Allograftic and alloplastic auricular reconstruction

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ABSTRACT

Objectives: The ear is considered a major asthetic unit that is not easily duplicated. Children born with microtia and patients who suffer from total auricular deformities present with one of the most challenging problems a facial plastic surgeon may encounter.

Methods: Various modalities have been described in the literature. The aim of this paper is to describe the results obtained when the ear is reconstructed using different modalities (autogenous and non-autogenous) with special emphasis on the results of using polyethylene (Med pore) ear implants.

Results: A retrospective chart review was conducted on 22 patients who had major ear reconstruction using bovine cartilage, autogenous costal cartilage and alloplastic polyethylene (Med Pore) material. The advantages, disadvantages and results of each modality are outline by case examples.

Conclusion: It is concluded that the best results are still obtained by autogenous ear reconstruction. The use of bovine cartilage is not recommended due to its high resorption and complication rate, which limits its use in the pediatric age group.

Keywords: Ear, microtia, alloplast, allograft, reconstruction, med pore, polyethylene, ear.

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Although the auricle constitutes only a small portion of the total body surface area, it is probably one of the most complicated and sophisticated morphological structures of the body.[1] Any alterations in its size, shape and position may cause significant noticeable asthetic disturbances.[2] Correcting any of these disturbances is a very challenging task. Several autogenous and exogenous reconstructive options have been described in the literature. Most of those options were attempted over the years, in Riyadh Al-Kharj Hospital. This paper aims at highlighting this experience.

Methods. A retrospective chart review was conducted on patients who underwent major ear reconstruction in Riyadh Al-Kharj Hospital since 1985. The following variables were recorded. Age, sex, diagnosis, family history, presence of other anomalies, type of operation, age at time of reconstruction, number of stages and the complication type and rate. The asthetic outcome of the modality was assessed by analyzing the pre and postoperative photographs. The photos were studied to define whether the following surgical goals were achieved. 1. Symmetrical size, shape and position, 2. A normal ear outline and correction of the morphological abnormality, 3. Correction of the functional problems of inability to wear glasses hearing aids and masks.

Results. There were 22 patients who underwent major ear reconstruction starting in 1985. The etiology of the deformity was either congenital or traumatic. There were 18 cases of congenital

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Table 1 - Incidence amongst the patients studied.

Side	Male No.	Female No.	Total No.	%
Right	7	4	11	50
Left	6	1	7	32
Bilateral	2	2	4	18

deformity (82%), and 4 cases with traumatic deformities (18%). The average age at the time of correction in the traumatic group was 37 years. In the congenital group the average age for autogenous reconstruction was 8 years in comparison to 2.7 years when an axogenous material was used. Males constituted the majority of the patients (68% - 15 patients), and the right side was more frequently affected than the left side, followed by the bilateral cases (Table 1).

Several reconstructive modalities were attempted. These varied from local flaps to correct helical defects to major reconstruction by implantation of a framework. The framework was autogenous costal cartilage in 3 cases; performed according to the technique described by Brent.[8] Bovine cartilage was used in 8 patients (36%). Alloplastic material polyethylene implant was used in 10 cases (45%). Data regarding the clinical course of the patients and the outcome was obtained from the charts and by analyzing the pre and the postoperative photographs. Complications were classified as major and minor. Minor complications included minimal exposure or superficial infection and were managed conservatively or by minor surgical revisions to improve the outline. Major complications included extensive framework exposures, which required revisions and surgical removal of the implant either partially or totally (Table 2).

The following are some case examples demonstrating the results of each modality:

Patient 1. Figure 1a and 1b shows a 2-year-old female child who presented with unilateral microtia with no family history of a similar condition. Ear reconstruction was attempted with a post-auricular skin flap. The post-operative appearance was not satisfactory. The ear appeared to lack normal morphology and was not symmetrical. Functionally it may perform as a support post for glasses.

Patient 2. A 5-year-old male child who was born with microtia and underwent multiple attempts at ear reconstruction. Initially a bovine cartilaginous framework was used. It eventually had to be removed and was replaced with sculpted autogenous costal cartilage. This patient underwent more than 8 procedures, and the reconstructed ear lacked normal definition and symmetry, possibly due to cartilage resorption and severe local scarring.

Patient 3. A 5-year-old child who underwent ear reconstruction using a Med pore implant. The operation was complicated by implant extrusions on several different occasions and locations. Eventually the alloplastic material had to be removed. The child and his parents were extremely concerned and declined any other procedure.

Patient 4. Figure 2 shows a 4-year-old who underwent a 4-stage ear reconstruction using Med pore implant. The results again were far from ideal. The condition will not improve as the child grows, as the alloplast has no potential capacity for growth.

Patient 5. Figure 3a and 3b shows a 47-year-old male who sustained traumatic ear loss and was reconstructed with a Med pore implant. The results in the early post-operative period appeared to be satisfactory.

Patient 6. Figure 4a and 4b shows a 27-year-old male patient who presented with a post traumatic ear deformity involving the superior two thirds. He underwent a 3-stage ear reconstruction utilizing autogenous costal cartilage. Morphologically it appeared close to normal with good outline and satisfactory symmetry.

Patient 7. Figure 5a and 5b shows a 5-year-old girl who was born with Tanzer Type 2B microtia. She underwent primary ear reconstruction using autogenous costal cartilage. The outcome was satisfactory, but her post-operative course was complicated by minor skin necrosis in an area of approximately 3mm. The area was treated conservatively and eventually was closed surgically during the second stage.

Table 2 - Complications.

		Flap	Costal cartilage	Bovine cartilage	Alloplast
Minor complications	Exposure		1		1
	Infection				1
	Revision	1		1	
Major complications	Partial removal			1	3
	Total removal			1	4

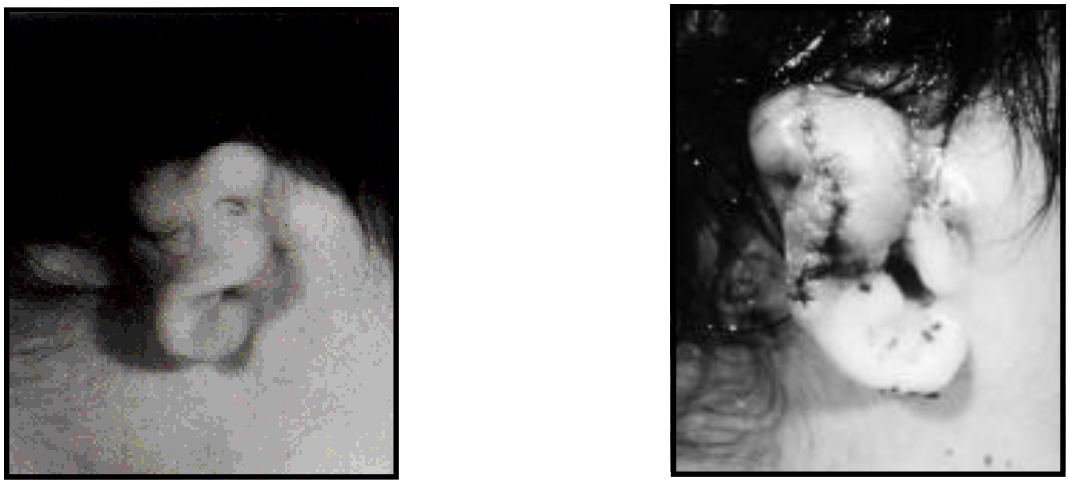

Figure 1 - (a) Pre-operative - two year old female born with untilateral microtia. (b) Post-operative - Appearance after an attempt at reconstruction using a post-auricular skin flap.

Figure 2 - Operative view of a 4-year old child who underwent ear reconstruction using a med pore implant.

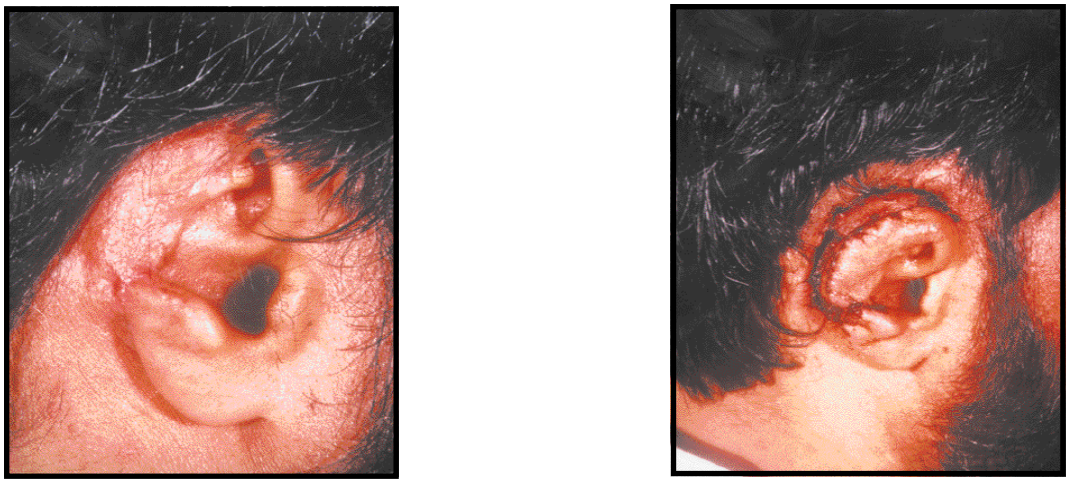

Figure 3 - (a) Pre-operative - traumatic loss of the superior 2/3 of the ear. (b) Post-operative - Appearance following reconstruction with a med pore implant.

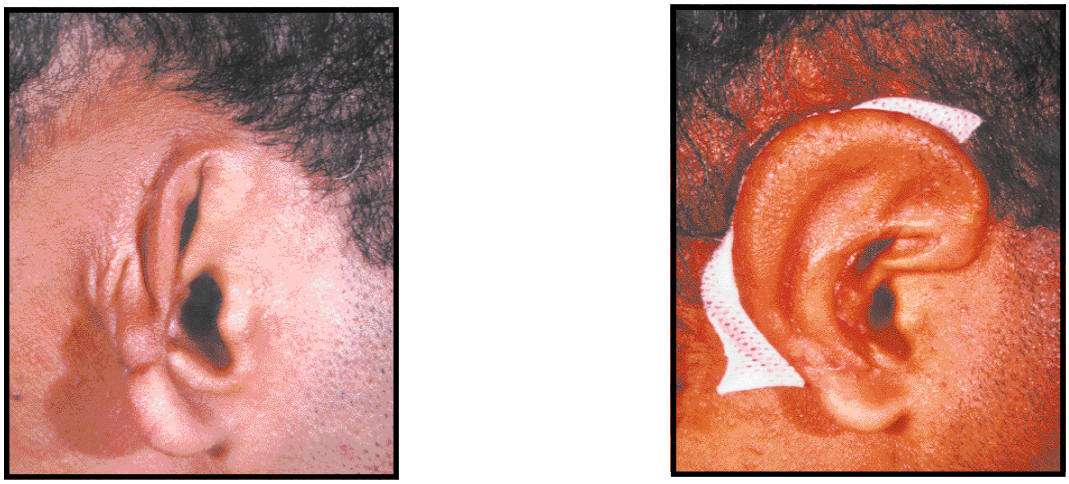

Figure 4 - (a) Pre-operative - close-up view of the ear prior to reconstruction. (b) Post-operative - Close up view of the outcome with silicone gel sheet placed behind the ear.

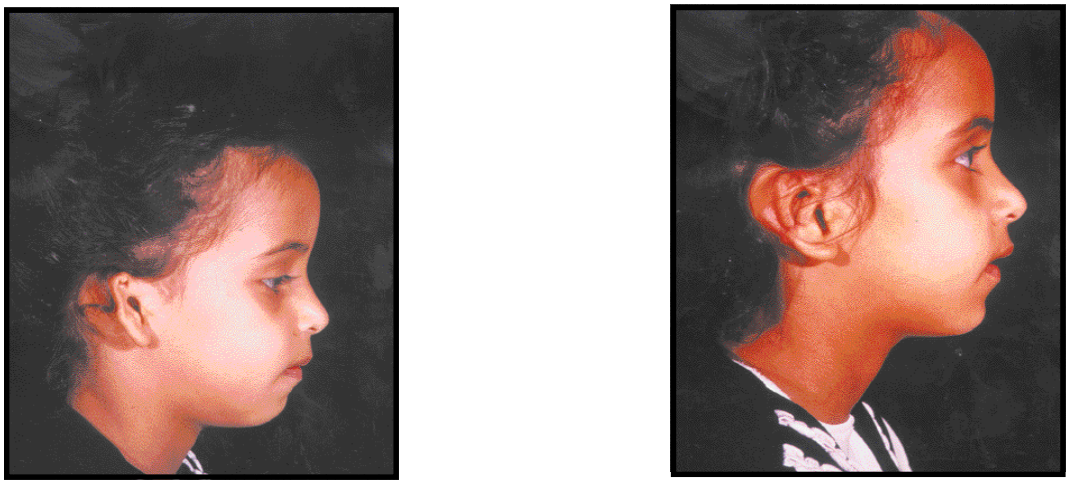

Figure 5 - (a) Pre-operative - Four year old child who was born with unilateral mirotia. (b) Post-operative - result after reconstruction with autogenous cartilage.

Discussion. Embryologically the external ear arises on the 5th gestational week from the 6th hillock of the first and second branchial arches. Congenital deformities may occur during this week due to non-specific chromosomal aberrations, hereditary transmission, infections, or drugs. Other associated deformities can also be seen, including hemifacial atrophy, muscular weakness, microsomia and other craniofacial deformities. Organ systems developing at the same time e.g. the urogenital system may also become abnormal.[4] Morphologically the ear consists of a C shaped helix that encloses a Y shaped antihelix and a conchal concavity bordered by the tragus anteriorly. The upper edge lies at the level of the most lateral point of the eyebrow in 85% of all normal individuals. The rotation of the ear is determined by the position of its longitudinal access. The longitudinal access is defined by a line connecting the fullest portion of the upper one-third of the ear and the most dependant part of the ear lobe. The angle between the longitudinal access of the ear and the vertical line of the face averages 21° (9-29°). Normally shaped ears, in which the positions diverge from these norms, appear odd and less asthetically pleasing.[5] Several classification systems were proposed for congenital ear deformities.[6] To date the Tanzer classification[7] is still used. The literature reported incidence of major congenital ear deformities (microtia) varies between 1:6000 to 1:2500 cases and the male to female ratio is 2:1. It is often unilateral with a right to left ratio of 5:3. One half of all children with microtia have other congenital abnormalities. Historically several methods have been used to reconstruct the ear. The

milestones for ear reconstructions were set by Tanzer in 1959 when he described Autogenous Reconstruction, Brent in 1974 with his refinements of the techniques, and by Nagata with further modification into two-stage reconstruction instead of four in 1994. The use of alloplastic material has also been described. Initially silicone was used but was associated with high complication and exposure rates. Lately the use of polyethylene has been described as an alternative alloplastic material. It is described as "an inert porous material, fashioned into a pivoting helix framework." It is a ready to use sterile alloplast that is both strong and flexible. The porous nature of the implant allows for vascular and soft tissue ingrowths that may render the framework resistant to infection and extrusion. The concomitant deposition of collagen adds tensile strength and allows for continued flexibility of the auricle.[8]

Ear reconstruction in Riyadh Al-Kharj Hospital has been through several phases where various procedures were attempted. Attempting major auricular reconstruction with local flaps, performed in patient 1, was not successful. This option does not address the frame base and it ultimately did not give a pleasing result. The use of xenograft in 8 patients resulted in higher complications; which included chondral resorption and possible rejection as demonstrated by major exposure in 2 patients. It's use in Patient 2 resulted in an unsatisfactory outcome due to resorption that led to poor morphology, which required multiple procedures to correct. The multiplicity of surgeries led to excessive scarring in the area, which contributed to the poor outcome. Polyethylene implants were used in 10 cases at an average age of 2-7 years. The use of polyethylene implants at an early age when the ear is not close to its adult size is not recommended for the following reasons: 1. It does not grow with the child. 2. The implant needs durable skin and connective tissue cover, which may not be possible at an early age. In adults the use of a temproparietal fascial flap could be an option to add durability to the coverage. 3. Despite the claim of soft tissue and vascular in growth into the pores it does not behave as autogenous tissue, i.e. it does not heal, and the overlying skin does not heal well if it has ulcerated or necrosed. In addition major exposures were seen in 7 out of the 10 cases. This high exposure rate could be explained by the skin cover in this young group and its poor tolerance to pressure especially in the non-compliant age group. Autogenous reconstruction using costal cartilage appears (Patients 6 and 7) to give favorable results in comparison to the other methods. The advantages outweigh the disadvantages of the donor site and it is currently still considered the gold standard. In comparison, there were fewer patients who had autogenous reconstruction due to the impression that other methods are more convenient with less morbidity in the donor site. Naturally each modality has an inherent complication rate. Table 2 illustrates these and one can derive the following from it: 1) Minor complications were more frequent when an autogenous method was used. 2) The use of alloplastic material led to more major complications as opposed to using autogenous material. 3) Major complications are more frequently seen when an alloplastic material is used at an early age when there is not sufficient soft tissue cover.

In conclusion, the results of autogenous reconstruction for major ear deformities are better in achieving a satisfactory morphology, symmetry and function. Major complications are more commonly seen when an alloplastic or an allograft material is used especially at a young age. The alloplastic material does not grow with the child and any skin ulcerations rarely heal. A durable soft tissue coverage is required when a polyethylene implant is used which is not seen in early childhood.

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