Induced condylar growth in a patient with hemifacial microsomia

Hemifacial microsomia is a congenital abnormality which results in progressive, three-dimensional facial asymmetry in the growing child. Functional appliance therapy was instituted in an 11 year, 7 month old boy with hemifacial microsomia in order to determine if symmetry could be re-established by promoting masticatory muscle function on the affected side, thereby stimulating bone growth in the affected condyle over and above what would occur without any treatment intervention. Removable functional appliance therapy, and later, unilateral Herbst appliance therapy, produced a dramatic change in the condylar growth on the affected side. Herbst therapy has the advantage over a removable functional appliance in that patient acceptance is much greater. Lack of patient compliance may be the primary cause of the variable results obtained with functional appliances in hemifacial microsomia cases as reported in the literature.

By Ross G. Kaplan, BDS, MSD

Microsomia is defined as an undersized state of the body or body part.[1] One of the primary features of hemifacial microsomia (previously known as first arch syndrome or first and second branchial arch syndrome) is unilateral failure of formation or underdevelopment of the mandibular ramus and/or condyle and the associated muscles of mastication.[2] The maxilla and malar bones on the ipsilateral side are frequently underdeveloped. Failure of the affected side to grow downward and forward results in the three dimensional asymmetry: the mandibular skeletal midline deviates to the affected side; unilateral hypoplasia results in mandibular retrognathia; and lack of vertical growth on the affected side produces a tilting of the occlusal plane as viewed from the frontal aspect. The severity of the deformity varies from mild to severe. Epker and Fish[3] report that the more severe the congenital deformity, the more likely it will worsen with growth.

Ware[4] states that although conventional orthodontic tooth movement is of little value in prepubertal patients with hemifacial microsomia, efforts should be made to guide skeletal growth and stimulate the affected areas. Harvold et al[5] first suggested that functional appliance therapy may have a stimulatory effect on muscle development and would prevent canting of the occlusal plane. According to Epker and Fish,[3] the response to functional appliances is

Figure 1a and 1b
Pretreatment frontal facial views

Figure 2a
Pretreatment submental facial view

Figure 2b
Pretreatment facial profile view

Figure 1a

Figure 1b

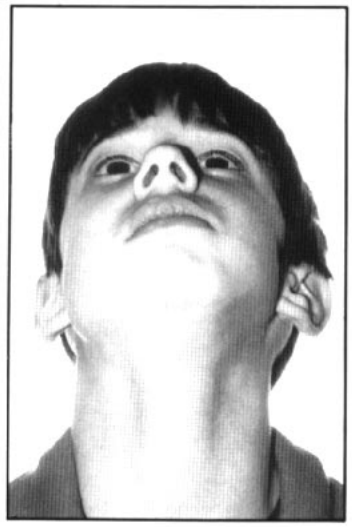


Figure 2a

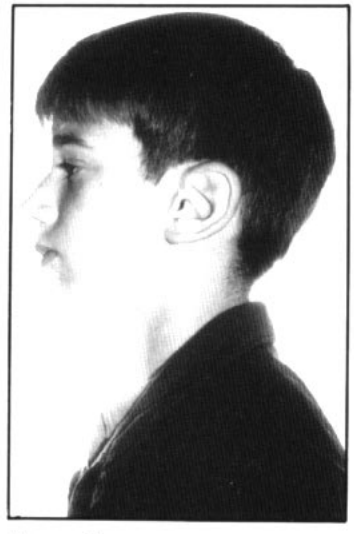


Figure 2b

not predictable in prepubertal hemifacial microsomia patients. They report that the less severe the three dimensional deformity, and the more normal the mandibular movements, the greater the likelihood of a favorable response to functional appliance therapy.

Melsen et al[6] reported the successful results of functional appliance therapy in a 5-year-old girl exhibiting hemifacial microsomia. Surgical treatment was avoided by provoking sufficient growth in the mandible. They concluded that the generation of normal muscle balance in the absence of a condyle resulted in sufficient bone apposition to restore symmetry.

Case report:

In October, 1982, an 11 year, 7 month old boy was referred for clinical examination to the Department of Orthodontics at The Oregon Health Sciences University.

The patient exhibited marked facial asymmetry when viewed from the frontal aspect (Figure 1a). In centric occlusion, the mandible was deviated to the left and the left ramal height was reduced compared to the right side. Lack of vertical development on the affected side produced a tilt of the occlusal plane (Figure 1b). A submental view also demonstrated the mandibular asymmetry (Figure 2a). In lateral view (Fibure 2b), the profile was convex with obvious mandibular retrognathism.

Functionally, the patient's range of mandibular motion was reduced. Protrusion was limited to two or three millimeters, while maximum opening was 25 millimeters measured at the central incisors.

Intraoral examination revealed a permanent dentition with a Class II molar relationship on the left and Class I on the right (Figures 3a, 3b, 3c and 3d). The mandibular dental midline was coincident with the maxillary midline, but it was not coincident with the mandibular skeletal midline. This was because the mandibular right canine was completely blocked out of the arch and the mandibular incisors were tipped to the right. Overjet was five millimeters and overbite was 100 percent.

Radiographic cephalometric examination confirmed the significant mandibular retrognathism seen in profile (Figure 4). A marked discrepancy existed between the right and left lower borders of the mandible with a definite antegonial notch on the left. The left ramus was underdeveloped with the left gonial angle 12 millimeters superior to the right angle. The posterior border of the left ramus was included anteriorly ending in a rudimentary condyle. The asymmetry was confirmed by a posteroanterior headfilm which demonstrated that the mandibular skeletal midline, as defined by the genial tubercles, was deviated 10 millimeters to the left of the midsagittal plane (a line drawn through crista galli perpendicular to a line through the superior orbital rims). The left ramus height measured 46 millimeters and the right ramus height 60 millimeters. The frontal headfilm also confirmed the upward tilt of the occlusal plane on the left side.

Treatment

The current treatment approaches in young, actively growing individuals with hemifacial microsomia aim to improve facial appearance by promoting continued facial growth to reduce the severity of the deformity in adulthood. In moderate to severe cases with a missing ramus and no discernible mandibular articulation, a growth center transplant may be indicated; costochondral junction is commonly used.[4]

The other approach is functional orthopedic therapy to normalize the position of the mandible horizontally, vertically and transversely. This approach, advocated by Harvold,[5] is intended to produce a normal functional matrix or microenvironment to facilitate additional mandibular growth.

In this case, it was decided to begin treatment with a hybrid functional orthopedic appliance as advocated by Vig.[7] The intent was to reposition the mandible downward, forward and to the right, producing a posterior open bite. Acrylic was removed from the occlusal surfaces of the maxillary left posterior teeth to allow supraeruption for the purpose of leveling the tilt of the occlusal plane. As the patient's range of mandibular movement was limited, the amount of mandibular repositioning was initially only a few millimeters. Subsequently, the appliance was gradually activated by a screw incorporation on the left side of the appliance in the manner of an orthopedic corrector.

The appliance was placed in March, 1983 and by August, 1983 it was evident the mandibular range of movement had markedly improved. The appliance apparently facilitated stretching of the deficient soft tissues. In November, 1983, the mandibular arch was banded and bonded to begin opening space for the impacted mandibular right canine. The functional appliance was modified and the patient continued to wear it with the fixed appliance in place.

In February, 1984, when the patient was 12 years, 10 months, a panoramic radiograph was taken (Figure 5). This demonstrated a normal right condyle, but the left condyle was still rudimentary and not articulating in the joint fossa.

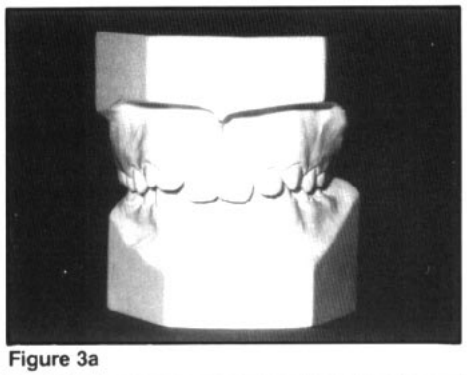


Figure 3a

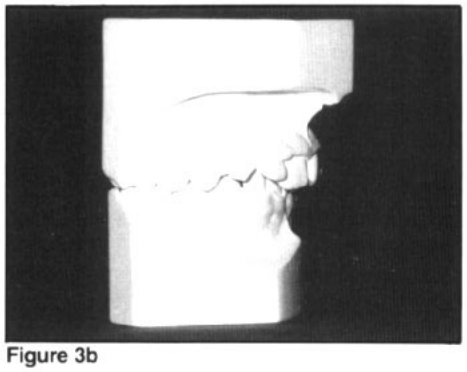


Figure 3b

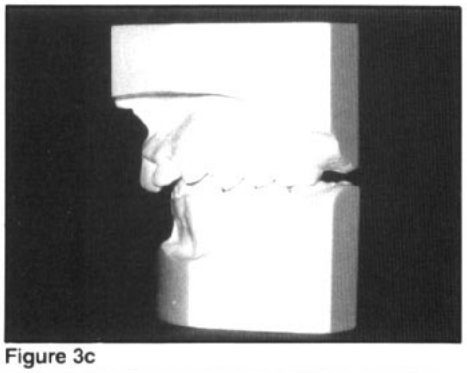


Figure 3c

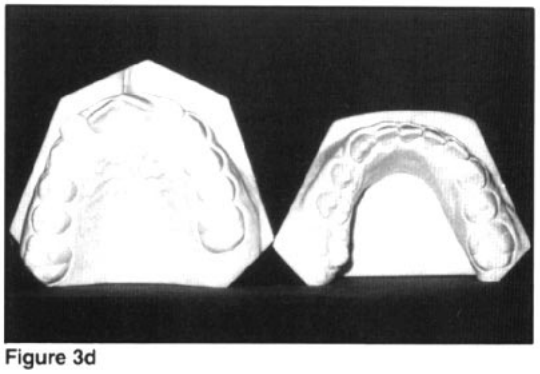
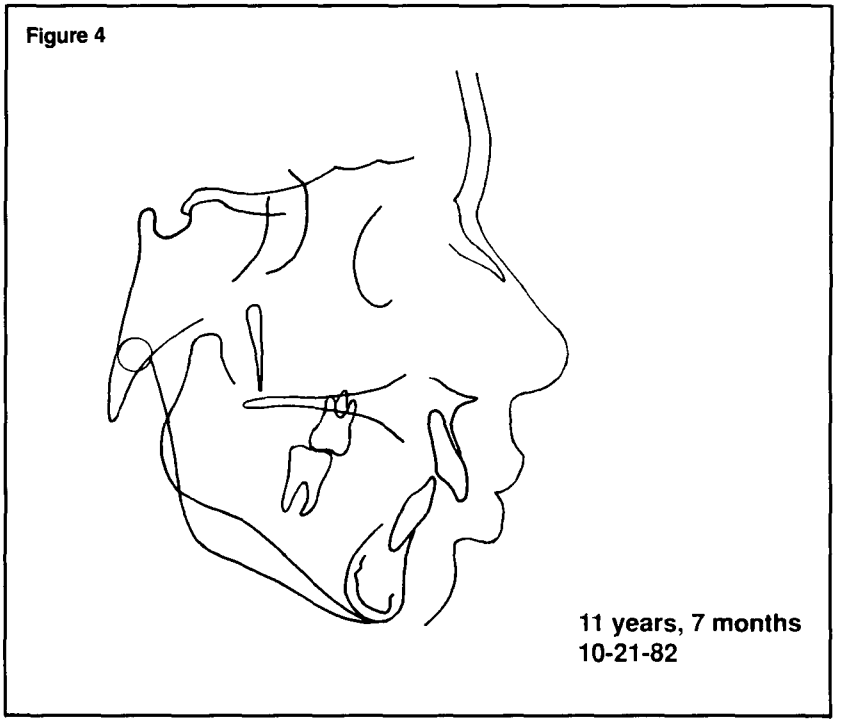
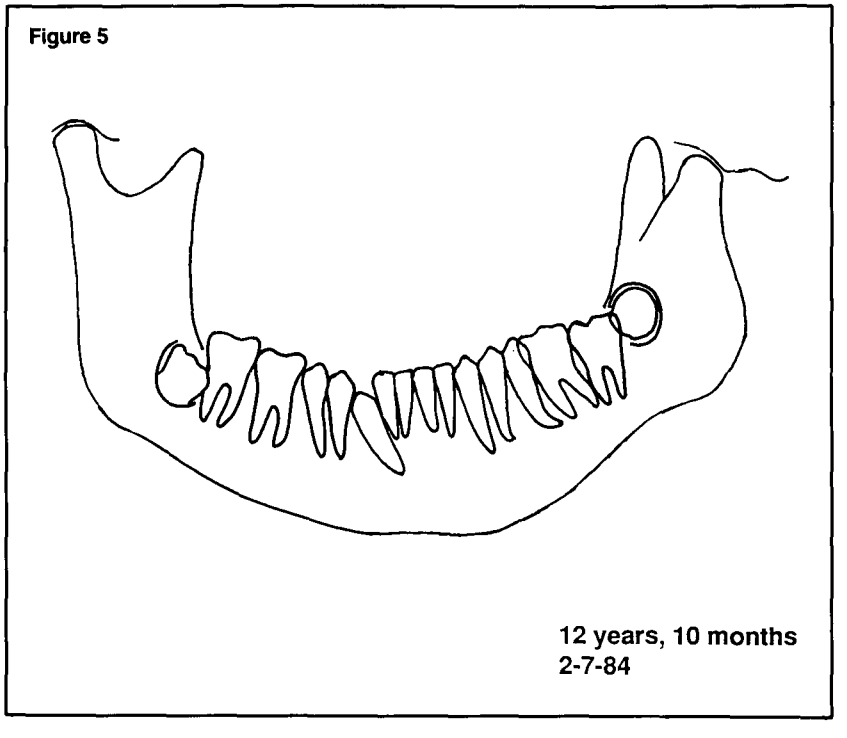


Figure 3d





Space for the mandibular right canine was opening. In August, 1984, the functional appliance was discontinued altogether.

In May, 1985, fixed appliances were placed in the maxillary arch. The following month, a panoramic radiograph showed significant morphologic change in the left condyle. The condylar neck was arching posteriorly as if reaching for the fossa, and a definitive yet not quite normal looking condyle was developing.

In April, 1986, a lower removable splint with a Herbst tube and piston on the left was constructed. The appliance further postured the mandible downward, forward and to the right. In June, 1987, the Herbst appliance was discontinued and finishing adjustments were made. The case was debanded and retained in January, 1988.

Figure 3a, 3b, 3c and 3d
Pretreatment study models

Figure 4
Tracing of pretreatment lateral cephalometric radiograph

Figure 5
Tracing of panoramic radiograph at 12 years, 10 months

Results

The dental malocclusion was resolved. The left molar relationship was corrected to Class I and the maxillary and mandibular midlines were made coincident (Figures 8a, 8b, 8c and 8d).

Comparison of facial photographs taken pretreatment (Figures 1a, 1b, 2a and 2b) and those posttreatment (Figures 6a, 6b, 7a and 7b), demonstrated a noticeable improvement in facial asymmetry and profile.

Superimposition of tracings of the pre- and posttreatment lateral cephalometric radiographs (Figure 9) revealed significant downward and forward growth of the mandible approximately along the Y-axis. In the five year, four month period between age 11 years, 7 months, and 16 years, 11 months, gnathion moved downward and forward 23 millimeters. Superimposition of the tracings of the pretreatment and posttreatment frontal (P-A) radiographs of the head revealed an improvement in the skeletal asymmetry (Figure 10).

Examination of the panoramic radiograph taken at age 12 years, 10 months (which was after approximately one year of the patient wearing the orthopedic corrector) revealed that the left mandibular condyle was rudimentary with poor definition and no well demarcated neck (Figure 11). The rudimentary process extended vertically up from the ramus. A panoramic radiograph taken three years later (at age 15 years, 10 months) while the patient was still wearing the Herbst appliance, revealed that the left condylar neck deviated posteriorly and a pronounced enlarged condylar head was evident (Figure 12).

Tracings of the vertical ramus, coronoid and condylar processes made from the panoramic radiographs taken at age 12 years, 10 months and posttreatment (at age 16 years, 11 months) were superimposed on the lower border of the mandible (Figure 13). A significant amount of growth occurred which was much more pronounced on the left side than on the right. It is evident that the increased growth of the left condylar process was responsible for the correction of the mandibular retrognathism and the improvement in the facial asymmetry.

Discussion

In this patient, improvement in maximum opening probably resulted from stretching of the deficient soft tissues and normalization of the functional matrix. The radiographic results are consistent with the hypothesis that a change in the muscle/bone interaction would produce a microenvironment conducive to bone apposition. This could be attributed to the use of the functional appliance, which intercepted the usual pattern of growth in cases of hemifacial microsomia in which the asymmetry is reported to increase in severity with age.[8]

Results achieved in this case support the findings reported by Melsen et al[6] that functional appliance therapy can establish symmetry in cases of hemifacial microsomia. They emphasize that treatment should be initiated as early as possible because results depend upon both

Figure 6a and 6b
Posttreatment frontal facial views

Figure 7a
Posttreatment submental facial view

Figure 7b
Posttreatment facial profile view

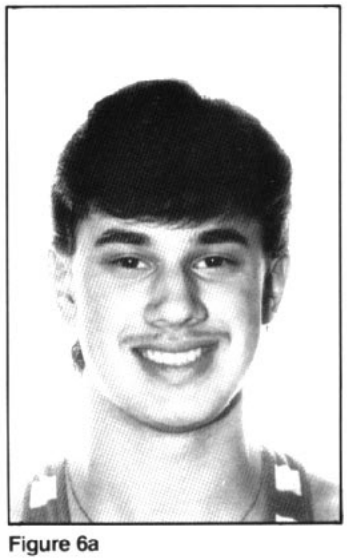


Figure 6a

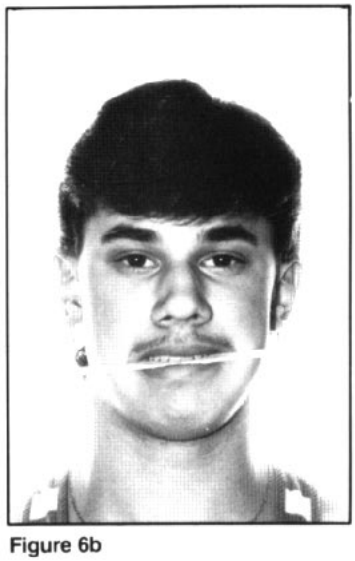


Figure 6b

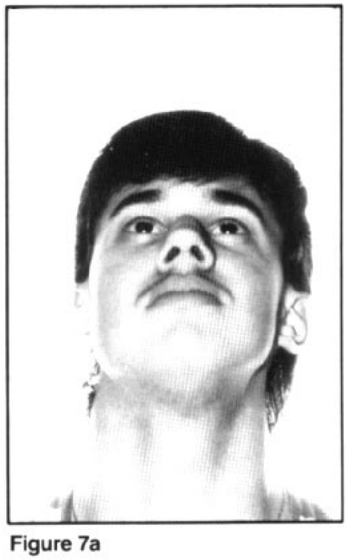


Figure 7a

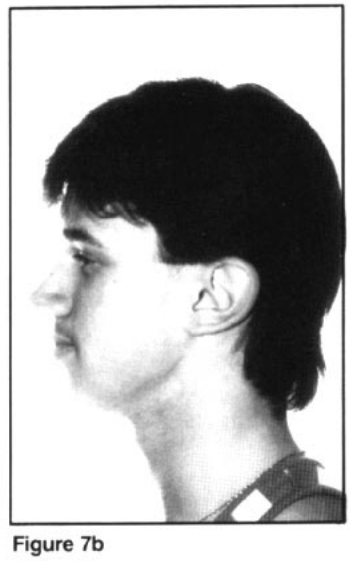


Figure 7b

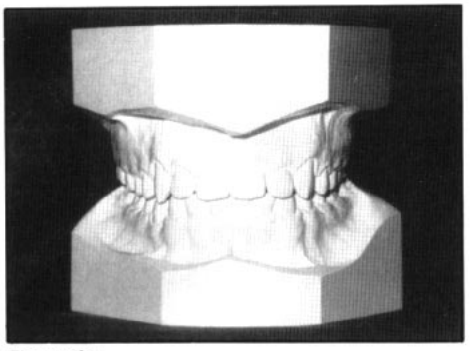


Figure 8a

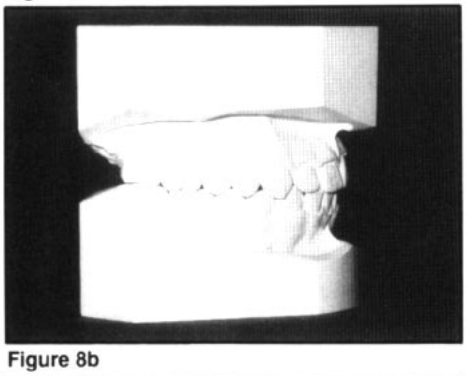


Figure 8b

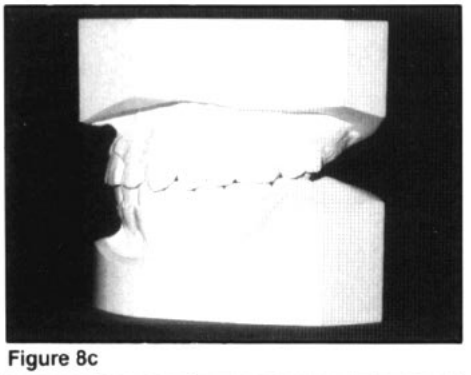


Figure 8c

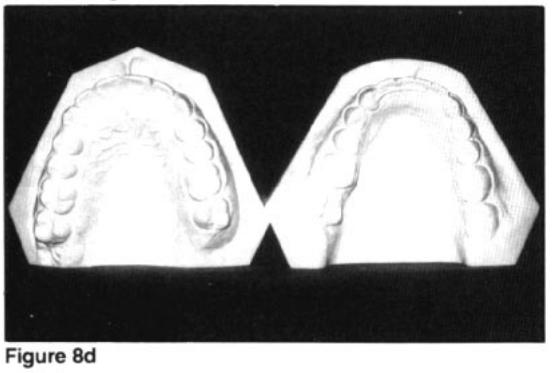


Figure 8d

Figure 8a, 8b, 8c and 8d
Posttreatment study models

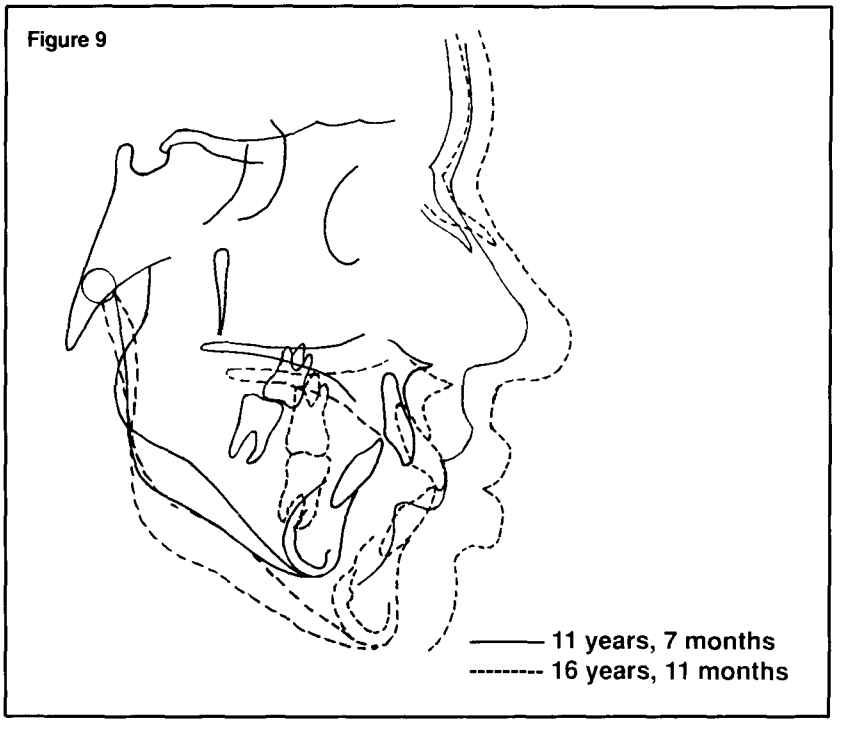


Figure 9
Superimposition of tracings of pre- and posttreatment lateral cephalometric radiographs

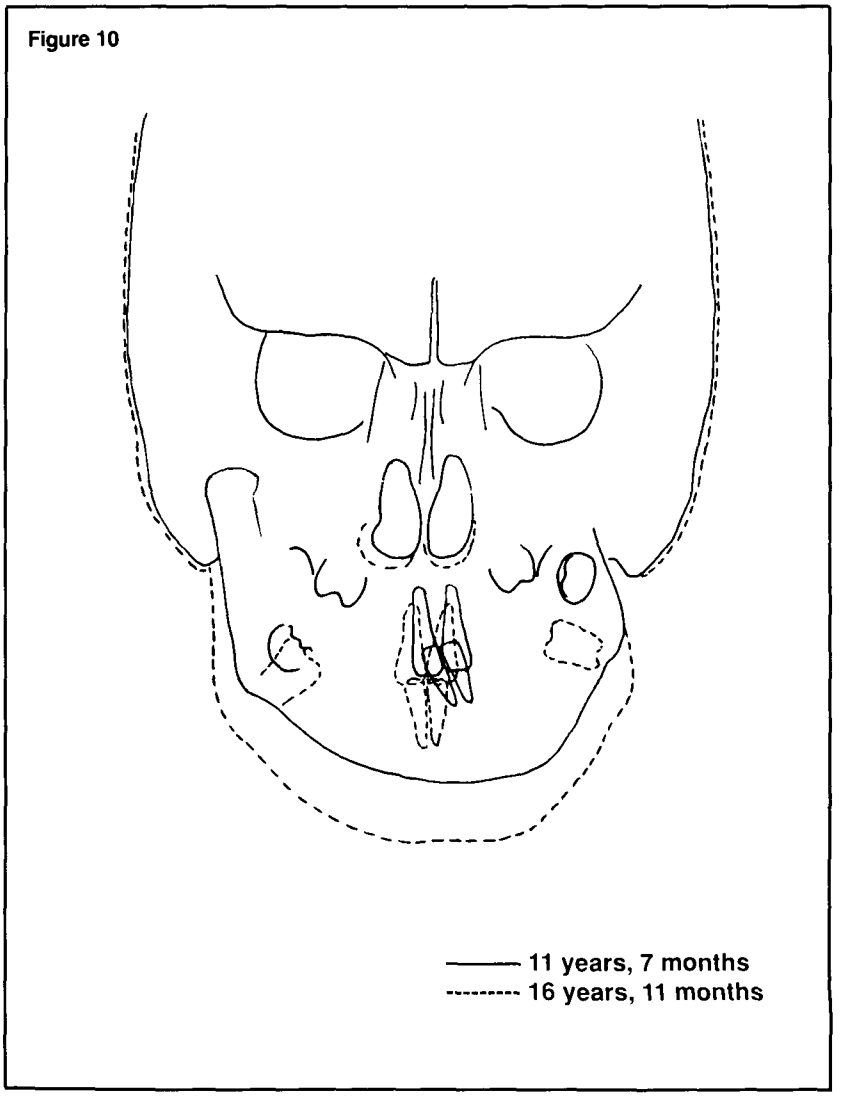


Figure 10
Superimposition of pre- and posttreatment frontal radiographs

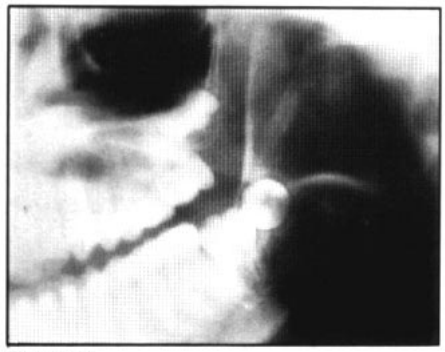


Figure 11

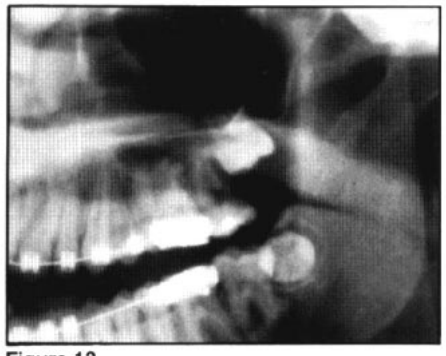


Figure 12

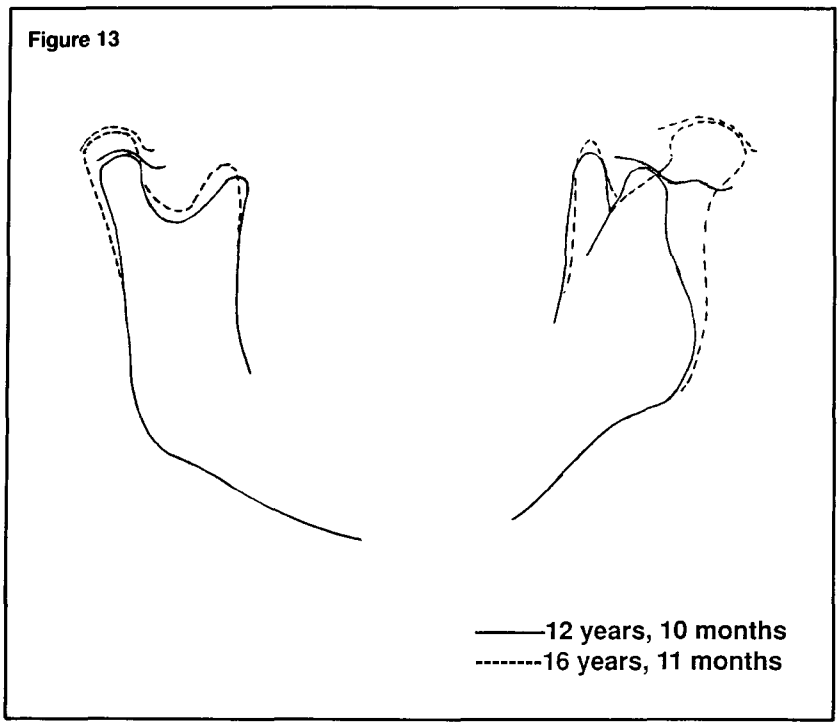


Figure 11
Radiographic view of left mandibular ramus at age 12 years, 10 months

Figure 12
Radiographic view of the left mandibular ramus at age 15 years, 10 months

Figure 13
Superimposition of tracings of mandibular rami from panoramic radiographs taken at age 12 years, 10 months and 16 years, 11 months

timing and patient compliance. This case illustrates that treatment initiated as late as 11 years of age in a boy can still be successful. It was suggested to the patient that a genioplasty could be performed to correct the slight skeletal asymmetry that remains. The patient declined. Cooperation in this patient was excellent and no doubt contributed to the overall treatment success.

Epker and Fish's[3] contention that functional appliance therapy has limited application in hemifacial microsomia cases and that results are not predictable may in part be due to variable patient compliance. The use of the Herbst appliance can greatly improve treatment results because patient cooperation is no longer a factor with the fixed type of Herbst. In those cases with the removable lower Herbst splint, cooperation is still greatly improved due to improved patient acceptance because interference with speech is much less than with traditional removable functional appliances.

Author Address

Dr. Ross Kaplan
620 12th Street SE
Salem, OR 97301

Dr. Kaplan is in private orthodontic practice in Salem, Oregon. He is an Associate Professor in the Department of Orthodontics at the Oregon Health Sciences University in Portland, Oregon. He received his orthodontic specialty training at the University of Washington. He is a Diplomate of the American Board of Orthodontics.

References

1. Dorland's Illustrated Medical Dictionary, 26th Edition, W.B. Saunders, 1981.
2. Gorlin, R.J., Pindborg, J.J., Cohen, M.M. Jr.: Syndromes of the Head and Neck. 2nd Edition, pg. 546, McGraw-Hill, 1976.
3. Epker, B.N., Fish, L.C.: Dentofacial Deformities: Integrated Orthodontic and Surgical Correction. Vol. II, pg. 949, Mosby, St. Louis, 1986.
4. Ware, W.H., Bell, W.H., Proffit, W.R., White, R.P.: Surgical Correction of Dentofacial Deformities. Vol. II, W.B. Saunders, Philadelphia, 1985.
5. Harvold, E.P.: The theoretical basis for the treatment of hemifacial microsomia. In Harvold, E.P., Vargerik, K., Chierici, G.: Treatment of Hemifacial Microsomia. Alan R. Liss, Inc. New York, 1983.
6. Melsen, B., Bjerrejaard, J., Bundgaard, M.: The effect of treatment with functional appliance on a pathologic growth pattern of the condyle. Am J Ortho, 90:503, 1986.
7. Vig, P.: Functional appliances. *PCSO Bulletin*, 55:60, 1983.
8. Edgerton, M.T., Marsh, J.L.: Surgical treatment of hemifacial microsomia. Plast Reconstr Surg, 59:653-666, 1977.