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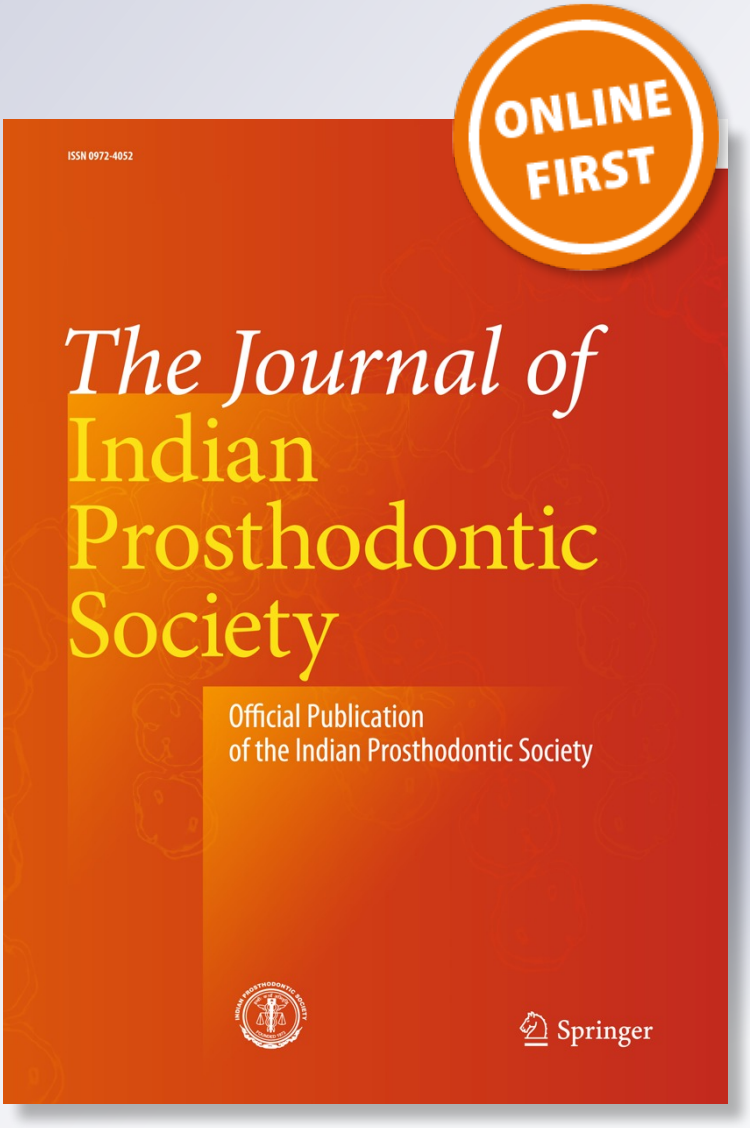

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CLINICAL REPORT

Prosthetic Rehabilitation of Partial Ear Defect: 2 Case Reports

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Abstract The loss or absence of an auricle may result from trauma, disease or congenital anomalies and causes a considerable aesthetic problem. If the deformity involves the external auditory canal, it can affect hearing. This case report describes the surgical and prosthetic treatment of two patients with partial defects of their right external ears from different causes. Implant-retained auricular prostheses fabricated from heat-temperature-vulcanised silicone were used in both the cases; they were designed to be harmonious with the remaining tissues. The patients experienced improved retention, aesthetics, hearing and quality of life with these prostheses. During the approximately 3 year follow-up, both the prostheses were re-fabricated once; however, problems related to implant stability and peri-implant tissue health were not encountered.

Keywords Partial ear defect · Implant · Retention · Implant-retained auricular prosthesis

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Introduction

Ear defects can occur secondarily to congenital malformations, trauma or tumour surgery. The absence of an ear is a considerable aesthetic problem that may affect the patient's psychology and social behaviour [1]. Correction of ear defects can be accomplished surgically, prosthetically or through a combination of these approaches; the choice of treatment depends on the site, size, age and aetiology of the defect as well as the patient's desires [1, 2]. However, reconstructive surgery is limited by the age and medical conditions of the patient, insufficient residual tissue, vascular compromise due to radiation and the patient's preferences [3, 4]. Further, after a surgical procedure, the reconstructed ear may not resemble the normal one [5].

On the other hand, prosthetic treatment can produce an anatomically accurate and aesthetic device [4, 6]. Before the introduction of osseointegration, auricular prostheses were retained by adhesives or a connection to eyeglasses [4, 6, 7]. Nowadays, craniofacial implants are used to support and retain such prostheses. Studies have shown successful retention and stability of auricular prostheses anchored to the temporal bone with titanium implants [7–9]. Tjelstrom et al. [7] used titanium implants to attach auricular prostheses and obtained successful results after a 5-year follow-up. This case report describes the surgical and prosthetic treatment of two patients with partial defects of their right external ears from different causes who were followed for ~3 years.

Case Report

Case 1

A 58 year-old man with a deformed right ear was referred to the Selcuk University Department of Prosthodontics. His

medical history revealed that he had undergone surgery for malignant melanoma. After the operation, he had received 6,000 cGy of external beam irradiation in 30 sessions over 6 weeks. Three years after radiotherapy, in 2007, he presented for prosthetic treatment. Extra-oral examination revealed that the right lobule, tragus and antitragus were missing, but the helix, antihelix, crura of the antihelix, scapha, cymba concha and external auditory canal were present. The patient was dissatisfied with his appearance. An implant-retained auricular prosthesis was selected to correct the defect.

The implant sites were evaluated for bone width and depth by computerised tomography (CT). In October 2007, three 5 mm-long extra-oral endosseous implants (042.362S; Institut Straumann AG, Basel, Switzerland) were placed at the 9, 10 and 11 o'clock positions in the mastoid region under local anaesthesia (Fig. 1). The implants were left unloaded for 3 months to allow osseointegration. They were exposed during the second stage of surgery, and extra-oral conical abutments (048.526; Institut Straumann AG) were screwed onto them under 15 N by using a torque-control device (Institut Straumann AG).

The peri-implant tissue was allowed to heal for approximately 2 weeks. Before taking the final impression, the hair adjacent to the remaining tissues was isolated with Vaseline, and the external auditory canal was blocked by using lubricated cotton. Impression cylinders (048.104; Institut Straumann AG) were screwed to the extra-oral conical abutments and used with polyvinyl siloxane impression material (Elite HD; Zhermack, Rovigo, Italy) to obtain an impression of the defect and abutments. After controlling the impression, the impression cylinders were disassembled, screwed to the extra-oral conical implant analogues (048.136; Institut Straumann AG) and placed in the obtained impression. Then, a die stone cast was obtained, and extra-oral gold caps (048.236; Institut Straumann AG) were screwed onto the conical implant analogues with an SCS guide screw (048.360V4; Institut Straumann AG). A gold bar was placed between the gold caps and soldered onto them after adjusting its length. A dolder bar (048.411; Institut Straumann AG) was fabricated to splint the implants together. On both sides of the dolder bar, the cantilever length was shortened to less than 6 mm. On the cast, the bar was screwed to the abutments, and retention clips were positioned over the bar. The fit of the bar was checked on the patient (Fig. 2). The clips were then secured in a plate made of self-curing acrylic resin (Meliodent; Heraeus Kulzer, Hanau, Germany).

A wax pattern was constructed by using a cast of the patient's normal auricle. It was tried on the defect, and its dimensions and contours, as well as its relationships with the head and contralateral auricle, were evaluated. The borders of the wax pattern and the areas adjacent to the healthy tissues were left thin in order to appear natural. In addition, the borders of the wax pattern were hidden behind the patient's existing tissues. The auricular prosthesis was fabricated from heat-temperature-vulcanised (HTV) silicone (Cosmesil; Principality Medical Ltd., South Wales, UK). Bonding between the silicone prosthesis and the acrylic plate was achieved by two methods: before moulding, small bur holes were created on the acrylic plate for mechanical retention, and then, Platinum Primer (Cosmesil; Principality Medical Ltd.) was applied with a brush on the plate for chemical retention and dried with air.

The colour of the prosthesis was determined from the patient's skin colour. Intrinsic pigments were added to the silicone, which was then placed in the mould. After polymerisation, the auricular prosthesis was checked and adapted on the patient. External staining with room-temperature-vulcanised (RTV) silicone (Cosmesil; Principality Medical Ltd.) was also performed on the patient (Figs. 3, 4). The placement path of the prosthesis was demonstrated

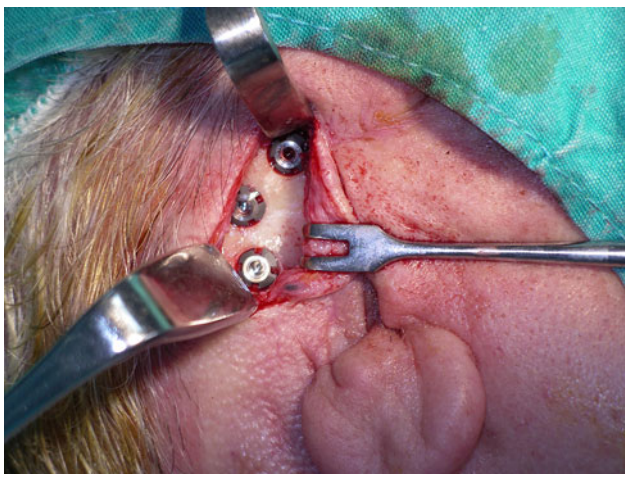

Fig. 1 Implant positions in the mastoid region

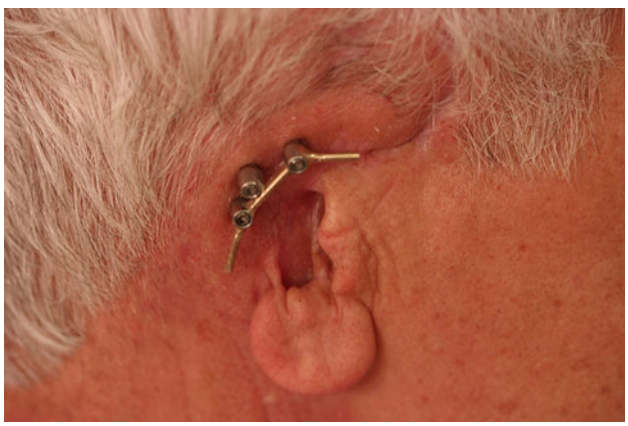

Fig. 2 Partial auricular defect and the *dolder bar* placed in a passive fit

to the patient, and hygiene procedures, including how to clean the silicone prosthesis with a soft toothbrush and mild soap, were explained. He was also advised to remove the prosthesis before bathing and sleeping.

The patient was followed both medically and prosthetically for about 3 years. During this period, no tumour recurrence was observed, but the prosthesis was replaced once after 2 years because of discolouration. In the follow-up period, the implant stability was good, and no adverse skin reactions were noted.

Case 2

A 36 year-old woman with a deformed right ear was referred to the Selcuk University Department of Prosthodontics. The patient's right helix, antihelix, crura of the antihelix, scaphoid fossa and external auditory canal were congenitally missing. The lobule and crus of the helix were present, and the lobule covered the tragus. The patient had no systemic disorders, and her chief complaint was her appearance.

An implant-retained auricular prosthesis was selected for treatment. Considering the bone width and thickness, which were determined by CT, two extra-oral implants (042.362S; Institut Straumann AG) were placed at the 9 and 11 o'clock positions in the mastoid region under local anaesthesia, in November 2007. The inter-implant distance was 15 mm. A two-stage procedure was used for this patient as well. The implants were left unloaded for approximately 3 months to allow osseointegration.

During the second surgical stage, the implants were exposed, and extra-oral conical abutments (048.526; Institut Straumann AG) were screwed to them under 15 N by using a torque-control device (Institut Straumann AG). The surgical sites were then closed, and the peri-implant tissue was allowed to heal for approximately 2 weeks. Thereafter, a detailed impression of the defect and

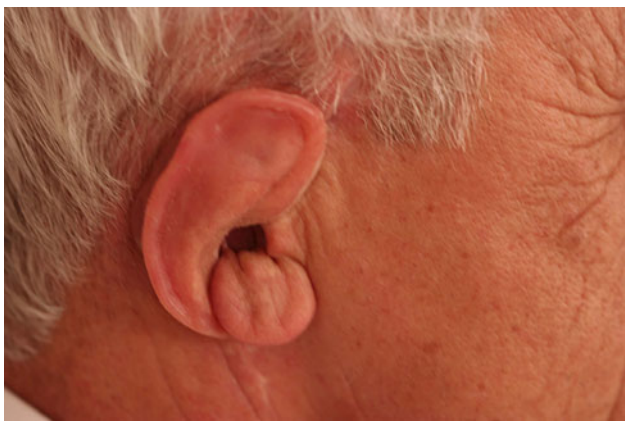

Fig. 3 The placed silicone prosthesis

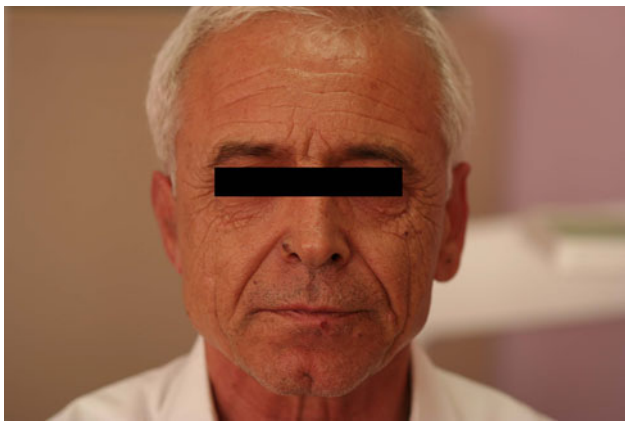

Fig. 4 *Anterior* view of the patient

abutments was made with polyvinyl siloxane impression material (Elite HD; Zhermack). Extra-oral conical implant analogues (048.136; Institut Straumann AG) were connected to the impression cylinders (048.104; Institut Straumann AG), and a die stone cast was obtained. On the model, a dolder bar (048.411; Institut Straumann AG) was fabricated to splint the implants together. A rigid framework was also fabricated. The bar was screwed to the abutments (Fig. 5), and retention clips were positioned over the bar. The clips were then secured in a plate made of self-curing acrylic resin (Meliodent; Heraeus Kulzer).

Meanwhile, an impression of the normal external ear was obtained and used to sculpt the anatomical contours of the missing one. A wax pattern was constructed and tried on the defective external ear, and its size and shape were modified to fit. The auricular prosthesis was fabricated from HTV silicone (Cosmesil; Principality Medical Ltd.).

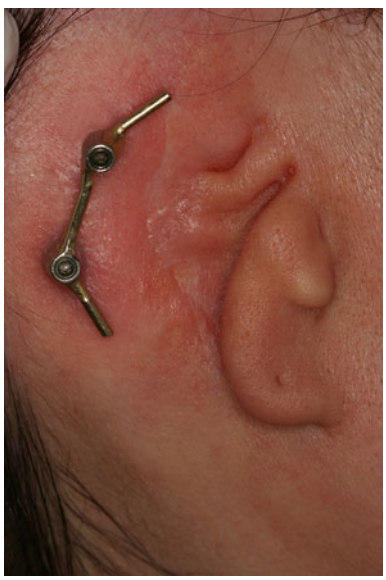

Fig. 5 Partial external-ear defect and the *dolder bar* placed in a passive fit

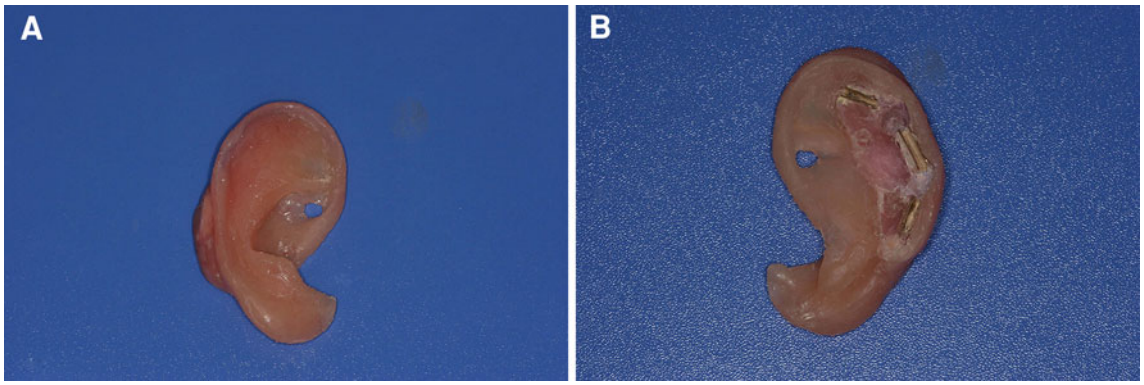

Fig. 6 Silicone prosthesis. **a** Outer surface of the prosthesis. **b** Inner surface of the prosthesis

After polymerisation, it was checked on the patient, and minor external staining with RTV silicone (Cosmesil; Principality Medical Ltd.) was performed (Figs. 6, 7 and 8). The same hygiene procedures as in the first case were explained to the patient.

This patient was also followed for about 3 years. The prosthesis was replaced because of a tear 1.5 years after the first one was delivered. During the follow-up period, the implant stability, hygiene procedures and peri-implant tissue health were annually assessed.

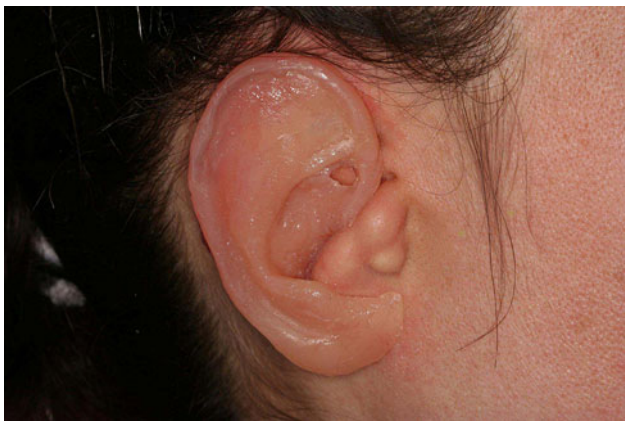

Fig. 7 The placed silicone prosthesis

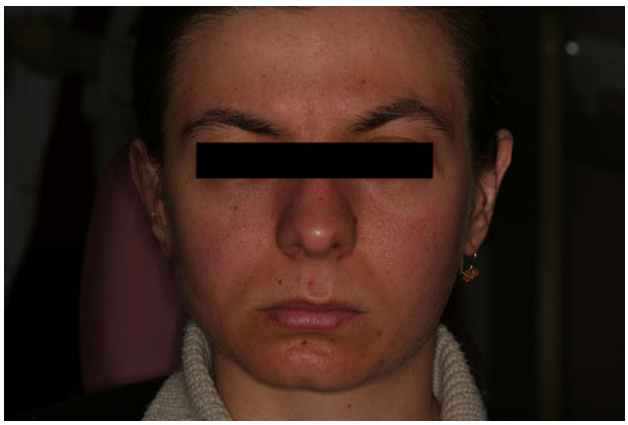

Fig. 8 *Anterior* view of the patient

Discussion

A totally resected auricle is easily reconstructed prosthetically, but defects secondary to partial resection or microtia are more difficult to restore. Most patients avoid surgical procedures because they do not want to lose the remaining tissues, as was the case with the patients described here. Therefore, implant-retained auricular prostheses were fabricated to be harmonious with the existing tissues.

Because of its numerous advantages, the implant-retained auricular prosthesis has become a valid therapeutic alternative for patients with auricular deformities. These advantages include increased comfort and retention, elimination of adhesives, maintenance of marginal integrity and longevity of the prosthesis [4, 10–14]. Aesthetics are also improved by the maintenance of feathered margins in the prosthesis [4].

To obtain successful results with implant-retained auricular prostheses, detailed information about implant and retention systems, anatomical locations and factors affecting the success of such treatments is necessary. Pre-implant treatment planning is essential to coordinate the patient's surgical and prosthetic management. The number of implants required for retention has reduced from five to three. Although three craniofacial implants have been used in some cases [15, 16], two implants are considered sufficient for retaining auricular prostheses [17]. McKinstry [18] recommends placing implants at the 1 and 3 o'clock positions for the left ear, and conversely, the 9 and 11 o'clock positions for the right ear, approximately 18 mm from the centre of the external auditory canal and 15 mm apart from each other. In the present cases, the implants were placed according to the McKinstry concept [18]. Considering the bone thickness and volume, three implants were placed at

the 9, 10 and 11 o'clock positions in the mastoid region of patient 1 and two implants were placed at the 9 and 11 o'clock positions in the mastoid region of patient 2.

Patients with auricular prostheses that are fixed to the abutments of osseointegrated implants may encounter some problems, especially during bathing and sleeping [7]. Therefore, these prostheses have removable external parts. Numerous attachments can be used for implant-retained prostheses. A bar with clips or a magnetic attachment is usually used as the main retainer [7, 9, 11–13, 19, 20]. These attachments are used to connect the removable parts to the implants [7, 9, 20] and aid in the proper placement of the prosthesis by both the patient and the dentist.

The morphology of the prosthesis is currently reproduced by one of the following methods: (1) using a presurgical cast; (2) obtaining a cast of the patient's normal external ear by taking a direct impression and sculpting a mirror-image wax pattern for the missing one; (3) obtaining a cast of an external ear with compatible morphology and using it to create the prosthesis or (4) making a wax cast of the normal external ear, sectioning it into 1 mm slices and reversing the sections to create a mirror-image wax pattern [21–23]. In the cases described here, the morphology of the auricular prostheses was reproduced by sculpting mirror-image wax patterns for the missing tissues.

Silicones have been used for many years in the field of maxillofacial prosthetics, because of desirable material properties such as aesthetics, flexibility, biocompatibility, ability to accept intrinsic and extrinsic colourants, translucency, chemical and physical inertness, mouldability, softness and ease of cleaning [24, 25]. The borders of prostheses fabricated from these materials were once very evident; however, with the silicones currently available, micron-level borders can be produced. Therefore, the implant-retained auricular prostheses of the patients were constructed by using HTV silicone.

Conclusions

By using the implant-retained auricular prostheses, the patients with right partial external-ear defects experienced improved retention, aesthetics, hearing and quality of life. In addition, the remaining tissues were protected. During the follow-up period, although both the prostheses were refabricated once, implant stability, peri-implant soft tissue health and hygiene procedures were found to be good.

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