CASE REPORT

Digital Fabrication of a Custom Auricular Prosthesis for Congenital Microtia of Right Ear: A Case Report

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Abstract

Maxillofacial defects, whether extraoral or intraoral, can lead to facial asymmetry, esthetic concerns, and emotional distress, particularly in children. These deformities not only affect physical appearance but also serve as a constant reminder of trauma, potentially impacting psychological well-being. Although reconstructive surgery offers long-term benefits and is generally preferred, it may be impractical in certain clinical situations. In such cases, prosthetic rehabilitation plays a crucial role in restoring esthetics, maintaining facial symmetry, providing limited functional improvement, and positive psychological impact. Effective management in growing children requires a collaborative effort between prosthodontists and pediatric dentists, with the latter contributing significantly by evaluating and monitoring craniofacial and skeletal development to support timely and suitable prosthetic intervention planning. Regular evaluations, ideally every 3 months, help in maintaining the prosthesis and fabricating replacements as needed to accommodate growth.

Keywords: Auricular prosthesis, Case report, Digital approach, Microtia, Three-dimensional printing.

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Introduction

Maxillofacial deformities may present either extraorally or intraorally and can result from various causes such as congenital defects, genetic disorders, trauma, burns, or surgical removal of tissues following treatment of pathological lesions. Such facial anomalies can have a profound psychological impact, often influencing a child's social interactions and self-esteem.[1] Total absence of the external ear, known as anotia, is an uncommon condition. More frequently, affected individuals exhibit a partially developed or malformed auricle, referred to as microtia.[2] Microtia is a developmental defect involving underdevelopment or absence of the external ear (pinna), typically occurring on the right side, and is commonly accompanied by narrowing or complete absence of the external auditory canal.[3] Management options for such defects include surgical reconstruction or prosthetic rehabilitation. Due to the complex anatomy, surgical intervention entails multiple stages of surgery, time, and expenses, while prosthetic rehabilitation proves cost-effective and time-efficient.[4]

It requires a multidisciplinary approach involving collaboration among experts such as otolaryngologists, maxillofacial prosthetists, audiologists, and psychologists. The patient's parents expressed a clear expectation for a prosthetic solution that would provide an esthetically acceptable replacement for the absent auricle, thereby improving facial symmetry and enhancing the child's appearance in social settings. They emphasized the importance of achieving a close anatomical and color match to the contralateral ear to ensure a natural appearance. In addition, the prosthesis was expected to be comfortable, durable, and capable of remaining securely in place during routine activities.

A growing child typically requires replacement of an auricular prosthesis every 1–2 years, depending on factors such as growth rate, fit, and the condition of the prosthesis. Replacement becomes necessary when there is improper alignment with facial structures due to growth, loss of retention, skin irritation, color mismatch with the surrounding skin, or general wear and tear of the prosthetic material. Ongoing follow-up appointments are crucial to monitor developmental changes and to maintain the prosthesis's functionality, comfort, and esthetic appearance.

This case report describes the rehabilitation of a 12-year-old child with a right auricular defect, utilizing a silicone prosthesis fabricated through an advanced 3D digital process, which offers greater accuracy and efficiency than traditional fabrication methods.

Case Description

A 12-year-old male patient reported to the Department of Pediatric and Preventive Dentistry with the chief complaint of congenital absence of the right external ear. The medical history revealed conductive hearing loss on the affected side. Clinical examination showed a small cartilaginous lobule remnant on the right side with complete absence of the external auditory canal (Fig. 1), while the left ear exhibited normal structure and function. Based on the

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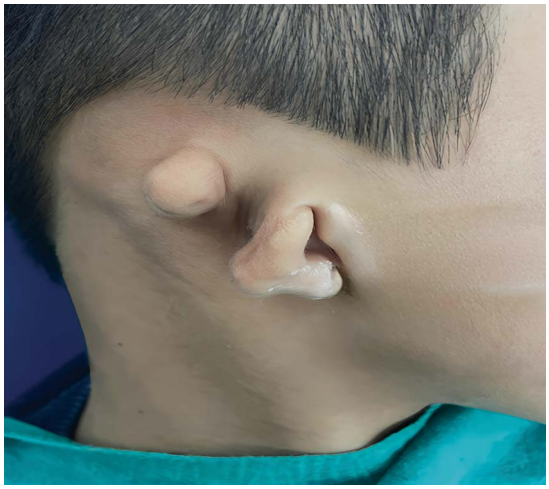


Fig. 1: Preoperative picture showing microtia of right ear

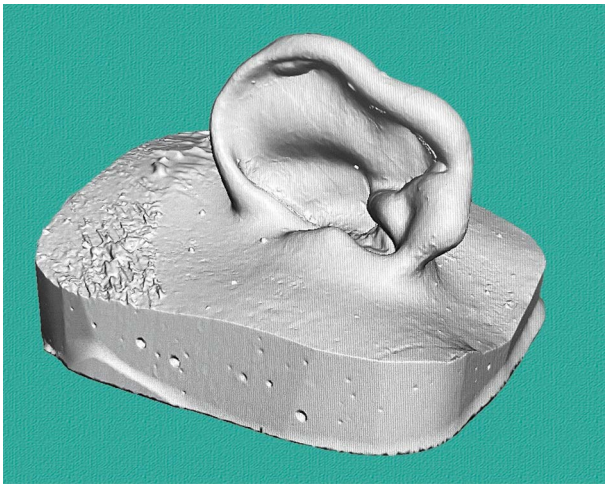
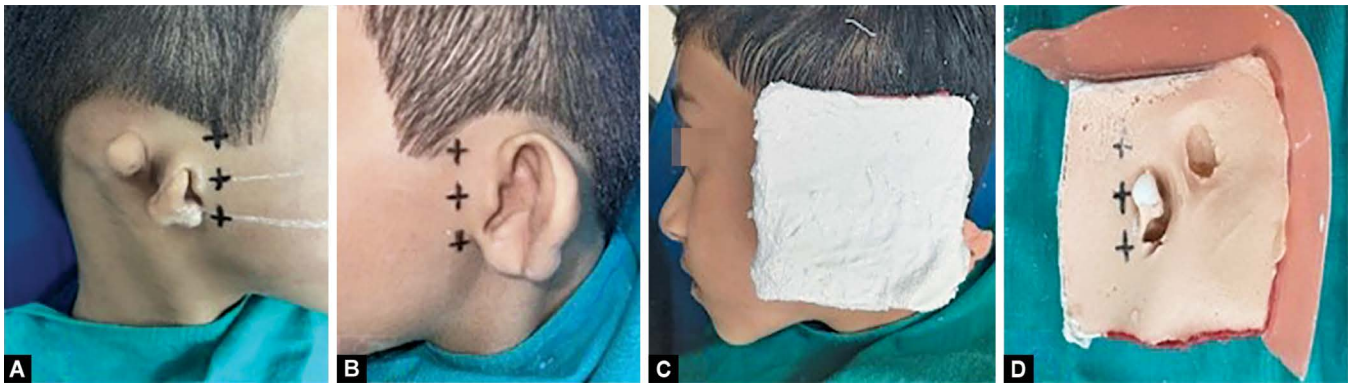


Fig. 3: STL file from digital scanning of stone cast



Figs 2A to D: (A and B) Markings with indelible pencil; (C and D) Impression of affected and contralateral ear with alginate

clinical findings, the condition was diagnosed as nonsyndromic Grade III microtia according to Marx's classification.[5]

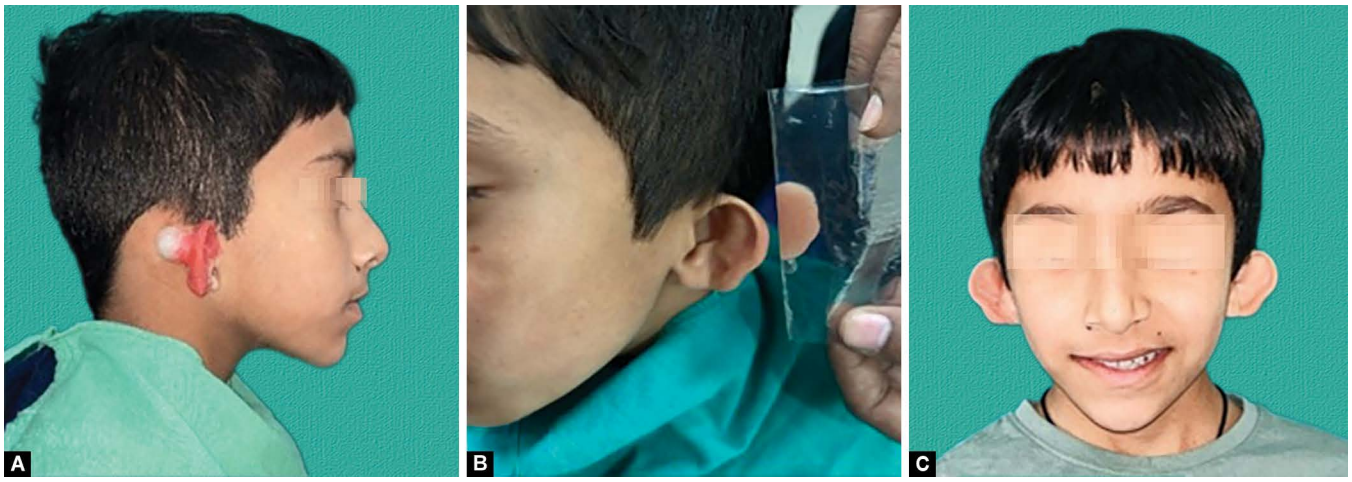
Treating pediatric patients in maxillofacial prosthetics presents several challenges, including managing their behavior, effective communication, and meeting the expectations of parents. Successful prosthetic rehabilitation in children requires the clinician to have a thorough understanding of growth patterns, behavior management strategies, and the ability to handle extended treatment sessions along with long-term follow-ups. The Frankl Behavior Rating Scale is utilized to evaluate the patient's behavior, which assists in planning future appointments, and improved child cooperation is often achieved through behavior guidance provided by a pediatric dentist.[6]

Marks were placed on the defect area using an indelible pencil to facilitate accurate alignment of the prosthesis with the contralateral natural ear (Figs 2A and B). A conventional impression was made using alginate impression material (Tropicalgin; Zhermack, Rovigo, Italy). Impressions for both sides were poured with Hydrocal (Type IV gypsum), and master casts were obtained (Figs 2C and D). Reference points were marked on the stone cast, followed by scanning using a digital lab scanner (Autoscan DS EX series, SHINING 3D).

Powdering of the stone cast was carried out to enhance detail, and the resulting data were obtained in Standard Tessellation Language (STL) format (Fig. 3). First, the STL file of the normal ear was imported into Autodesk Meshmixer V3.5 software, where it was mirrored to generate a virtual replica of the affected side of the ear. The affected-side STL file was then imported into the software, and both files were merged with the use of reference points. Once the final design was satisfactory, the design was extracted and imported into a 3D printing machine (ENDER Pro). A mirror image of the unaffected ear was digitally created and fabricated using 3D printing technology with resin material. A putty (GC Flexceed Heavy Body) index was made over the previously obtained 3D-printed resin model, and modeling wax was flowed into the index to attain an identical ear wax pattern. This was then adjusted and tried on the patient for esthetics, horizontal alignment, and margin integrity during jaw movements (Fig. 4A). After achieving a satisfactory wax trial, the wax pattern was securely sealed over the defect ear cast. A three-pour mold was then created, followed by conventional dewaxing.

Medical-grade silicone (Silastic MDX4-4210 Biomedical Grade Elastomer; RRBS Enterprises, Gurgaon, India) was selected for fabrication of the prosthesis. The base skin tone was achieved by gradually blending multiple intrinsic silicone pigments (Cosmesil), specifically shades P416, P409, P105, P406, P106, and P117, into the primary resin mixture. The developing shade was intermittently compared with the patient's natural skin tone by placing a small sample on the mixing spatula adjacent to the unaffected ear, and necessary adjustments were made by incorporating minimal quantities of higher-intensity pigments to attain optimal shade matching (Fig. 4B).

Once the final intrinsic coloration was established, silicone was packed into all 3 segments of the mold, which were then precisely



Figs 4A to C: (A) Wax try-in; (B) Shade selection; (C) Postoperative

Fig. 5: 6 months follow-up

reassembled to form the complete mold configuration. The mold was placed under bench pressure for 24 hours to facilitate complete polymerization.[5] After curing, the prosthesis was carefully retrieved, and excess material was removed using a silicone trimming bur (Dreve Dentamid). The prosthesis was then finished, trial-fitted, and minor adjustments were made as required. Retention was achieved using medical-grade adhesive and remover (RRBS Enterprises, Gurgaon, India) (Fig. 4C). The patient was provided with detailed home-care instructions regarding insertion, removal, cleaning of the prosthesis, and maintenance of the surrounding skin tissue.

At the 6-month follow-up, the prosthesis showed good fit and stability, with healthy surrounding tissues and no signs of irritation or infection. Hygiene around the attachment area was satisfactory, and the patient reported comfort and satisfaction with appearance. Minor refinements were done, and the patient was advised to continue regular cleaning and follow-ups (Fig. 5).

Discussion

Maxillofacial prosthodontics focuses on restoring both function and appearance for individuals with facial defects, helping them engage more comfortably in daily social and professional activities.[1] Creating realistic facial and body prostheses requires careful replication of the missing anatomy's form and color, ensuring the prosthesis harmonizes with surrounding facial features for a natural look.[7] Traditionally, ear prostheses have been created through manual sculpting techniques. This involves using measurements from the patient's unaffected ear or, in some cases, impressions taken from volunteers with similar ear anatomy. A wax model is commonly shaped and adjusted during clinical appointments to achieve proper symmetry, positioning, and projection relative to the other ear.[8] This conventional approach is often labor-intensive and relies heavily on the clinician's or technician's artistic ability to accurately recreate human anatomy. As a result, it can be a lengthy and skill-dependent process.

In the present case, the impression was made using the conventional technique with alginate, and a laboratory scanner was subsequently employed to generate the STL (Standard Tessellation Language) file for further digital processing. De Crescenzio et al. (2011) presented a study on using rapid prototyping (RP) techniques for the design and fabrication of customized ear prostheses. A streamlined digital process was employed, beginning with the 3D scanning of the patient's unaffected ear. This scan was then used in computer-aided design (CAD) software, followed by rapid prototyping (RP) techniques such as stereolithography to create precise molds for the prosthesis.[9] The design phase was completed entirely in a digital environment, while the final fabrication of the prosthesis itself was performed manually using the digitally created molds. Recent studies have shown that modern intraoral scanners can also be effectively used to capture ear impressions, potentially eliminating the need for the initial 3D scanning step.[10,11] This highlights a major benefit of using digital technology in auricular prosthesis fabrication, namely, a reduction in production time and increased accuracy compared to conventional methods. In this case, intrinsic pigmentation was applied using liquid colorants during the fabrication process. This method offers improved durability and stability under environmental stress compared to extrinsic coloration. However, research by Leow et al. notes that these pigments may still degrade over time due to factors such as UV exposure, heat, and perspiration.[12,13]

In pediatric patients requiring auricular prosthetic rehabilitation, several important considerations must be taken into account to ensure optimal outcomes. The timing of prosthesis placement is crucial, particularly for implant-retained prostheses, which are typically deferred until craniofacial growth is sufficiently

complete to support the implants securely and avoid future complications.[14] Early intervention with an auricular prosthesis can have a significant positive psychosocial impact, enhancing the child's self-esteem, improving social interactions, and reducing the emotional distress associated with ear deformity or absence.[15]

Conclusion

Digital techniques in auricular prosthetic fabrication offer a reliable and efficient alternative to traditional methods. For pediatric patients with microtia, early prosthetic rehabilitation can significantly improve quality of life. This case demonstrates the value of a multidisciplinary digital workflow in achieving optimal esthetic and functional outcomes.

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