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Original Research Article

A COMPREHENSIVE STUDY OF MICROSCOPIC VERSUS ENDOSCOPIC STAPES SURGERY

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Abstract

Background: Otosclerosis is one of the commonest causes of non suppurative conductive hearing loss. Stapedotomy is the most common surgery done for otosclerosis. Traditionally the surgery is being performed by an operating microscope. With the introduction of endoscopes, the surgery is also being done with their assistance in the recent years. The objective of this study is to compare the efficasy of endoscopic stapedotomy with microscopic stapedotomy. **Materials and Methods:** The study was prospective study. The study group consists of 60 patients who were operated by the same surgeon in Srikakulam, India. The patients were divided randomly into two groups of 30 each who underwent either microscopic or endoscopic stapedotomy surgery. **Result:** Here there is no differences of operating time or postoperative hearing results between the endoscopic and microscopic stapedotomy. In endoscopic group post operative pain was less which was statistically significant [P<0.0048]. **Conclusion:** Endoscopic stapedotomies have shown to reduce post operative pain and dysgeusia due to chordatympani nerve injury. However, in terms of the functional improvements, both endoscopic and microscopic techniques have been equally effective.

INTRODUCTION

Otosclerosis is one of the commonest causes of non suppurative conductive hearing loss.Vasalva was the first to describe Otosclerosis in 1735, as an ankylosis of the stapes to the margins of the oval window.[1]

The occurrence of clinical otosclerosis vary worldwide, with the highest rate reportedin Southern India and the lowest rate in Africa.[2] Approximately 0.2–1% of light skin populations have clinical otosclerosis.[3-5]

The technique of surgery for otosclerosis has evolved in the hands of different surgeons and there is diversity of opinion among the otologists about the type of operations that will give satisfactory and lasting results. In this effort new modifications have been introduced from time to time.

Small fenestra stapedotomy was first developed by Shea in 1962.[6] After 50 years of first Microscopic stapedotomy, Endoscope-assisted stapedotomy was first described by Poe in 2000.[7] Endoscopic stapedotomy was first performed by João Flávio Nogueira Júnior, in 20088 and since then there has been a growing interest in the technique. The present study was undertaken to compare the pros and con of the two surgical techniques.

MATERIALS AND METHODS

The study design was a prospective comparative study between the endoscopic and microscopic stapedotomy. 60 patients were randomly enrolled into two groups of 30 each. Patients in Group A underwent microscopic stapedotomy and in Group B underwent endoscopic stapedotomy. The randomization was done by using table of random numbers. The inclusion criteria for the patients were progressive conductive deafness with a normal tympanic membrane, air bone gap of ≥ 25dB and an impedance audiometry showing A or As curve with absent acoustic reflexes. Pregnant patients and patients having any other cause of deafness, surgically unfit patients and those having only hearing ear were excluded from the study group. The surgery in both the group were performed by the same person with experience in both the techniques. Same set of equipments and instruments

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were used in both the groups as per the standard procedure. All the surgeries in both the groups were done under local anesthesia. Both the surgical techniques were compared in relation to the post operative result, postoperative pain and ease of access to the oval window and the time taken for the surgery. The patients in both the groups were followed up for approximately 9 – 15 months and the post operative pain and complications were assessed by a blind investigator. Hearing results were calculated from air and bone conduction thresholds measured pre- and postoperatively at 500, 1, and 2 kHz for all patients. The average threshold levels for each ear at 500, 1000, and 2000 Hz had been recorded .The success of operation was determined by the degree of closure of air bone gap in speech frequencies (500, 1000 & 2000 kHz) and the results were classified into four categories.[9]

- Air bone gap 10 db or les–Excellent
- Air bone gap 11 – 20 db–Good
- AB gap persisting at pre-operative level – Poor
- Deterioration of hearing –Worse

Pre operative procedure:

- All the hair from the external canal of the ear to be operated were cut as and when necessary.
- The ear was syringed with luke warm water to remove any desquamated debris and cerumen. The ear canal was dried and cleaned with rectified spirit.

Pre medication:

The following drugs were administrated as a pre - medication:

Diazepam – 1 tablet night before operation.

Injection Phenargan 0.5mg/kg + Inj. pentazoine 0.5mg/kg: Intramuscularly 30 minutes before operation.

Operative Procedure

a. Position of the patient:

The patient was made to lie supine on the operation table with the head turned to the opposite side so that the ear to be operated was upper most. After preliminary sterilization procedures, the patient was draped. The external canal was cleared of collected antiseptic lotion by suction and swabbed dry.

b. Obtaining the tissue seal:

A number of auto graft tissues can be used to seal the oval window, including vein, Temporalis fascia, perichondrium, and fat. Vein is harvested from the back of the hand all loose connective tissue is removed and it is used adventitia side down intima side up. Fat was obtained form the lobule of the ear. Temporalis fascia was harvested through a small incision above and behind the ear.

Procedure of stapedotomy:

Anaesthesia: All the patients were operated under local anesthesia using 1% xylocin with 1 in 1,00,000 adrinaline infiltration.

Oval window exposure:'U' shaped Rosen's incision is made in the posterior canal wall with a round knife. The incision begins at 6 O'clock just lateral to the annulus extends posteriorly and laterally, and then courses medically again to end just lateral to pars flacida at 12 O' Clock. In five cases endaural incision given where external auditory canal was narrow. The flap in elevated to the sulcus tympanicus with a round knife, and the tympanic cavity mucosa is then perforated with a curved blunted needle. The tympanomeatal flap is folded anteriorly; taking care to preserve the chorda tympani nerve.

With the operating microscope and ear speculum in position, two hands can be used but with narrow view

With endoscope, there is wide and magnified view but it is one handed surgery even trivial bleed causes problem in surgery.

A small amount of 2% xylocine with 1 in 20,000 epinephrine is infused into the middle ear, and immediately suctioned. This provides excellent middle ear anesthesia.

In endoscopic stapedotomy,foot plate of stapes,horizontal facial nerve,pyramid and both crura can be visualized without bony curettage. As less bony curettage there is less chance of the chorda tympani nerve injury.

In microscopic stapedotomy 2 - 4mm rim of postero-superior canal must usually be removed in order to provide adequate exposure of stapes and oval window. Sufficient curettage is performed when the pyramidal process and horizontal part of facial nerve is visualized where chance of injury to the chorda tympani nerve injury is more.

In microscopic stapedotomy, the chorda tympani nerve is in the middle of surgical field,so to visualize the foot plate it should be manipulated where chance of injury to the chorda tympani nerve injury is more. in endoscopisc stapedotomy the chorda tympani will not come in the middle of surgical field so less chance of injury to chorda.

The malleus is then probed to assess the mobility of the malleus and incus this is done to exclude fixation of the these ossicles as a cause of conductive hearing loss. The stapes is then palpated to confirm fixation. In endoscopic stapedotomy as there is wide panaronomic view it is very is easy to assess the fixation of stapes compare to microscope.

The distance between the foot plate and medial surface of the lower aspect of the long process of the incus is then measured. About 0.25 mm is added to the measured distance to accommodate entrance of the prosthesis slightly into the vestibule.

Creation of a fenestra:A small fenestra is created in posterior half of foot plate of stapes the fenestra size isincreased with help of hand drills of various sizes (0.6mm to 0.8 mm)

Prosthesis Placement: A proper size teflon piston is introduced into fenestra made in the foot plate of stapes with help of alligator forceps other end is anchored to the long process of incus and is crimped into place. After placement of the prosthesis the malleus is palpated to insure appropriate movement of the repaired ossicular chain.

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Removal of the stapes superstructure: After sectioning the stapedius tendon, the posterior crus is cut at its midpoint with crurotomy scissors and the anterior crus fractured fragments of crura are then turned inferiorly, severed from the lenticular process with micro scissors and removed

Tissue seal of oval window: The autogenous graft is draped over the oval window and overlaps the oval window margin by 1-2mm. Several materials including vein grafts and temporalis fascia have been successfully used to create an oval window seal there by preventing fistula formation.

The procedure is completed by moving the prosthesis caudally to the desired position on the incus where it is then crimped firmly.

Closure: The tympano meatal flap is placed back into its anatomic position. Hearing tested on table. The external canal is packed with gelfoam.

Postoperative Course:

1. The patient is instructed to lie on the opposite side with the operated ear up.
2. Head of the bed elevated.
3. Inj. cefotaxim 40-50 mg/kg/day /IV/given on the day of operation and followed by oral antibiotics for 1 week.
4. Tab. Cetrizine, OD at bed time.
5. Ear pack was removed on 7th day. stitches are removed from the vein graft donor site.
6. The patient was instructed to avoid swimming and exposure to noise. He was advised to report for review after 1 month and then every 3 months. Post operative audiometry was done after 1 month & 3rd month.

RESULTS

This clinical series consists of a study of 60 otosclerotic patients who were randomly subjected to endoscopic stapedotomy and microscopic stapedotomy, The disease is mainly observed in 2nd and 3rd decades. Out of the 60 cases studied, 55 cases were in this age group. [Table 1]

Females [n=41 were more affected than males [n=19]. [Table2]

In the study otosclerosis was bilateral in 55 cases, unilateral in 5 cases (2 in endoscopic group,3 in microscopic group). In our study, majority of the patients maintained the improvement in hearing pattern gained initially till the period of follow-up. 73.3% of the patients showed closure of a-b gap to within 10 dB in both groups. 23.3% of the patients in endoscopic and 20% of the patients in microscopic stapedotomies showed closure of a-b gap of 11-20 dB. 3.3% of the patients in endoscopic and 6.6% of the patients in microscopic stapedotomies showed poor improvement. [Table3]

Problems faced during surgery: Injury to chorda tympani nerve: All were seen in patients undergoing microscopic stapedotomy. Disturbance of taste was complained in 5 patient complete recovery was noticed in 4- 5 months.

Vertigo occurred in 4 patients in endoscopic stapedotomy 6 patients in microscopic stapedotomy, which is transient, and all were free of symptoms after one to two weeks. [Table 4]. Birch et al and Wang et al. found vertigo is quite common, with an incidence of up to 45% postoperatively in earlier reports.[10,11]Causes of post operative vertigo were proteolytic enzymes, antigen-antibody reaction, change labyrinth fluid pressure and decreased blood supply to the labyrinth [Causse et al. 1988],[12] insertion of a long prosthesis or to adhesions or negative middle ear pressure forcing the prosthesis deeper into the inner ear.

Even though in initial cases, endoscopic stapedotomy took longer time, as the number of cases increased both techniques take same operative time. [Figure 1]

Post operative pain is minimal in endoscopic stapedotomy compare to microscopic stapedotomy. In endoscopic stapedotomy 19 patients have Mild pain not required medication and 11 patients have pain that required medication. In microscopic stapedotomy 9 patients have Mild pain not required medication and 21 patients have pain that required medication. [Table6]

Table 1: Age Distribution

Age Group [In years]	Endoscopic [number of patients]	Microscopic [number of patients]
21-30	17	16
31-40	11	11
41-50	2	3

Table 2: Sex distribution

	Endoscopic [number of patients]	Microscopic [number of patients]
Male	10	9
Female	20	21
Total Cases	30	30

Table 3: Post-operative Air-Bone Gap

Post op AB GAP	Endoscopic [number of patients]	Microscopic [number of patients]
<10 dB	22	22
11-20 dB	7	6
>21 dB	1	2

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Table 4: Complications following stapedotomy

Complications	Endoscopic[number of patients]	Microscopic[number of patients]
Vertigo	4	6
Injury to chorda tympani	0	5
Tympanic membrane tear	0	1

Table 5: table showing comparison of post operative results and operative time between endoscopic and microscopic stapedotomy

	Endoscopic stapedotomy[mean ±SD]	Microscopic stapedotomy[mean ±SD]	p-Value
Pre op AB gap	35.16±4.37	34.5±4.53	0.568
Post op AB gap	8.83±5.72	9.33±4.53	0.7483
Operative time in minetus	53.5±11.70	49.16±8.66	0.1079

SD -slandered deviation, AB gap- air -bone gap

Table 6: Postoperative Pain

	Endoscopic N(Percentage)	Microscopic N(Percentage)	p-value
Mild pain not required medication	19(63.33)	9(30)	0.0048
Pain required medication	11(36.66)	21(70)	
Total	30(100)	30(100)	

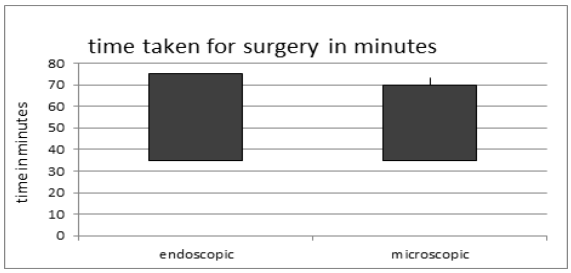

Figure 1: figure showing time taken for surgery in minutes in both groups

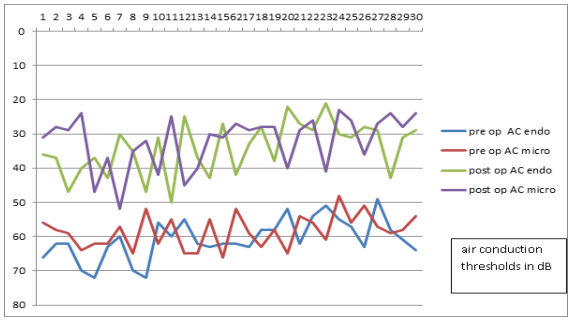

Figure 2: figure showing pre operative and post operative air conduction thresholds(in dB) of both endoscopic and microscopic groups.

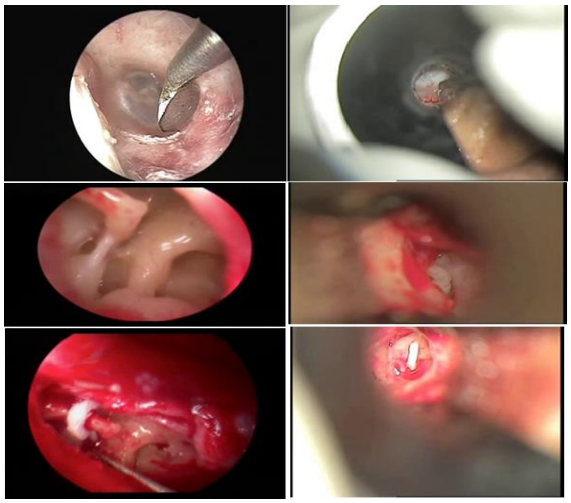

Figure 3: a and b. showing canal wall incision in endoscopic and microscopic Stapedotomy, c. showing base of pyramid and horizontal facial nerve and oval window without bony curettage in endoscopic Stapedotomy d. showing only incudostapedial joint without bony curettage in microscopic Stapedotomy. e and f . showing piston in position in endoscopic and microscopic Stapedotomy.

Figure4: figure showing base of pyramid and horizontal facial nerve and oval window without bony curettage in endoscopic stapedotomy.

Figure 5: figure showing only incudostapedial joint without bony curettage in microscopic stapedotomy

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DISCUSSION

Endoscopic versus microscopic Stapedotomy has been a topic of debate among the otology surgeons. Conventional stapedotomy procedure advocates the use of microscopy due to the advantage of the double handed instrumentation giving better control over the surgical procedure. The microscopic technique also gives a better depth perception and stereoscopic view which is very crucial when working over the delicate region of the oval region. Endoscopic stapedotomy on the other hand give a better and magnified visualization of the oval window from close range.[13]Modern day endoscope holders also enable the surgeon to have a double handed approach.

Increasing number of otology surgeons consider otosclerosis to be a suitable condition for an endoscopic approach.[14-19]

However there are also disadvantages of the endoscopic approach due to lack of stereoscopic view and a concern on the thermal changes resulting from the light source. Besides there is a longer learning curve for the technique.[13]

The hearing outcome gained by endoscopic and microscopic stapedotomies are similar and there is no added advantage of one technique over the other. Postoperative hearing results are same in both endoscopic and microscopic stapes surgery results. [Figure 2]. In our study, majority of the patients maintained the improvement in hearing pattern gained initially till the period of follow-up. 73.3% of the patients showed closure of A-B gap to within 10 dB in both groups. 23.3% of the patients in endoscopic and 20% of the patients in microscopic stapedotomies showed closure of A-B gap of 11-20 dB. In 3.3% of the patients in endoscopic and 6.6% of the patients in microscopic stapedotomies showed only slight improvement.

Similar results were also reported by various authors.[18,20,21] Meta-analysis conducted on original interventional controlled studies comparing the ability of endoscopic and microscopic stapedotomy to restore hearing (postoperative ABG of maximally 10 dB) did not show any statistically significant difference between the two methods.

Migirov and Wolf showed that the endoscopic stapedotomy is a safe, feasible technique and has good hearing results.[22] Daneshi et al showed that audiological outcomes were found favorable in endoscopic stapes surgery and they suggested that endoscopic stapes surgery is an alternative to the microscopic stapes surgery.[23]

The time taken for endoscopic surgeries depends on the experience of the surgeon. In initial cases, endoscopic stapedotomy may take longer time, but with experience both techniques take similar duration. Similar findings were also reported by Kojima et al study where no difference in operative time in both endoscopic and microscopic stapedotomies.

The time needed to perform stapes surgery with the use of an endoscope and a microscope has been reported to be variable. Iannella G et al study, shows greater duration of endoscopic stapes surgery,[14] Daneshi A, et al however found less operaing time for endoscopic stapedotomy.[23]

In our study post operative pain is comparatively less in endoscopic stapedotomy group as compared to microscopic stapedotomy.

Similar results were found in Kojima et al and Harikumar B et al. This is probably due to avoidance of post aural incision and minimal posterosuperior canal drilling.[18,24]

Operating Microscope provides good quality image but requires more bony curettage for visualization of foot plate hence there are chances of injury to the chorda tympani.[25] This can be prevented by endoscopic approach where minimal bony curettage is required and hence there are less chances of chorda tympani injury. However manipulation at the oval window may be difficult at times with minimal curettage and requires fine angled instruments for the same. Injury to the chorda tympani nerve can result in taste disturbance which is rarely permanent. All the five cases of chorda injury which occurred with microscopic stapedotomy recovered completely in about 5 months. Various other studies also reported less incidence of taste abnormality due to chorda injury in endoscopic technique compared to microscopic technique.[8,18,21,24] Endoscopic stapedotomy has also the advantage of limited neck manipulation which is an issue in obese , short neck and in patients with limited neck movements due to conditions like cervical osteoarthritis.

CONCLUSION

The stapedotomy surgery has been revolutionized over the years with the introduction of newer technologies. Induction of endoscopic techniques in the armamentarium of otologic surgeon is one such milestone development. Endoscopic stapedotmies have shown to reduce post operative pain and dysguesia due to chorda tympani nerve injury. However in terms of the functional improvements, both endoscopic and microscopic techniques have been equally effective. In view of the longer learning curve associated with endoscopic stapedotomies we recommend that novice otology surgeons master microscopic techniques before venturing out into endoscopic stapedotomies.

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