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Review Article

Use of porcine small intestinal submucosa for pediatric endoscopic tympanic membrane repair

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Abstract Tympanic membrane perforationsoccur frequently in children, and can result in hearing loss, otorrhea, pain, and cholesteatoma. Due to the narrower ear canal in children, a postauricular incision is often needed to access the tympanic membrane for surgical repair. Endoscopic approaches are increasingly being used for tympanic membrane repair, reducing the need for postauricular incisions. As the need for a postauricular incision decreases, the demand for non-autologous grafting material has increased. Acellular porcine small intestinal submucosa (SIS) has been described in the literature as an alternative to commonly used autologous grafts, and is well suited for use with transcanal endoscopic ear surgery as a minimally invasive approach. This paper describes techniques for use of SIS in endoscopic tympanic membrane repair in children.

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Introduction

Tympanic membrane perforation is a common problem in children. A tympanic membrane perforation is readily diagnosed on otoscopic exam and can result in multiple sequelae including conductive hearing loss, chronic otorrhea, tinnitus, and cholesteatoma.[1] Surgical repair of tympanic membrane perforation is performed via a wide range of techniques, through several approaches, and with numerous grafting materials. Recently, many surgeons have introduced rigid endoscopes into the surgical armamentarium for visualization during tympanic membrane repair. Advantages of visualization with an endoscope as compared to the microscope include a broader view, improved depth of field, and a minimally invasive approach via the external auditory canal.[2] While improvements in visualization are enjoyed with any endoscopic ear surgery (EES), the benefit of a minimally invasive approach occurs only when the entire surgery is performed via the ear canal, with transcanal endoscopic ear surgery (TEES). The decision to perform TEES depends on many factors, however, a particular advantage is seen in children where most cases of tympanic membrane repair are performed via a postauricular approach simply due to the limited view afforded via the microscope with a speculum in the ear canal, and not for any special access to the mastoid or other anatomic structures. As a result, TEES in children can allow for a reduction in morbidity such as postop pain, hematoma or keloid scar (Fig. 1) by eliminating the need for a postauricular approach in many cases.[3–5]

There are many factors that affect surgical outcomes following tympanic membrane repair including age, location and size of the perforation, presence or absence of otorrhea, condition of the drum adjacent to the perforation edge, and technique used in performing the repair.[6,7] Although the use of those factors as a prognostic tool for predicting surgical success remains controversial, one cannot ignore the importance of considering them when choosing the right timing and techniques for tympanic membrane repair, particularly in the pediatric population. The degree to which those factors affect surgical outcomes has been widely reported.[8]

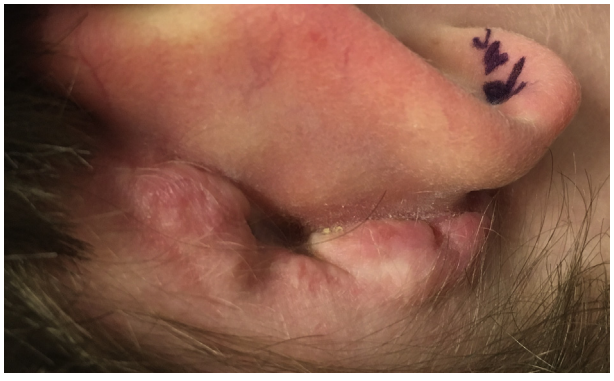

Fig. 1 Keloid scar following post-auricular incision. Such complications can be prevented by eliminating this incision with transcanal endoscopic ear surgery.

Another important consideration in tympanic membrane repair is the type of graft used to perform the repair. A common source of graft material is autologous temporalis fascia, which requires a small incision for harvest. As cases are increasingly performed via TEES, with a resultant decrease in the need for postauricular incisions, the availability of a robust, easily manipulated, cost-effective option for graft material is attractive. In this article, we discuss strategies for tympanic membrane repair in the pediatric population, with particular attention to the role of porcine small intestinal submucosa (SIS) as a graft material using an endoscopic approach. Techniques used by our group using SIS are described in-depth.

Discussion

Nomenclature

The nomenclature for tympanic membrane repair has many iterations and subtleties. For the purpose of this paper, myringoplasty refers to repair of the tympanic membrane limited to the drum head without elevation of a tympanomeatal flap. Tympanoplasty refers to all other repairs of the tympanic membrane, can be performed with or without ossicular chain reconstruction, and can be subdivided into lateral graft tympanoplasty and medial or underlay graft tympanoplasty.

Endoscopic vs microscopic ear surgery

The binocular operating microscope has long been the stalwart tool for visualization in otologic surgery. It offers high resolution, excellent depth perception, and fixed positioning allowing two free hands for surgical dissection. Limitations of the operating microscope include direct line-of-sight visualization, hindering the ability to see around anatomic obstacles such as the anterior canal wall or scutum. Furthermore, as magnification increases, illumination and depth of field decrease, making visualization poorer. Due to the limits of the external auditory canal diameter, particularly in children, many otologic procedures require a postauricular approach and division and retraction of the lateral hair-bearing skin of the ear canal, just to obtain a full view of the tympanic membrane. Even after these maneuvers have been performed, prominence of the anterior canal wall can limit a full view of the anterior tympanic membrane, and anterior canal skin elevation and canalplasty are necessary to obtain a full view of the drum. Over time, as rigid endoscopes became smaller and high resolution camera systems became available, endoscopes were used as a tool to diagnose and photograph diseases of the middle ear.[9] Subsequently, the endoscope has moved beyond a tool for visualization alone, and techniques for performing otologic surgery under endoscopic visualization have emerged.[4] Without question, endoscopes provide superior visualization of the tympanic membrane.[10] In order to take advantage of this superior visualization, gradual incorporation of one-handed surgical techniques and strategies for managing ergonomics and hemostasis have evolved, allowing for minimally invasive approaches to common otologic pathology.[4,5,11–17]

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