

## Endoscopic transcanal stapedotomy: how I do it

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**Abstract** Current paper presents a surgical technique and preliminary results of the first eight consecutive fully endoscopic transcanal stapedotomies. All eight procedures were performed under local anesthesia by the same surgeon using rigid endoscopes of 3-mm diameter, 14-cm length, 0° and 30°. A posterior tympanomeatal flap was elevated transmeatally with the 0° endoscope and then transposed anteriorly. Stapes fixation was confirmed, the stapes tendon was cut with curved micro-scissors, and the stapes was separated from the incus in the incudo-stapedial joint. The anterior and posterior stapedial crus were carefully fractured, and the superstructure was removed. The hole in the foot-plate was created with a Skeeter microdrill using a 0.5-mm-diameter diamond burr. A platinum/fluoroplastic piston prosthesis (0.4-mm diameter) was placed into this hole and fitted along the long process of the incus. The tympano-meatal flap was repositioned, and the external auditory canal was filled with Gelfoam®. The chorda tympani nerve was preserved in all cases. A 4.5-mm prosthesis was used in six cases and a 4.75-mm prosthesis in two. Pure tone audiograms demonstrated improved air- and bone-conduction threshold averages across the three speech frequencies (0.5–1.2 kHz) 6 months after surgery (64 vs. 29.8 dB and 30.6 vs. 25.1 dB, respectively). The average postoperative air-bone gap was within 10 dB in six ears and between 10 and 15 dB in the other two ears. Our preliminary results indicate that transcanal fully endoscopic stapedotomy is a feasible and safe technique for

surgical management of hearing loss associated with otosclerosis.

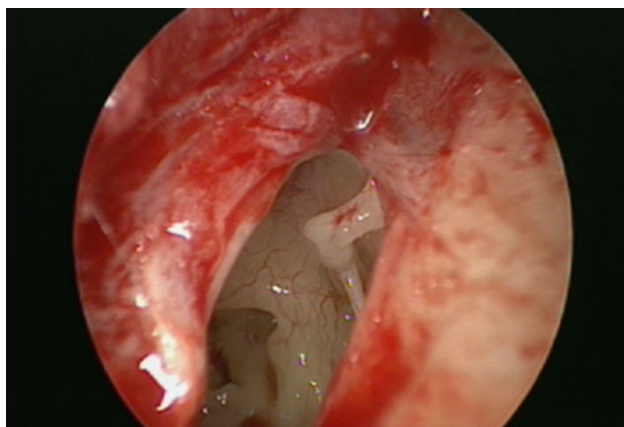
**Keywords** Otosclerosis · Surgery · Endoscopic · Technique · Stapedotomy

### Introduction

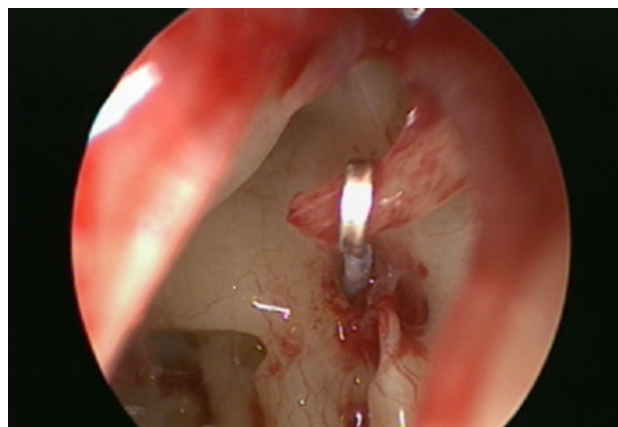
Stapedotomy can be technically difficult and challenging due to anatomic variations in size, configuration, shape, or irregularity of the external ear canal. The stapes and oval window niche (OWN) can be obscured by the scutum. When the posterior part of the bony annulus is removed to visualize the stapes, the chorda tympani nerve (CTN) can be occasionally touched and stretched [1]. The reported rate of postoperative taste disorders or tongue symptoms after stapes surgery is 20–60 % in patients whose CTN was manipulated or transected [1, 5–9]. Excessive removal of the bone for better visualization of the middle ear (ME) structures can rarely result in subluxation of the incus [2–4]. However, damage to the CTN and subluxation of the ossicles or stapes fracture significantly decreases with increased surgeon's experience.

Although endoscope-assisted stapedotomy was first described by Poe in 2000 [10], there is only one publication on fully endoscopic stapedotomy (ES) [11]. Our otologic team traditionally performs stapes surgery via the transcanal approach. Our experience with over 150 endoscopic ear surgeries since 2008 showed that a transcanal endoscopic approach to the ME obviates the need to divide the CTN to obtain adequate access to the stapes and OWN (Fig. 1) [12]. The current paper presents a surgical technique and preliminary results of the first eight transcanal fully endoscopic stapedotomies.

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**Fig. 1** Endoscopic view of the *left middle ear* after an elevation of the tympano-meatal flap. Good access to the stapes and oval window niche was achieved without removal of the scutum and without touching the chorda tympani nerve



**Fig. 2** Endoscopic view of piston prosthesis placed in the hole that was created in footplate

### Patients and methods

Eight consecutive patients (six females and two males, age range 35–74 years) diagnosed as having otosclerosis underwent fully ES (without conversion to a conventional otomicroscopic technique) in our department in 2012. They were followed up for at least 6 months (range 6–11 months). Five left ears and three right ears were operated. Pre- and postoperative audiometric data included averaged of air- and bone-conduction thresholds, and air-bone gap (ABG) measurements at the three speech frequencies (0.5–1.2 kHz). Postoperative audiometry is routinely performed at 1, 6, and 12 months following surgery. Closure of the ABG to within 10 dB was defined as surgical success, while closure to within 20 dB as improvement.

### Surgical technique

All procedures were performed under local anesthesia by the same surgeon (L.M.). The external ear canal was injected with lidocaine 1 % with 1:100,000 epinephrine. The position of the patients was the same as for routine otomicroscopic ear surgeries. A fully endoscopic transcanal procedure was undertaken using rigid endoscopes of 3-mm diameter, 14-cm length, 0° and 30°. Angled picks, curved scissors, and forceps were used in addition to the routine otologic micro-instruments. A posterior tympanomeatal flap was elevated transmeatally with the 0° endoscope and then transposed anteriorly. All the surgeries were performed with a 0° endoscope, while a 30° endoscope was required to better visualize the OVN, the anterior crus of the stapes, the tympanic portion of the facial nerve and the pyramidal eminence in two cases due to bony overhang in posterior tympanum. Endoscopic view

of the ME was sufficient in all cases and does not require any curettage or drilling of the scutum or mobilization of the CTN (Fig. 1). Stapes fixation was confirmed by gentle testing of ossicular chain mobility. The stapes tendon was cut with curved micro-scissors and the stapes was separated from the incus in the incudo-stapedial joint. The anterior and posterior stapedial crus were carefully fractured and the superstructure was removed. The distance between the footplate and medial surface of the long process of the incus was measured to determine the required prosthesis size. The hole in the foot-plate was created with a Skeeter microdrill using a 0.5-mm-diameter diamond burr. A platinum/fluoroplastic piston prosthesis (0.4-mm diameter, 4.5/4.75-mm length) was placed into this hole and fitted along the long process of the incus (Fig. 2). The appropriate ossicular chain movement with the replaced stapes was ensured by malleus palpation. The tympano-meatal flap was repositioned, and the external auditory canal was filled with Gelfoam<sup>®</sup> soaked in ear drops containing antibiotics.

### Results

The CTN was preserved in all cases, and all the patients described their postoperative taste function as being normal. One patient had an obliterated footplate. The facial nerve was dehiscant in its tympanic portion in three patients. A 4.5-mm prosthesis was used in six cases, and a 4.75-mm prosthesis in two. Seven patients were discharged 2 days after surgery according to the routine post-stapedotomy protocol that is accepted in our department. One patient developed vertigo 30 h post-stapedotomy and was treated with intravenous amoxicillin clavulanate and steroids. Those symptoms resolved 1 week following surgery.

All the operated patients reported subjective improvement of their hearing intra- and postoperatively. Pure tone

audiograms demonstrated improved air- and bone-conduction threshold averages across the three speech frequencies (0.5–1.2 kHz) 6 months after surgery (64 vs. 29.8 dB and 30.6 vs. 25.1 dB, respectively). The average postoperative ABG was within 10 dB in six ears and between 10–15 dB in the other two ears compared to the 31.4 dB preoperative average ABG.

## Discussion

Endoscopic stapedotomy was introduced in our department with the intent to avoid injury to the CTN when attempting to achieve visibility of the ME structures. The CTN was preserved in all cases, and our preliminary audiometric results were comparable with the others [11].

The existing data indicate that the CTN should be preserved whenever possible, especially if surgery is bilateral [5, 6, 9, 13–15]. Bilateral CTN damage can result in transient or permanent bilateral ageusia of the anterior two-thirds of the tongue, as well as a decreased resting salivary flow rate. In addition, the patients may suffer from transient or persistent, distressing xerostomia or tactile dysgeusia [13, 16, 17].

The possible benefits of ES are excellent visibility and accessibility of the stapes and the OVN, and avoiding manipulation of the CTN and blind fracture of the stapedial crurae. The main limitation of a transcanal ES is one-hand surgery. Otorologists routinely look directly and binocularly into the operated ear through the otomicroscope and use both hands for the eradication of the pathology, suctioning, hemostasis, and subsequent reconstruction surgery while one hand is occupied with the endoscope and another performs the other manipulations during ES [11]. In addition, the endoscopic surgeon watches a monitor, and this can result in a loss of depth perception that is later compensated with greater experience [11]. Assistance in using the operating microscope can be required when there is the need for two-hand manipulations for proper placing and coupling of the prosthesis, especially during the surgeon's initial endoscopic procedures. Finally, right-handed surgeon (L.M.) found that the axis of work was initially more comfortable when performing surgery on right ears and that the relative difficulty in creating a hole in the footplate and positioning the prosthesis in left ears could be overcome with more training. The lack of stereoscopic vision was not considered to be a drawback.

## Conclusion

Our results indicate that transcanal fully endoscopic stapedotomy is a feasible and safe surgical technique in

limited case series. This approach can be utilized in patients with unfavorable external or middle ear anatomy, in candidates for revision or bilateral stapedotomy, in patients with already impaired taste sensation, with food-, smell- or taste-related occupations, and in those for whom the taste of food contributes appreciably to their quality of life.

**Conflict of interest** None.

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