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Bilateral Implant-Retained Auricular Prosthesis for a Patient with Congenitally Missing Ears. A Clinical Report

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Abstract

Microtia is a major congenital anomaly of the external ear. It includes a spectrum of deformities from a grossly normal but small ear to the absence of the entire external ear. These deformities account for three in every 10,000 births, with bilaterally missing ears seen in fewer than 10% of all cases. Congenital abnormalities of the ear are unlikely to result in the complete absence of the ears, but the patient presented in this article had bilateral congenitally missing ears. There was loss of anatomic landmarks and alteration of normal bony architecture. Minimal tissue was available for retention; therefore, conventional techniques could not be used for achieving retention. A two-implant-supported auricular prosthesis was planned, but the patient was found to have deficient bone in the implant site. Hence the implants were placed posterior to these sites, and the superstructure was modified to accommodate for this change in position of the implant to ensure the esthetic positioning of the prosthesis.

A facial deformity can have a significant impact on a patient's self-image and the ability to function and interact socially. The rehabilitation of these patients with a prosthesis that replaces the missing tissue functionally and esthetically can bring back not only their appearance but also the confidence needed to live in society. Reconstructive methods follow the principle of what should be either replaced or repaired. Sometimes repair is difficult. In such cases, replacement is an attractive option.

The definition of function is an interesting one, because surely if a patient is using a prosthesis for cosmetic reasons, then it is serving a function. Therefore, both the psychological and functional effects of the prosthesis enhance rehabilitation by helping patients to adjust to their loss and by permitting a more normal professional and social life.[1] With advancements in maxillofacial prosthetics, such patients can be rehabilitated very effectively.

An auricular defect can be caused by trauma, congenital malformation, or surgical removal of a neoplasm.[1,2] A major congenital abnormality of the ear is microtia. The term microtia includes deformities from a normal but small ear to the absence of the entire external ear, which can occur unilaterally or bilaterally. The unilateral form is much more common, occurring in approximately 90% of patients.[3,4] It is seen more commonly in male patients and on the right side. Several classification systems describe microtia. Tanzer[3] classified microtia according to the description and location of the defect.

Type A: anotic ear.
Type B: completely hypoplastic ear with or without aural atresia.
Type C: hypoplasia of the middle third of the auricle.
Type D: hypoplasia of the superior third of the auricle.
Type E: prominent ear.

Anotia ("no ear") describes a rare, congenital deformity with a complete absence of the auricle, the external, visible part of the ear. This contrasts with microtia, where there is malformation or hypoplasia (decreased growth) of the auricle. This malformation may range from a small, but otherwise normal, external ear to an external ear with major structural changes.

Microtia may present as an independent anomaly or it may be associated with other syndromes (Goldenhar syndrome and Treacher Collins syndrome). Microtia may be commonly associated with external ear canal atresia or aural atresia and middle ear anomaly, resulting in conductive hearing loss. The occurrence of major ear anomaly is three in every 10,000 births; its appearance also causes a psychological impact on the affected children and their families.[3,4] Only two treatment options are available in such cases: surgical reconstruction or prosthetic rehabilitation. Surgical (autogenous) reconstruction of an ear is a laborious process involving multiple plastic surgeries.[3] Prosthetic rehabilitation by fabrication of an auricular prosthesis has been suggested as an alternative.[2] Auricular prostheses can offer psychological, functional, and rehabilitative advantages.

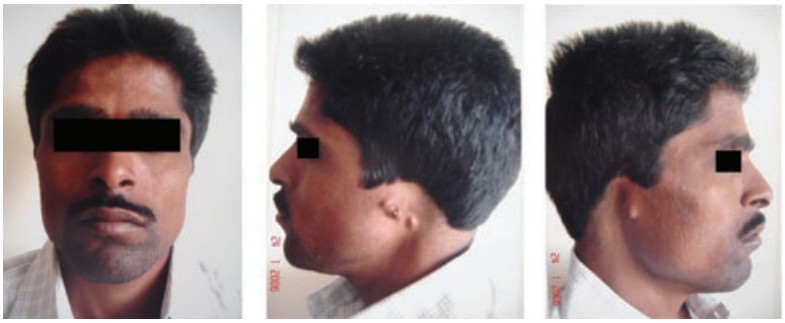

Figure 1 Preprosthetic images of patient's completely anotic ears.

By restoring the natural appearance of the ear, the prosthesis eliminates the trauma caused by the constant reminder of the handicap, thus offering true psychological therapy.[2]

In patients where a prosthesis is indicated, the anchorage could be by adhesives, undercuts, eyeglasses, or implants.[5,6] The retentive media used in these patients is critical for the satisfactory rehabilitation of these defects.[7] The implant-supported ear prosthesis has an advantage over the earlier-mentioned retention systems in that it is a safe, easy, and secure anchoring method, thus making craniofacial osseointegration a valuable salvage option.

Clinical report

A 25-year-old patient reported to the Department of Maxillofacial Prosthodontics, The Oxford Dental College, Hospital & Research Institute, Bangalore, India, with a desire to replace his bilaterally missing ears. On examination, it was observed that the patient had a bilaterally symmetrical face, with Tanzer's Type A, completely anotic ears (Fig 1). He was devoid of any other systemic disorders. The various treatment options were explained to the patient. As minimal tissue was available for retention, the difficulties in achieving retention by conventional techniques were explained to him. A diagnostic 3D CT Scan of the temporal bones was done to develop and implement a cohesive and comprehensive treatment plan for the patient. The objectives of this phase of imaging were to determine the quantity, quality, and angulation of bone and the relationship of critical structures to the prospective implant sites.[8,9] The optimal implant site was found to have suboptimal bone, so the

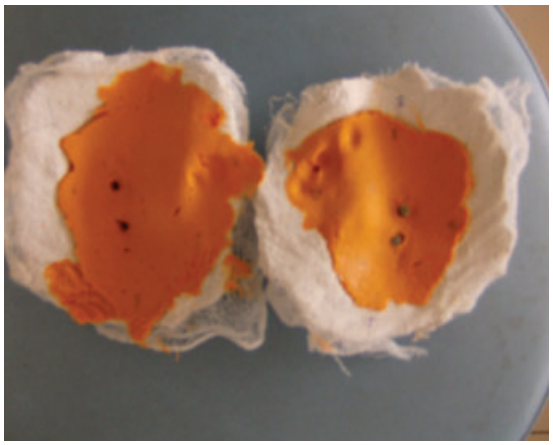

Figure 3 Impression posts captured.

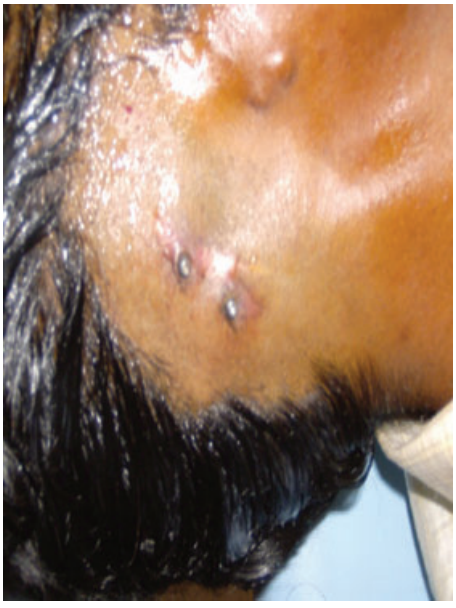

Figure 2 UMA abutments in patient.

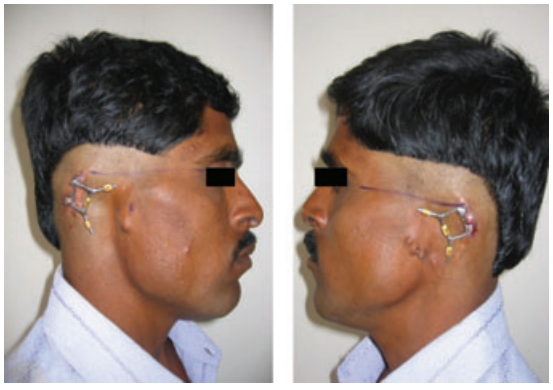

Figure 4 Modified implant superstructure.

next-best site was chosen. To accommodate for the change in implant site, a change in the design of the bar was planned so as to place the prosthetic ear in the esthetically correct position. The patient chose to proceed with the suggested treatment plan.

Surgical technique for auricular implant placement

Tjellstrom et al[10] recommend two well-spaced implants 15 mm apart as adequate for an auricular prosthesis. Under local anesthesia, two endosseous, extraoral screw-type implants, measuring 5 mm with external hex (Endopore dental implant system; Sybron Implant Solutions, Bremen, Germany), were selected to be placed in the mastoid region. Ideally on the right side, two implants should be placed in the eight o'clock and eleven o'clock positions, and on the left side at the four o'clock and one o'clock positions in the mastoid region at a distance of 20 mm from the center of the external auditory meatus.[11] As no adequate bone was available at these sites, the implants were placed posterior to this ideal position. The primary stability was excellent. The mucoperiosteal flaps were then repositioned and sutured.

Six months following surgery, osseointegration was confirmed by means of Schuller's projection, which was useful in assessing the quality of the implant bone interface and the degree of fit between implant fixtures and abutments. Individual implants were immobile. Next, second-stage surgery was performed. Implants were uncovered, and UMA abutments (Endopore, Hybrid/Entegra, Sybron Implant Solutions) with length of 5.5 mm and width of 5 mm were placed with cover screws. Subcutaneous tissue around the implants was thinned. The cover screws were then removed (Fig 2). The abutment was placed onto the implant fixture. The implant was also tapped with a mirror handle to elicit a ringing sound.[10] The surgical procedure was completed after applying a firm mastoid dressing for 1 day. After this, only a light dressing was needed.[11,12] After the initial healing period when a surgical dressing was no longer needed, the patient was instructed to clean this area on a daily basis to remove cellular material on the skin or abutment. This cellular material can come from the interface of the epithelium and abutment. This can be performed with a soft-end nylon bristle toothbrush, an interproximal dental brush, or a cotton swab.

Fabrication of prosthesis

Ear impression

As described by Branemark and de Oliveira, the first step was to reproduce detailed anatomic information about the defect area and precise positions of the abutment.[12] A moulage impression was made at the abutment level with poly(vinyl siloxane) (PVS) impression material (Aquasil; Dentsply, York, PA) supported by a plaster backing. A detailed anatomic impression of the defect area was made using impression copings. A thin layer of light-body PVS (3M ESPE Dental Products, St. Paul, MN) was applied around the copings and over the area where the prosthesis would be fabricated. The outside edges of the defect area were outlined using an indelible pencil, and the vertical and horizontal lines were retraced on both the defect areas for positioning purposes. Pieces of gauze were placed on the surface of the light body. Next, a layer of fast-set plaster was poured over the light body. The plaster secures the impression copings in position and also stabilizes the light-body impression material. When the plaster was set, the impression copings were unscrewed, and the impression was removed. Abutment replicas were connected to the impression coping and the impression was poured in die stone (Kal Rock, Kalabhai Karson Pvt. Ltd., Mumbai, India). Once the die stone was set, the impression material was removed. This working model of the patient's defect with the abutment replicas was now in the same position, direction, and height as the abutments to serve as a guide for fabrication of the prosthesis (Fig 3).

Implant superstructure

The Hader bar, cast in Co–Cr alloy (Wirolloy, Bego Dental Products, Bremen, Germany), was designed to be clear of any soft tissue. This clearance must be maintained during tissue movement. From the mechanical aspect, it is important that the cantilever did not extend more than 8 to 10 mm beyond the abutments.[11] This reduced the leverage forces while placing and removing the prosthesis. The greater the distance from the abutments, the greater the bending moment applied on the implants will be, therefore possibly compromising the long-term success. The bar framework was modified to enable the placement of the auricular prosthesis at the ideal position and to compensate for the fact that the implants were placed posteriorly, due to nonavailability of bone. The bar should have a passive fit so as not to place any undue stress on the implants (Fig 4). Extensions were made on the tissue surface of the acrylic plate to take support from underlying temporal bone, and the whole assembly was tried in situ to check the fit and contours (Fig 5).

Wax pattern

One of the methods of fabricating a wax pattern is using the ''donor technique,''[13,14] in which a relative or a person with ear contours that closely mimic those of the patient acts as the donor to make an ear impression. Selecting a donor involved finding someone of the same age, sex, and build as the patient. This resulted in a wax prosthesis needing a minimal amount of work at the try-in stage. After a suitable donor had been found, an impression of the ear to be used was made. This impression was poured in wax. The wax was cooled for 5 minutes before pouring to ensure good consolidation and reproduction of detail.

Wax try-in

Following a satisfactory fit of the bar, it was polished and placed back onto the model. Rider clips were then positioned onto the bar to ensure adequate retention (Fig 6). The undercuts of the bar were blocked out using wax. The margin areas of the model were reduced to ensure good marginal integrity of the silicone. The prosthesis was then adapted on the model. The following were checked during try-in:

- The fit of the prosthesis on the tissue.
- The correct horizontal alignment.

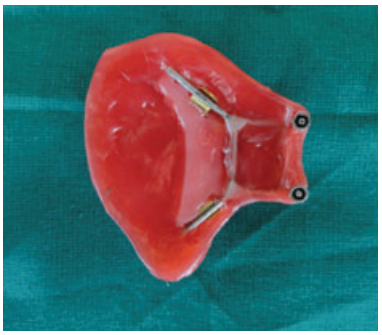

Figure 5 Tissue side of the prosthesis showing acrylin resin substructure.

- The projection of the ear in relation to the side of the head.
- The integrity of the margins during simple jaw movements.

Making the mold

For an auricular prosthesis, a three-part mold seems to be ideal, because it facilitates intrinsic coloration and deflasking (Fig 7).[15] The three main objectives of this technique were (1) to construct a multisectional stone mold for the fabrication of prosthetic ears with multiple anatomic undercuts, (2) to decrease the risk of tearing the prosthesis during deflasking and recovery, and (3) to decrease the risk of fracturing the mold during the deflasking procedure, thereby rendering it unusable.[15] Once the wax pattern was refined, and the bar fitted to the pattern, dental stone was poured, making the first part of the mold. When setting time was completed, the second part was made by pouring dental stone until the back part of the helix and lobule was completely covered. The third part was later made by pouring dental stone until all the wax was covered. The stone should be allowed to harden for approximately 1 hour before dewaxing. Once dewaxing was carried out, the three sections were separated individually and painted with separating medium. The remaining dental stone surfaces were also painted with separating medium.

Color matching

Accurate representation of skin color in a prosthesis is essential for achieving a successful esthetic result, yet it remains one of the greatest challenges to the clinician. Cosmesil M511 Platinum Silicone (Principality Medical Ltd., South Wales, UK) 10:1 heat-curing silicone was used in conjunction with M513 Softening Agent (15–20 Shore A hardness value) and M516 Hard Catalyst (Principality Medical Ltd.) (35–40 Shore A hardness value). The softening agent (10 g) used with M511 reduces standard hardness to 15–20 Shore A hardness values whilst retaining other mechanical properties. Anti-Slump Agent (Principality Medical Ltd.) (20 g) was used as a thickening

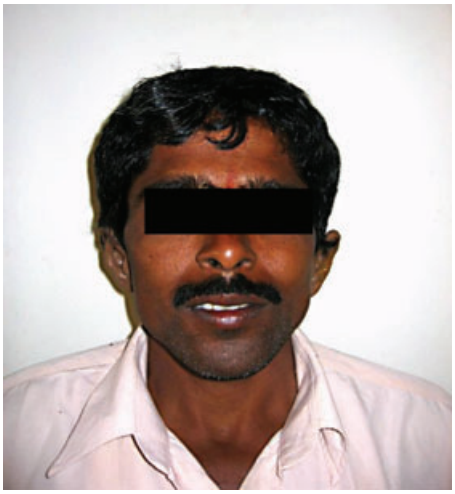

Figure 8 Postprosthetic view of patient.

Figure 6 Wax try-in.

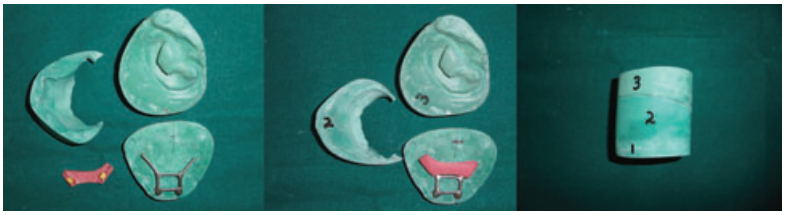

Figure 7 Mold-making procedure.

agent to assist placing M511 in the mold. Intrinsic coloration was applied within the mold during the processing procedure. Cosmesil P199 Master Colour Kit, which had fibers for flocking, was used along with colors for the comprehensive intrinsic master color kit. The advantages of intrinsic coloration are increased service life of the prosthesis and planned translucency. The colors were mixed to achieve the appropriate characterization for the inner and outer surfaces, and patient approval was sought. Shade matching was done using natural daylight.

Packing and curing

Once shade matching was completed, the material was packed and cured, for 30 to 45 minutes, at 100°C in a hot air oven. After curing, the mold was cooled to room temperature. The prosthesis was carefully lifted out of the mold using air suction. Sharp scissors were used to trim the residual flash. Extrinsic coloration was added to refine the color, and gauze was used to dull the surface. The prosthesis was cured for 5 to 10 minutes in the hot air oven.

Insertion

On the day the prosthesis was given to the patient, adequate time was allotted for instructions on placing and removing the prosthesis as well as proper maintenance of the prosthesis, abutments, and surrounding skin areas (Fig 8). During the placement of the prosthesis, the patient was asked to apply petroleum jelly under the thin edges. The petroleum jelly helps to blend the silicone to the skin by eliminating air between the prosthesis and skin.[10] The patient was asked to be careful while removing the prosthesis so that the thin margins would not tear and the silicone rubber would not separate from the resin plate. Proper removal by grasping a thick portion of the prosthesis and slowly disengaging the retentive elements was demonstrated to the patient and performed several times. The patient was asked not to wear the prosthesis during sleep so that air could circulate around the abutments to maintain skin health. If worn continuously, the dark moist environment underneath the prosthesis and around the abutments is ripe for bacterial and fungal growth, leading to inflammation and infection. He was asked to store the prosthesis in a dry, covered container away from sunlight to prevent discoloration and degradation of the prosthetic material. Follow-up management began once the abutments were placed. The patient was evaluated monthly until the prosthesis placement completion, after which he was evaluated every 6 months for 2 years from the initiation of treatment. During this time we encountered slight reddening of the skin around the implant, which subsided with the use of antibiotic cream and reinforcement of hygiene around the skin and the abutments.

Patient maintenance of the prosthesis

For long-term success, the patient was instructed to clean the skin around the abutments on a daily basis to remove cellular material on the skin or abutment. The cellular material can come from the interface of the epithelium and abutment. To facilitate cleaning, the patient was instructed to moisten the area with a piece of gauze soaked in a solution of hydrogen peroxide and saline mixed in a ratio of 1:1. This was done to soften any dried debris. This can be performed with a soft-end nylon bristle toothbrush, an interproximal dental brush, or a cotton swab. Soap and water can also be used. Dental floss can also be used to clean around the abutments. The patient was cautioned against using sharp instruments to avoid traumatizing the skin around the abutments.

Discussion

Auricular defects can result from tumor resection, congenital malformations, and trauma.[1,2] As an alternative to the autogenous reconstruction, prosthetic replacement of the ear normally has a favorable outcome. When considering a prosthesis for these patients, one must evaluate subjective as well as objective factors.[10] Patient experience with previous prostheses must be elicited. Objective concerns related to the size, shape, and location of the defect should be considered as well. Residual structures must be assessed for their capacity to support and retain a prosthesis.[10] Auricular prostheses may be retained by adhesive materials or through mechanical means. Adhesive retention of these prostheses is often less satisfactory as a result of the lack of facial contours that may assist proper positioning of the prosthesis and movement of associated facial structures with mandibular movement.[10] Mechanical retention is possible if the defect presents undercuts that may be engaged with the restorative material or through use of prosthetic connections to endosseous implants.

Predictable esthetic results coupled with a survival rate of more than 95%[10,16] have made implant-supported auricular prostheses one of the most accepted modalities to treat auricular defects. Osseointegrated implants have demonstrated an excellent level of predictability when placed in bone in the auricular area.[16,17] The densely corticated bone of the auricular region makes it easy to stabilize the implant at surgery, and the vasculature in this region ensures the maintenance of a bone/implant interface adequate to support the functional loads.[17] Hence, after a thorough evaluation of the patient, a decision to use two endosseous implants connected by a bar clip system to assist in prosthesis retention was made. The patient was kept fully informed about all aspects of the nature of treatment and given a realistic view of the likely outcome.

Site selection for the implant placement was critical to avoid unfavorable soft-tissue response and failure of osseointegration. Concurrently, positioning of implants in temporal bone was also important to achieve esthetics. In this patient, there was inadequate bone available at the optimal sites. Therefore, the implants were placed posterior to this ideal position. To compensate for this posterior positioning of the implants, the bar framework was modified to achieve an esthetic outcome. The framework fulfilled the objectives of strength, support, non-tissue impingement, and non-interference with the desired contour of the prosthesis.[7,18,19]

Color matching substantially affects the acceptance of the prosthesis by the patient. External light conditions are important for visual color assessment because the spectral composition of standard light sources differs from that of daylight, leading to metamerism.[20] Only daylight lamps (D65) emit radiation of a spectral composition comparable with that of natural light. The use of daylight lamps with spectral radiance corresponding to

daylight with well-defined intensity helped us to standardize light conditions and significantly improve the ability to match colors.[20–24] In the absence of these daylight lamps, instead of standard light sources alone, diffused northern light at noon is regarded as standard.[23,24] It has also been suggested that this metameric color difference can be minimized if the prosthesis is matched under a combination of lights, which were found to give the best perceived match.

Complications associated with silicone prostheses include the following:[10]

- Rapid degradation of elastomers and color dexterity.
- Deterioration due to environmental exposure to UV light, air pollution, and changes in humidity and temperature.
- Tearing of margins.
- Delamination of silicone rubber from the resin plate, fracture of the resin plate, and loosening of the retentive components.
- Microbial growth due to the porous nature of silicones.
- Short durability (1–2 years)
- Necessity for meticulous hygiene at skin/implant interface.
- Preclusion of future autogenous reconstruction.

Implant-retained auricular prostheses provide multiple advantages for the patient: convenience, security, consistent retention and positioning, elimination of the need for adhesives, and maintenance of marginal integrity and longevity.[20] It is crucial that each patient is provided with individual reconstruction procedures related to bone and soft tissue handling. In particular, the prosthesis should be tailored to become part of the patient's body.

Summary

Maxillofacial rehabilitation poses many challenges. Achieving functional esthetics is very complex, especially when it comes to those parts of the human body that cannot be masked by clothes. Surgical reconstruction techniques, prosthetic rehabilitation, or a combination of both of these methods to restore these facial disfigurements may improve the level of function and self-confidence for these patients. In the absence of anatomic landmarks that can be used for prosthesis orientation, adhesive retention will be a compromise because it is difficult for the patient to repeatedly position the prosthesis for maximum tissue contact with the underlying skin. In such situations, an implant-supported prosthesis will provide retention and support that would not otherwise be available. Thus, an implant-supported prosthesis can be a critical requirement to improve the quality of life of an individual where rehabilitation is a lifelong proposition.

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