Total Reconstruction of the Microtic Ear with Autogenous Rib Cartilage: The State of the Art

Frederick N. Lukash, MD

ABSTRACT: Reconstruction of the microtic ear is a challenge that demands artistic creativity and strict attention to the principles of tissue transplantation. The process involves the use of autogenous rib cartilages sculpted into an auricular framework and placed beneath the ear skin. Other stages include reconstruction of the earlobe, tragus, and auriculocephalic sulcus to closely replicate the normal ear.

INTRODUCTION

Reconstruction of the external ear is one of the greatest challenges to a plastic surgeon. The discipline involved in the construction of an auricle is demanding and tests the balance between artistic creativity, biologic principles of wound healing and tissue transplantation. A child born with a dramatic physical defect such as an absent ear (microtia) immediately bursts the bubble of the joy of pregnancy. Worried parents are concerned about correction or concealment. The plastic surgeon who undertakes the challenge of ear reconstruction embraces not just the physical deformity but also the emotional roller coaster of the entire family—the insecurity of the child looking different from his or her peers and the guilt of the parents.

ANATOMY, EMBRYOLOGY, AND GENETICS

The auricle arises for the 1st (mandibular) and 2nd (hyoid) branchial arches. Hillocks appear on these arches during the 6th week of gestation. The anterior hillocks give rise to the tragus (1), helical root (2), and superior helix (3). The posterior hillocks contribute to the antihelix (4), antitragus (5), and lobule (6)[1] (Fig. 1).

Ear deformities result from embryonic accidents between the 6th and 12th weeks of gestation. The more extreme, such as microtia, occur early in development. The incidence of microtia occurs in 1–7000 births. The right side is affected twice as often as the left, and bilateral deformities occur in only 10% of cases. The male-to-female ratio is approximately 2:1.[1,2]

This is truly quality of life surgery.

PREOPERATIVE EVALUATION

Microtia may be part of the constellation of hemifacial microsomia.[4] Therefore, a full evaluation of the craniofacial skeleton is necessary, including imaging of the skull and jaw and a full audiologic examination. The absent ear may be an isolated embryonic arrest of part of the branchial arch development or it may be part of a complex craniofacial deformity, such as Teacher Collins Syndrome and Goldenhars (occuloauriculovertebral syndrome). Invariably, the external ear deformity is associated with middle ear pathology ranging from mild dysplasia of the ossicles to complete obliteration of the tympanic cavity.[5] This is associated with hearing impairment that is of significant clinical importance in only the 10% who have bilateral microtia. The current prevailing feeling is to address the middle ear pathology only in the bilateral 10% in whom hearing is impaired.[6]

Babies with microtia are most often seen soon after birth. It is at this initial consultation that the issues of associated anomalies must be investigated and the surgical expectations and psychological aspects of the de-

From the Division of Plastic Surgery, Department of Surgery, Long Island Jewish Medical Center, New Hyde Park, New York.

Address correspondence to Frederick N. Lukash, M.D., 1129 Northern Boulevard, Manhasset, New York 11030.

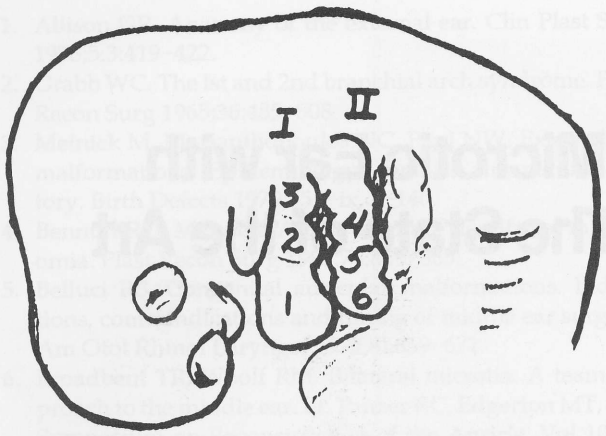


Figure 1A. Embryology and anatomy of the external ear. The auricle arises from the 1st and 2nd branchial arches (I and II).

formity discussed. It is a delicate and fragile time that demands compassion and understanding.

The timing for external ear reconstruction is a balance between physical growth of the tissues to be used for reconstruction and the emotional disturbances caused by the deformity. Fortunately, these factors coalesce around the age of six. Psychological studies have indicated that it is at about this age that peer influence begins.[7] At this age the normal ear is >90% of adult size and the costal (rib) cartilages used in the reconstruction are of adequate size to allow for framework fabrication.[8]

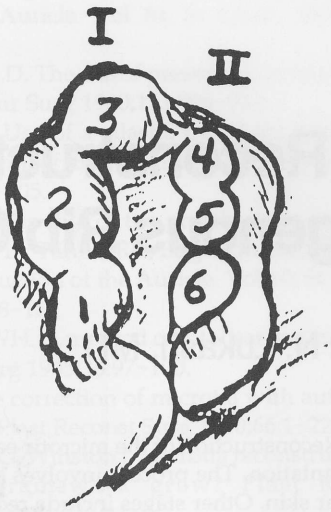
It is of paramount importance for all involved with the child and family to be supportive during the years prior to surgery. Although the waiting period may be difficult, no temporizing procedures should be performed. The success of the surgery rests on the "purity" of the tissues.

SURGICAL CORRECTION

Successful total auricular reconstruction is a staged process that usually begins the summer before first grade in school. (This is, of course, predicated by otherwise normal growth and development.) (See Fig. 2.)

The first stage involves the harvesting of the contralateral costal cartilages of the 6th and 7th synchondrosis and the free floating 8th rib (Fig. 3A). A template made from the opposite normal ear serves as a guide for matching the anatomy (Fig. 3B). The remnant cartilage is removed from the microtic ear and replaced with the anatomically correct framework (Fig. 3C,D,E). This first stage is arduous and technically demanding. It takes approximately 4–6 hours to complete. The postsurgery hospitalization is approximately 5 days.

The second stage can be performed as early as 3 months after a successful first stage. This procedure consists of rotating the abnormally positioned earlobe and splicing it onto the cartilage framework (Fig. 4). This is an outpatient procedure.



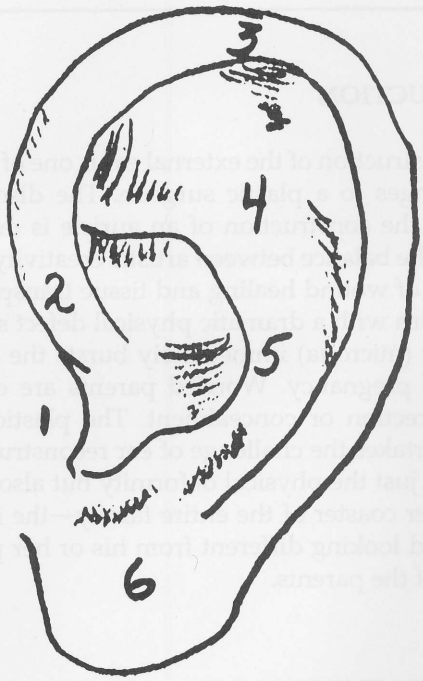


Figure 1B & C. Six hillocks arise on these arches during the sixth week of gestation giving rise to the tragus (1), helical root (2), superior helix (3), antihelix (4), antitragus (5), and lobule (6).

The third stage, also ambulatory, involves the creation of a tragus. Usually, about 3 months is allowed between stages. This is accomplished by utilizing a chondrocutaneous graft from the opposite ear conchal region. This useful donor site permits the delicate reconstruction of cartilage and skin and provides for an opposite ear "otoplasty" to bring it closer to the head and balance it to the reconstructed ear (Fig. 5A, B).

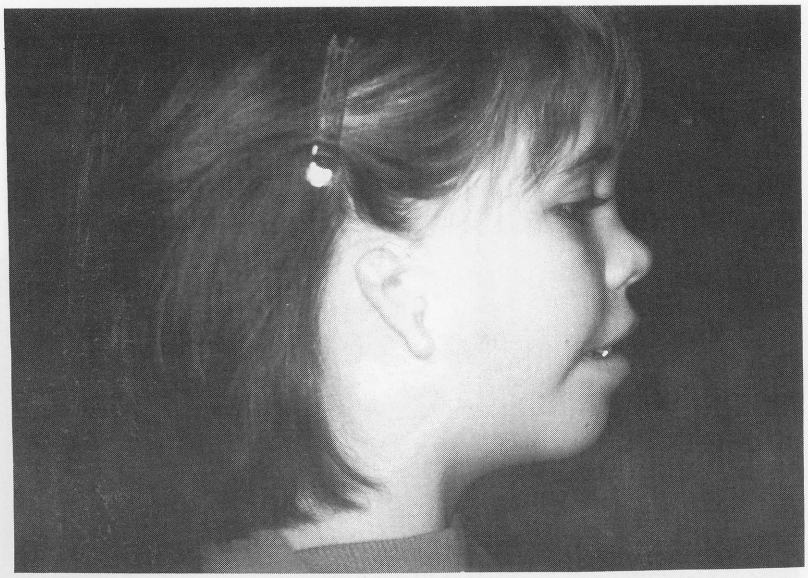


Figure 2. Six-year-old female with right unilateral microtia.

The final procedure in this reconstruction is to increase the projection of the ear and convert it from a two-dimensional relief to a three-dimensional entity. The creation of an auriculocephalic sulcus by elevation and skin grafting allows for hair to fall behind the ear, a place to rest glasses (and pencils)—and normalizes the ear. This procedure can also be performed on an ambulatory basis approximately 1 year after completion of the other stages to allow for complete healing.

DISCUSSION

A microtic ear can be compared to a flower that failed to unfurl. Many types of procedures have been utilized in its reconstruction—ultimately evolving into the autogenous rib cartilage procedure. Historically, homogenous cartilage frameworks were tried, but resorbed rapidly.[9] Silastic frameworks were also tried, but experienced a high rate of infection and extrusion.[10]

Auricular prostheses have no major role in reconstructive pediatric microtia. They should be reserved for patients in whom surgical reconstruction is contraindicated or for cases in which an experienced surgeon is unavailable.[11]* In the late 1950s the modern era of ear reconstruction was ushered in with the use of autogenous costal cartilages.[12] This procedure has undergone many modifications and refinements to yield today the most reliable, lasting result with the least morbidity.[13] The reconstructed ears are durable and withstand the traumas of active children and appear to grow with respect to the opposite ear[14] (Fig. 6).

*Ed. Note: Total ear reconstruction requires special artistic skills. Few plastic surgeons have the artistic training and ability to achieve the desired result.

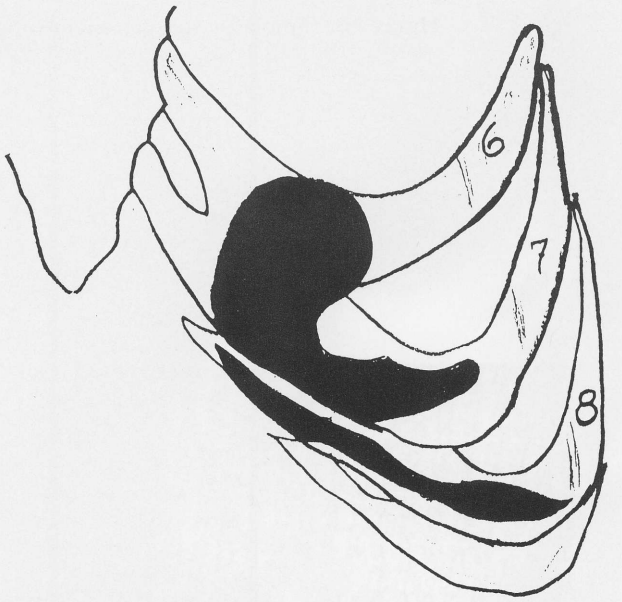


Figure 3A. First stage of ear reconstruction. Drawing demonstrating costal cartilage donor site for framework reconstruction utilizing the synchondrosis of the 6th and 7th costal cartilage and the 8th costal cartilage.

CONCLUSION

There is no greater joy for a plastic surgeon than to see ponytails and pigtails and earrings on children who have undergone total ear reconstruction. This is truly quality of life surgery (Fig. 7).

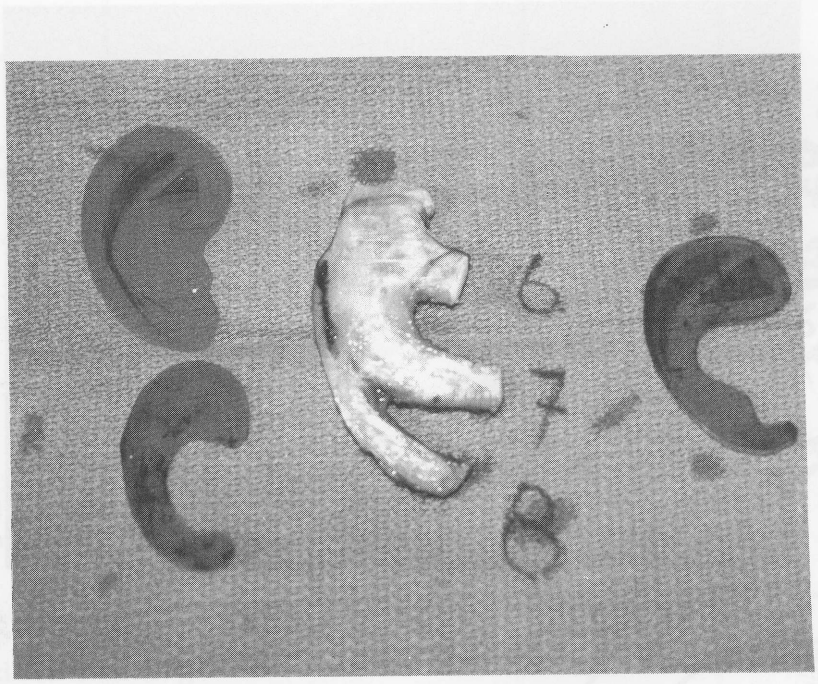


Figure 3B. Templates drawn from the opposite normal ear serve as a guide for reconstruction.

Figure 3C. Cartilage removed from the microtic ear (note its crumpled amorphic shape).

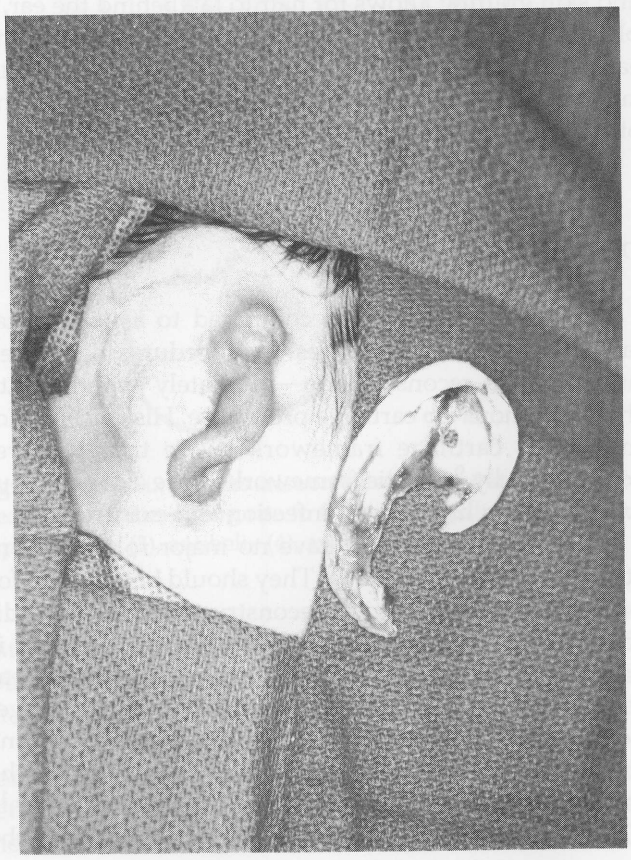


Figure 3D. Newly carved auricular framework prior to implantation.

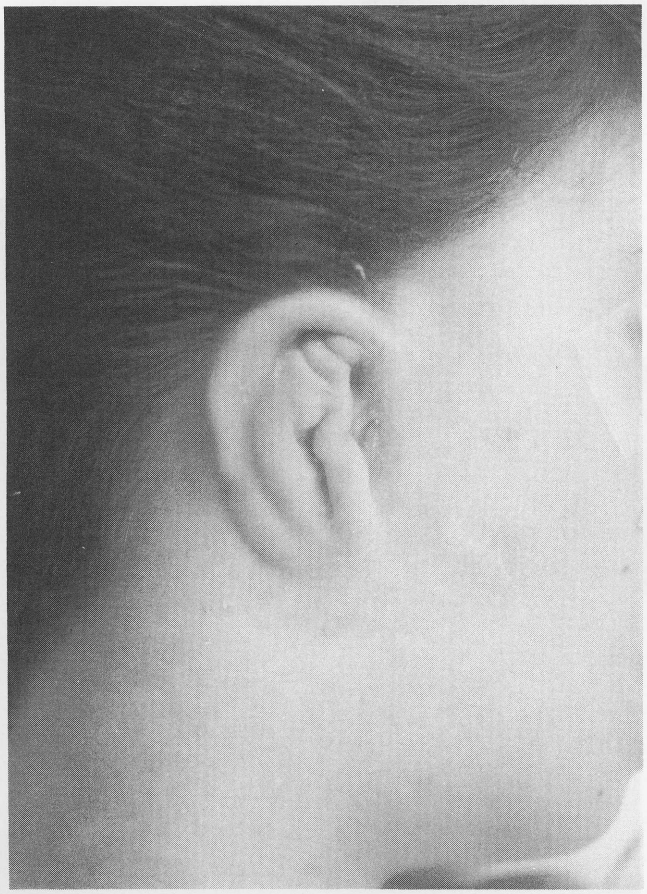


Figure 3E. Framework in place—note vertical portion of earlobe within depths of ear.

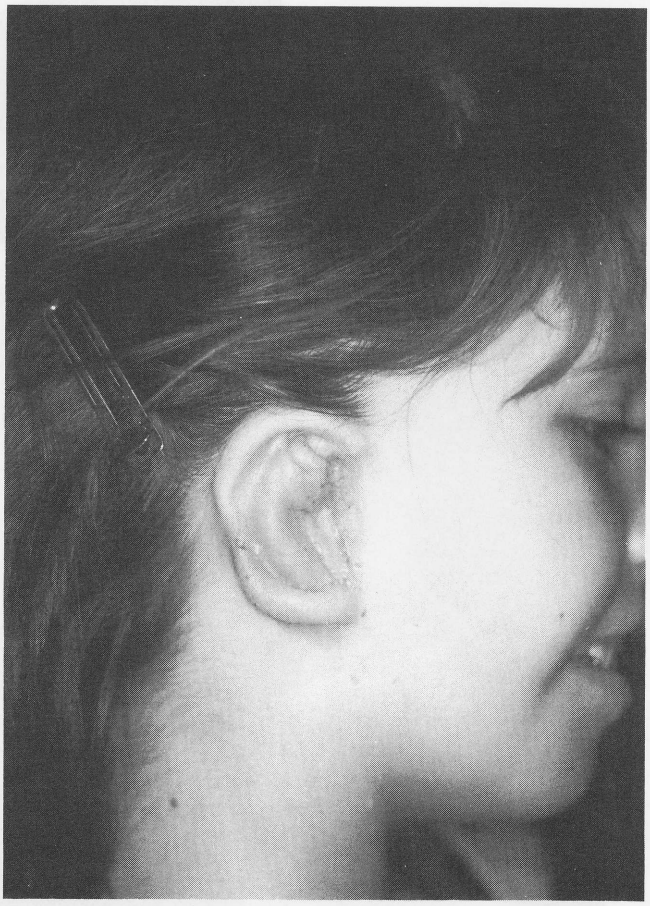
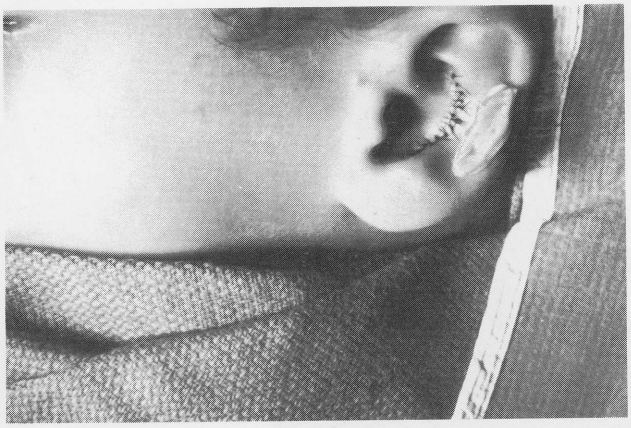
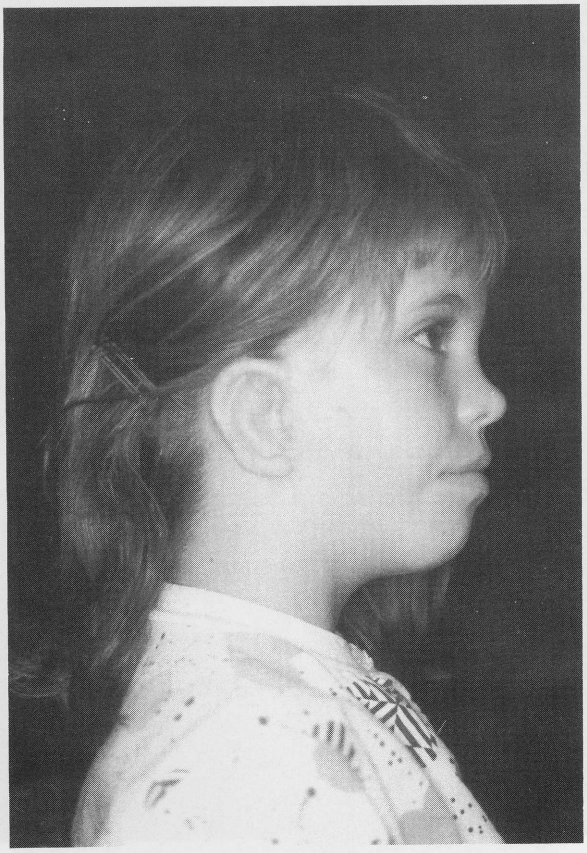


Figure 4. Rotation of earlobe from depths of ear with splicing onto framework.



(A)



(B)

Figure 5. Chondrocutaneous graft from opposite ear to create a tragus.

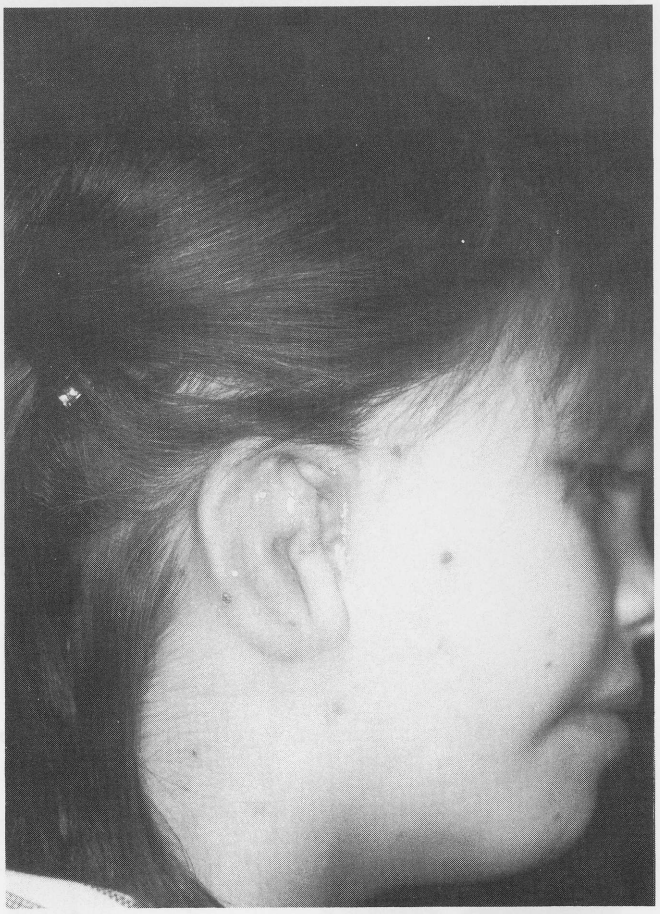


Figure 6. Chicken pox on reconstructed ear framework. No damage resulted to this living tissue transplantation.

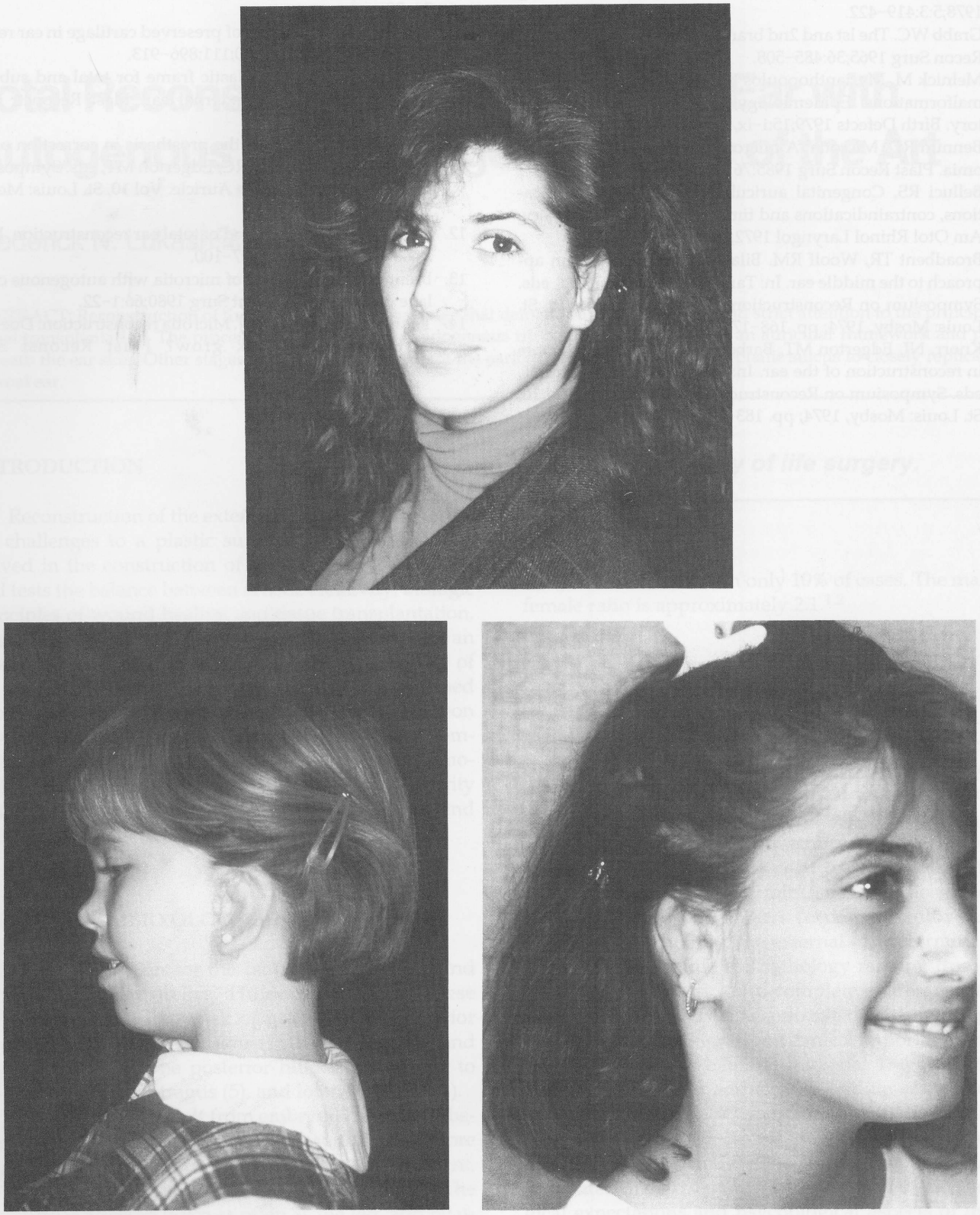


Figure 7. Reconstructed ears on growing children. (Note earrings and hair tucked behind ear.)

REFERENCES

1. Allison GR. Anatomy of the external ear. Clin Plast Surg 1978;5:3:419–422.
2. Grabb WC. The lst and 2nd branchial arch syndrome. Plast Recon Surg 1965;36:485–508.
3. Melnick M, Myrianthopoulos NC, Paul NW. External ear malformations: Epidemiology, genetics and natural history. Birth Defects 1979;15:i–ix, 1–140.
4. Bennun RD. Microtia: A microform of hemifacial microsomia. Plast Recon Surg 1985:76:859–865.
5. Belluci RS. Congenital auricular malformations. Indications, contraindications and timing of middle ear surgery. Am Otol Rhinol Laryngol 1972;8l:659–671.
6. Broadbent TR, Woolf RM. Bilateral microtia: A team approach to the middle ear. In: Tanzer RC, Edgerton MT, eds. Symposium on Reconstruction of the Auricle. Vol 10, St. Louis: Mosby, 1974; pp. 168–177.
7. Knorr, NJ, Edgerton MT, Barberie M. Psychologic factors in reconstruction of the ear. In: Tanzer RC, Edgerton MT, eds. Symposium on Reconstruction of the Auricle. Vol 10, St. Louis: Mosby, 1974; pp. 183–187.
8. Farkas L. Growth of normal and reconstructed auricles. In: Tanzer RC, Edgerton MT, eds. Symposium on Reconstruction of the Auricle. Vol 10, St. Louis: Mosby, 1974; pp. 24–32.
9. Kirkham HLD. The use of preserved cartilage in ear reconstruction. Aur Surg 1940;111:896–913.
10. Cronin TD. Use of a silastic frame for total and subtotal reconstruction of the external ear. Plast Reconstr Surg 1966;37:399–405.
11. Simons JN. The role of the prosthesis in correction of ear deformities. In: Tanzer RC, Edgerton MT, eds. Symposium on Reconstruction of the Auricle. Vol 10, St. Louis: Mosby, 1974; pp. 178–182.
12. Steffensen WH. A method of total ear reconstruction. Plast Reconstr Surg 1965;36:97–100.
13. Brent B. The correction of microtia with autogenous cartilage grafts. Plast Reconst Surg 1980;66:1–22.
14. Thomson HG, Winston J. Microtia reconstruction: Does the cartilage framework grow? Plast Reconst Surg 1989;84:908–915.