 14 UCLP patients of the ages 5–18 years by using modified Coben's basion horizontal analysis. There were three populations included in this study: The Eastman cleft group (sample size, 24) and the Miami cleft group (sample size 23) served as patient group, and the Bolton templates (ages 5–18) served as controls. Samples were divided into four age periods according to the chronological ages, and then the growth pattern of each period were evaluated and compared. A total of 301 images of lateral cephalograms were examined and digitized. These characteristics of the skeletal facial growth of the UCLP are summarized as: (1) There is no difference of posterior cranial base over time; (2) maxilla is positioned posteriorly relative to basion (BA) during the early ages and is getting retrusive due to the deficient growth with time; (3) upper anterior facial height (UAFH) is almost the same as the control; (4) lower posterior facial height (LPFH) is increased but is not as much as lower anterior facial height (LAFH); (5) lower anterior facial height (LAFH) is significantly increased; (6) total facial height (TFH) is significantly increased; (7) mandible is positioned backward and downward due to the posterior position of the maxilla and the elongation of LPFH and LAFH; and (8) skeletal profile is more convex and is getting straight and finally is flatter over time in the clefts than in the controls. Generally, the manifestation of the cleft characteristics of the Miami group is increased when compared to that of the Eastman cleft group. The skeletal growth leads to not only the maxillary retrusion but also to position the mandible down and back. Early orthopedic intervention followed by the fixed edgewise appliance and prolonged retention is recommended to try to correct the skeletal problems, camouflage by dental correction, and maintain to the treatment outcome with reasonable retainer.

6.1.3 Reflection on Ross' Excellent Multicenter Study (Ross 1987a, b, c)

In the foreword of the multicenter study, Treatment Variables Affecting Facial Growth in Complete Unilateral Cleft Lip and Palate, Bruce Ross discussed the difficulty of performing this type of study due to the variability in sample size, age, sex, precise cleft type, and ethnic origin. He then mentioned the problems associated with doing cephalometric measurements and suggested using one center to control measurement errors; this was an excellent solution. According to Ross (1987a, b, c), the study considered virtually every aspect of treatment that might influence facial growth. An attempt was made to control many variables that influence growth research, so that a clear picture of the effects of each procedure would be available. Two major assumptions about the study are necessary if any conclusion can be drawn from these studies. The first is that all groups of infants with complete unilateral cleft lip and palate have exactly the same facial morphology at birth in spite of enormous individual variation within the group. The second assumption is that one group of infants will respond on the average in exactly the same way as any other group to a particular treatment. The intent was to assemble relatively pure samples of individuals who had received the given management techniques used consistently on all subjects from a particular center.

Berkowitz believes the study was a noble attempt by excellent clinicians/researchers to pool their sample cases to investigate treatment results. By necessity, it was limited to cephalometric records. By lumping all CUCLP cases together, regardless of the degree of palatal deformity at birth, much potential prognostic information for the treatment of individual cases is unavailable. Ross had no choice for discounting Slavkin's and Ross and Johnston's statements that palatal defects may be caused by either the failure of the separated palatal segments to fuse or, possibly, palatal osteogenic deficiency, a variable that needs to be considered in treatment planning. This statement on the embryo-pathogenesis of cleft palate explains why all clefts within a cleft type are not alike. It is not hard to reason that as the extent of the cleft palatal defect varies, so will the resulting quantity of palatal surface area and the resulting quantity of post-surgical scar tissue. Because excessive scarring inhibits palatal growth and development, the palatal surface area at the time of closure needs to be considered in treatment planning. Berkowitz believes that the variability of palatal surface area within a particular cleft type weakens the value of Ross's (1987a, b, c) conclusions, which are based on the second assumption that "one group of infants will respond on the average in exactly the same way as any other group to a particular treatment." Berkowitz concludes that the next level of treatment evaluation studies designed to improve differential diagnosis requires the establishment of specific criteria based on quantitative and qualitative characteristics of the palatal defect when related to treatment outcome (see Chap. 7).

6.2 How the Palate Grows

As ready discussed in Chap. 1 on facial growth, bone growth involves the increase in size as well as remodeling. Serial palatal three-dimensional growth studies by Berkowitz et al. (2005) have shown that growth and remodeling occurs over the entire palatal surface even at the medial border the palate at the cleft (Figs. 6.2 and 6.3).

6.3 Treatment Sequence

6.3.1 Usual Treatment Sequence

1. Lip adhesion: 3 months
2. Definitive lip surgery (rotation advancement): 10 months
3. Hard and soft palate closure (von Langenbeck with vomer flap): 18–24 months (rarely 36 months)
4. Orthodontic expansion (quad helix): 5–7 years
5. Superior-based pharyngeal flap: 6–8 years if necessary
6. Bone graft (iliac crest): 7–9 years
7. Protraction facial mask (if necessary): 8 years or later
8. Maxillary surgical advancement (Le Fort I or distraction osteogenesis): varies
9. Lip/nose revisions techniques

6.4 Reports

In this section, treatment outcomes of selected cases are presented with photographs and dental casts. The casts started at birth and continued through adolescence; these records show the natural history of palatal and facial growth and development when conservative surgery was performed without the use of presurgical orthopedics.

In some cases, the lip was united after the use of a Logan's bow (Fig. 6.4), and in others, after lip adhesion at approximately 3 months of age. In some cases, the cleft of the soft palate was united at the same time the hard palate was closed. Definitive lip surgery was performed at 6 months, and hard palate closure using a modified von Langenbeck procedure with a vomer flap was performed between 12 and 24 months of age.

Selected cases are presented in Figs. 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16, 6.17, 6.18, 6.19, 6.20, 6.21, 6.22, 6.23, 6.24, and 6.25 to show various treatment solutions to complex problems.

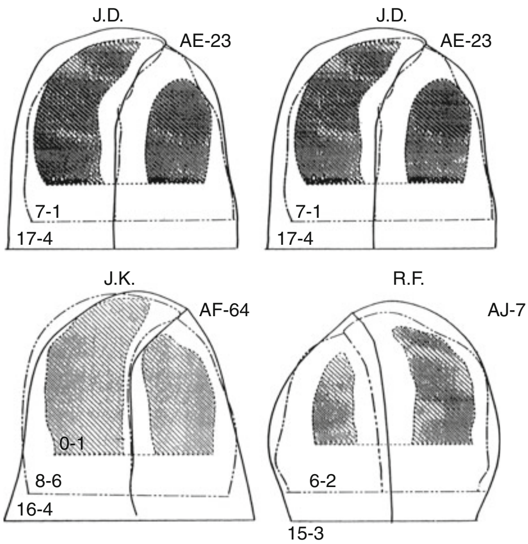

Fig. 6.2 (**a**, **b**) Superimposed computer-generated images of serial CUCLP casts superimposed on the rugae and registered on the vomer AP line. The alveolar ridge is the outer limits of the palate. Surgery: Lip adhesion at approximately 3 months, definitive lip surgery at approximately 6 months, and hard and soft palate closure between 18 and 24 months using a von Langenbeck procedure with a vomer flap. No presurgical orthopedics. Results: These four illustrations show the result of molding and growth. The least growth occurs anteriorly. Most of the growth occurs posteriorly to accommodate the developing deciduous and permanent molars. The palatal mucoperiosteum covers increase palatal size and the palatal cleft, which greatly reduced in size

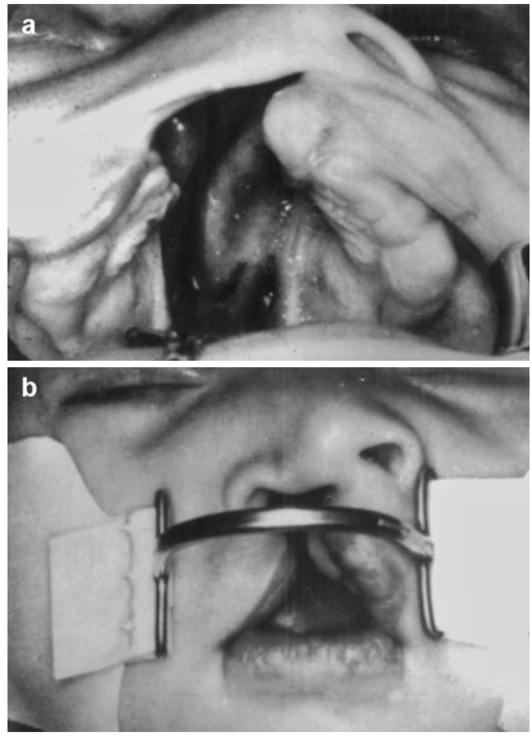

Fig. 6.4 (**a**, **b**) Logan's bow. Pressure is placed on the cheeks to bring the lips together prior to surgery. The bow helps to reduce tension at the suture line

Fig. 6.3 Case KK-55. Serial growth of the palatal segments in CUCLP. Using computer-generated 3D images, the surface areas mesial to the alveolar ridges were analyzed using an electromechanical digitizer. The same surgery stated in Fig. 6.2 was used. Results: This case is an example of 60 cases analyzed in the study; it shows (1) both palatal segments grow at the same rate and (2) the most rapid period (velocity) of growth occurs during the first 18 months. Comments: Because the most rapid period of growth occurs between 8 and 24 months when cells are most active, it is best to postpone palatal surgery until a later age in order to not inhibit growth

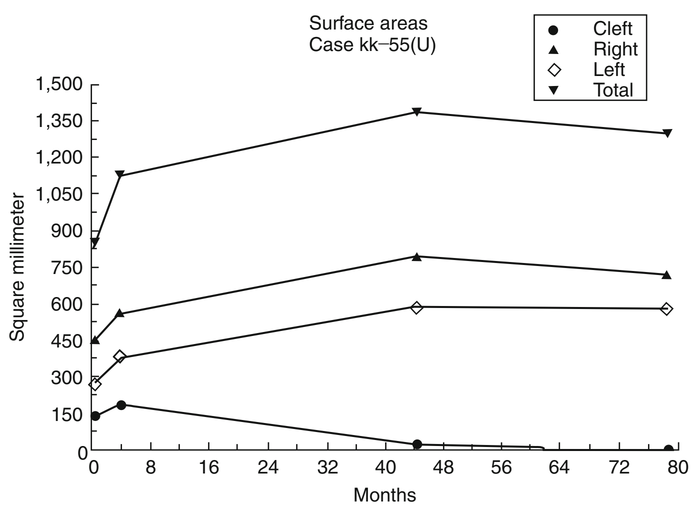

Fig. 6.5 (**a**–**v**) Case: KC (ZZ-1) demonstrates good palatal and facial growth in CUCLP. A very small cleft space at 5 months of age allowed for easy closure without much scar formation. Surgical treatment: No presurgical orthopedics. Lip adhesion followed by Millard's rotation advancement. Soft palatal closure at 2 months. Palatal cleft closure at 15 months using modified von Langenbeck procedure. Secondary alveolar cranial bone graft at 6 years and 8 months. Photographs showing various treatment stages from birth to 17 years of age. (**a**, **b**) Newborn. (**c**) Lip adhesion at 4 months. (**d**) Lip at 2 years of age. Orthodontics during the deciduous dentition. (**e**) 2 years, showing anterior crossbite. (**f**) 2 years, 7 months: palatal view showing fixed buccal expander

Fig. 6.5 (*continued*) (**g**) Anterior teeth were advanced and the cleft buccal segment expanded. (**h**) 5 years. Fixed palatal retainer. (**i**–**k**) Fixed palatal retainer with lateral incisor pontic (tooth). (**l**, **m**) Facial photographs at 6 years

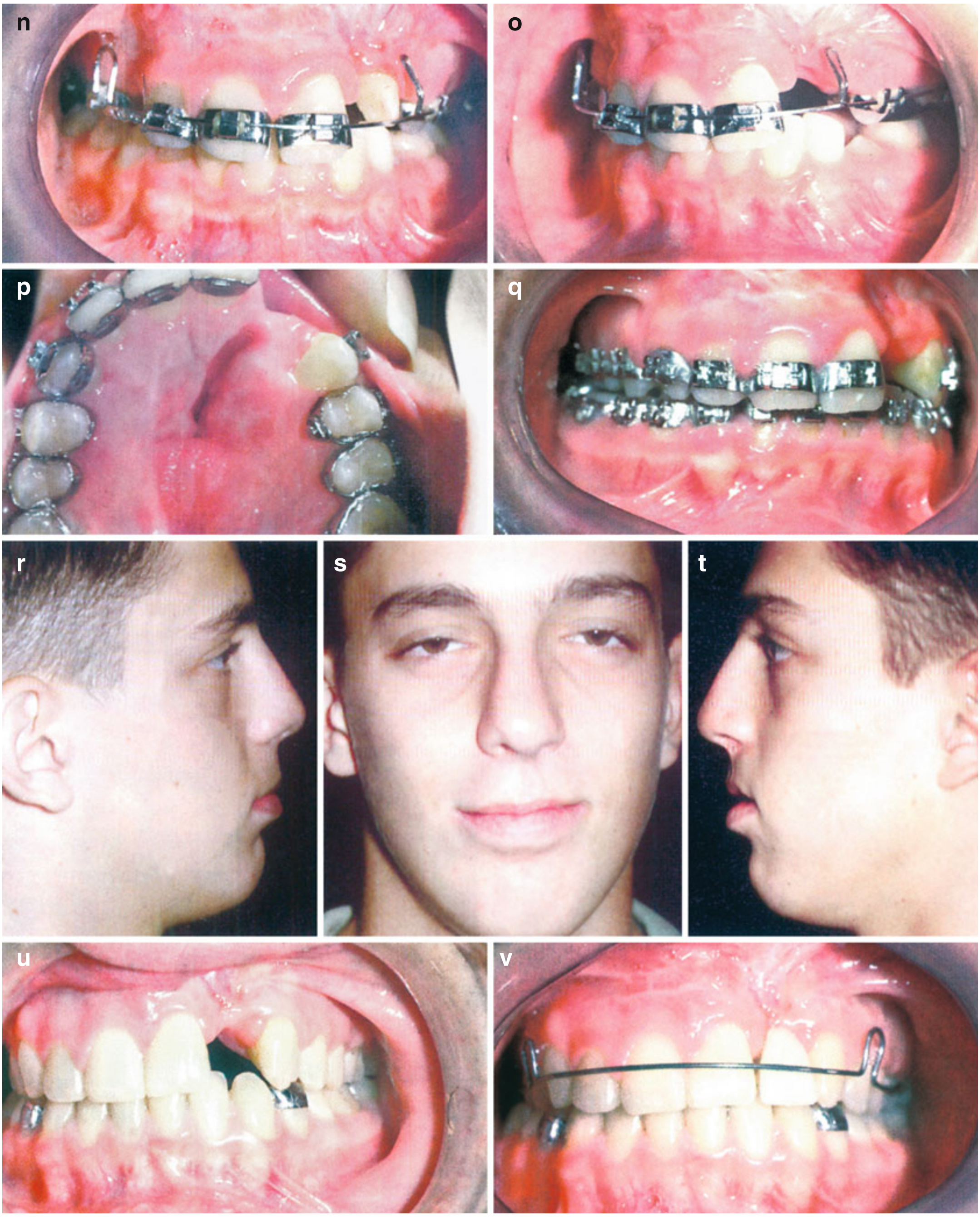

Fig. 6.5 (*continued*) (**n**, **o**) 7 years, 3 months: Lateral incisor is erupting through cranial bone graft. Orthodontics in the adult dentition: (**o**) Lateral incisor is extracted due to poor root development. (**p**, **q**) Conventional orthodontics. Surgery to close the palatal fistula was unsuccessful. (**r**–**t**) Facial photographs at 17 years. (**u**, **v**) Intraoral photographs. Hawley orthodontic retainer with lateral incisor pontic

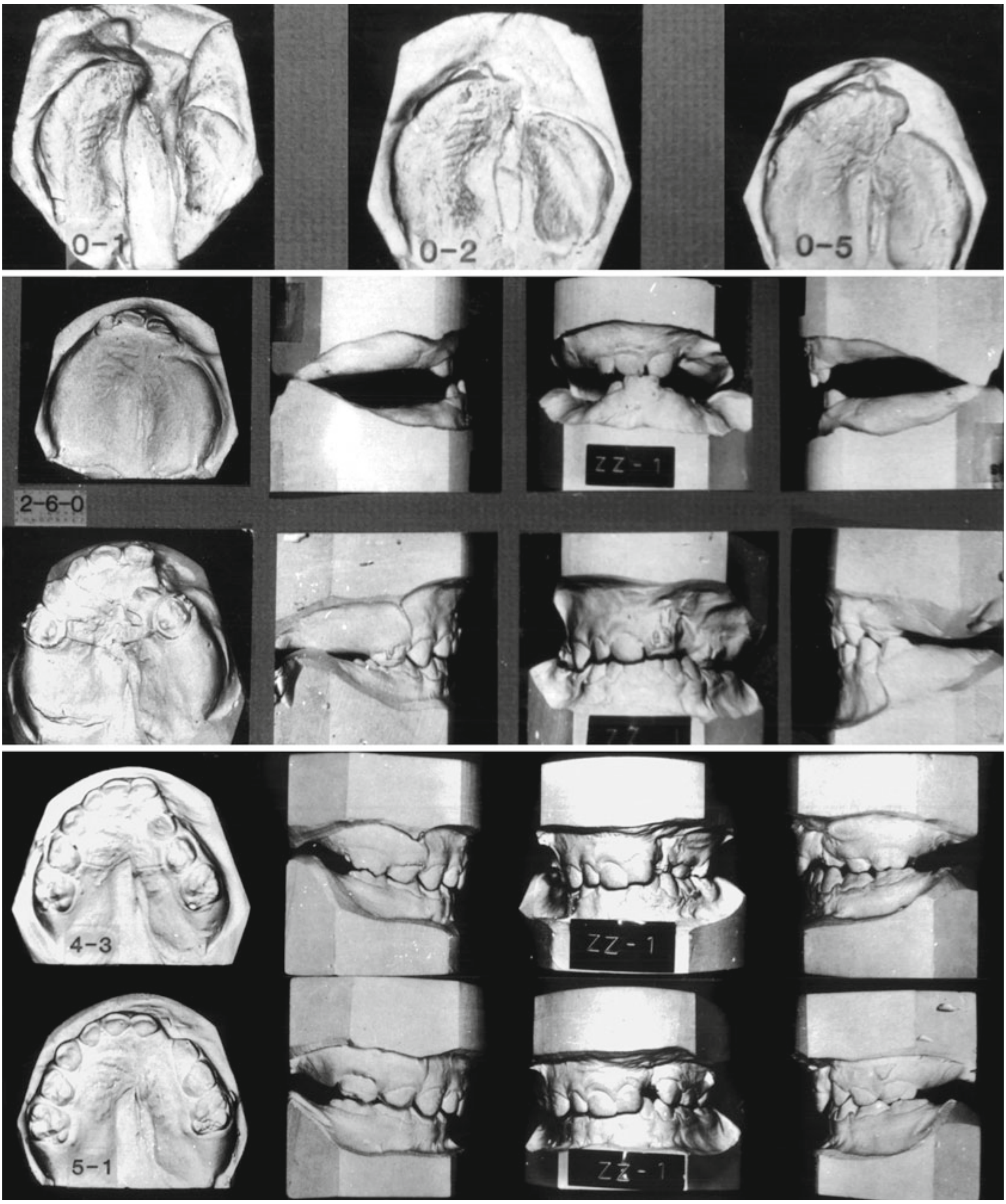

Fig. 6.6 Case KC (ZZ-1). Serial casts from 0–1 to 0–5 show medial movement and growth changes to the palatal segments. 0–5 The cleft space is extremely small with the palatal segments making contact anterior to the cleft space. 2–6–0 and 4–3 Mesioangular rotation of the lesser segment placed the deciduous cuspid in crossbite. 5–1 A fixed palatal expander rotated the segment outward, placing the teeth in ideal occlusion

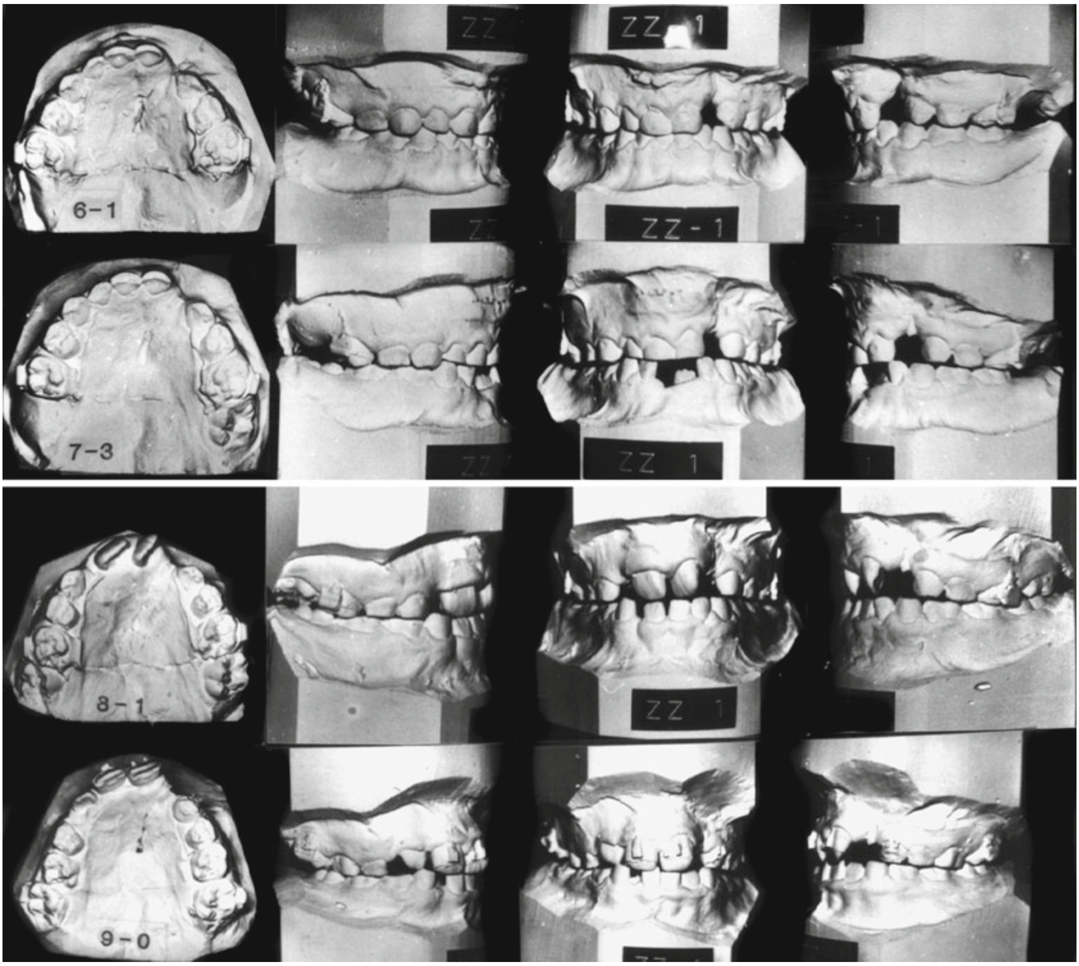

Fig. 6.6 (*continued*) 6–1 Fixed retainer maintained the correction. Secondary alveolar bone graft was performed at 7 years, 3 months of age. 9–0 The maxillary anterior teeth were rotated for aesthetic reasons

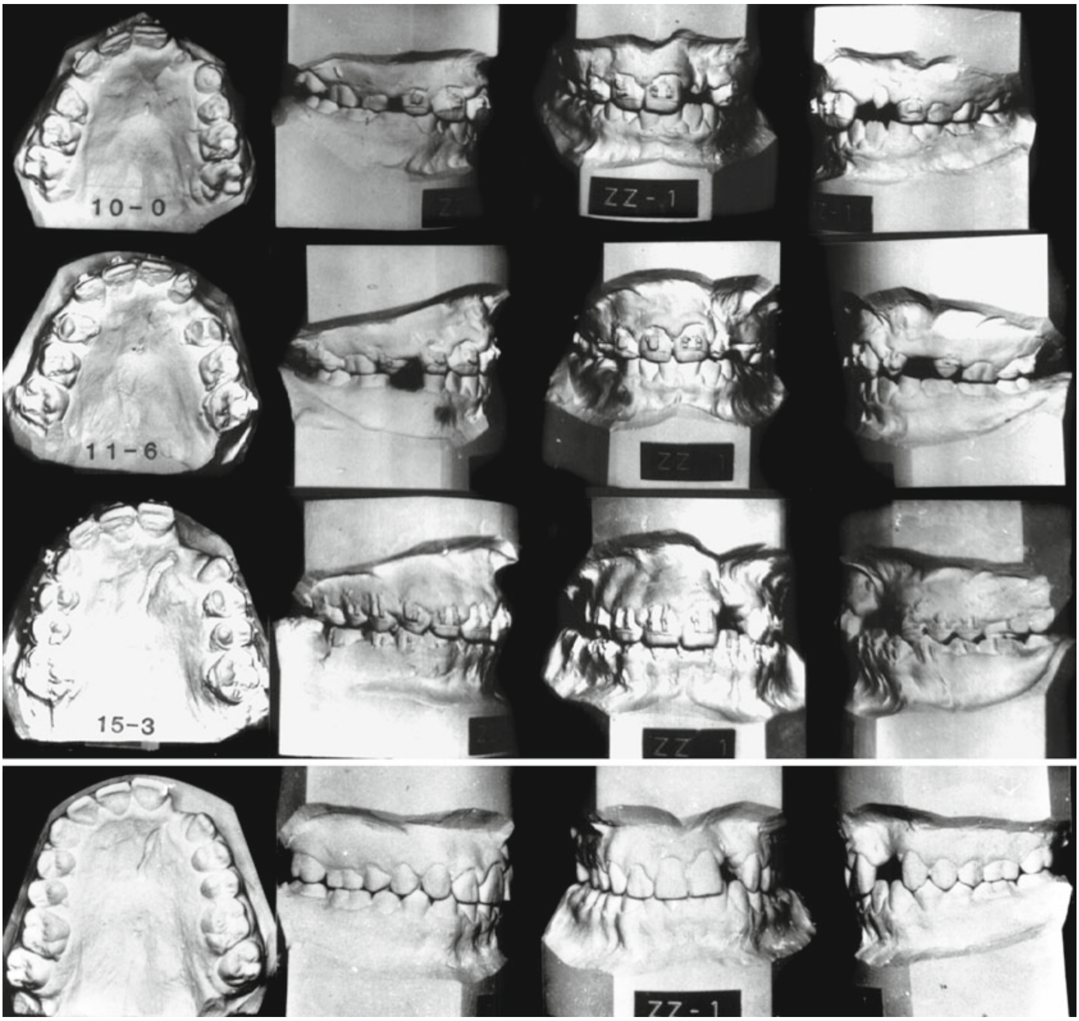

Fig. 6.6 (*continued*) 11–6 The left lateral incisor is now in place within the arch. As a result of poor root development, it had to be extracted. Conventional orthodontics was instituted and completed by 15–3. Maxillary fistula was surgically closed at 16–3, and the arch form maintained with a removable Hawley retainer with a lateral incisor pontic. 17–0 Final occlusion. Comment: Because most cleft palatal arches have some degree of osteogenic deficiency, when all bicuspids are retained, it is usual for the second molars to be blocked out and be impossible to position within the arch. This then necessitates their removal with possible replacement by the still unerupted third molars. In some instances, a small palatal fistula may not pose a speech problem or be a source of nasal drainage

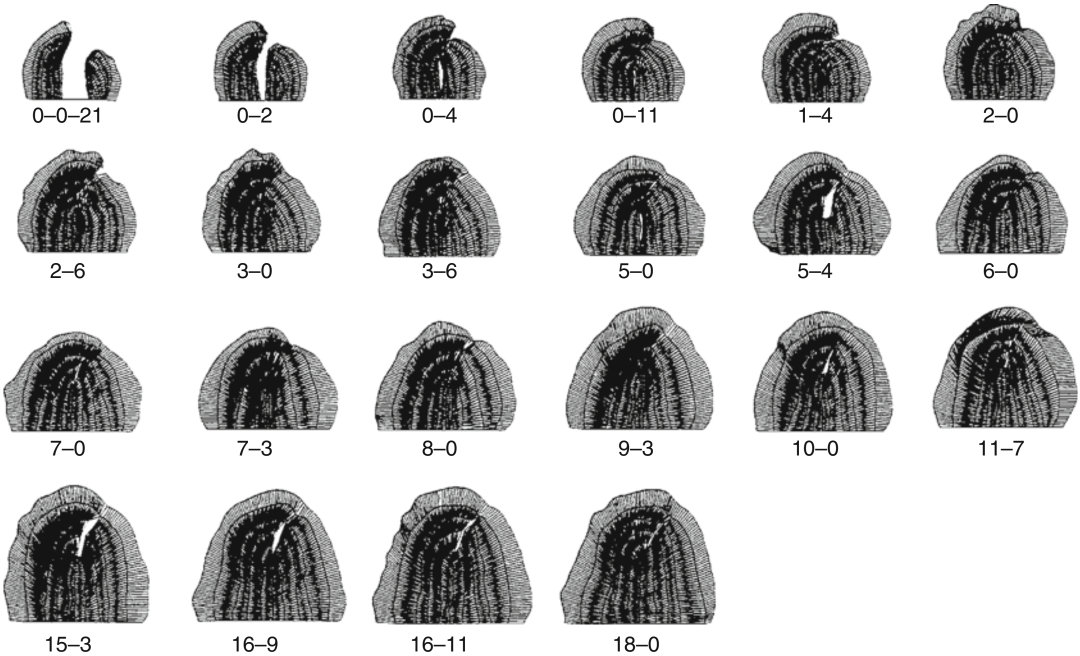

Fig. 6.7 Case KC (ZZ-1). Computer-generated drawings of serial casts which are in the same scale. The soft palate was united at 2 months and the hard palate closed at 15 months. This series demonstrates a rapid reduction in palatal cleft size with molding action and palatal growth. A palatal "fistula" was exposed when the cleft buccal segment was expanded to correct the crossbite. It was closed but reappeared when final orthopedic treatment moved the palatal segments slightly apart. The "fistula" did not penetrate into the nasal chamber. Therefore, it did not pose a speech or feeding problem

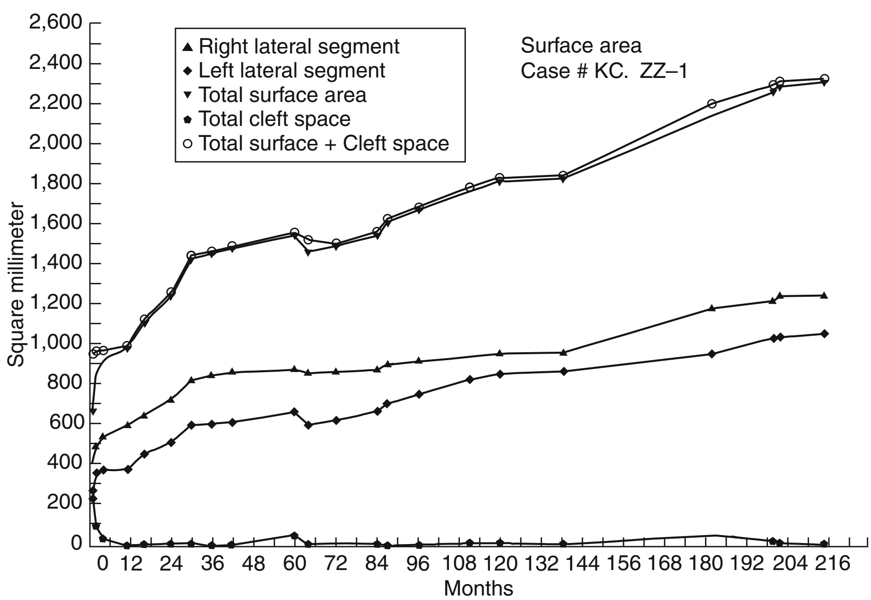

Fig. 6.8 Case KC (ZZ-1). The palatal growth chart shows (1) rapid growth acceleration in the first year which continues only slightly decreased until 36 months; (2) the palatal growth rate did not diminish after palatal surgery at 15 months; (3) palatal growth slowed between 60 and 84 months and then steadily increased; (4) between 60 and 120 months, the growth of the lesser cleft segment increased more rapidly than the noncleft segment; and (5) the palatal growth rate accelerated after 136 months. Comment: Based on palatal growth acceleration rates and the developing occlusion, one can safely conclude that palatal surgery did not interfere with its growth and development

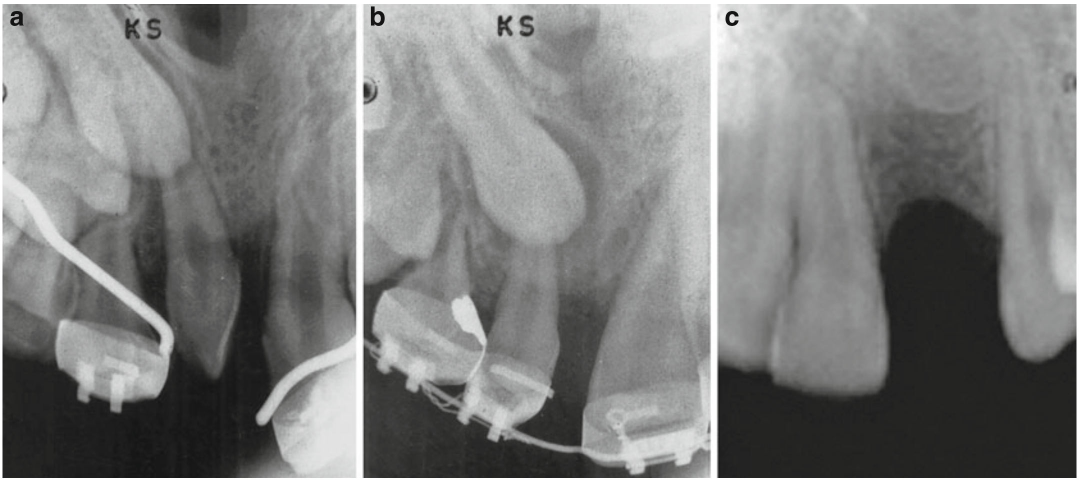

Fig. 6.9 (**a**–**c**) Case KC (ZZ-1). Tooth eruption into a secondary alveolar cranial bone graft performed at 7 years and 3 months of age. (**a**) The permanent lateral incisor is erupting into the graft. (**b**) Good root development, the lateral incisor, is brought into the arch orthodontically. (**c**) Its root began to absorb and was extracted, good alveolar bone in the cleft space

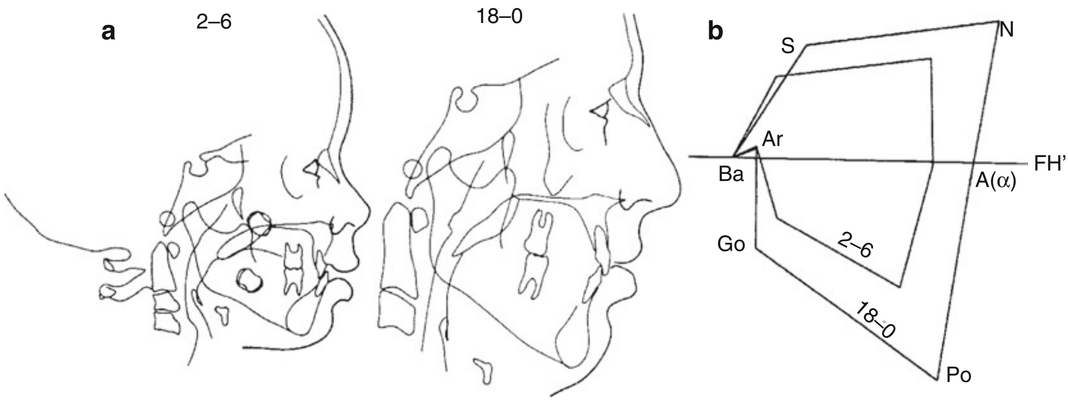

Fig. 6.10 Case KC (ZZ-1). (**a**) Lateral cephalometric tracings and (**b**) superimposed polygons using basion horizontal method (Coben). Both show an excellent facial growth pattern. At 18–0, the midface is slightly recessive but still very acceptable aesthetically

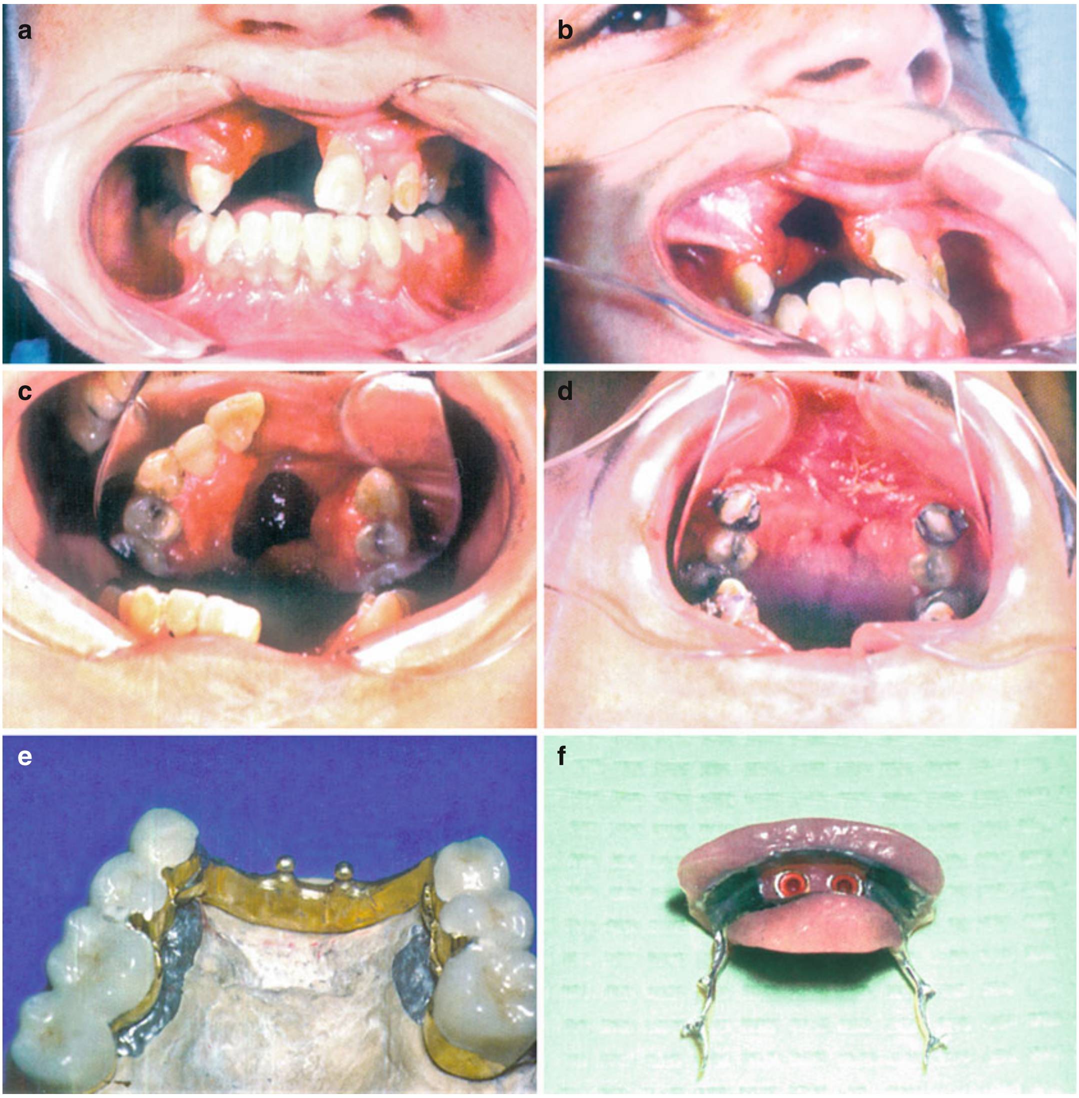

Fig. 6.11 (**a**–**m**) Case SP. Surgical and prosthetic treatment to replace a missing portion of a premaxillary segment and to close an oronasal opening (a transfer patient). Loss of blood supply to the right premaxillary area led to its exfoliation. Treatment plan: Because the remaining blood supply to the left maxillary and central incisor was questionable and the teeth showed marked root absorption, the dentist (Alan Stoler) recommended their removal. The remaining teeth were to be crowned to support an anterior cast gold section to which a removable prosthetic appliance would replace the missing incisor teeth and bumper the lip. (**a**–**c**) Frontal and palatal view of an oronasal opening due to the loss of a portion of the right premaxillary segment. (**d**) Palatal view following soft tissue closure of the oronasal opening. (**e**, **f**) Anterior prosthetic appliance with splinted posterior teeth; anterior appliance with two holes and "o" rings to receive the two extensions on the anterior splint

Fig. 6.11 (*continued*) (**g**) Posterior teeth splints with the anterior removable prosthesis in place on a model. (**h**, **i**) The gold anterior section spans the inter-cuspid space. (**j**) Palatal view with the anterior prosthetic appliance in place. (**k**–**m**) Facial photographs showing good upper lip support with excellent dental aesthetics

Fig. 6.12 (**a**–**k**) Case JK (AF-64). Excellent facial and palatal growth in CUCLP when the palatal segments did not make contact after the lip was united. The lateral incisor is in position in the alveolar cleft area. (**a**–**i**) Serial facial and intraoral photographs show changes to the lip and nose after lip adhesion and definitive lip surgery using Millard's rotation advancement procedure. Left facial asymmetry is apparent in the frontal photograph and is more noticeable in the intraoral photograph at completion of orthodontic treatment. The *left side* was kept in class II occlusion

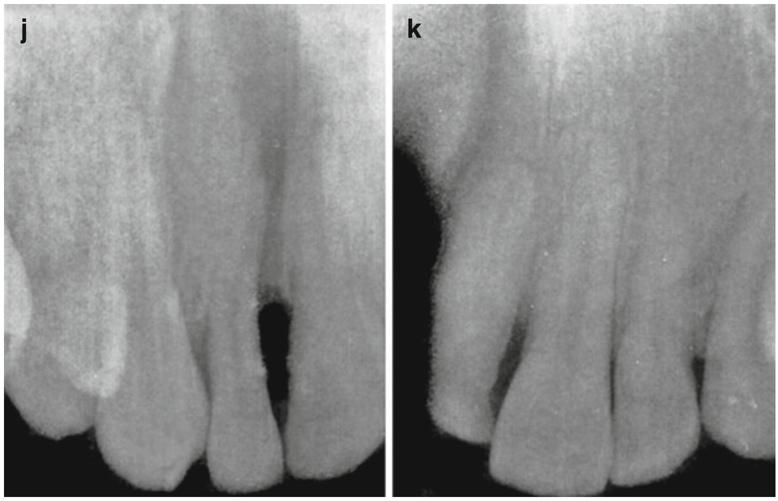

Fig. 6.12 (*continued*) (**j**, **k**) Periapical films show bone closure of the alveolar cleft space with good lateral incisor alignment

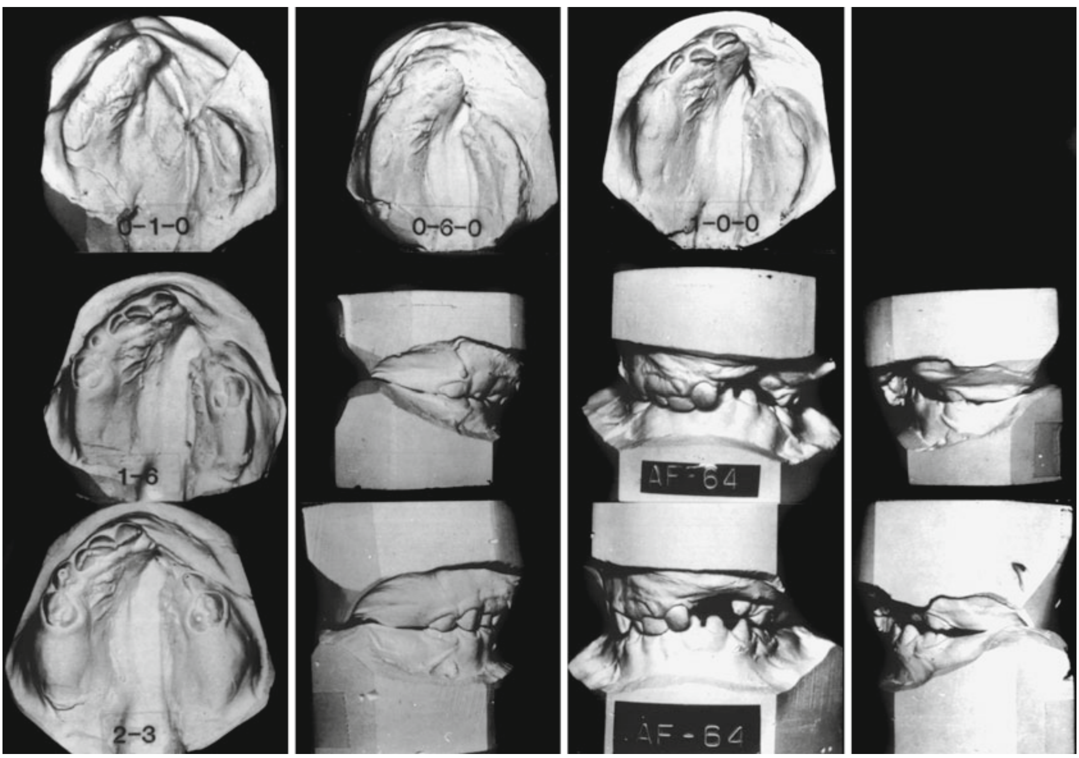

Fig. 6.13 Serial casts of Case JK. Newborn: The nasal septum bows toward the cleft segment, creating a very small cleft space. The great distance between alveolar segments is due to the upward tilt of the larger segment coupled with a small cleft segment. 0–6–0 After the lip is united, both palatal segments move toward the midline, narrowing the cleft space, more on the right than the left side. However, the alveolar segments still do not meet due to the inferior turbinate on the lesser segment making premature contact with the septum, preventing the lesser palatal segment from further medial movement. Note that the premaxillary portion of the larger segment has not moved medioposteriorly 1–0–0, 1–6, 2–3, 3–2

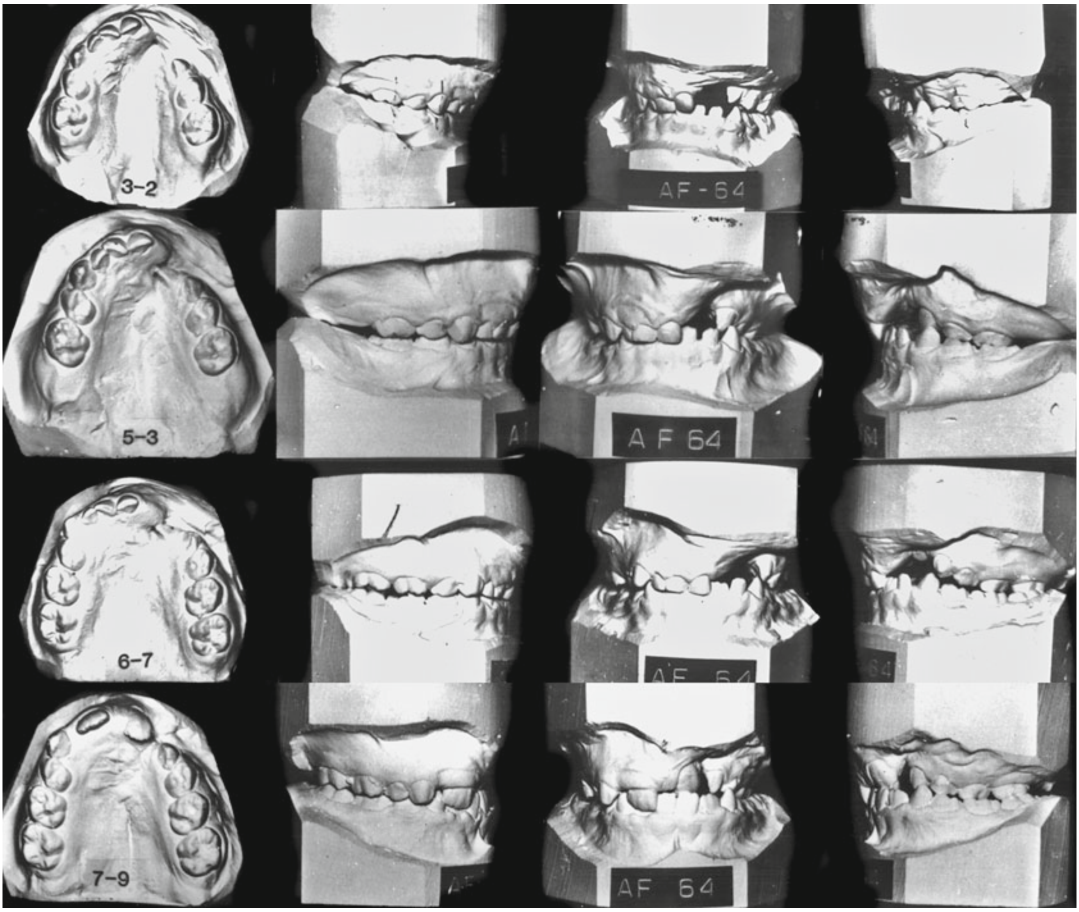

Fig. 6.13 (*continued*) The palatal segments are still apart. 5–3 After removal of the inferior turbinate and with palatal closure, the tissue contracture created by the modified von Langenbeck procedure pulls the palatal segments together, placing the buccal teeth in the cleft segment in crossbite. 6–7 The palatal segments have been expanded. 7–9 Without palatal arch retention, the crossbite returned. The ectopically erupted left central incisor is in crossbite

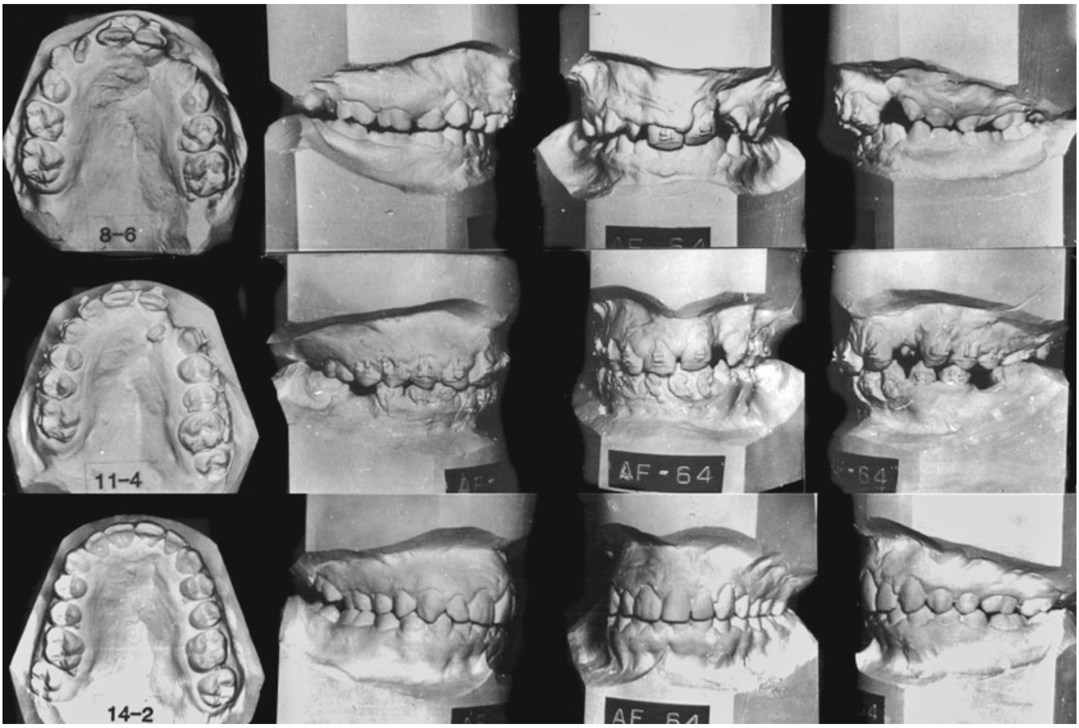

Fig. 6.13 (*continued*) 8–6 Arch expansion mechanics were reinstituted, and the left central incisor advanced into proper overjet. 11–4 and 14–2 Final orthodontic treatment was instituted and completed at 14 years of age. The impacted left lateral incisor was brought into alignment through the secondary alveolar cranial bone graft. Comment: After secondary alveolar bone grafting, arch expansion in most cases is stable. However, in cases where new bone does not extend to the nasal aperture, we believe the buccal crossbite has a good chance of returning. The left side was in class II occlusion, because it was not certain that the left lateral incisor could be properly aligned. If it was to be extracted, the cuspid would be positioned in the lateral incisor space

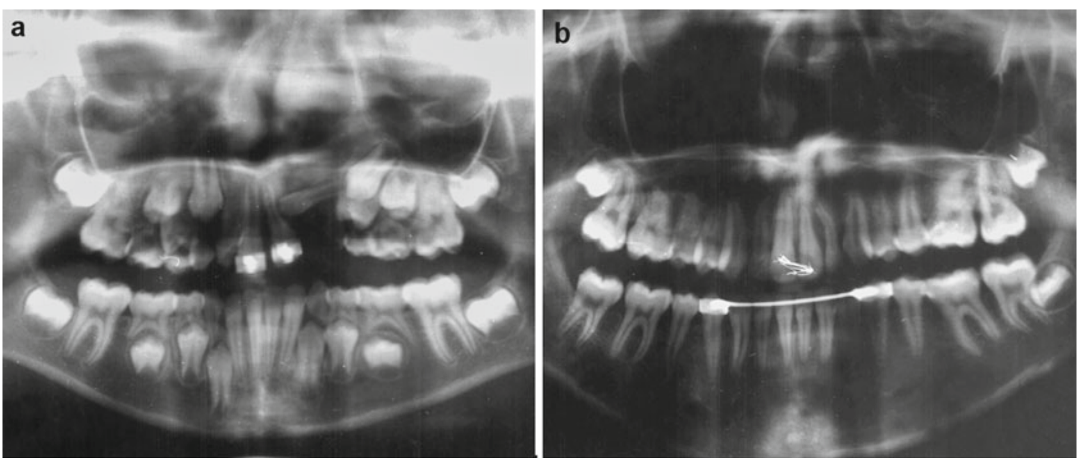

Fig. 6.14 (**a**, **b**) Case JK (AF-64). (**a**) Panorex: The left lateral incisor is palatally and horizontally impacted. (**b**) After treatment, the lateral incisor is well-aligned within the arch. Note that the curvature to the root possibly occurred before it was fully formed and during orthodontic movement

Fig. 6.15 Case JK (AF-64). Frontal cephaloradiograph shows that the nasal chamber on the cleft side is very narrow with a very flattened inferior conchae. The nasal septum is extremely bowed toward the cleft side. A lower cuspid to cuspid retainer is being worn

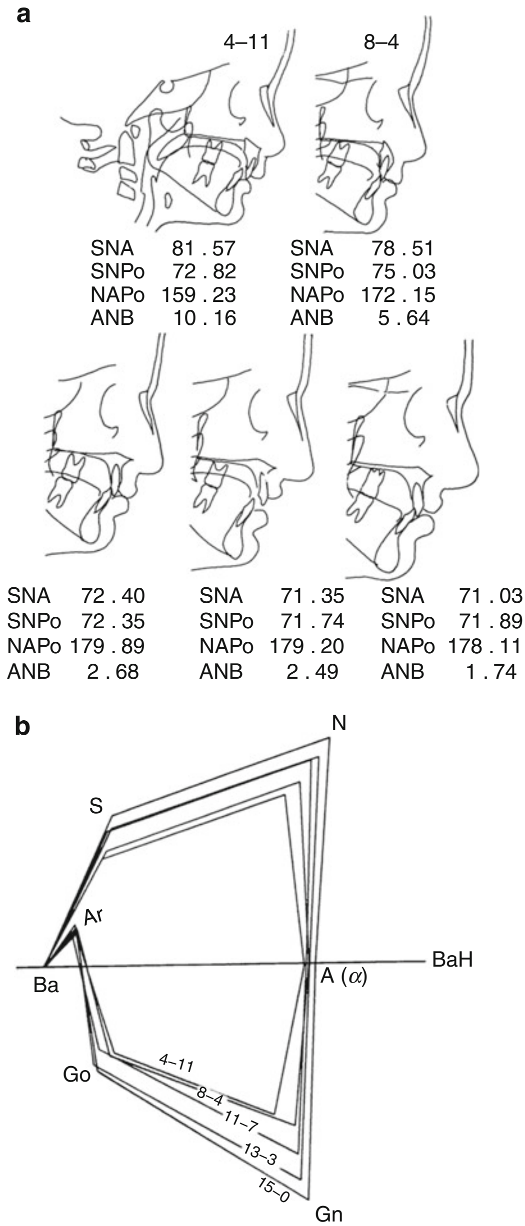

Fig. 6.16 (**a**, **b**) Case JK (AF-64). (**a**) Skeletal and soft tissue profile changes shown by lateral cephalometrics. The anterior projection of the midface and mandible relative to the anterior cranial base decreases with time as the profile flattens. The decreasing ANB angle reflects this change. (**b**) Superimposed polygons using the basion horizontal method. This series clearly shows that the flattening of the skeletal facial profile occurred around 8 years of age and was brought about by the growth at the anterior cranial base and the mandible, whose plane angle increased with time. There was almost no forward growth of the midface between 4–11 and 13–3 years with only a small postpubertal growth increment between 13–3 and 15–0 years of age

Fig. 6.17 (**a**–**s**) Case JD (AE 23). Complete unilateral cleft lip and palate. Excellent palatal and facial growth. A relatively large cleft space necessitated postponement of palatal closure until 20 months. Early secondary alveolar bone graft. Surgical history: Lip adhesion at 3 months followed by rotation advancement definitive lip repair at 6 months. Modified von Langenbeck palatal cleft closure at 20 months. Secondary alveolar cranial bone grafts at 6 years. (**a**) Before and (**b**) after lip repair. (**c**) 2 years, 5 months. Anterior and buccal crossbite. (**d–f**) 3 years, 4 months. Anterior and buccal crossbite correction with fixed palatal expander

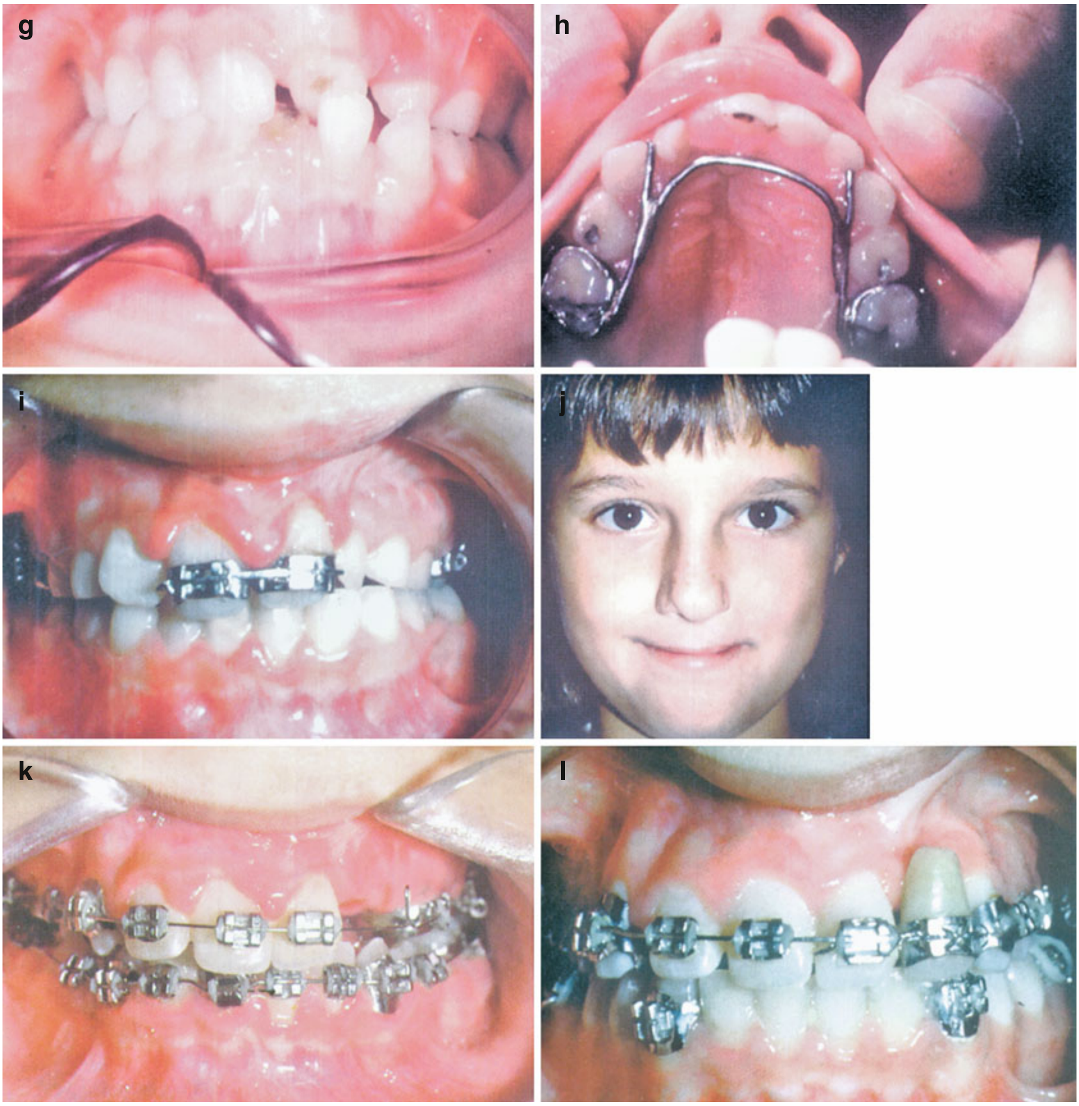

Fig. 6.17 (*continued*) (**g**, **h**) 4 years, 6 months. After expansion, a fixed palatal retainer. (**i**, **j**) 9 years. Central incisor aligned in the mixed dentition. (**k**, **l**) Orthodontic appliance with a false lateral incisor tooth with band attached to the orthodontic arch wire

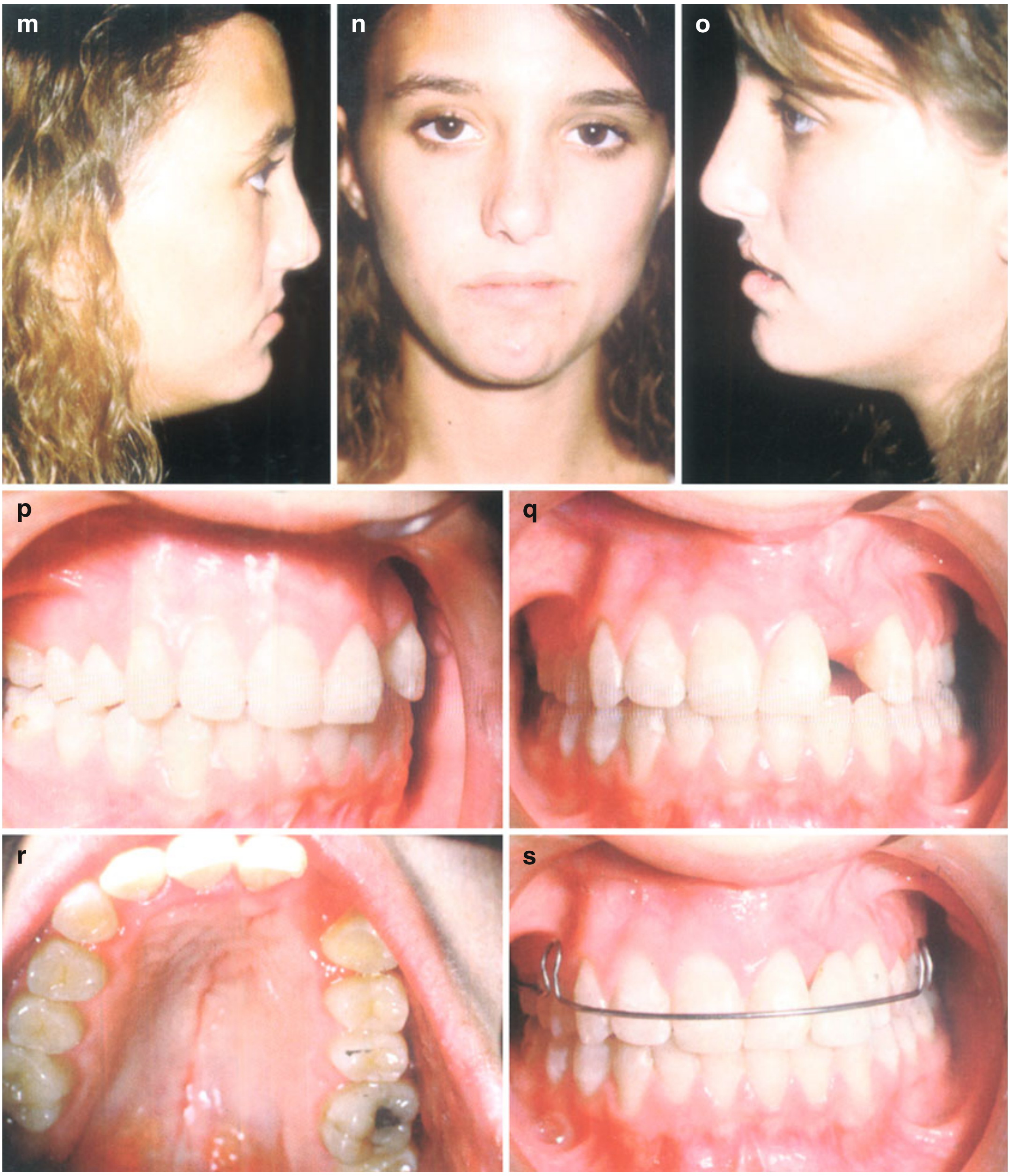

Fig. 6.17 (*continued*) (**m**–**r**) Facial and intraoral photographs at 15 years of age – on completion of orthodontic treatment. Ideal dental occlusion. (**s**) Maxillary retainer with an attached lateral incisor pontic tooth

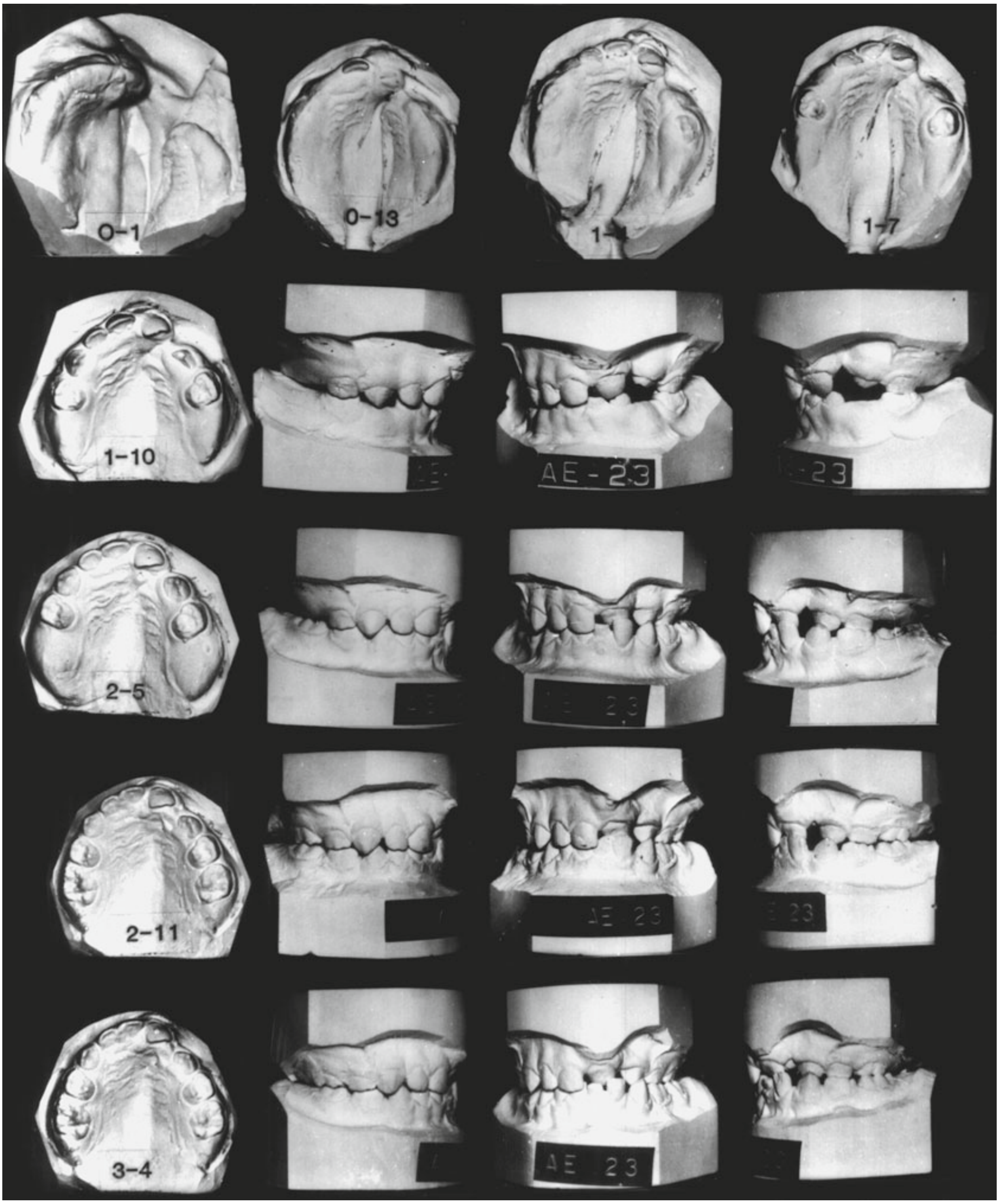

Fig. 6.18 Serial casts of Case JD. 0–1 At birth. 0–13, 1–4, and 1–7 With the institution of compressive lip muscle forces by uniting the lip, the lesser cleft segment moved medially to make contact with the vomer. The geometric changes to both segments brought the alveolar segments in good approximation 1–10, 2–5, 2–11, and 3–4

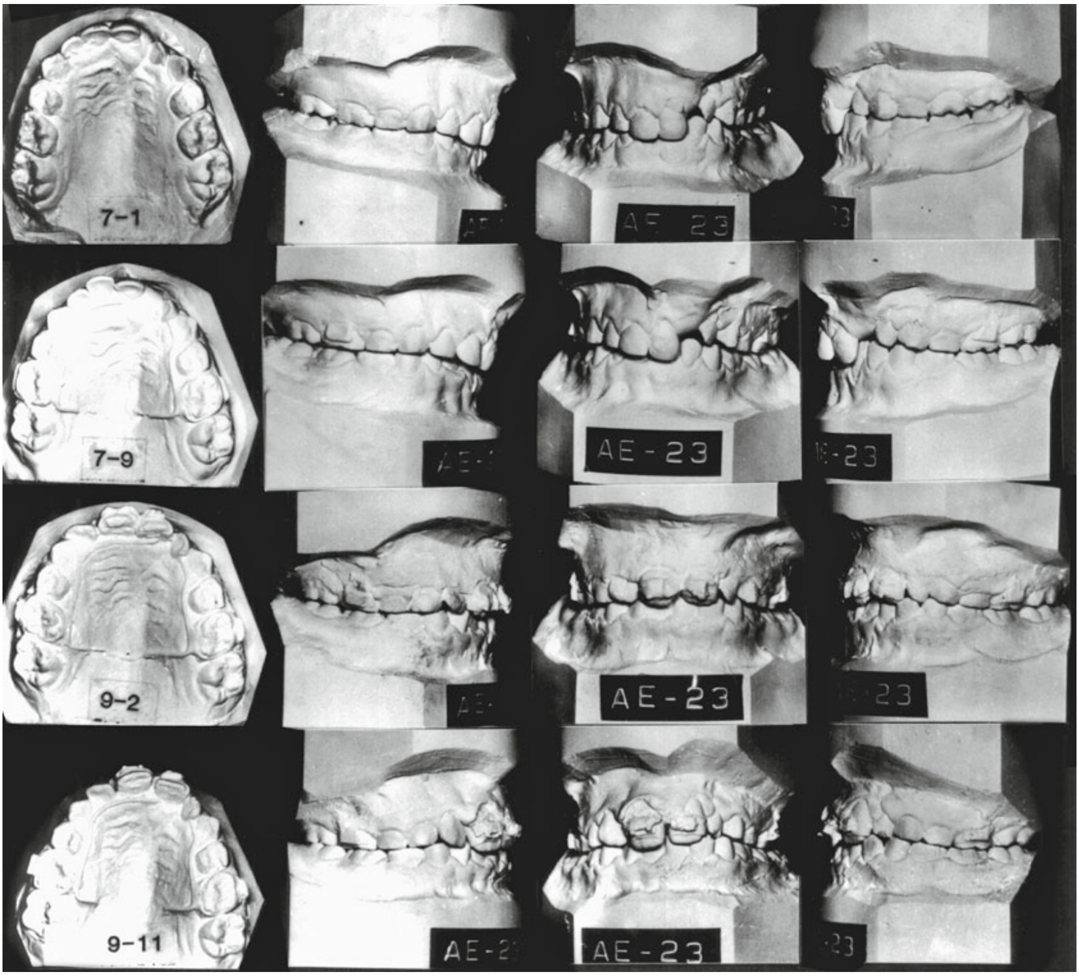

Fig. 6.18 (*continued*) However, after palatal cleft closure at 20 months, the lesser segment moved further medially placing the left cleft segment in crossbite. Due to ectopic eruption, the left central incisor was in crossbite. After palatal expansion and advancement of the left central incisor, excellent buccal occlusion was established. 7–1, 7–9, 9–2, and 9–11. Fixed palatal retainer is worn to maintain the arch forum

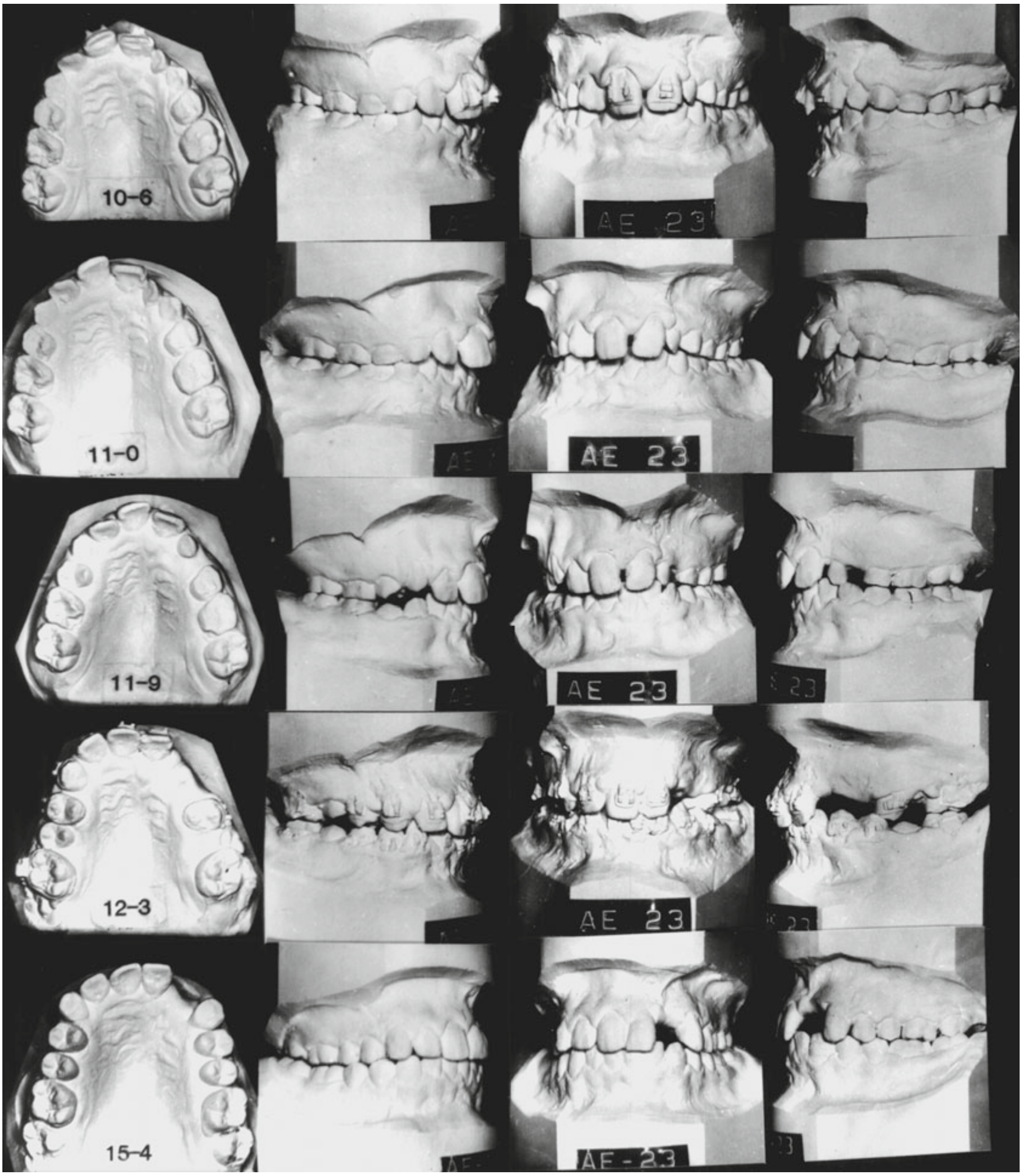

Fig. 6.18 (*continued*) 10–6, 11–0, and 11–9 Palatal form retained with palatal appliance. The upper central incisors were rotated for aesthetic purposes. The left malformed lateral incisor was left in place until orthodontic treatment was instituted at 12 years of age. 15–4 Orthodontic treatment completed. Note the slight flaring of the upper incisors and upper left cuspid, which was due to slight anterior maxillary bone deficiency. This is not an uncommon finding in complete unilateral clefts of the lip and palate

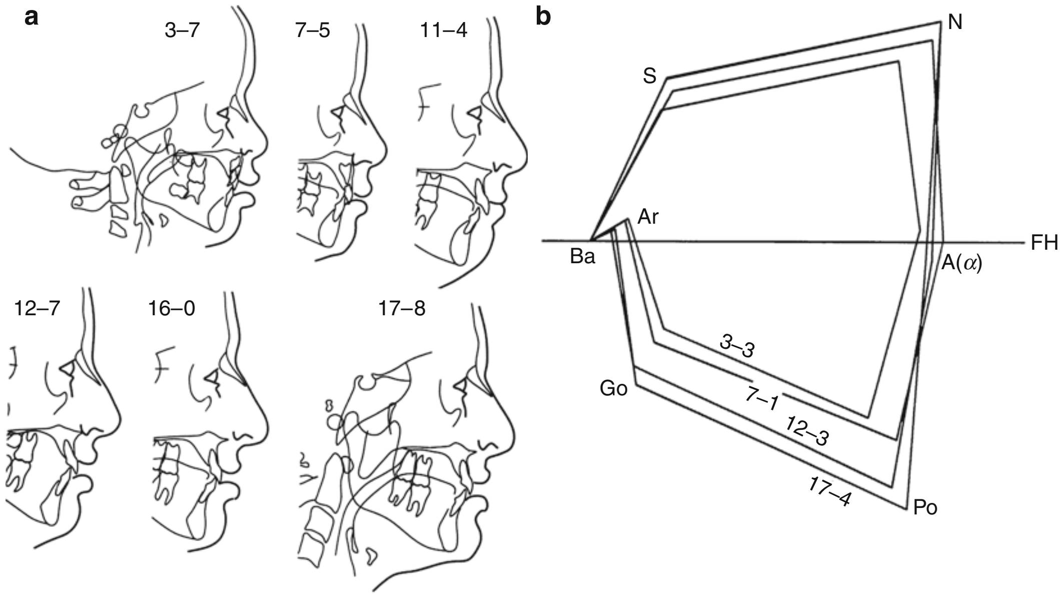

Fig. 6.19 (**a**) Skeletal and soft tissue changes in Case JD. (**b**) Superimposed polygons using basion horizontal method (Coben). Both of these analyses show excellent facial changes. The midfacial protrusion actually reduced between 7–1 and 17–4. Comments: One of the main controlling factors in the treatment of children with clefts that involve the anterior bony segment is the amount of osteogenic deficiency in the area. In many noncleft children, some advancement of the anterior teeth is essential; however, advancing the anterior teeth in the child with a cleft results in flared incisor teeth because the bone deficiency prevents the roots from being brought forward, even with anterior root torque using rectangular arch wires

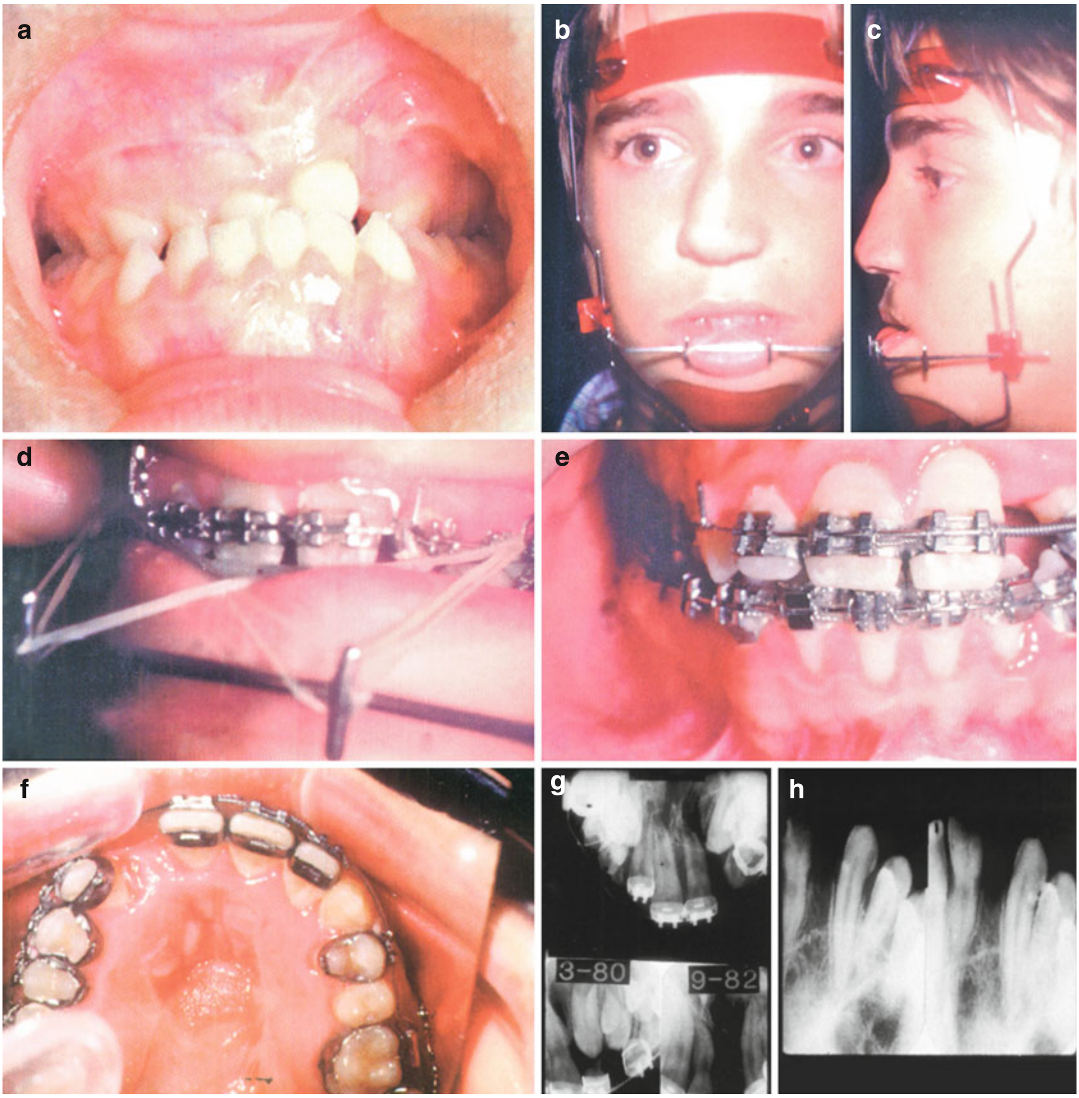

Fig. 6.20 (**a**–**n**) Case AB (EE-49). UCLP illustrating use of protraction maxillary orthopedics to correct midfacial retrusiveness secondary to growth-inhibiting scar tissue and/or maxillary osteogenic deficiency. Surgical history: Lip closure at 6 months. Hard and soft palate cleft closure at 16 months using an island flap pushback. Secondary alveolar cranial bone graft at 10 years of age. (**a**) Two years 11 months of age. Anterior and bilateral buccal crossbite could not be corrected in the deciduous or mixed dentition. (**b**–**d**) Orthodontic-orthopedic forces to correct an anterior crossbite were initiated at 12 years of age using a Delaire-style protraction facial mask. (**e**, **f**) Ideal class I (neutroclusion) with an ideal overjet and overbite. Palatal view shows thick transpalatal scar tissue caused by the island flap. (**g**, **h**) Periapical films after secondary alveolar cranial bone graft. No left lateral incisor is present, but good cleft space closure is evident

Fig. 6.20 (*continued*) (**i**–**k**) Facial and occlusal photographs before and after orthodontic treatment. (**l**) Upper retainer with pontic left lateral incisor. (**m**) Shows fixed bridge with false tooth and (**n**) cast palatal bar used to maintain the upper palatal form for relapsing in a crossbite occlusion

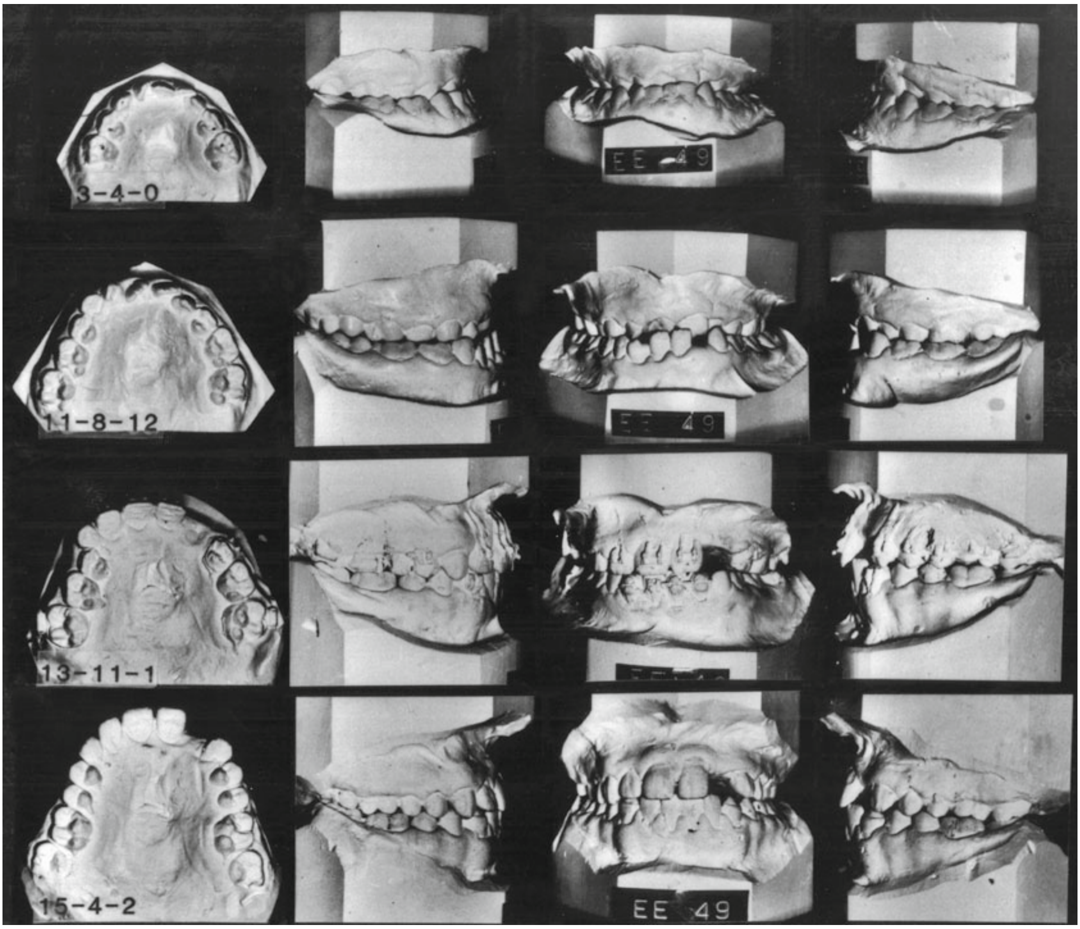

Fig. 6.21 Serial casts of Case AB. 3–4–0 After island flap hard and soft palate closure at 16 months of age resulting in bilateral buccal and anterior crossbites. 11–8–12 Occlusion just prior to orthodontic treatment. 13–11–1 After protraction mechanics using a Delaire-style facial mask. 15–4–2 Occlusion after orthodontics. Comments: Because maxillary deficiency is almost always present, "A" point (subnasal) in the premaxillary area needs to be brought forward by using labile root torque on a rectangular arch

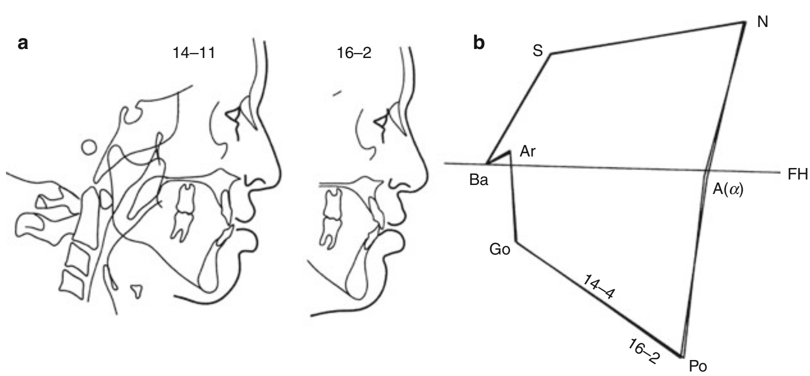

Fig. 6.22 (**a**, **b**) Case AB. (**a**) Cephalometric tracings at 14–11 and 16–2. (**b**) Superimposed polygons using basion horizontal method. A slight change in midfacial protrusion is noted after protraction forces were used to correct the midfacial retrusion and anterior crossbite. In this case, the changes in the maxillary incisor axial inclination aided anterior crossbite correction more than maxillary protraction

Fig. 6.23 Conservative treatment of a patient with CUCLP. Lip adhesion at 3 months. Rotation advancement at 6 months. Palatal closure at 22 months using a von Langenbeck and vomer flap. Excellent occlusion and a flat face profile resulted

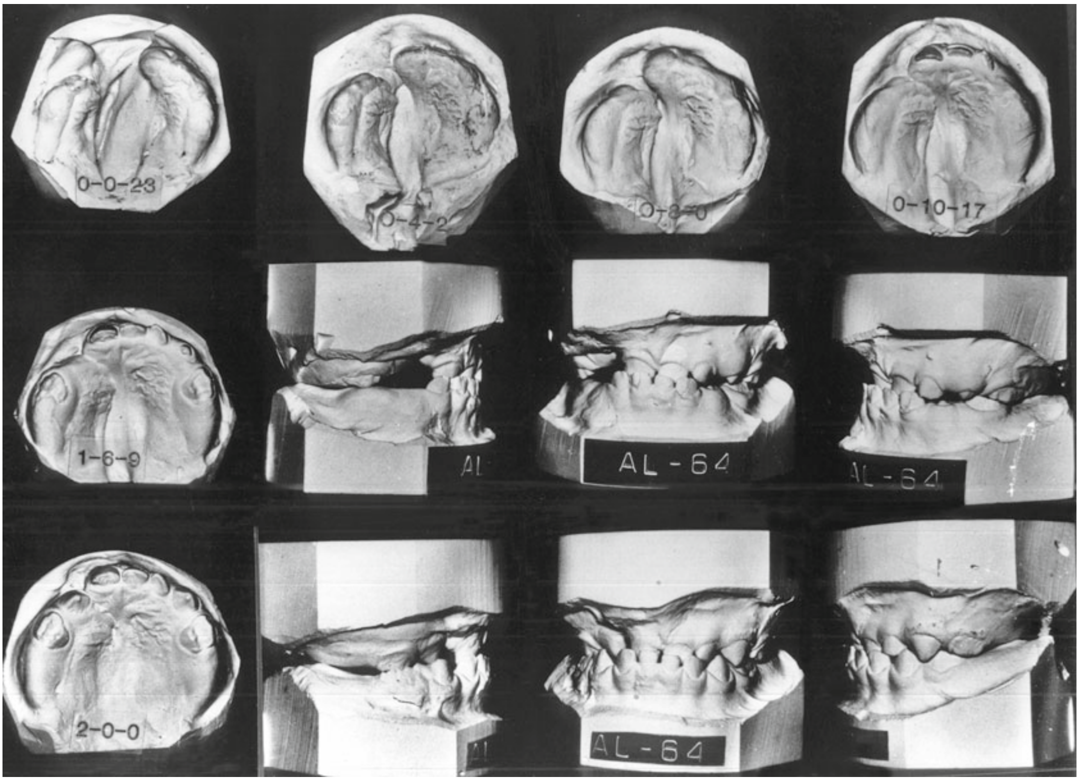

Fig. 6.24 Case AL 64. Complete unilateral cleft lip and palate. Serial casts, 0–0–23 to 2–0–0: Lip adhesion brings the overexpanded palatal segments together. The premaxillary portion of the larger noncleft segments palatally positioned placing the teeth into an anterior crossbite. The palatal cleft was closed at 1–11 with von Langenbeck plus vomer flap

Fig. 6.24 (*continued*) 8–9–13 to 15–4–7 The maxillary anterior teeth were advanced into a proper overjet and overbite. Due to arch crowding, the first bicuspids were extracted and spaces closed. The alveolar bone graft at approximately 8 years permitted the impacted lateral incisors to erupt into place. Note: The right lateral incisor crown is malformal, but the root size and shape is normal. The crown will eventually be capped

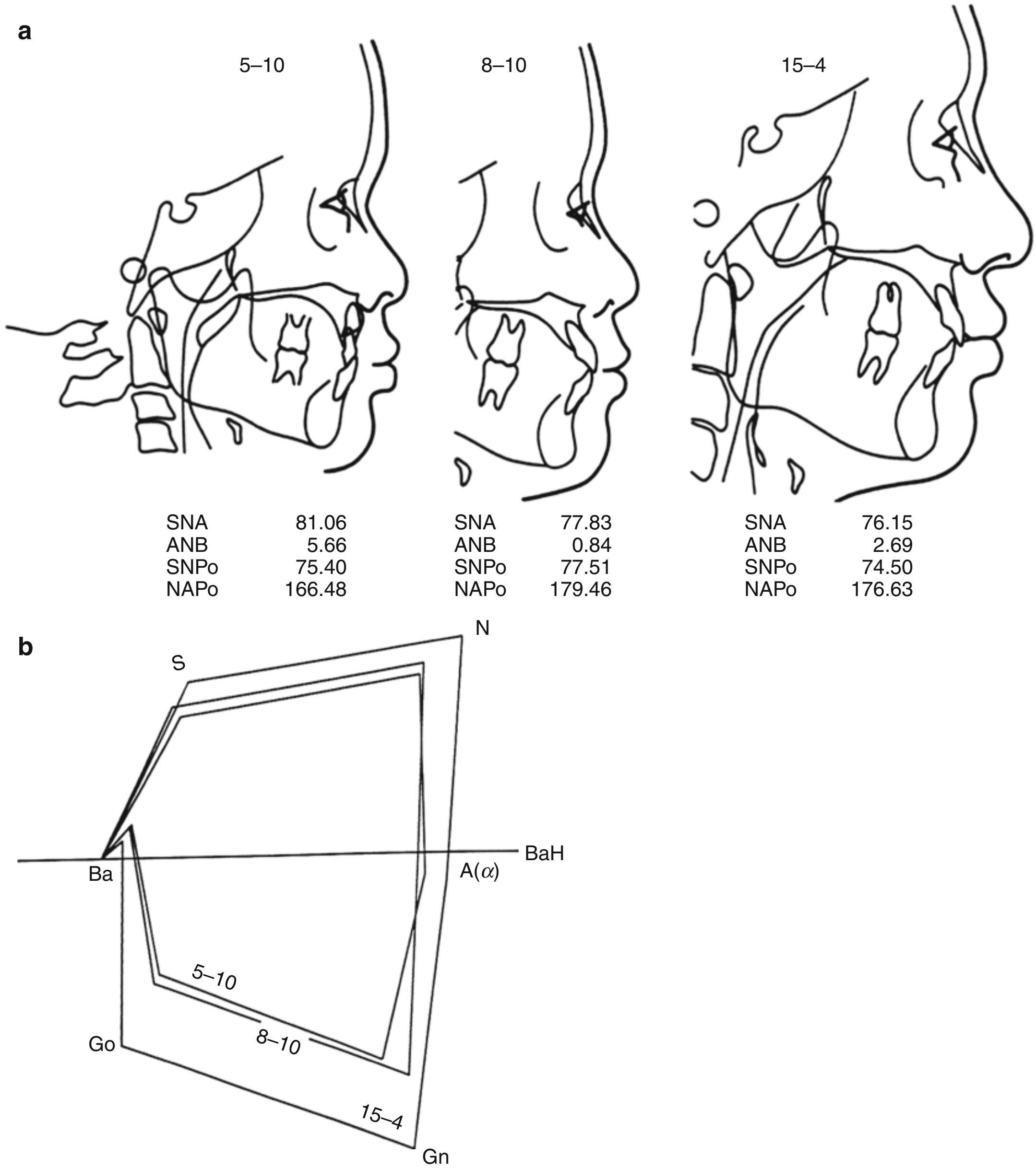

Fig. 6.25 (**a**, **b**) Case DM-AL 64. Very good facial growth pattern. The flattening of facial profile was dependent on good growth of all parts of the facial skeleton. The extraction of all the maxillary and mandibular first bicuspids was necessary to retract the incisors and uncrowd the dentition

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