



Description of the Surgical and Prosthetic Workflow of a Patient Rehabilitated with Implant-Retained Auricular Prosthesis

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Abstract

Facial tissue loss is acquired as a result of congenital anomalies or acquisitional misshapen like tumoral lesions or accidents. These defects result in functional problems, esthetic concerns, and also psychosocial troubles and could be repaired by plastic surgery or reconstructed using facial prostheses. Conventional tissue-supported auricular prostheses meet lots of challenges due to dependence on tissue undercut or adhesive for retention. Implant-retained auricular prostheses lessen the complications related to adhesive-retained prostheses and alleviate the need for invasive plastic surgery. Implant-retained auricular prostheses provide patients with secure retention and avoid prosthesis disengagement caused by movable surrounding soft tissue. The impact of prostheses with secured retention and satisfactory esthetics on the self-confidence of patients with facial defects is promising. This paper aimed to describe the surgical and prosthetic workflow of a patient with acquired ear deformity due to basal cell carcinoma (BCC) which was rehabilitated with implant retained auricular prosthesis.

Keywords: Maxillofacial prosthesis, Acquired ear deformities, Rehabilitation, Implant-supported prosthesis

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Introduction

Facial tissue loss is acquired as a result of congenital anomalies or acquisitional misshapen like tumoral lesions or accidents. Whatever the cause is, these defects result in functional problems, esthetic concerns, and psychosocial troubles (1-4), and could be repaired by plastic surgery or reconstructed using facial prostheses (5,6). As in most facial defects, functional limitations could not be revived; accordingly, esthetic, retention, and biocompatibility are known to be the most common topics of interest (3).

Plastic surgery in which costal cartilage is used to replace the lost ear seems to be the most permanent option in pinna reconstruction (7,8). However, complications like invasive surgical procedures, comorbidity in the donor site, and less optimal esthetic results made prosthetic reconstruction more appealing for many patients (9-12).

Facial prosthesis success depends on the means of making retention (2,13). Although skin adhesive and facial undercut are reported to be used as retainers in tissue-born prostheses (14), implants are the most effective way to retain the bulk of facial prostheses (15,16). Implant-retained auricular prostheses provide patients with secure

retention and avoid prosthesis disengagement caused by movable surrounding soft tissue. Besides, they are convenient and needless to using adhesives which help maintain tissue health and prolong prosthesis longevity (17,18). Consequently, using a bone-anchored implant to retain auricular prosthesis is recommended when the sufficient healthy bone is present in the defect site and the systemic and financial condition of the patient is appropriate (19).

Presurgical planning is an important step in determining the position of the implant which specifies the future location of the prosthesis (20,21). Digital technology helps in the reconstruction of the lost ear by scanning the contralateral healthy one and designing the form of the lost ear (19,20,22-24).

In this paper, the prosthetic and surgical workflow of fabrication of an auricular prosthesis with the help of digital technology in designing the lost ear from the contralateral healthy one is described.

Case Presentation

A 55-year-old man with a history of resected basal cell



carcinoma (BCC) in the right ear area and devoid of any systemic problem, was referred to the maxillofacial prosthodontic department of Tehran university of medical sciences, Tehran, Iran. Local in situ tumoral lesion resulted in no involvement of the surrounding bony structure, and no radiotherapy or chemotherapy was administered after surgical ablation. However, since soft tissue involvement was suspected, the right ear excision has been done (25). One year after the surgery, when no evidence of recurrence was observed, to resolve esthetic concern caused by tumoral resection, he was referred for prosthetic reconstruction.

The prosthetic team started presurgical planning by taking an impression from the defect area, the healthy left auricle as a reference, and the dentition of both maxillary and mandibular arches using irreversible hydrocolloid impression material (Alginate CA 37 Superior Pink, Cavex Holland). Before starting, hair adjacent to the site of impression was protected with the application of petroleum jelly (Vaseline; Chesebrough-Pond's USA Co, Greenwich, Conn), and cotton was placed in the ear canal to prevent impression material entry (26).

Three lines were marked from the right side to the left side of the face taking the superior, middle, and inferior border of the natural ear on the left side as a reference. Boxing around the auricular area was done with C silicone putty to confine the impression material (Speedex, Coltene, Switzerland). To obtain an impression from the ear, the irreversible hydrocolloid was mixed with cold water in low viscosity to be used in a syringe and extend the working time (26). This mixture was injected in the anatomic depression of normal ear structure, followed by applying high viscosity hand-mixed alginate over the first material. Ripped gauze was embedded into the impression material to act as a retention form for the plaster. Fast-set plaster (Rhombstone White; Ryoka Dental, Mie, Japan) was applied over the alginate to protect the elastic impression material from distortion after setting and stabilize the whole impression. Slightly moving the patient's head helped break the seal to lift the impression after the plaster setting was completed (Figure 1) (19,26).

Since the patient's left ear was intact, an impression was made to be used as a reference in forming the right auricle via the mirroring technique. After pouring the cast of both healthy and defective ears with die stone (Kal Rock, Kalabhai Karson Pvt. Ltd., Mumbai, India), the cast of the healthy ear was scanned with Amann Girschbach Ceramill Map 400 scanner (Amann Girschbach AG, Austria) and the 3-D image was mirrored in EXOCAD software then, the STL file was used to print the sample of the mirrored ear in resin (Detax Dental, Detax GmbH & Co, Germany) (Figure 2) (27-29).

The acrylic model was used to make a wax model to be used in the try-in procedure and radiographic stent

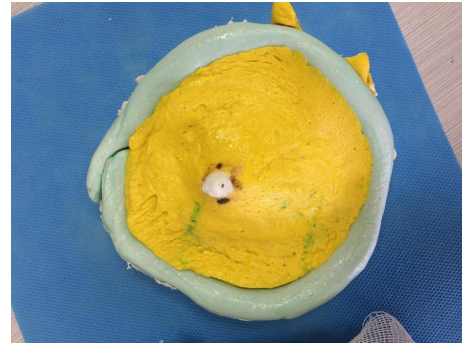


Figure 1. Primary alginate impression



Figure 2. The resin sample of the mirrored ear

fabrication (28). Wax-up try-in was done concerning inclination, projection, and vertical and horizontal measures of the opposing intact ear (19). As the scanning of the opposite ear was done, to obtain intimate symmetry and meticulous detail reproduction, little adjustment was done in the wax pattern. Moreover, the functional movement of the lower jaw was done to confirm that the future position of the ear will not be disturbed by this movement (30). After transferring the above measurements to the cast, the wax pattern was fixed in the correct position according to the marked area in the stone cast.

The ideal implant position is within the confine of the expected ear position at about 20 mm posterior to the center of the external auditory canal (6,31). The radiographic and surgical stent helped us to insert the implant in the ideal position (32).

In this stage, to determine the bone quality and quantity in relation to the optimum auricular prosthesis position, a radiographic stent using the tried-in wax pattern was made. To achieve this, an acrylic transparent surgical template (Premium Denture Resin, Lang Dental Mfg Co., Inc) containing intraoral, extraoral, and linking parts was made (Figure 3). The intraoral part was made using the cast of both arches. The extraoral part was a reproduction of the auricular wax model. The intraoral and extraoral parts were connected at the chairside with acrylic resin



Figure 3. Radiographic stent

pattern material (Pattern resin LS, GC America Inc). Transparency of the stent helped us evaluate the existence of qualified bone in an ideal clinical position (5).

The radiographic stent was perforated in the antihelix area which is about 20 mm posterior to the expected external auditory canal (5) and is the thickest area allowing placement of the attachment component (24). The holes were filled using gutta-percha (GAPADENT, Germany). While the patient wore the stent, a CT scan was obtained to determine the quality and quantity of the bone in the ideal places.

In the surgical phase under general anesthesia, the radiographic stent was used as a surgical stent to insert implants in predetermined places in the mastoid process of the temporal bone. These locations were marked on the skin and periosteum by needle smeary with methylene blue thorough surgical stent. The centers of implants should be 15 mm away from each other (33). This helps maintain tissue health between the attachment components. About 30 mm posterior to the opening of the auditory meatus template, a vertical incision was made (5). After skin and periosteum elevation, a 4mm guide drill was used to start drilling at the marked place. Drilling was continued using larger drills and finalized using a countersink. Three 4 mm length fixtures (Standard Plus implant, RN, 4.8 mm neck, 4.1 mm diameter, Straumann, AG, Switzerland) were implanted in the prepared area. Since the two-stage surgical process was deemed, cover screws (RN closure cap, 3.5 mm Straumann, AG, Switzerland) were inserted and the incision was completely closed to uncover the implants (33).

After six months, when the osseointegration was confirmed using Schuller's projection, fixture uncover was done under local anesthesia (4) and healing abutments (RN healing cap, 5.5 mm diameter, 3mm height, Straumann, AG, Switzerland) were screwed to the fixtures and prosthetic phase was commenced.

Long open-tray impression copings (RN synOcta, Straumann, AG, Switzerland) were screwed onto the implants. Boxing was done by C silicone putty (Speedex, Coltene, Switzerland). Impression was made by injecting

light body A silicone (Panasil, Kettenbach, Germany) around impression copings and defect site. Meanwhile, a regular body A-silicone (Hydroxtreme, Coltene, Switzerland) was injected over the light body to support light material and make retentive parts for plaster.

Plaster (Rhombstone White; Ryoka Dental, Mie, Japan) was mixed with salt and warm water to accelerate the setting process and placed over the silicone except for impression copings screws. After the setting was completed, impression copings were unscrewed, implant analogs (RN synOcta, Straumann, AG, Switzerland) were screwed to the impression copings, and the impression was poured with die stone (Nok stone, Lafarge).

Bar, which is the most common attachment type in an auricular implant-supported prosthesis, requires good manual movements for insertion and removal of the prosthesis and also maintaining implant site hygiene. Moreover, enough space in the antihelix position is mandated for bar attachment (5,34,35). A two-piece silicon putty index was made of the acrylic model to act as a guide for the substructure's waxing up. As the space for bar attachment was enough and patient manual dexterity was promising, bar and ball attachment was chosen.

Three UCLA abutments (RN synOcta, Gold abutment, non-engaging, Straumann, AG, Switzerland) were screwed to the analogs and bar (Castable bar, version A, Rheine, USA). Ball (Castable single sphere, normal size, Rheine, USA) wax pattern attachments were formed in resin and wax. An eight mm cantilever bar was designed to assure future retention on side of two terminal fixtures (31) and a two-ball attachment was planned between the fixtures.

One mm of clearance on the master cast was created before the fabrication of the acrylic resin substructure (36). Substructure investing (Deguvest L, Degussa, Hanau, Germany) and casting with gold dental alloy (Midas, Jelenko, Armonk, NY) were done.

After that, the polishing process was done, then the passive fit of the substructure was checked on the cast. Housings (Stainless steel, normal size, Rheine, USA) and Hader bar clips (Yellow Hader rider; Sterngold attachments) were embedded in the wax sculpture which would be turned into acryl. The bar and ball attachment with wax-up of the auricle was tried-in and the accuracy of fit, orientation, and esthetic with the patient in the physiologic rest position and mouth opening was verified (Figure 4) (4).

The wax pattern was sealed in the correct position on the master cast (19). To simulate the natural texture of normal skin, damping with wet gauze was done (26). The wax pattern was placed into a flask and a three-piece mold was made using type III die stone (Kal Rock, Kalabhai Karson Pvt. Ltd., Mumbai, India). Conventional procedures for wax elimination of the auricular mold were followed (19).

The silicon elastomer (A-RTV-30, Factor II, Lakeside, USA) which was colored intrinsically (Intrinsic Coloring Kit Factor II, Lakeside, USA) and had flakes (Cosmesil Flocking, PRINCIPALITY, Newport, Wales, UK) similar to the left normal ear was entered into the flask. After wax elimination, the mold was filled with silicone and processed according to the manufacturer's instructions. After setting completion and removal of excessive flash, extrinsic pigments (Cosmesil Dry Pigment, PRINCIPALITY, Newport, Wales, UK) were utilized to mimic tissue colors while the patient was present (Figure 5) (37).

The inner surface of the final prosthesis contained heat-polymerizing acrylic resin (Vertex Rapid Simplified, Vertex Dental) (acrylic plate) which surrounded bar clips and housings of ball attachment, while the outer surface consisted of silicone (Figure 6) (6).

The abutments were screwed with 30 N-cm torque and the prosthesis was inserted. Margins were tried to be matched with the surrounding tissue (Figure 7).

Written and verbal instructions for prosthesis maintenance and keeping site hygiene using an interproximal dental brush or cotton swabs were given (4). Regular follow-up (every three months for the first year, and every six months afterward) was scheduled.



Figure 4. Bar and ball attachment with wax-up of the auricle



Figure 5. External surface of the final prosthesis

Written informed consent was obtained from the patient to report this workflow.

Discussion

Facial prosthesis needs to possess esthetic requirement, functional capacity, and proper retention to be accepted by the patient (13) and affect his/her self-image positively to be back in society (4).

The complex anatomy of the auricular structure makes plastic surgery a challenging task. This process may need several surgical procedures to be done which may compromise the esthetic outcome and causes morbidity at the donor site (5,11).

Adhesive-retained prosthesis complication is associated with the effect of adhesive material on both skin and prosthesis structure. Unpredictable retentive properties and the need for prosthesis remake, due to silicon deterioration as a result of the adhesive effects, were also reported (5). The retention of the conventional tissue-born maxillofacial prosthesis is affected by the weight of the prosthesis, the manual dexterity of the patient, humid condition, and the impact of muscular activation on prosthesis elevation. Dermatitis is a common complication resulting from the daily application of adhesives (26). The mentioned criteria made us remake the adhesive-retained prosthesis which has inevitably unsecure retention (5,14).

The good prognosis of implant insertion in the auricular region makes implant-retained auricular prosthesis

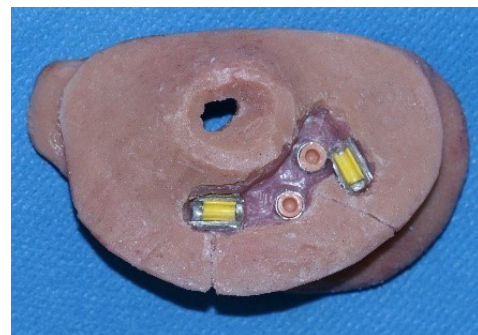


Figure 6. The inner surface of the final prosthesis

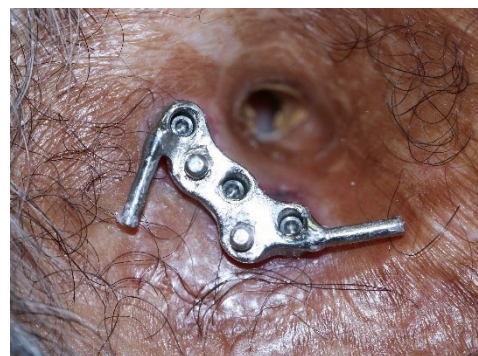


Figure 7. Substructure

a treatment of choice in many clinical scenarios (12). The retention acquired by attachment of an integrated implant can relieve most of the problems related to an adhesive-retained prosthesis, prolongs the longevity of the prosthesis, and make its insertion and removal easy (5).

There are different techniques to fabricate a wax pattern of a defective ear similar to the healthy one. Carving the wax to finally reach the desired shape, using the ear of a sibling (donor technique), slicing technique by using the pattern of the patient's healthy ear (26), using rapid prototyping technique to design the defective ear by using the shape of the contralateral healthy one (24), and the last one is the method of choice which is easier to conduct by less skilled technicians (28).

Based on previous studies, two implants suffice for an auricular prosthesis (34). However, extended tissue loss after tumor removal and expected heavy prosthesis persuaded us to add another implant to assure the future longevity of the treatment.

The patient's expectancy of retention and his good manual dexterity for maintaining hygiene and also enough space in the antihelix region were in mind in choosing attachment (34,35). Among bar and magnet which are the frequent options in the auricular implant-retained prosthesis, the bar (bar and ball attachment) was chosen to provide the mentioned desires.

In many clinical reports on making facial prostheses, using digital technology to design the orientation of prostheses and the location of implants were described (4,20,25). However, till now the prosthetic workflow for making the final prosthesis in silicon consists of a conventional three-piece mold and lost wax technique. The nature of silicon material precludes using them in the milling system (28). By merging digital technology in the fabrication of prosthetic ears and the traditional way of making a silicone auricular prosthesis and shade matching, benefits of both modern and old systems were gathered to get the desirable goal (24).

Conclusion

Using a dental implant to restore lost facial disfigurement helps to relieve the complication of a conventional adhesive-retained prosthesis and has a pronounced effect on the treatment outcome. The cooperation of the prosthetic and surgical team is necessary for an excellent final result, patient satisfaction with a normal-looking appearance, and secured retention.

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