Case Report

Reconstruction of the external ear using implant-supported alloplasts—Our experience

ABSTRACT

Surgical reconstruction of the missing external ear is difficult, and the results are often far from satisfactory. An implant-retained auricular prosthesis is a suitable alternative. Microtia, malformation, deformity, and partial or complete loss of the external ear may be due to various congenital or acquired factors. A case series of three patients treated with implant-retained auricular prostheses is presented in this article. For each missing pinna, two titanium implants were placed in the temporal bone. After 6 months of osseointegration, the implants were loaded. All three cases were rehabilitated with a bar and clip retained prosthesis. There were two male and one female patient with an average age of 16.6 years. One patient had unilateral absence of external ear and two had bilateral absence. A total of 10 implants were placed, 4 on the right side and 6 on the left. The average post rehabilitation follow-up was 18 months. Peri-implant tissue reactions were observed at two sites. The implant-retained auricular prosthesis is an alternative treatment approach with good retention and patient satisfaction. Long-term follow-up is required to assess delayed sequelae.

Keywords: Acquired ear defect, congenital ear defect, endosseous implants, maxillofacial prosthesis retention

INTRODUCTION

The external ear is a complex structure with a detailed topography. The ear is unique among facial features; it projects away from the side of the head as a free-standing structure with high visibility.[1] Functionally, the external ear directs sound waves into the acoustic meatus.[2] It provides a hearing assistance device crucial for social interaction and quality of life.[2]

Patients with auricular deformities are known to suffer physically and psychologically.[3] Auricular defects may be congenital, syndromic, as in cases of oto-facial, craniofacial, and oto-cervical dysostosis, or non-syndromic, postsurgical, as in after tumor resections, or traumatic origin, which includes motor vehicle accidents, dog bites, human bites and chemical assaults.[4,5] Malformations or loss of ear tissue can be reconstructed surgically and prosthetically; placement of an auricular prosthesis is an alternative method to surgical reconstruction.[4] This option must be considered for any patient who is a poor surgical candidate.

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CASE REPORT

Three patients who had anotia and/or microtia of varying degrees due to different reasons [Table 1 and Figure 1] reported to the Department of Maxillofacial Surgery between March 2017 and March 2019 are presented in this article with a minimum follow-up period of 18 months. Written consent from each patient was obtained after explaining the pros

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and cons of this modality of treatment using endo-osseous implants.

Endosseous implants with dimensions 4.3 mm × 4.0 mm (five implants) and 4.8 mm × 4.0 mm (five implants) were used.

Patients with diseases of the temporal bone and mastoid process, an ear infection, a previous history of mastoid surgery, or a systemic illness were excluded. Patient data are presented in Table 1.

A standard protocol was followed for all three cases with minor modifications depending upon the needs of each case. A thorough case history was recorded, and a detailed local examination was done to examine the remnant ear morphology, surrounding skin, and underlying bony morphology. An ENT and a neurosurgical consultation were also sought.

Table 1: Patient data

Case no.	Age (years)	Sex	Side	No. of implants	Etiology	Follow-up (months)
1	26	M	Bilateral	4	Burns	30
2	10	F	Unilateral	2	RTA	26
3	14	M	Bilateral	4	Congenital	20

Figure 1: Preoperative view

Computed tomography (CT) scan measured the thickness of available bone in the mastoid region. Maxillofacial prosthodontists were involved in prosthetic rehabilitation. A facial casting was made by making an impression. For accurate positioning, a face-bow orientation was used. A template of clear polymethyl methacrylate was fabricated, and two markings were about 10–15 mm from the external acoustic meatus and equidistant from each other [Figure 2]. These positions were then assessed clinically and radiographically using a CT scan for the thickness of available bone.

First-stage surgery was performed under general anesthesia. A William Wilde mastoid incision was marked, and a surgical stent was used to mark the position of the implants on the skin. A full-thickness flap was raised to expose the mastoid process. In cases 1 and 3, remnant tags of ear tissue were also excised. Implant osteotomies were carried out to the required dimensions in a sequential manner. A torque wrench was then used to place the implants into their final positions. In case one additional excision of the hypertrophic scar was done, the raw area was covered by a partial-thickness skin graft. Hemostasis was achieved, and the wound was sutured in layers [Figure 2]. A postoperative mastoid view radiograph was taken to confirm the position of implants and evaluate the surrounding bone [Figure 3]. The patients were discharged on the seventh postoperative day for evaluation and were recalled after three months for reevaluation and healing abutment placement.

The second stage of surgery was done after three months for all three cases under local anesthesia, using palpation and a

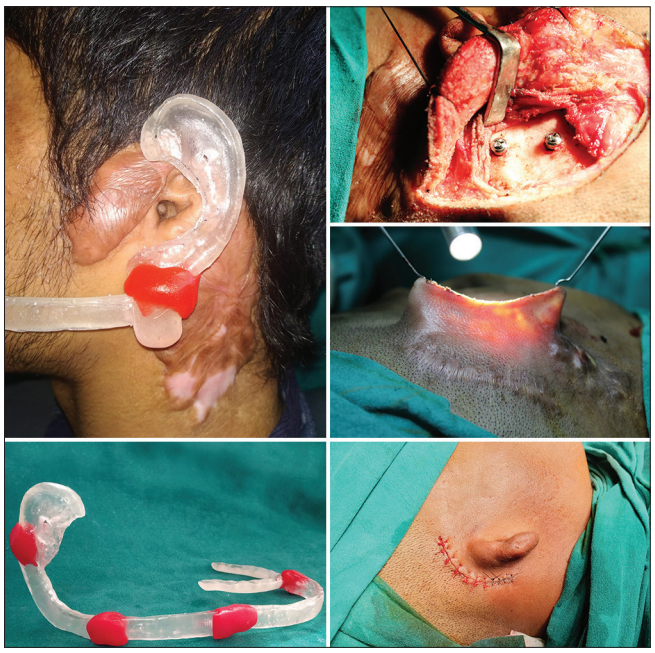

Figure 2: Polymethyl methacrylate stent and intraoperative pictures

mastoid view radiograph. The exact location of the implants was determined, and two stab incisions were placed. The implants were located, checked for stability, and the healing abutments were placed. Teflon strip was used around the abutments, and rebase material was placed over and around the abutments [Figure 4]. Antibiotic and analgesic coverage was given, and the patient was recalled after a month for the fabrication of a Hader bar by the prosthetic team.

The procedure for fabrication of the wax pattern included a donor impression taken and a wax pattern fabricated and customized. The wax pattern was placed over the missing ear and evaluated for form, position, and angulations concerning the head and contralateral ear (case 2). Impressions of the abutments were made using the addition silicone elastomeric impression material, putty, and light body in a custom tray, and the master casts were retrieved. A spacer of 2 mm in thickness was adapted over the master cast, and a template incorporating the two abutments was then fabricated using polymethacrylate resin. After the application of an appropriate separating medium, a counter-template was fabricated over the prepared template with a locking surface all around. This counter-template was then incorporated into the prepared wax pattern. The template was fitted passively to the abutments using photo-cured composite resin. The wax pattern with the counter-template was invested, de-waxed, and the mold retrieved. Room temperature vulcanizing silicone was manipulated according to the manufacturer's recommendations, and color matching was done using intrinsic stains. The mold was packed and cured according to the manufacturer's recommendations. The prosthesis was retrieved, trimmed, and adjusted. Further fine adjustments and detailing were made using extrinsic staining [Figure 4].

The procedure for fabrication of a bar and clip retained prosthesis included placement of impression copings on the implants, the impression was recorded, and fabrication of the cast incorporating the implant analog was done. The castable abutments were screwed to the implant analog, and the prefabricated pattern of the bar was attached to the castable abutment with the help of inlay wax. The assembly was lifted and invested, and casting was done. The finished framework was positioned for a passive fit and fixed to the implants with screws. Two clips were placed on the bar and incorporated into the silicone prosthesis [Figure 4]. The finished prosthesis was delivered, and necessary instructions were given to the patient regarding the care and maintenance of the implants and the prosthesis [Figure 5].

The only care needed is to clean the exudate that tends to accumulate around the transcutaneous implants. A saline solution or hydrogen peroxide applied with a cotton-tipped swab can clean the dried exudate. Implant manufacturers often supply a kit with a brush and maintenance instructions. Should the tissue around the implants become inflamed or infected, the patients were asked to report back, and antibiotics would be prescribed as needed.

RESULTS

Three patients were part of this study, two males and one female. They were aged 26 years, 10 years, and 14 years (mean age = 16.6 years). One patient had a unilateral absence of the external year, and two had a bilateral absence. The loss

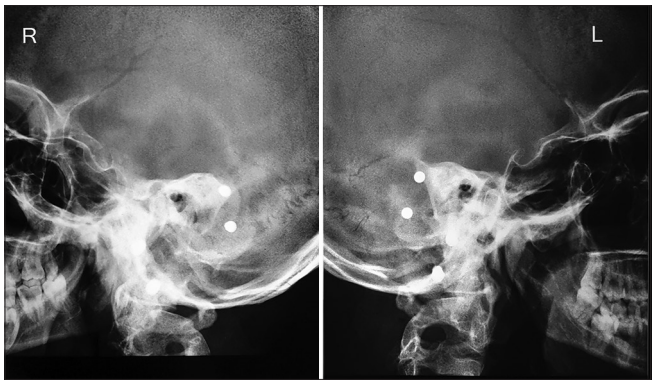

Figure 3: Post-op mastoid view

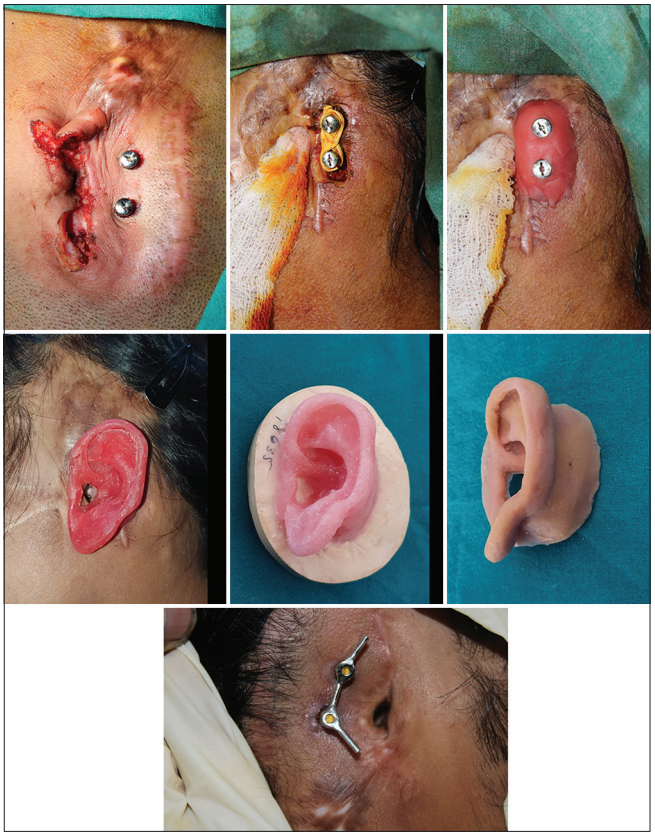

Figure 4: Second stage surgery, wax pattern, and Hader bar

was due to burns in case 1, trauma in case 2, and congenital absence in case 3. A total of 10 implants were placed, four on the right side and six on the left. Follow-up was done every month for six months following the placement of implants. Post rehabilitation, the patients were reviewed at 3, 6, 12, 18, and 24 months. The cases were jointly evaluated by the same team of maxillofacial surgeons and prosthodontists. Peri-implant tissue reactions were recorded, and the prosthesis was evaluated for loss of retention, wear and tear, and patient comfort. Case 1 had also undergone excision of hypertrophic scar in relation to left pre and post-auricular sites, followed by radiation to prevent the recurrence of hypertrophic scar. Post rehabilitation, the minimum follow-up period for all patients in the study was 18 months. Peri-implant tissue reactions were recorded according to the criteria proposed by Holgers *et al*.:[6] "0" no irritation, "1" slight redness, "2" red and slightly moist tissue, "3" granulation, red and moist tissue, and "4" for infection. Two implant sites had inflammation of the skin (case 1 and case 2) that was graded as 2, and these were managed with the topical application of antibiotic ointment. None of the implants had mobility or loss.

Figure 5: Final result

DISCUSSION

Microtia/anotia may be acquired or congenital.[4] Trauma accounts for the most common cause of external ear defects; other causes include dog bites, human bites, burns, and also ablative surgery.[4] Occurring more often unilaterally, with a predilection for the right side. In our case series, two patients were male and one female; case 1 was a result of burns, case 2 was a victim of a road traffic accident, and case 3 had congenital microtia with a hearing deficit.

Randall A *et al*.[7] have summarized the various options for the management of microtia given in Table 2. All our patients were rehabilitated using osseointegrated implant-supported clip on the prosthesis. This decision was mainly decided upon based on the cost factor and patient needs.

Basel Al Kadah *et al*.[8] evaluated 39 patients with 43 implants, of which 21 patients had silicon prostheses, and 18 had porous polyethylene prostheses. They found no implant failure in any of the two groups. The most common side effect in the porous polyethylene group was the formation of retroauricular adhesions in 11.1% by postoperative scarring, while in the silicone prosthesis group, 71.4% of the patients presented with skin reactions around the titanium implants.[7] They concluded that both techniques are valuable and should be offered to patients in cases of auricular reconstruction due to the low rate of severe complications and the good functional results.[8]

A bar/clip mechanism or magnets are used as the interface for attaching the prosthesis [Figure 6].[9] One contraindication to osseointegrated implants is radiation therapy treatment.[9] After radiation therapy, the bone suffers from demineralization, hard tissue vasculitis, fibrosis, long-lasting infections, poor blood supply, and oxygen deficiency.[9]

In our cases, there were no intra-op complications, and only two implant sites had a Holgers grade 2 skin infection, both of which were managed successfully.

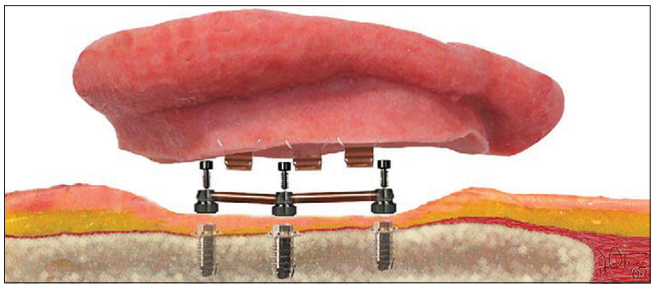

Figure 6: Diagrammatic representation of prosthesis retained on the bar that is placed on the osseointegrated implants

Table 2: Management options for microtia

Type	Details	Advantages	Disadvantages
Observation		No risk	Cosmesis Psychological issues
Prosthetic	Adhesive retained	Appearance	Insecure Prosthetic care Daily maintenance Use restrictions
	Implant retained	Appearance Secure retention	Multiple procedures Removal of remnant soft tissue Prosthetic care Daily maintenance Use restrictions
Re-construction	Autologous	Autologous tissue Minimal maintenance Becomes sensate Atresia repair	Appearance Donor sites Multiple surgeries
	Alloplastic	Less donor site morbidity Less variability in carving Appearance Single surgery	Foreign body More challenging to do atresia repair

Adequate thinning of the flap is an important factor for better adaptation over the bony surface. In our cases, for better adaptation during the second stage of surgery Teflon strip was used around the two implants and further reinforced with rebase material for a better fit. After a period of six months, the implants were loaded. There was no implant failure or prosthetic complications. Case 1 was unsatisfied with the color of the silicone prosthesis, which was eventually modified.

Scope and Future

Federspil[10] explains the importance of computer science with virtual planning and rapid prototyping can revolutionize the process of prosthetic auricular rehabilitation.[11]

Modern silicones and osseointegrated titanium implants allow for the rehabilitation of patients with microtia with an inconspicuous auricular prosthesis. Auricular prostheses may be used as a temporary measure, a rescue procedure in failed auricular reconstruction, or as a definitive treatment option.[10]

SUMMARY AND CONCLUSION

Prosthodontic rehabilitation using endo-osseous implants offers an effective alternate treatment modality for older patients or patients who are not good surgical candidates and for patients who are not willing for other forms of reconstructive surgery. The use of craniofacial implants for the retention of a prosthesis, such as an ear, offers excellent support and retentive abilities when proper selection of cases and meticulous planning and execution of surgical and prosthetic techniques are followed. The success rate during the follow-up period was 100%.

Implants may be associated with delayed problems of bone resorption, osteomyelitis, and implant failures; hence periodic follow-up and maintenance are essential.

Written Consent was obtained from all three study participants for publication.

Patient consent

All patients signed an informed consent agreement before the start of treatment.

Declaration of patient consent

The authors declare that they have obtained consent from patients. Patients have given their consent for their images and other clinical information to be reported in the journal. Patients understand that their names will not be published and due efforts will be made to conceal their identity but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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