

Original Research Article

Comparative study between microscopic and endoscopic stapes surgery

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ABSTRACT

Background: To investigate whether endoscopic stapes surgery is safer and less invasive than conventional stapes surgery using an operating microscope.

Methods: The subjects were 60 patients who were divided consecutively into group A undergoing microscopic stapedotomy and group B undergoing endoscopic stapedotomy. The procedures for endoscopic surgery were fundamentally the same as those for microscopic surgery, except for post aural incision used in some patients in microscopic group. The two surgical techniques were compared with respect to the operating time, approach, drilling of posterosuperior canal, manipulation of chorda tympani, visualisation of anterior crus, postoperative hearing, postoperative pain, and complications.

Results: There were no differences of operating time or postoperative hearing between the endoscopic and microscopic groups. There was very little postoperative pain in the endoscopic group. Drilling at the posterosuperior part of the external auditory canal was less extensive in the endoscopic group than in the microscopic group. Visualisation of anterior crus of stapes was good in endoscopic group.

Conclusions: Endoscopic stapes surgeries are technically feasible, safe and promising. The main advantages were: easy access, virtually no trauma to the chorda tympani nerve and excellent vision. The disadvantages were the lack of stereoscopic vision, having to work with one hand only and the learning curve.

Keywords: Endoscope, Stapedotomy, Otosclerosis, Microscope

INTRODUCTION

Stapedectomies and stapedotomies are done in most centres of the world under the operating microscope with excellent results and very low risk of complications.¹⁻³ Surgical microscopes provide a good quality amplified image in a straight line. However, it limits visual field when we make exclusively transcanal access in the narrowest segment of the external ear canal. In narrow and curved external auditory canals, this may represent an even greater limitation, requiring other access pathways to the middle ear like posterior auricular approach.^{3,4} Even with extended access to the middle ear, one of the important steps in performing stapes surgery under the microscope is to partially remove the bony wall of the posterosuperior part of the external auditory canal. This important step in this surgery enables a better

exposure of the incudostapedial joint, oval window, pyramidal eminence and other important middle ear structures. In some cases, irreversible trauma of the chorda tympani nerve can occur. Another important point to be considered during stapes surgery under the microscope is the visualization of the stapes suprastructure in which the surgeon is unable to see the anterior crus, forcing him to blindly fracture it.

Although endoscopes were introduced in ear surgeries over 15 years ago, their role has been limited in the treatment of middle ear inflammatory disorders and otosclerosis.¹⁻⁵ Sinonasal scopes with 4mm diameter and 18 cm length, with wide-angle lens and different angles, allow for an amplified image which can be quickly modified by advancing or pulling the instrument back.² Among otological disorders, otosclerosis is considered to

be a most suitable disease for endoscopic surgery for the following reasons: very good vision can be obtained with the endoscope because stapes surgery only requires viewing the area around the stapes; and the transcanal approach is superior to the postauricular approach as a route for assessing the stapes.

In the present study we compare the outcome of endoscopic stapes surgery with that of conventional surgery under the operating microscope to determine which method achieved better results.

METHODS

We studied sixty consecutive cases of otosclerosis selected by inclusion and exclusion criteria, admitted in Saveetha Medical College, Chennai between July 2013 and July 2016. All patients were counselled about the nature of the study and informed written consent obtained. All cases were randomized into two groups consecutively. Group A included cases undergoing microscopic stapedotomy and Group B undergoing endoscopic stapedotomy.

Inclusion criteria were patients diagnosed with otosclerosis - based on clinical history, normal otoscopy and with audiometric tests showing conductive hearing loss with an air-bone gap larger than or equal to 30 decibels (dB), no stapedius reflex, with normal bone conduction values at 500, 1000, 1500 and 2000 Hertz (Hz), without middle ear disease and with normal temporal bone CT scan.

Exclusion criteria's were past middle ear infectious disease, audiometry showing conductive hearing loss with an air-bone gap less than 30 dB.

Surgical technique

All procedures were carried out under hypotensive general anesthesia. The same technique and instruments were used in both groups, except for the use of the 4mm diameter and 18cm long endoscope with 0 to 30 degrees, curved micro aspirators and curved tip micro scissors in endoscopic surgery. The external auditory canal was infiltrated with 1% lignocaine containing 1/200,000 epinephrine. Tympanomeatal flap was raised in the posterior region of the external auditory canal. In microscopic surgery, patients with narrow or curved ear canal were operated with post aural incision for good exposure. In microscopic method while preserving the chorda tympani, the bony wall in the posterosuperior part of the external auditory canal was drilled out until the pyramidal eminence and the horizontal part of the facial nerve came into view. In endoscopic method, 30° endoscope was used to inspect middle ear for oval window, facial nerve and stapes crura. Minimal drilling was done if required. Ossicular chain was checked for stapes fixation. The stapes tendon was cut with a micro-knife or a curved micro-scissors and the incudostapedial

joint cut. The stapes superstructure was carefully fractured in the anterior and posterior crura and removed, leaving the footplate fully exposed. A small, 0.6 mm diameter hole was punched in the posterior portion of the stapes foot-plate. The Teflon prosthesis was placed in this hole and fit along the long process of the incus. In order to seal the footplate, small pieces of dry gelfoam were used. Tympanomeatal flap was repositioned and gelfoam dressing was done in the external auditory canal, without ointments or creams.

Parameters investigated

Intraoperative parameters like operating time, approach, extent of drilling at the posterosuperior part of the external auditory canal, need to manipulate the chorda tympani nerve, visibility of the stapes crura (especially the anterior crus), and complications.

Postoperative parameters like pain, hearing improvement and complications.

Operative time is calculated from injecting the local anaesthetic agent in external auditory canal to repositioning of tympanomeatal flap and placing gel foam in canal.

Approach to middle ear can be transcanal, or by posterior auricular incision. Transcanal approach used in wide canals while posterior auricular incision made in narrow and curved canals.

Severity of postoperative pain at approximately 6 hours after surgery was recorded using three grades; grade 1- almost no pain, grade 2- mild pain requiring no analgesics, and grade 3- pain requiring analgesics.

Patients were usually discharged on the first or second postoperative day if there were no complications. On the seventh postoperative day, support materials in the external ear canal were carefully cleaned. Ear drops containing topical antibiotics were administered for prevention of local infections. Patients were reviewed after 6 weeks and 6 months postoperatively.

Pure tone thresholds were analyzed at 6 weeks postoperatively for the first audiological assessment and repeated at sixth postoperative month. For evaluating the success of surgery on hearing, the pure tone air-bone gap averages were compared to the preoperative records. The patients were classified into three groups of 10 dB or less, 11-20 dB, and 21 dB or more according to postoperative air-bone gap results.

RESULTS

The results were compared between two groups using paired t test. With mean age of 41.5 years, 12 males and 18 females underwent microscopic stapedotomy while 10

males and 20 females with mean age of 40.5 years underwent endoscopic stapedotomy.

The mean operating time were 53.0 and 54.1 minutes in microscopic and endoscopic group respectively, showing no significant difference between the two groups.

In microscopic stapedotomy, 22 surgeries done by transcanal approach while the other 8 required post auricular incision. All patients in endoscopic method were operated transcanally.

In microscopic method, drilling of posterosuperior canal was done and chorda tympani nerve was manipulated during drilling in all patients. Only 2 patients required posterosuperior canal drilling and tympani nerve manipulation in endoscopic method. Thus the extent of drilling required for endoscopic surgery was smaller than that for microscopic surgery.

In endoscopic group, stapes crura were visualised using 30 degree endoscope and fractured under vision in all patients while in microscopic group, stapes crura were visible only in 4 patients. Comparison of intra operative parameters is shown in Table 1.

Table 1: Comparison of intraoperative parameters.

S.	Parameter	Group A (n=30)	Group B (n=30)
1	Mean Age (in years)	41.5	40.5
2	Sex		
	Male	12	10
	Female	18	20
3	Mean Operative time (in minutes)	53	54.1
4	Approach		
	Transcanal	22	30
	Post aural	8	0
5	No. of cases drilling done	30	2
6	No. of cases Chorda tympani manipulated	30	2
7.	No. of cases Anterior crus visualised	4	30

In microscopic method, 14 patients had grade 1 pain, 10 patients had grade 2 pain and 6 patients had grade 3 pain while 22 patients had grade 1 pain, 8 patients had grade 2 pain and none had grade 3 pain in endoscopic method as shown in Table 2.

Postoperative air bone gap at 6 weeks was less than 20 decibel in 26 patients and 27 patients respectively in microscopic and endoscopic method showing no significant difference between two groups as shown in Table 3.

Table 2: Grading of postoperative pain.

Grade of pain	Group-A (n=30)	Group-B (n=30)
Grade-1	14	22
Grade-2	10	8
Grade-3	6	0

Table 3: Postoperative air bone gap at 6 weeks.

Air bone gap	Group-A (n=30)	Group-B (n=30)
< 10 db	16	17
10-20 db	10	10
>20 db	4	3

In endoscopic method 1 patient had perilymph gusher intraoperatively which was managed appropriately. In microscopic method 1 patient had floating foot plate intraoperatively and 6 patients had temporary dysgeusia post operatively. As chorda tympani nerve was preserved in all patients, temporary dysgeusia may be attributed to traction and excessive manipulation of the nerve.

DISCUSSION

Ear surgery is usually performed with both hands under an operating microscope. However, endoscopes have been used for observation and treatment of conditions in the areas that may be hard to visualize completely under the microscope.⁶⁻⁸ In treatment of cholesteatoma, we have employed an endoscope combined with a microscope to minimize drilling, thereby preserving hearing and facial nerve called as “endoscopy assisted surgery”.¹⁰ Few reports have been published concerning stapes surgery that is entirely performed by endoscopy.

In this study, we preferred to use 4 mm diameter and 18 cm long sinonasal scopes instead of 3 mm diameter and 10 cm long otological scopes. These sinonasal scopes were used for its easy availability and with wide-angle lens and different angles, allow for an amplified image.

Comparison of the operating time showed no difference between endoscopic surgery and conventional surgery under the operating microscope. Considering that endoscopic stapes surgery was only introduced 6 months before commencement of the present study, the operating time will become shorter with improvement of the surgical technique in the future.

In our study it was seen that there was no need for post aural incision even in narrow and curved canals in endoscopic group. As there was no need for additional incision in endoscopic group, postoperative pain was less and they recovered early.

There was minimal or no drilling required in endoscopic group compared to microscopic group. This was in

accordance to Nogueira et al who minimized the extent of drilling by using a 30° endoscope and completed surgery without drilling in some cases.⁹

Migirov and Volf reported that they achieved to preserve chorda tympani nerve in all 8 endoscopic stapedectomy procedures.¹⁰ Similarly our study also preserved chorda tympani in all cases in endoscopic group while there was some temporary dysgeusia in microscopic group. In endoscopic group, anterior crus was visualised in all cases and hence improves the quality of surgery, obviating need for blind procedure.

Postoperative hearing was satisfactory in both groups, showing no difference between the two surgical methods. In 2013, Ataide et al observed the same result in 75.8% of patients undergoing stapedotomy.¹¹ In 2006, Vincent et al performed a prospective study in which the results of 3050 stapedotomies were analyzed over a period of 14 years.¹² The mean preoperative and postoperative air-bone gap was 25.6 and 1.7 dB, respectively, and the gap was 10 dB in 94.2% of cases. Therefore, the audiometric results obtained in the present study are consistent with those in the literature.

In our study postoperative pain was less in endoscopic group. This was mainly due to avoidance of post aural incision and minimal posterosuperior canal drilling.

Kojima et al compared endoscopic versus microscopic stapedectomy procedure.¹³ They reported that there were no differences of operating time or postoperative hearing between the endoscopic and microscopic groups. There was very little postoperative pain in the endoscopic group. Postoperative dizziness was mild in all patients who underwent endoscopic surgery. Drilling at the posteriorsuperior part of the external auditory canal was less extensive in the endoscopic group than in the microscopic group. Our study results were consistent with this comparative study.

Over the last 20 years, the number of stapes operations performed has decreased steadily. Possible reasons for the reduction could be the fluoridation of water supplies and improvement of the quality of hearing aids. Yung et al investigated the learning curve in stapes surgery and its implication to training.¹⁴ They reported that only 900 stapedectomies were performed in England and Wales in year 2000. In their study, it took at least 60 to 80 cases for two different authors to reach a landmark point in their learning curves. Therefore as the number of practicing otolaryngologists steadily increases, it is inevitable that fewer cases of otosclerosis present to each surgeon. Endoscopic stapedectomy procedure can also facilitate the learning curve of surgical technique and anatomy for trainees. Since both the surgeon and assistants can view the monitor, the surgical anatomy and procedure can be understood more easily.

CONCLUSIONS

Endoscopic surgery is particularly suitable for stapedial disease. Endoscopic stapes surgery can be performed despite a curved and narrow external auditory canal and is minimally invasive, being characterized by little drilling and almost no postoperative pain. Endoscopic surgery is also suitable for education; the surgical anatomy can be easily understood and both the surgeon and assistants can observe procedures on the same monitor. It should only be performed by experienced surgeons because the operation has to be done one handed and stereoscopic vision is unavailable.

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