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Effect of Complete Dentures on Craniofacial Growth of an Ectodermal Dysplasia Patient: A Clinical Report

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Keywords
Age appropriate denture teeth; cast analysis; complete anodontia; complete denture; cephalometric analysis; lingualized occclusal scheme.

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The authors deny any conflicts of interest.

Accepted November 19, 2012

doi: 10.1111/jopr.12026

Abstract

The aim of this clinical report was to observe the effect of complete dentures on craniofacial growth and development of an ectodermal dysplasia (ED) patient. A complete anodontia patient diagnosed with ED was successfully rehabilitated with conventional complete dentures at the ages of 5, 8, and 10 years. Three sets of complete dentures were made with age-appropriate denture teeth and a bilaterally balanced lingualized occlusal scheme. Periodic follow-up and adjustment when needed was done to maintain proper oral function and esthetics. Serial cephalometric analysis exhibited a marked restriction of forward growth at the anterior nasal spine (ANS) point between 5 and 10 years of age, although there was little change from average in the anteroposterior length of the mandibular body and the height of the mandibular ramus. So, while maxillary growth was reduced, mandibular growth did not significantly change. Cast analysis showed that the increase in arch length was greater than in arch width for both the maxilla and mandible. There was little increase in alveolar ridge height in the anterior region but a considerable increase in the height of the alveolar ridge in the middle and the posterior region. Our findings concluded that the absence of teeth did not affect the growth of the jaws, and it is probable that the denture flange did not arrest the jaw growth, but rather improved the masticatory function by providing good denture stability and retention.

Ectodermal dysplasia syndrome (EDS) has been described as a group of disorders of morphogenesis displaying two or more of the symptoms of trichodysplasia, dental anomalies, onychodysplasia, and dyshidrosis.[1] According to an estimate, 150 subtypes of ED can be defined, with an estimated frequency of one case occurring in every 10,000 to 100,000 births.[2] Some EDS types are mild, while others can be devastating. Although female carriers outnumber affected males, the female carriers show little or no signs of the condition because it is usually transmitted through a sex-linked recessive gene, so the manifestations are predominant in males.[3] In children with ED, the appearance of the teeth is extremely important, because it can affect the patient's self-esteem, creating challenges for the dentist.[4]

Complete dentures are fabricated for restorations of oral functions and esthetics in complete anodontia cases. Some cases of prosthetic management of ED have been reported in the literature, although there is little information to notice the effect of dentures on the growth and development of jaws.[5–10] The present study was performed to discuss the effects of complete dentures on jaw growth and development of such a rare case.

Clinical report

A 5-year-old boy with hereditary ED reported to the Department of Prosthodontics, Faculty of Dental Sciences, CSMMU, Lucknow, Uttar Pradesh, India. His parents' main concern was their son's lack of teeth, difficulty eating properly and, to some extent, esthetics. The boy exhibited classic features of ED: anodontia, hypotrichosis, saddle nose, and prominent forehead (Fig 1). Family history was noncontributory, as none of the parents or siblings had similar features. Radiological examination revealed absence of all teeth or tooth buds (Fig 2). According to the American College of Prosthodontists (ACP) classification, the patient had class III residual ridge height of mandible and type A residual ridge morphology for maxilla.[11] A facial height index of 108° as compared with an ideal score of 80° indicated an extremely decreased occlusal vertical dimension (OVD).[12]

Figure 1 Facial view.

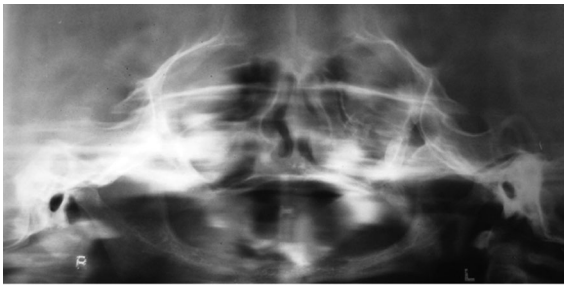

Figure 2 Orthopantomogram showing absence of all teeth or tooth buds.

Among the treatment modalities available, the best treatment option for the child was fabrication of complete dentures. At the age of 5 years the first set of complete denture was fabricated in the usual manner. An age-appropriate tooth set was fabricated using tooth-colored heat-curing acrylic resin (DPI Heat Cure Tooth Moulding Powder, Dental Products of India, Mumbai, India).[13] To prepare age-appropriate teeth, a patient of similar age was selected, and an impression of his dentition was made with irreversible hydrocolloid impression material (Zelgan, Dentsply, Gurgaon, India), and molten modeling wax (Metrodent, Mumbai, India) was poured in the tooth impression area. The wax model of the teeth was obtained and invested in plaster of Paris. After dewaxing, the mold was filled with tooth-colored heat-curing acrylic resin and polymerized. The teeth were retrieved after the curing cycle was complete and were then trimmed, finished, and polished.

A bilaterally balanced lingualized occlusal scheme was provided in the denture to reduce lateral forces and create an intercuspal contact area with freedom of movement.[14-16] Facial-height index measurements made after inserting the prostheses showed approximately normal values (79%).

Thereafter, the patient was under regular observation for growth changes, any discrepancy in the occlusal relationship, and the fit of the tissue surfaces. The loss of posterior tooth contact and presence of anterior tooth contact were the recurring occlusal changes. Self-curing acrylic resin (Trevalon, Dentsply Ltd) was added on the occlusal surfaces of the posterior teeth to produce uniform posterior tooth contact and to eliminate anterior tooth contact.

At the ages of 8 and 10 years, new sets of complete dentures were fabricated containing the teeth suitable to the patient's age. The steps of fabrication were essentially the same as described earlier for the first denture (Fig 3).

Analysis of craniofacial growth

Craniofacial growth analysis was done with the help of cephalometric and diagnostic cast analysis. Serial lateral cephalograms were taken at 5, 8, and 10 years of age. These lateral cephalograms were analyzed to study the change in jaw growth pattern and occlusal relationship. Cephalometric measurements were compared with the average values corresponding with age as reported by Sakamoto[17] (Table 1) and Bolton standards (Table 2). Angular measurements were analyzed to compare the positional relationship of craniofacial landmarks, and linear measurements were made to record the change in size and compare it with average values (Fig 4).

Serial diagnostic casts were prepared at 5, 8, and 10 years of age. These diagnostic casts were measured for dimensional changes in arch length and width of the alveolar ridge. Arch length and width was measured by the segmental method of cast analysis, in which each half of the arch was divided into three segments by four reference points: the midline of the arch (a), canine eminence (b), posterior limit of the retromolar pad for mandibular arch or hamular notch for the maxillary arch, (d) and mid-point between point b and point d (Figs 5 and 6).

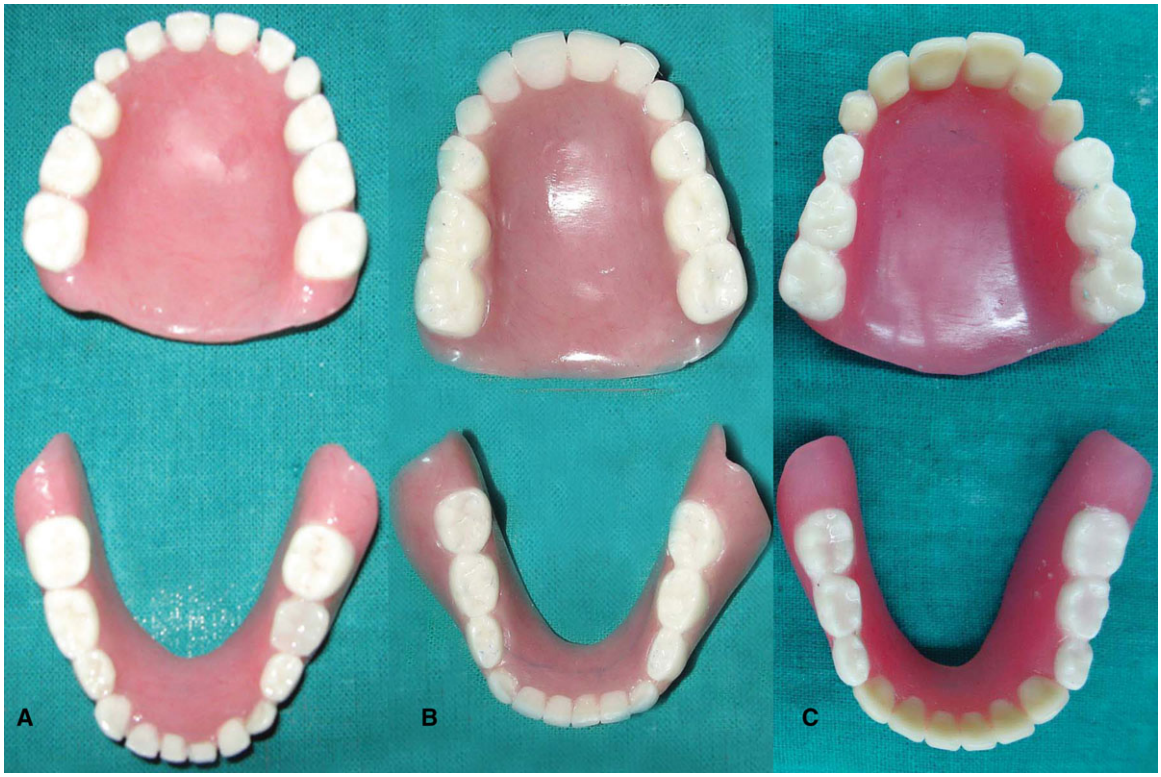

Figure 3 Three sets of complete dentures at age of 5 (A), 8 (B), and 10 (C) years.

Table 1 Cephalometric analysis of the patient at 6, 8, and 10 years of age and values compared with the normal average values reported by Iizuka[18] (1958) and Sakamoto (1959)

	Patient		Average values	
Angle (°)	5 year 3 months	7 year 10 months	9 year 6 months	7 year 7 months
Facial angle	92.2°	92.3°	85.2°	83.7°
y-axis	48.6°	50.4°	59.6°	63.8°
Mandibular plane				
Angle	13°	13.5°	25.5°	31.5°
Length (mm)				
N-ANS	46.1	44.2	50.2	47.1
ANS-ME	52.5	56.1	61.8	57.7
ANS-PTM	40.3	42.8	44.1	46.8
GO-X	60.2	64.4	70.3	63.6
GO-ME	58.7	62.4	67.7	64.5
Ratio of lengths (%)				
N-ANS/ANS-ME	87.8%	84.13%	81.22%	81.6%
ANS-ME/GO-X	89.43%	87.11%	87.90%	90.7%

Table 2 Cephalometric analysis of the patient at 5, 8, and 10 years of age and values compared with the skeletal values derived from the Bolton Standards for age and sex

	Patient		Average values		
Length (mm)	5 years, 3 months	7 years, 10 months	9 years, 6 months	6 years	9 years
Co- Point A (maxillary length)	73.4	75.3	77.1	81.7	87.7
Co- Gn (mandibular length)	95.2	97.6	100.2	99.3	107.7

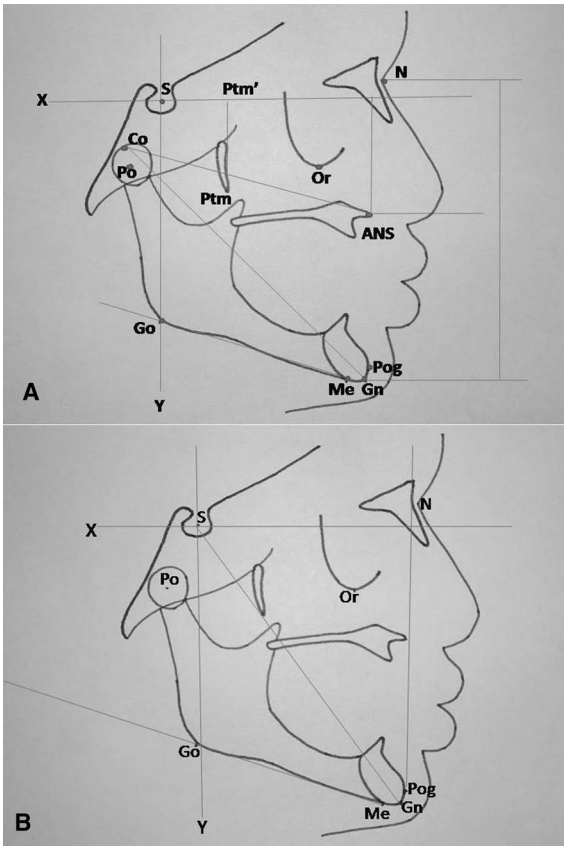

Figure 4 Craniofacial landmarks used for Cephalometric analysis. Upper: Angular measurements; Lower: Linear measurements.

Outcome

The facial plane angle was greater than average, while the *y*-axis angle and the mandibular plane angle were smaller than average. The anterior nasal spine-menton (ANS-ME) length increased with the fabrication of new dentures at 5, 8, and 10 years of age, although these values are slightly smaller than average values. The gonion (GO) and pogonion (POG) points were located posteroinferior and anterosuperior to the average, respectively.

The N-ANS/ANS-ME ratio, which represents the ratio between the upper facial height (nasion-anterior nasal spine) and the lower facial height (anterior nasal spine-menton) was greater than the average values, indicating a reduced lower facial height. This deficiency in vertical dimension was addressed during denture fabrication and after the denture insertion, the value was almost equal to that of the average values corresponding to the age.

The lengths of the maxilla (Co-Point A) and mandible (Co-Gn) were calculated at age 6, 8, and 10 years and compared with the average values derived from Bolton standards for age and sex. There was a 3.7 mm increase in maxillary length from 6 to 10 years of age, while at the same time there was a 5 mm increase in mandibular length.

Cast analysis revealed that in the maxilla there was a 13 mm increase in arch length and a 2 mm increase of arch width in the anterior segment, a 4 mm increase in the middle segment and 5 mm increase in the posterior segment from 5 to 10 years of age. While in the mandible there was a 16 mm increase in arch length and a 2 mm increase of arch width in the anterior segment, a 2 mm increase in the middle and 4 mm increase in the posterior segment from 6 to 10 years of age. There was a slight increase in alveolar ridge height in the anterior region, but a considerable increase in the height of the alveolar ridge in the middle and the posterior region. The flat appearance of the alveolar ridge also decreased, owing to a slight increase of the concavity of the palatal surface along with the increase in height of the alveolar ridge.

Discussion

Various treatment modalities are possible for ED patients depending upon the age, alveolar bone volume, and presence of teeth. In the case discussed here, a tissue-supported removable complete denture was planned because of the patient's young age and ongoing growth and development. The influence of the complete denture on the growth and development of facial as well as alveolar structures was evaluated with the help of cephalometric and cast analysis.

As there is no medical treatment for this condition, affected individuals with dental defects could be subjected to early dental evaluation and intervention beginning at an early age. This would not only help the child's psychological growth but also physical growth and development. Denture fabrications at an early age lead to significant improvements in appearance, speech, and masticatory functions. Such positive changes increase the self confidence of the child and aid in establishing lifelong dietary patterns.

During denture fabrication, vertical dimension was established clinically by physiologic rest position and was verified by observing facial support and with the help of cephalometric analysis of the patient and normal individuals of the same age. Thus, the correct vertical dimension was established in a complete denture that could not only help prevent development of class 3 malocclusion but also improve skeletal relationship during the child's growth period. Considering the individual variation in growth and development, direct comparison between the measured values and the average values cannot be justified. So, the ratio between upper and lower facial height was used for evaluation of OVD.

With the construction of new dentures, we were able to bring the N-ANS/ANS-ME value (87.8% at 5 years of age to 81.22% at 10 years of age) quite close to the average value (81.6%). This helped to ascertain that the vertical dimension was adequately established. Though the ANS-ME/GO-X value (89.43% at 5 years, 87.9% at 10 years) was smaller than the average value (90.7%), it does not mean a lack of vertical dimension, but might be influenced by the greater value of GO-X in this case. This was also supported by Sarnart et al,[5] who in their longitudinal study on craniofacial growth in patients with anodontia through serial cephalometric measurements obtained from individual cases, described the growth of facial structures and

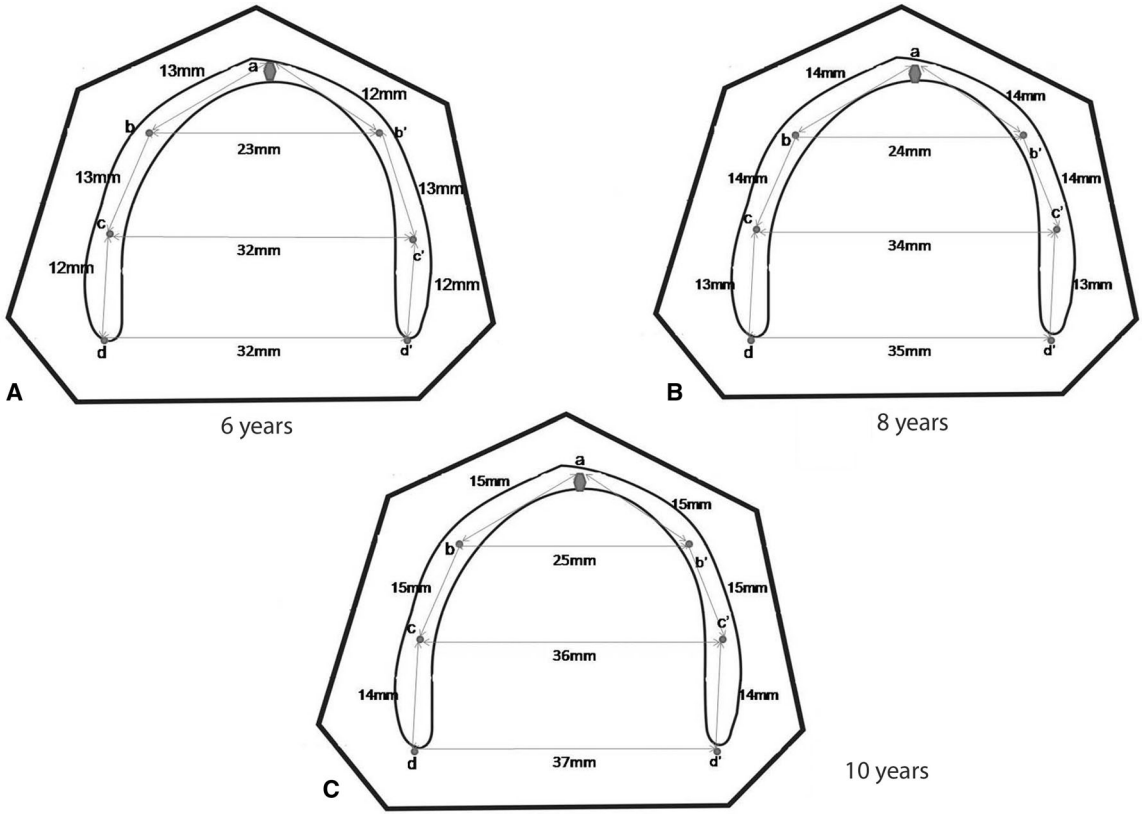

Figure 5 Diagnostic cast analysis of maxillary arch at age of 5 years (A), 8 years (B), and 10 years (C).

jaws as lying within the lower range of normal. They concluded that the absence of teeth did not affect the growth of the jaws.

For this patient, the cephalogram showed a marked restriction of forward growth at the ANS point during 5 to 10 years of age, which was also reported by Sarnart et al[5] in their study. There was little change from average in the anteroposterior length of the mandibular body and the height of mandibular ramus. There was a 3.7 mm increase in maxillary length from 6 to 10 years of age, while at the same time there was a 5 mm increase in mandibular length. So, the maxillary growth was reduced but mandibular growth did not significantly change. This restriction of maxillary growth may be the effect of the presence of complete dentures during the growing phase, but it cannot be confirmed with the present study design. Tocchini et al[10] found that the forward growth of the maxilla was reduced in cases of anodontia, but it was difficult to determine whether this decrease in growth was due to absence of teeth or due to the effect of prosthetic replacement of the teeth. Hamano et al's[19] study on craniofacial growth in anodontia cases with anhidrotic ED concluded that the lack of forward growth of the maxilla was due to the interplay between the absence of teeth and the atrophic rhinitis.

In our patient, the increase in arch length was greater than in arch width. This was also supported by the studies performed independently by Shirakawa et al[20] and Tocchini et al.[10] Shirakawa et al measured the alveolar ridge arch on the study casts during the period of 3 years 2 months to 5 years 11 months of age and reported a 5 mm increase in arch length and 6 mm in arch width in the maxilla and a 12 mm increase in arch length and 6 mm in arch width in the mandible. The results of the increase in arch length and width between our patient and those of Shirakawa et al vary somewhat, perhaps due to the different ages of the patients.

Our findings and conclusion support the conclusions of Sarnart et al[5] and Ochiai et al[9] that the absence of teeth does not affect the growth of the jaws, and the denture flange probably did not arrest the jaw growth, but rather, improved the masticatory function by providing good denture stability and retention. In a clinical report of anodontia reported by Shaw,[7] underextension of dentures and posterior open bite were recurring problems he attributed to the growth of the jaws. In this patient also, the lack of posterior contact was managed by adding autopolymerizing acrylic resin to the occlusal surface of the posterior denture teeth. We support that use of acrylic teeth and autopolymerizing acrylic resin are suitable choices for coping with growth changes in such patients. Periodic recall examination and the necessary adjustments are very important to address the growth changes occurring in a child.

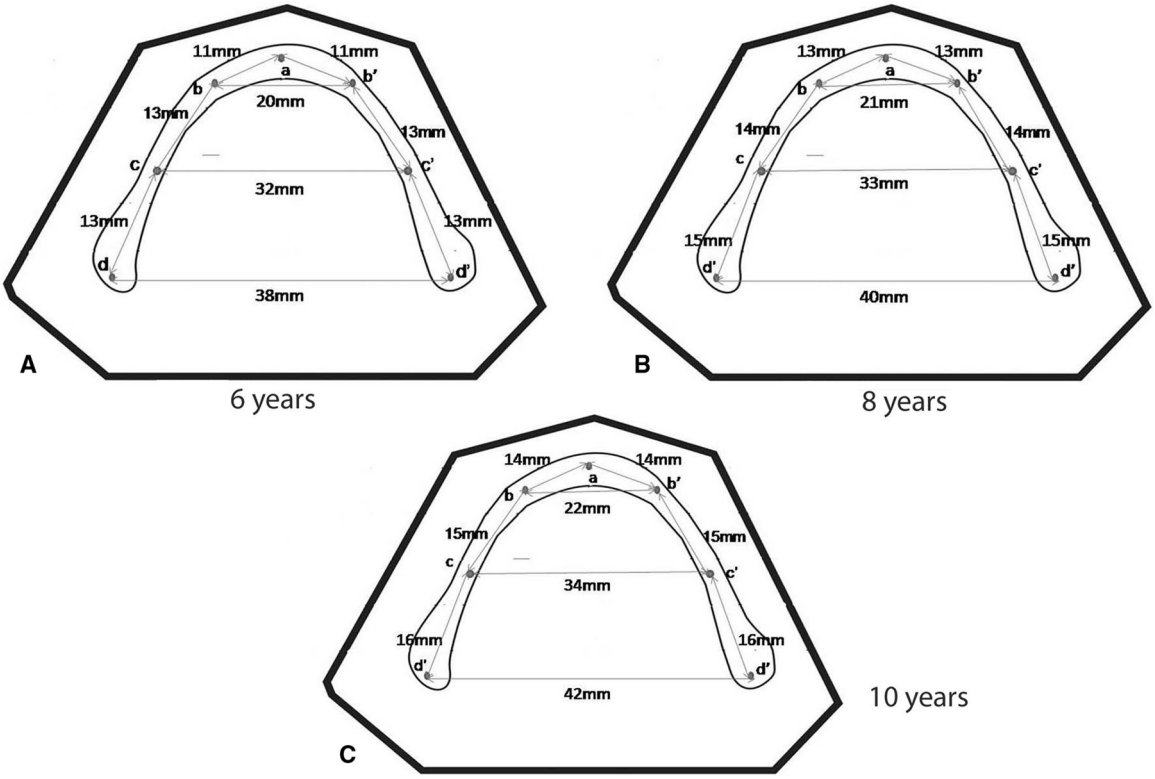

Figure 6 Diagnostic cast analysis of maxillary arch at age of 5 years (A), 8 years (B), and 10 years (C).

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