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Endoscopic Stapedotomy: The Merits and Demerits

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Abstract

Objective: In this study, we aimed to analyze and compare the outcomes and complications of endoscopic stapes surgery versus microscopic stapes surgery.

Patients and Methods: This study is a comparative analysis of patients with conductive hearing loss who were going to undergo stapedotomy at department of otorhinolaryngology, faculty of medicine, mansoura university, egypt, between September 2015 and july 2016. The patients; diagnosed as having otosclerosis and full filled the selection criteria; were randomly divided into 2 groups. Group A included 28 patients who underwent microscopic surgery and group B included 14 patients who underwent endoscopic surgery using the nasal endoscopes.

Results: The group A included 28 patients (aged 19 - 60 years) and the group B included 14 patients (aged 22 - 56 years). Mean follow-up durations were 4.5 months (1-8.5) in the endoscopic group and 5.5 months (1.5-8) in the microscopic group. The difference in preoperative and postoperative air-bone gap in two groups was statistically significant (p = 0.031). But there was no statistical difference for hearing results between two groups and the two techniques have similar audiological outcomes. The main merits of endoscopic stapedotomy are the good quality panoramic image, well identification and visualization of vital structures of the middle ear, minimal handling of chorda tympani nerve if needed with practically no curettage of bony wall.

Conclusion: In the present series, we show that it is possible to perform stapes surgery using only the 4mm in diameter and 18 cm long endoscopes of different angulations, without major difficulties.

Keywords: Endoscopic stapedotomy; Microscopic stapedotomy; Nasal endoscopes

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Introduction

Surgery for stapes is usually performed using either the transcanal or endaural approach. Retroauricular incision is used by some surgeon to evaluate the external auditory canal and middle ear. Those approaches are specially used on patients with a narrow or curved external auditory canal. Surgical microscopes are preferred to perform those procedures where they provide good magnification and allow the surgeon to use his both hands [1].

Patients who undergo stapes surgery, particularly with endaural or retroauricular incision, suffer from some complications like pain auricular numbness or cosmetic problems. Also, this surgery may come technically difficult when there are hidden stapes and oval window or narrow external auditory canal. Removal of the scutum may be needed for better exposure of the stapes and oval window, and consequently there is always a risk of damage to the chorda tympani. Postoperative taste disorders were encountered in 20-60% of patients after stapes surgery [1,2]. In addition, sublaxation of the ossicular chain may result from removal of the posterior part of the bony canal [3,4].

In 2000, Poe [5] described endoscopic assisted stapedotomy. The use of the endoscopes would offer many benefits such as good panoramic view and easy accessibility to the oval window niche, the stapes and facial nerve. Also, with this technique, removal of the scutum and manipulation of the chorda tympani are less frequent. On the other hand, endoscopic ear surgery have some limitations such as one hand surgery and the needed learning curve [6,7].

In this study, we aimed to analyze and compare the outcomes and complications of endoscopic stapes surgery versus microscopic stapes surgery.

Patients and Methods

This study is a comparative analysis of patients with conductive hearing loss who were going to

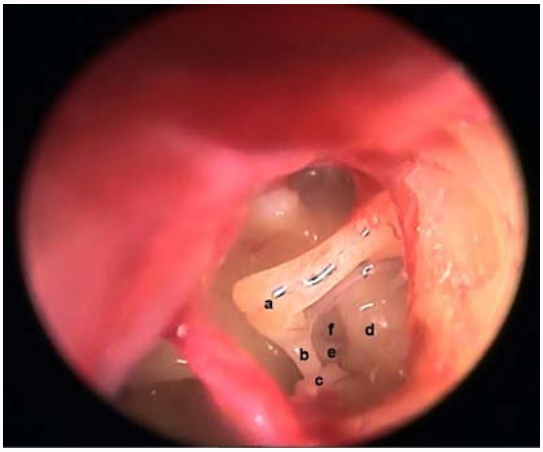

Figure 1: Endoscopic image from a 0 degree scope after making the tympanic-meatal flap showing the middle ear structures: (a) incudostapedial joint, (b) stapedius tendon, (c) facial nerve, (e) crus of stapes, (f) foot plate of stapes.

undergo stapedotomy at department of otorhinolaryngology, faculty of medicine, mansoura university, egypt, between september 2015 and luly 2016. Institutional Ethics Committee approval was received.

Patients included in this study were already diagnosed with otosclerosis and full filled the following criteria: (1) Normal external ear canal; (2) Normal otoscopy; (3) Their pure tone audiogram shows conductive hearing loss; normal bone- conduction threshold at 500, 1000, 2000, and 4000 Hz; absent stapedius reflex; (4) Absent history of past middle ear infectious diseases. Patients not fulfilling the inclusion criteria or requiring a revision surgery or surgery on the only hearing ear were excluded.

The patients were randomly divided into 2 groups. Group A included 28 patients who underwent microscopic surgery and group B included 14 patients who underwent endoscopic surgery. The endoscopic group was operated by the first author while the microscopic group was operated by the rest of authors.

Procedure

After a written informed consent was obtained from the patients, they were randomly selected into the two groups as long as fulfilling the selection criteria. All patients were operated under local anesthesia and the transcanal approach was the slandered approach in all of them. The same surgical steps were performed in the two groups.

In the endoscopic group, zero and thirty degree, 4 mm diameter, 18 cm length endoscope and 3 chips camera were used and they were hold in the left hand of the operating surgeon. The position usually used for conventional ear surgeries when done under the microscope is the one applied for all patients. The monitor and video tower settings were placed in front of the surgeon as for endoscopic nasal surgery. Also, the techniques and instruments used in conventional stapedotomies are applied in the endoscopic procedure.

Hearing was subjectively assessed by the surgeon at the end of every surgery to preliminary evaluate success of operation. Admission of the patients was made for 1-2 days and all post–operative medications and precautions were followed. They were discharged and follow–up was asked at 2 weeks and 1 month. Audiogram was usually done at 4-6 weeks and wound healing was assessed.

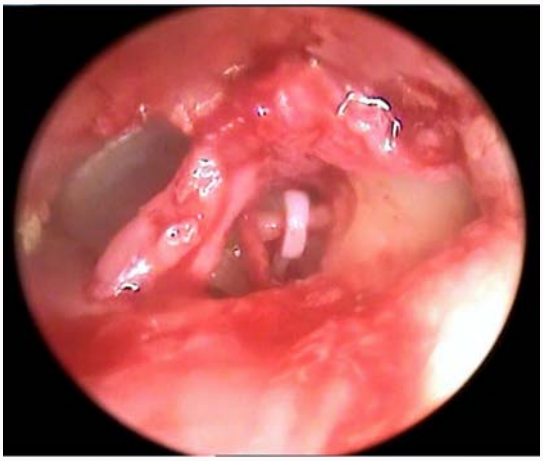

Figure 2: Endoscopic view (30 degree endoscope) of the Teflon prosthesis in place.

Notes about important steps during surgery that to be analyzed were made and included:

1. Well identification of the following structures of the middle ear (Figure 1) on the monitor: the Incudo-stapedial joint, the stapes tendon, the pyramid, the foot-plate, and the crura of stapes 2. If mobilization of the chorda tympani nerve was needed or not 3. If curetting/drilling the postero-superior bony canal wall was needed or not 4. Way of fracturing the crura under vision 5. Fenestration of foot-plate 6. Placement and stabilization of the piston (Figure 2).

Notes for time taken; in minutes; for surgery starting from incision to reposition of flap was made. Any complication was reported and post–op audiograms at an average of 1 month were analyzed.

Results

In microscopic stapedotomy, the mobilization of the chorda tympani nerve and curetting the postero-superior bony canal wall is almost mandatory to visualize the incudo-stapedial joint, stapedius tendon, pyramid, the stapes foot-plate and crura after elevation of the tympanomeatal flap. Fenestration of stapes footplate with perforator was performed with preservation of the stapedius tendon and the suprastructure intact for fear of floating footplate or dislocation of the incus. Teflon piston (0.6 mm in diameter and 4.5 mm in length) was used in all cases. Lastly, the surgeon cut the stapedius tendon, separated the incudostapedial joint, fractured the stapes suprastructure and removed it.

In the endoscopic stapedotomy group, after elevation of the tympanomeatal flap starting from endomeatal incision of the skin of the external canal, 8 mm lateral to the tympanic annulus either from 12 o'clock position to 4 o'clock position in left ears or from 8 o'clock position to 12 o'clock position in right ears. The surgeon assessed the ossicular chain mobility and visualized the incudo-stapedial joint, stapedius tendon, pyramid, the stapes foot-plate and crura (especially the anterior crus) without a need to mobilize the chorda tympani nerve or to curette the postero-superior bony part of the canal except in one case where the last 2 steps were needed. Fenestration the foot-plate and stabilization of the prosthesis were done with comfort in all cases.

Patients were discharged in the next day of surgery with strict instructions of complete rest. The ear cover was removed after 1 week

Table 1: Postoperative audiological outcomes.

ABG (Post)	Group A	Group B	
Grade A 0-10 dB	16 (57%)	10 (71.4%)	(success)
Grade B 11-20 dB	9 (32%)	3 (21.4%)	(improvement)
Grade C 21- 30 dB	2 (7%)	1(7%)	(failure)
Grade D > 30 dB	1(3.6%)	0 (0%)	(failure)

with suction of the gelfoam in the canal with testing the hearing by tuning fork. Six weeks post-operatively, audiogram was done and the air-bone gap (ABG) was determined by calculating the mean of values at 500, 1000, 2000, and 4000 Hz.

ABG was validated as follows: grade A for 0-10 dB (considered a success); grade B for 11-20 dB (considered as improvement); grade C for 21-30 dB; and grade D: more than 30 dB (where C and D are considered a failure) as shown in (Table 1).

The group A included 28 patients with mean age 33 ± 11.2 years (range from 19 to 60 years) and the group B included 16 patients with mean age 33.6 ± 10.3 years (range from 22 to 56 years).

Mean follow-up duration was 4.5 months (1.5-8.5) in the endoscopic group and 5.5 months (1.5-8) in the microscopic group. The mean preoperative air-bone gap was 30 (25-40) dB in group A (microscopic) and 32.5 (25 - 45) dB in group B (endoscopic) whereas the mean postoperative air-bone gap was 12.5 (0-35) db in group A and 10 (0 - 25) dB in group B. The difference in preoperative and postoperative air-bone gap in two groups was statistically significant ($p = 0.031$). But there was no statistical difference for hearing results between two groups. This study showed that these two techniques have similar audiological outcomes. Mean operation time was 47.3 min in group A and 39.1 min in group B and the difference was statistically significant ($p = 0.014$).

Tearing of the tympanomeatal flap was encountered in 3 cases of microscopic stapedotomy (2 were left sided and one was right sided) and in one case of endoscopic stapedotomy (right sided). The 4 cases healed spontaneously.

Seven cases of microscopic stapedotomy (25%) and one case of the endoscopic group (7%) suffered from temporary impairment of taste and dysguesia due to manipulations of the chorda tympani. On the other hand 1 case of the microscopic group (3.6%) had accidental complete cut of the nerve.

Sublaxation of the incus was reported in 3 cases of microscopic stapedotomy but with successful placement of the prosthesis by supporting the incus with angled hook.

Four cases of microscopic stapedotmy and one case of endoscopic stapedotomy suffered from mild and transient intraoperative vertigo during fenestration of the footplate and placement of the prosthesis. The five cases were conservatively controlled.

Post-operative SNHL was not recorded in any case of neither microscopic nor endoscopic stapedotomy.

Discussion

Although the main advantage of the binocular operating microscope is giving a good magnified image in a straight line, it has some limitations in transcanal procedures like stapedotomies as the visual field becomes limited especially in tortuous narrow canals. However, it is still used worldwide in performing stapedotomies because of its satisfactory results.

Advancement of the endoscopes in the otology field was made 15 years ago. However they are mainly used for diagnostic procedures or as an additive tool to microscope for better visualization and identification of important structures and hidden areas of the middle ear which are difficult to access [8]. Surgeons usually find difficulty in handling the traditional otoendoscopess; 6-10 cm length and 2.7 mm diameter; during middle ear surgeries because of inconvenient interference with the free movement of the other hand holding the instruments. On the other hand, the view offered by the nasal endoscopes (18 cm in length and 4 mm in diameter) is larger and more panoramic. In addition, they allow the other hand to handle the instruments more efficiently [9].

Although the otoendoscopes were recommended to be used by many authors, in this study the whole procedure was done by using the nasal endoscope with 0° and 30° angle. There were no obstacles in manipulating the endoscope and instruments.

Curetting or drilling of the postero-superior part of the canal wall is routinely needed to remove adequate amount of bone for better exposure of the pyramid, stapes tendon and suprastructure of stapes. Consequently, this could cause unwanted trauma to chorda tympani nerve resulting in taste disturbances. Also, postero-superior retraction pockets may occur later because of excessive curettage [10].

In our study, we found that after elevation of the tympanomeatal flap the incudo-stapedial joint, the stapes suprastructure and the stapedial tendon could be easily visualized by just advancing the endoscope toward the middle ear then tilting it. Endoscope offered the best help during this stage of the entire procedure. Minimal removal of the postero-superior meatal wall is sometimes needed for an appropriate fenestration of the footplate and insertion of the prosthesis.

With the microscope, the highest degree of magnification is needed to visualize the footplate area and to fracture the crura. Yet in many a times the anterior crus of the stapes cannot be seen by the surgeon that would result in trying to remove the suprastructure blindly [7].

Nogueira Júnior and others, in 2011, [11] stated that a better view of the anterior crus was provided by the endoscope which would enhance fracturing under direct visualization and avoid blind maneuvers thus bringing chances to fracture the foot plate into nil.

In this series good visualization of both crura was achieved in all of the cases which allowed performing safe fracturing and removal of suprastructure. Moreover, when a higher magnification was needed, advancement of the endoscope was done to get a better picture on the monitor.

Other studies showed that there is no statistically significant difference between the endoscopic and microscopic stapedotomy as regard the postoperative air-bone gap. In addition they showed that fully endoscopic stapes surgery is technically feasible, safe, and promising and the main advantage is virtually excellent vision. On the other hand the disadvantages were the lack of stereoscopic vision, having to work with only one hand, and the learning curve. Also, some of the main favorable outcomes in endoscopic stapes surgery is the reported much lower rates of chorda tympani injury and tympanic perforation than with microscopic stapes surgery [12-14].

In this study, as regard the post–operative hearing improvement, the results were satisfactory. Success with air bone gap of 0-10 dB reported in about 71% of our endoscopic cases and in about 57% of our microscopic ones. Improvement with air bone gap 10-20 dB reported in about 21% of our endoscopic cases and in about 32% of our microscopic cases. These results are similar to findings in other case series in literature.

Conclusions

This case series preliminary results highlight that it is feasible to do stapedotomies with 0° and 30° nasal endoscope (4 mm, 18 cm) with great comfort. The main merits are the good quality panoramic image, well identification and visualization of vital structures of the middle ear, minimal handling of chorda tympani nerve if needed with practically no curettage of bony wall. The demerits are mainly the one handed work and the lack of sense of depth in vision, which can be overcome by a close magnified picture on monitor.

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