Otosclerosis is one of the most frequent causes of conductive hearing loss in adults. Surgical treatment is considered to be the gold-standard for this disease and stapes surgeries are currently performed with the aid of an operating microscope with excellent results worldwide. Although it has been more than 15 years since the introduction of operative endoscopy to middle ear surgery, there is still perceived to be a limited role for endoscopy in the surgical management of middle ear diseases and otosclerosis.

There are several possible reasons for this, including a potentially long learning curve through the initial stages of adapting newer techniques and different instrumentation for one handed work. As is well known, traditional microscopic stapedotomy requires optimal exposure of the oval window niche in order to reduce complications or failure in stapes surgery. In most of the cases it requires partial removal of the posterior bony wall of the external ear canal (EAC) and the manipulation of the chorda tympani. When using the microscope, the surgeon, most of the time, cannot easily see the anterior crus of the stapes, thus the removal of the superstructure will be performed in a blind fashion. This article describes the use of the endoscope during stapes surgery and discusses the advantages and disadvantages of this approach.

Surgical technique and equipment:
All of our endoscopic procedures are performed under general hypotensive anaesthesia. Patients are positioned in the same manner as traditional microscopic otologic surgery. The video equipment is placed in front of the surgeon. We use almost the same instruments, with the addition of some specially designed small suction Freer elevator and curved suction tips, as well as 0° and 30°, 4mm diameter, 18cm endoscopes. Adrenaline (1:2,000) soaked cottonoids are placed into the EAC for five minutes. No infiltration is performed. With a 4mm, 0° endoscope a tympanomalleal flap is raised at the posterior wall of the EM (Figure 1A).

With a 30° endoscope, an inspection of the middle ear is performed (Figures 1B and 2A). Attention is directed to the facial nerve to ensure that it is not prolapsed onto the footplate. After a test of the ossicular chain, the incudo-stapedial joint is disarticulated sharply in an anterior-posterior plane and the stapedial tendon is divided with a small pair of scissors. The stapes superstructure is downfractured with light force after the crura have been divided with a small drill and removed, leaving the footplate intact. During revision surgery we carefully remove the scar tissue from the oval window niche, exploring the stapedotomy hole and the position of the prosthesis. A regular Teflon or titanium prosthesis (0.6mm in diameter and 6mm in length) is sized by measuring the distance from the footplate to the medial surface of the incus. This measurement can be performed preoperatively using 3D virtual otoscopy programs using the DICOM files.
from the CT exam of the patient (Figures 1D and 3). This measurement is always confirmed during surgery.

A small fenestration is created at the midportion of the footplate with a traditional straight pick instrument or a small drill (Figure 2B). The prosthesis is placed between the oval window and the incus (Figures 1C and 2C). Perilymphatic fluid suctioning is avoided to minimise postoperative vertigo and cochlear damage. The malleus is carefully palpated to ensure movement of the ossicles all the way through the prosthesis. The tympanomeatal flap is repositioned (Figure 2D) and sealed with antibiotic ointment or antibiotic solution-treated Gelfoam®.

Results and discussion

All 30 patients in our series showed improvement of their hearing loss. The mean preoperative speech recognition threshold (SRT) was 65dB, postoperatively this improved to 30dB. Since the introduction of the classic stapedectomy technique by Shea many different procedures have been described in the literature using a microscopic approach. In the recent literature the introduction of the endoscope in middle ear surgery has permitted the development of new anatomical and physiological concepts specially in cholesteatoma surgery. It is well known that the operative microscope does not permit the surgical control of the hidden areas in the middle ear such as the sinus tympani, the anterior epytympanic space, the protympanic recess and the facial sinus recess.

At present, several works are focused on the importance of the endoscopic approach during cholesteatoma surgery to have a better view of the recesses of the middle ear, detecting residual disease. There is little in the literature regarding the use of the endoscope during stapes surgery (stapedotomy), given the magnification, exposition of the oval window niche and the view of the stapes that this allows. On basis of our previous work we started to perform stapes surgery (stapedotomy) using an endoscopic transcanal approach.

This endoscopic approach allowed us to have a better view and control on oval window niche bypassing the EAC and chorda tympani.

A disadvantage of the endoscopes is that it requires a one-handed surgery. However, most microscopic stapes surgeries are performed using one hand with excellent

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Figure 1: A: Endoscopic view (4mm diameter, 18cm length, 0º). Tympanic membrane (tm). B: Middle ear with structures: facial nerve (fn), pyramidal eminence (pe), long process of incus (lpi). Note the stapes footplate with a persistent stapedial artery. C: Prosthesis in place. D: Virtual otoscopy showing the resemblance between the real anatomy and the virtual 3D reconstruction.

Figure 2: A: Endoscopic view with 0º endoscope: optimal exposition of the oval window niche (own) without chorda tympani manipulation. Note the facial nerve (fn), incus (i), round window niche (rwn), pyramidal eminence (pe), B: The platinotomy at the stapes footplate (p). C: Prosthesis in place; D: Tympanic membrane after the repositioning of the tympanomeatal flap (tmf).

Figure 3: Virtual 3D reconstruction using the DICOM files from the CT scan. Note the malleus (m), incus (i), stapes (s), lateral semi-circular canal (lsc) and the virtual measurement of the space between the incus and the footplate (red line).
results worldwide. The lack of true three dimensional (binocular) vision during the procedure is perceived as a drawback, but with sufficient experience, this has a very limited impact on the procedure. Some advantages regarding the use of the endoscopes during stapes surgery include an excellent exposition of the oval window niche without removal of healthy bone from the EAC, avoiding any manipulation of the chorda tympani, and a good view of the anterior crus of the stapes, allowing its removal without blind manoeuvres.

Although this technique is not suitable for those at the early stages of endoscopic ear surgery, it has much to offer the surgeon and the patient.

Conclusion

In our series, endoscopic stapes surgeries using endoscopes were technically feasible, safe and promising. There were both advantages and disadvantages. The main advantages of the endoscopes were: no trauma to the chorda tympani, and an excellent field of view, with the visualisation of the anterior crus of the stapes, its suprastructure and the oval window niche. The disadvantages were lack of stereoscopic view, no capability of bi-manual work and a learning curve. As this technique develops, many of the drawbacks will be overcome and, given the advantages of access and reduced morbidity, the use of the endoscope in surgery of the middle ear and of the stapes will be likely to expand.

References