Prosthetic management of posttraumatic external auditory canal atresia: A rare cause of conductive hearing loss

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Case Report

INTRODUCTION

Acquired external auditory canal (EAC) atresia is a rare event, developing in a reported 0.6 cases/100,000 people.[1,2] Atresia is the absence or closure of an orifice or passage in the body which can be congenital or acquired. The presence of EAC atresia causes associated morbidity and patients generally suffer from conductive hearing loss and persistent otorrhea. According to Tos, it is a sequelae of either intraluminal or extraluminal inflammation of varying etiology, resulting in a blind sac in the EAC.[1] This may be either membranous or solid. It can occur at the meatal opening or along the cartilaginous or bony segment of the EAC. The most common etiologies include tumor, infection, trauma, and surgery. The ensuing inflammatory response, results in the formation of acute granulation tissue and if left untreated, it can epithelialize into a soft membranous stenosis. Eventually, this soft membrane will be remodeled and mature into a firm, fibrotic scar tissue, or stenosis.[2,3] Iatrogenic trauma from prior otologic surgery is a common initiating event.[4] However, direct trauma to EAC is a very rare cause of atresia. In one of the largest series on this subject, there was only one case of acquired EAC atresia due to direct trauma in a total of 49 patients.[5]

Management of an acquired EAC stenosis depends on the stage of maturation of the stenotic region. Immature stenoses, which are still soft and have not turned into firm dense scar tissue, can be treated with nonsurgical methods by means of frequent aural cleansing, ototopical antibiotic/steroid drops, serial...

Key Words: Acrylic, atresia, cholesteatoma, earmold

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local steroid injections, and prolonged use of stents.\textsuperscript{[2]} Mature stenoses are resistant to these conservative measures and require surgical excision. Once the stenotic region is surgically removed, canalplasty, meatoplasty, and split-thickness skin grafting (SSG) are commonly performed.\textsuperscript{[3]} These surgical procedures are used to widen the EAC, open the EAC meatus, and cover the resected area with the skin to prevent restenosis. The outcome of incomplete excision of the fibrotic scar tissue is a higher rate of restenosis.\textsuperscript{[2,4]} Often, these surgical procedures alone cannot prevent restenosis and the of a stent gains importance in this situation. Postoperative EAC stents are almost always used. Common/traditional stenting materials include plain and coated gauze such as iodoform or xeroform, expandable ear wicks, and absorbable gelatin sponges (gelfoam). Silicone dental-impression compounds (optosil and reprosil) have also been used on occasion as short-term stents, with conversion to custom acrylic stents for long-term use.\textsuperscript{[7,8]} Polymethyl methacrylate, polyethylene tetrapthalate, and silicones are the most commonly used materials for fabricating customized surgical stent. Stenting periods vary from 1 week to 3 months depending on surgeon preference and degree of stenosis.

This article presents an interesting case where in EAC stenosis had occurred due to direct trauma to the EAC and postsurgical stenting was accomplished through the use of a custom made heat cured acrylic ear mould with a large bore. Acrylic stents are inexpensive and easy to fabricate, and such a hollow tube not only provides a channel for ventilation and drainage but also attenuates the occlusion effect when employed in the EAC. Moreover acrylic stent is easy to maintain hygiene and has advantages of color stability, remains serviceable up to 2 years, and can be relined if required. This approach was highly successful and may warrant consideration in other cases where EAC stenting is required.

**CASE REPORT**

A 26-year-old male patient referred from the Department of Plastic surgery had a history of right ear block of 3 years duration and decreased hearing [Figure 1]. Past history of trauma to the ear canal during a road traffic accident with associated ear bleed 3 years back. He was found to have a right EAC stenosis on examination by the ENT surgeon. The computed tomography (CT) temporal bone showed soft tissue densities in EAC and biopsy was consistent with cholesteatoma. He was treated surgically by reconstruction of right EAC with SSG obtained from right thigh. The treatment was a combined effort of the Department of ENT and Department of Plastic surgery. Further treatment plan included placing EAC stent to prevent synechiae formation. He was using a coated gauze stent for 2 weeks after the surgery.

So, in the Department of Prosthodontics, Government Dental College, Kottayam, it was decided to fabricate a heat cured acrylic stent with a wide bore for the presenting case.

**Impression procedures**

An impression of the EAC along with that of the pinna was made in putty and light body consistency of polyvinyl siloxane elastomeric impression material. Length of the EAC was measured as 2.6 cm from CT temporal bone of the patient. A 20-gauge stainless steel wire (Deccan Dental Depot Pvt. Ltd., Konark, Odisha, India) was used according to the length of the EAC and putty material (Elite HD+, Zhermack, Italy) was added around the wire and inserted into the canal to record the impression of the canal. Light body material (Elite P and P, Zhermack, Italy) was injected into the folds of the auricle, and the whole impression was again picked up using putty [Figure 2]. The impression was retrieved as a single unit, and a stone cast was made [Figure 3].

**Fabrication of stent**

Color matching of the acrylic material with the auricle was done. The wax pattern was fabricated including the folds of the auricle to obtain maximum retention of the prosthesis [Figure 4]. The waxed model was flanked and dewaxed [Figure 5]. Putty material (Elite HD+, Zhermack, Italy) was shaped around a 20-gauge stainless steel wire (Deccan Dental Depot Pvt. Ltd., Konark, Odisha, India) into a rod of 3mm diameter to help make a bore in the stent [Figure 6]. After dewaxing, the mould was packed with heat cure acrylic (DPI, The Bombay Burmah Trading Corporation Ltd., Mumbai, Maharashtra, India) in dough stage and the putty rod was inserted into the center of the canal within the acrylic dough and acrylization was done using a long curing cycle to reduce the residual methyl methacrylate content.\textsuperscript{[9]} Following acrylization, the prosthesis was retrieved from the flask, trimmed, and the putty rod with the wire removed from the center of the prosthesis in order to create the bore of the stent [Figure 7].
The acrylic stent was trimmed according to the anatomy of the auricle and finishing, and polishing was carried out [Figure 8]. The stent was kept in water for 24 h for further reducing the monomer content and kept immersed in 2% glutaraldehyde solution before use [Figure 9]. The patient was instructed to remove and reinsert the stent by himself for cleaning at home. He was educated about the maintenance of hygiene including cleaning the bore of the stent. The patient was recalled once in every 2 weeks for the first 2 months and later once in every 1 month for 18 months. No signs of restenosis were found during the recall visits.
DISCUSSION

Acquired EAC stenosis is uncommon sequelae of previous trauma to the ear. This article presents a case where EAC stenoses occurred following the trauma of the right ear and treated successfully by surgery and postsurgical customized acrylic stent. During the prolonged period of EAC stenting, a customized earmold in our patient provided a safe, comfortable, and effective alternative to traditional stenting materials. Venting the stent subjectively reduced the conductive hearing loss encountered with traditional gauze stents, and it also helped in reducing the occlusion effect. Similar to the use of ear packing at the end of surgery, which creates a pressure effect to minimize the swelling and inflammation, the application of a stent in a newly made EAC is believed to modulate the remodeling process of both the extracellular matrix and bone through the pressure effect. Thus, prolonged use of stent have benefits in terms of preventing excessive granulation tissue formation, in addition to maintaining the patency of the meatus until adequate epithelialization has been achieved.[10]

Although traditional stenting materials like sponges or gauze can also provide some supportive strength to prevent stenosis of the EAC, those materials must be firmly packed for adequate maintenance of the width of the canal, thus resulting in an occlusion effect and poor drainage and ventilation. Ear occlusion-related aural fullness is the most frequent complaint for patients using traditional sponges and gauze.[10] The patient reported that the customized earmold/stent was very comfortable and easy to be inserted and removed from the ear canal. It alleviated his concerns of how large to make the gauze stent and how deep it should be placed inside the canal. The large bore also provided ventilation of the canal, with a subjective improvement in his hearing when compared to the gauze stent, which completely occluded the canal. Moreover, the folds of the auricle were also utilized for retention and the patient reported that it enhanced his confidence very much so that he is very comfortable during his work and on lying on his side since the stent is not getting dislodged. The outer portion of the stent was carved according to the anatomy of the auricle which made it as inconspicuous as possible.

The use of a stent made from an impression of the ear has been reported earlier by Sela et al.[7] and Weber et al.[8] They describe the use of a similar nonvented ear stent made from dental impression material intraoperatively and worn temporarily (1–2 weeks) until a hard customized acrylic stent could be constructed. Weber et al. recommend against using the impression material as a short-term stent due to difficulty with its removal after 2 weeks. They recommend using a coated gauze stent for 2 weeks until the acrylic stent can be fabricated.[8] Customized, hard acrylic stents with a central hole provide a nontraditional alternative for EAC stenting to successfully prevent restenoses.

CONCLUSION

Acquired EAC atresia is a very rare cause of conductive hearing loss, and direct trauma to the external ear can also cause this situation, and the management is challenging. Recurrence can be a late development, since the processes that drive the condition, such as otitis externa, may persist. Complete resection of fibrous plug with canalplasty and re-epithelization of EAC with SSGs along with the continued use of a stent should be the treatment of choice to achieve a patent external ear canal for a long period of time. This article describes a novel technique for fabrication of a wide-bored acrylic EAC stent which attained additional retention from the folds of the auricle. The patient showed a good outcome and normal hearing, without any recurrence, in a postoperative period of 18 months.
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Conflicts of interest
There are no conflicts of interest.

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