

Endoscopic ear surgery in children

BY ADRIAN JAMES

The benefits of endoscopes in otologic surgery, which have become increasingly widely appreciated in recent years, are very well suited to the management of paediatric middle ear disease. Although one might imagine that the smaller ear canal of a child might prevent adequate access, experience shows that this is rarely the case.

This article reviews a personal perspective on the current role of endoscopes in paediatric ear surgery, in what is a rapidly evolving field. It has been recognised for over 25 years that endoscopes provide access to recesses that are hidden from view with the operating microscope and that this facilitates more effective cholesteatoma removal. More recently, thanks to the inspiration of founders of the International Working Group in Endoscopic Ear Surgery, we have all begun to appreciate the possibility of totally endoscopic ear surgery through the ear canal (TEES). For the child and parents, the opportunity to have surgery seemingly without an incision is remarkably popular. At first, I considered that TEES had limited scope in a tertiary paediatric otology practice, thinking that the small ear canals and the complexity of cases made it impractical. But by learning new skills, gradually acquiring better equipment and persevering, it has become possible to complete nearly all tympanic membrane repairs and more than half of cholesteatoma surgeries with TEES.

Why use TEES in children?

To the surgeon, an inconspicuous end-aural or post-auricular incision may seem of little consequence. However the almost universal look of relief and gratitude on the faces of parents when they hear their child has avoided an incision shows that it is of far greater concern to the patient and family. Although wounds around the ear heal quickly, objectively, there really are advantages in avoiding the incision. Acutely, pain is reduced and the small risk of wound infection eliminated. Faster discharge from hospital, return to school and resumption of contact sports can all be anticipated and valued by the family. In the longer term, the risk of hyperesthesia, pinna numbness and unsightly keloid formation are all avoided (Figure 1). Wound complications may only occur in a small percentage of ear surgeries but can be unpleasant for the child and are obviously best avoided if possible.

Endoscopic indications in children

The primary indications for endoscopic

ear surgery in children are tympanic membrane perforation, cholesteatoma and ossicular anomalies. The tympanic membrane can be reconstructed with perichondrium or cartilage from the tragus, a relatively hidden donor site. However in young children it may be too small for the size of the tympanic membrane defect, especially if scutum reconstruction is also required. Porcine submucosal collagen graft is an ideal material to use when the tragus is insufficient – and avoids the small amount of donor site morbidity and time otherwise needed to harvest a graft. It is certainly possible to repair subtotal perforations using an underlay lateral graft technique with this xenograft though adjustment of large grafts through the paediatric meatus can be challenging.

Congenital cholesteatoma confined to the mesotympanum provides a perfect opportunity for TEES, not least because no challenging reconstruction of the tympanic membrane is required (Figure 2). Acquired cholesteatoma arises from the pars tensa more commonly in children than the pars flaccida, so



Figure 1. Large keloid scar which developed from a post auricular incision after tympanoplasty.

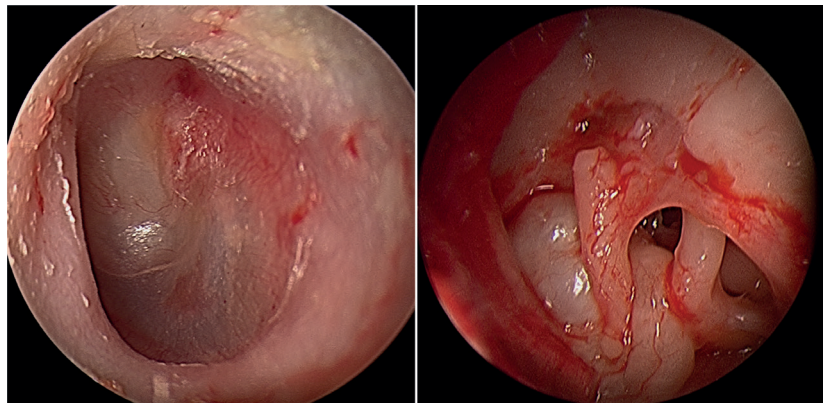


Figure 2. Congenital cholesteatoma in the antero-superior quadrant of the left middle ear in a 3.9-year-old child (left). This was removed using totally endoscopic surgery through the ear canal (right).

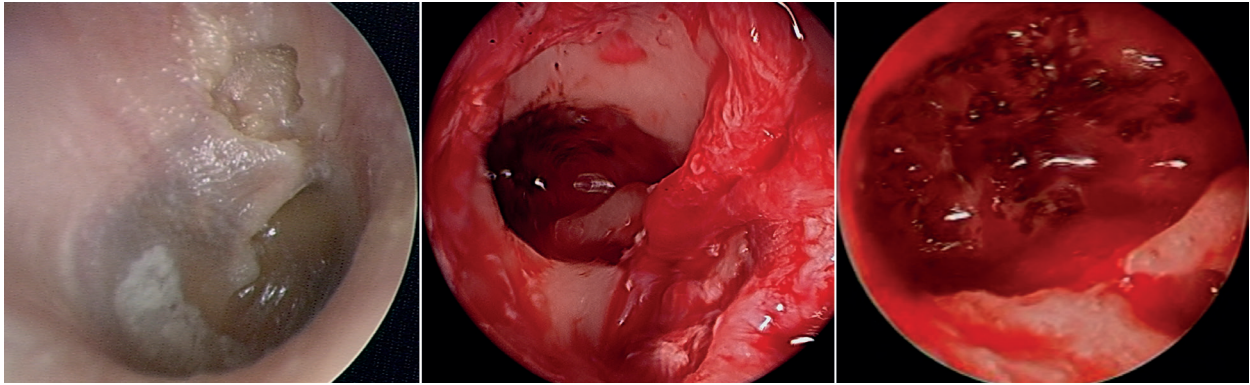


Figure 3. Pars flaccida cholesteatoma of the right ear in a 14-year-old (left panel) which extended into the mastoid antrum. Attico-anrostomy was completed totally endoscopically using a bone curette (centre). Close-up view with a 45° endoscope after KTP laser showing the lateral semicircular canal as the inferior and posterior limit of the dissection, and the short process of the incus anteriorly (right). As the pars tensa was normal, adequate tragal cartilage was available for canal wall reconstruction at this age.

commonly extends into retro-tympanic recesses. Angled endoscopes and instruments allow retro-tympanic dissection under direct vision so are ideally suited, whether used for TEES or through a post auricular incision. Using a front-to-back technique with TEES, cholesteatoma can be followed as far back as the mastoid antrum to the limits of the lateral semicircular canal (Figure 3). It is appropriate to reconstruct the canal wall defect to prevent recurrent disease, but in younger children, it is unlikely that the tragus will provide sufficient cartilage, especially if pars tensa reconstruction is also required. Careful consideration must be given between the merits of TEES in such cases or a conventional canal wall up procedure.

For congenital or acquired conductive hearing loss, endoscopic tympanotomy provides a good diagnostic and potentially therapeutic option with low morbidity (Figure 4). Endoscopic ossiculoplasty becomes much easier than one might initially expect.

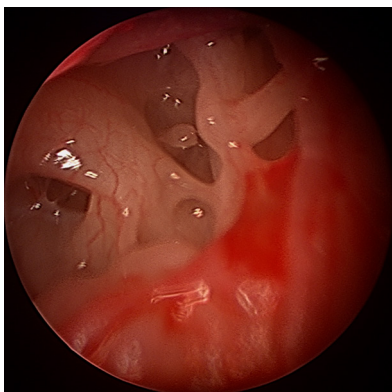


Figure 4. Endoscopic tympanotomy for left sided congenital conductive hearing loss, revealing the lenticular process of the incus against the facial nerve and a single columella stapes.

Age, size and access

It is important to note that although the ear canal is noticeably narrower in young children than in adults, it is also significantly shorter and generally straighter. Greater freedom to manipulate the angle of endoscope and surgical instruments is possible than in a longer ear canal which helps offset the narrower diameter (Figure 5). As a result, TEES is feasible even in children under three years of age. When access is restricted by bone, the curette, drills or other powered bone removal tools (e.g. piezo-electric or ultra-sonic) can be used alongside the endoscope, making it possible to complete even more cases with TEES.

Choice of instruments

As in adults, paediatric TEES can often be completed with readily available surgical equipment. In many children, the ear canal is wide enough for tympanoplasty to be completed with a 4mm diameter 0° endoscope, though if available, a 3mm scope is preferable. When operating medial to the annulus, 3 or 2.7mm scopes are necessary, with a choice of 0°, 45° and especially 30° being helpful. The requirement for angled instruments to reach into areas revealed by angled endoscopes is the same as in adult ears as the proportions of the middle ear do not change significantly with age. Caution is required when using the somewhat flexible angled suction cannulae which can be deflected by the endoscope. Combined suction-dissection instruments are ideal, but even in a child's ear, there is usually enough space for a skilled assistant to use suction to clear bleeding while the surgeon dissects.

KTP laser is ideally suited to endoscopic ear surgery in children, the slender and slightly malleable carrier easily working alongside the endoscope

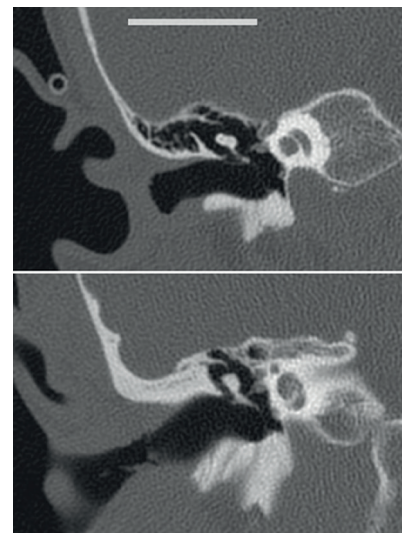


Figure 5. Coronal CT scans of the temporal bone from a 2.7-year-old child (upper panel) and a 17-year-old (lower panel; white bar = 2cm scale). Totally endoscopic surgery is feasible in young children as the ear canal is shorter and straighter in younger children, despite being narrower.

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to remove cholesteatoma from recesses that are beyond the reach of mechanical instruments. A 532nm filter can be placed between the camera and endoscope to prevent glare, and a suction cannula attached to the endoscope (or carrier) for hands-free smoke evacuation. When pathology lies beyond reach, and a drill is needed to remove bone, burs with protected shafts, especially curved burs, are recommended to avoid injury to canal skin from the rotating shaft.

When is the microscope still needed?

The microscope is of course still used when drilling in the mastoid to free up the other hand for suction of bone dust and irrigation fluid. Cochlear implant surgery is one area where we have not found endoscopes helpful, preferring instead the now traditional microscope-guided posterior tympanometry approach through a 3cm hairline incision. The length of the incision is determined by the size of the device, so unlike middle ear surgery, endoscopes cannot reduce wound morbidity.

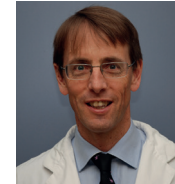
Otologists experienced with the microscope may initially find certain

tasks, such as graft or prosthesis adjustment, overbearingly laborious with the non-dominant hand constrained to holding the endoscope. In such instances it is perfectly reasonable to use the microscope to assist what otherwise would have been a totally endoscopic procedure. The priority is of course to achieve the best result for the child, not for the surgeon to compromise outcome for the self-satisfaction of completing TEES. Nevertheless without attempting to complete cases totally endoscopically, the skills will not be mastered. A careful balance is required when developing endoscopic skills in order to maintain successful outcomes.

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Declaration of Competing Interests: None declared.

ABOUT THE AUTHOR

Dr Adrian James has worked as a paediatric otolaryngologist at Sick Kids Hospital in Toronto, Canada since 2005 with a predominantly otologic practice, focusing particularly on chronic middle ear disease and including cochlear implantation. He was introduced to endoscopes in otology during registrar training in the Oxford region, UK, and has used them to an increasing extent in paediatric middle ear and anterior skull base surgery since. He has been an instructor on endoscopic ear surgery courses around the world and organises the International Paediatric Temporal Bone Surgery Course in Toronto.

SUMMARY

1. Totally endoscopic surgery is possible for tympanic membrane reconstruction and removal of cholesteatoma even in young children
2. Avoidance of an external skin incision is very popular with children and parents
3. Skills learned with a microscope may not transfer easily to endoscopic ear surgery in children, and patience is required to master new techniques effectively.