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Case Report

Auricular epithesis-Blending digital & conventional techniques

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ABSTRACT

Auricular epithesis is the most challenging in maxillofacial reconstruction. The advent of the digital technology in the field of the maxillofacial prosthesis ensures accuracy and precision. This paper highlights the case of a 34-year patient of an alleged road traffic accident with resultant in traumatic partial avulsion of the left ear. The data acquisition of the healthy ear was captured using a Computed Tomography Machine and mirrored using the Geomagic freeform Software to mirror the healthy ear into the defect area. The mirrored image was then processed to a watertight model for 3D printing. Stereolithography (SLA) was used to print the model followed by which the silicone epithesis was fabricated. This case report also explains about the various techniques to capture the data digitally and the several softwares that are available to process the data. Blending both analogue and digital method, an auricular epithesis can be made more lifelike, comfortable and functional thereby improving the quality of life of individuals with ear deformities.

1. Introduction

Face forms the physical basis for personal recognition. The face is a reliable index of all the musings that are harboured in one's mind. Unfortunately, the face and its related structures get affected or lost due to maxillofacial deformities. These maxillofacial deformities are caused by congenital malformations, developmental disturbances or acquired caused by pathologies such as necrotizing diseases and resective surgeries of neoplasms or trauma.[1] Reconstructive surgeries and oral and maxillofacial rehabilitation are considered as preliminary ways to restore these lost or affected tissues. However, several congenital and acquired defects still require prosthetic restoration.[2]

2. Case Presentation

A 36 -year-old male patient reported to the Division of Prosthodontics Crown & Bridge with a chief complaint of missing left ear. The patient had lost the full left ear alleged road traffic accident.

On examination, there was a residual auricular pedicle of dimension 5 Cms x 3 Cms x 2 present. Injury sustained involved more than two-thirds of the auricle with most of the caudal part of the ear missing but the external auditory canal was patent making the ear functionally normal. Clinical examination revealed deformed tragus, helix, antihelix, concha, anti-helical fold. Triangular and scaphoid fossa also was obliterated (Figure 1). Patient's right ear was functionally and structurally normal. There were no associated features of microtia or any other syndrome. CT was performed. Correlating the clinical and radiographic findings, the diagnosis made was residual auricular defect – post traumatic avulsion of left ear.

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2.1. Treatment plan

Patient was explained about the various treatment modalities and the non-surgical prosthodontic rehabilitation using the digital analogue method was considered as the treatment of choice.

2.2. Steps in fabrication of the auricular prosthesis

2.2.1. Step 1: Digitalization of the healthy ear data

A CT scan (Planmeca ®) of slice thickness (0.5 mm) was made. The data was extracted in DICOM format and converted into the. stl format, which represented the surface geometry as a polygon mesh. Data was then imported into the mesh mixer software tool. (Geomagic Freeform software ®) was used to mimic , mirror and overlap the healthy ear into the left ear defect area maintaining the auriculocephalic line angle of the healthy ear site (Figures 2 and 3). The mirrored .stl file was printed using stereolithography and cured for around 3 min inside the light curing unit (Figures 4 and 5). With the mirrored digital image, a virtual model of the required prosthesis was adapted to the defective side.

2.2.2. Step 2: Fabrication of the wax pattern

The 3D – Printed model was duplicated using duplicating silicone (Zhermack Elite Double, 22 FAST Silicone Duplicating Material). Then molten wax (MAARC, Modelling wax) was poured and the wax pattern was retrieved from the duplicated mould. Wax pattern was tried on patient and necessary correction were made (Figure 6).

2.2.3. Step 3: Silicone epithesis fabrication

After try-in and adjustment on the patient, dewaxing followed by silicone molding was completed. Shade selection was done using intrinsic coloration procedure using intrinsic stains (MP Sai, enterprise).

Separate shades were replicated into the various components of the patient's natural ear. Different shades were chosen for the lobule, concha, helix, and anti-helix. The choice of retention chosen was the medical grade tissue adhesive (Technovent ® B-400 Silicone Medical Adhesive)(Figure 7).

2.2.4. Step 4: Epithesis Delivery and patient instructions:

The patient was advised to use the epithesis regularly and avoid exposure to direct sun due to the limitations of silicone. He was instructed to regularly clean the prosthesis with a mild sodium lauryl sulphate solution. Patient was also educated to maintain the skin surface clean and to keep it free from natural oil secretions to make sure proper adhesion of the prosthesis. He was educated not to wear the prosthesis while sleeping as accidental pressure would lead to distortion or tearing of the prosthesis (Figure 8).

Figure 1: Residual auricular defect

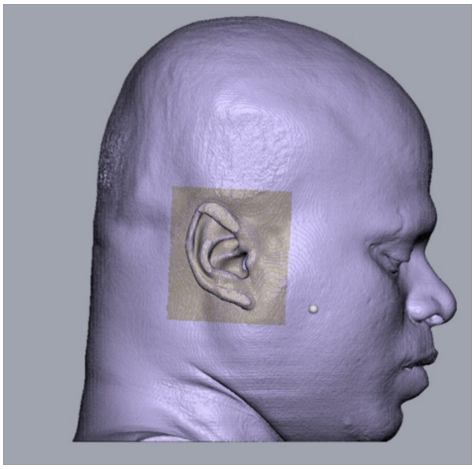


Figure 2: DICOM file– Healthy ear

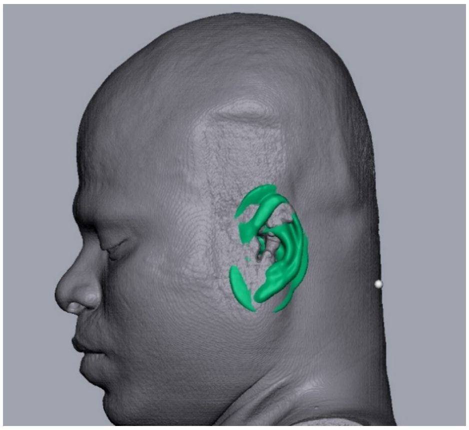


Figure 3: Mirroring of the healthy ear

Figure 4: STL Healthy EAR

Figure 5: Wax pattern trial

3. Discussion

Tumour resection, congenital malformations, trauma, inflammation and burn injuries are the common causes of auricular defects. Treatment options for such patients can be either surgical (autogenous reconstruction)[3,4] or prosthetic (acrylic or silicone retained by adhesives or mechanically) or combined (implant-supported prosthesis).[5–7]

There are various techniques to fabricate the auricular prosthesis. With the advent of the digital technology, it as possible to execute complex anatomical modelling procedures by clinicians at every level of the rehabilitation curve.

Figure 6: Wax pattern

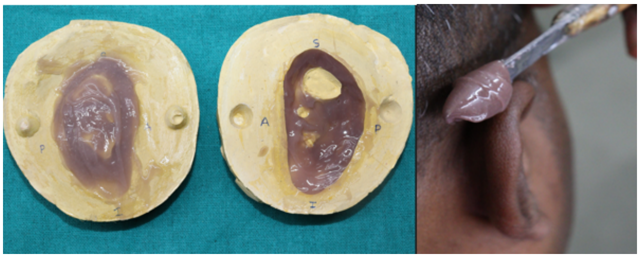


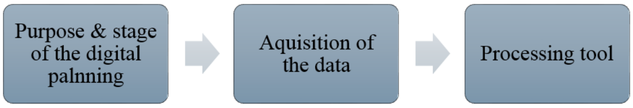
Figure 7: Processing of silicone prosthesis

Figure 8: Epithesis insitu

Fabrication of any epithesis can be of following methods.[7]

1. Analogue Method
2. Digital Method
3. Digital – Analogue Method

In the digital / digital analogue method, either all or any of the following step is done using the digital protocol.



3.1. *Purpose of the software planning:*[8–11]

Any Digital method or digital analogue method involves the use of digital tools in any of the steps such as fabrication of the ear model, fabrication of mold for auricular prosthesis and acrylic substructure, designing and creation of digital model and mold fabrication, virtual implant planning, fabrication of scan bodies and molds for auricular prosthesis. In our case, the purpose of the software planning was done in the image acquisition for the fabrication of the ear model.

3.2. *Acquisition of the data:*[12–14]

Acquisition of the data can be done by using the LASER scanner, CT scan, Desktop 3D scanner, 3D photography, 3D Photogrammetry system. In our case, CT Scan data in DICOM format was converted into .stl file. The use of CT scans to digitally fabricate auricular prostheses have been recorded as early as 1999 by Penkner[15] to create an auricular template. The study conducted by the Takashi Kamio et al., concluded that statistically no significant differences was found across software packages for size and volume. However, distinctive characteristics of each software package were noticeable. The CT scan data is a ready tool available if the case is further planned for an implant supported prosthesis. This CT scan data and the related .stl files can also help in virtual planning of the implants.

3.3. *Processing tool:*[16,17]

There are many commercial names for the CAD-CAM softwares used such as Polygon editing tool, Rapid form CAD software, Magics RP image ware, Freeform software Modelling software Mimics Software, Geomagic Studio software. In our case, we have used the Geomagic freeform software. Geomagic Freeform is a software suite designed for digital sculpting, modelling, and design. It is primarily used in maxillofacial epithesis like digital sculpting with intuitive tools, surface modelling, 3D printing preparation, mesh editing, organic and freeform design.

Digital techniques enable precise capturing of patient anatomical data and allows for highly accurate and patient-specific prosthetic designs. CAD software facilitates the customization of prosthetic shapes and sizes to match individual patient requirements ensuring a comfortable and natural fit. Additionally, digital workflows streamlined the fabrication process reducing turnaround time and enhancing overall patient satisfaction.

Furthermore, the versatility of digital techniques enables the incorporation of intricate details, textures color gradients into the auricular epitheses, resulting in lifelike and aesthetically pleasing outcomes. These advancements not only improve the functional and cosmetic aspects of auricular prostheses but also contribute to the psychological well-being and quality of life of patients with auricular defects.

4. Conclusion

Overall, the adoption of digital techniques in auricular prosthesis fabrication represents a paradigm shift in the field, offering clinicians and patients unprecedented levels of precision, customization, and satisfaction. As technology continues to evolve, further innovations in digital workflows are anticipated, promising even greater advancements in the field of maxillofacial prosthetics.

5. Conflict of Interest

None.

6. Source of Funding

None.

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