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Original Research Article

Endoscopic versus microscopic type 1 tympanoplasty in chronic suppurative otitis media- tubotympanic type

Kiran A. Deshmukh[1]*, Vinayak Kurle[2]

[1]Department of Otorhinolaryngology, MR Medical College, Sedam Road, Kalaburagi, Karnataka, India
[2]Department of Otorhinolaryngology, Grant Govt Medical College and Sir JJ Group of Hospitals, Mumbai, Maharashtra, India

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***Correspondence:**
Dr. Kiran A. Deshmukh,
E-mail: drkirandeshmukh8@gmail.com

ABSTRACT

Background: Chronic suppurative otitis media attributes to 71.6% of hearing impairment in which most of them only have central perforations without any ossicular erosion or middle ear pathology. There are insufficient explanations to conclude which technique is better for type 1 tympanoplasty. Hence the study was conducted to compare and analyze the endoscopic technique with conventional microscopic technique for performing type 1 tympanoplasty.
Methods: This prospective study was done at Basaweshwara teaching and general hospital attached to MR medical college, Kalaburagi from December 2015 to June 2017 after obtaining institutional ethical clearance. Patients were selected according to inclusion and exclusion criteria and randomly posted for surgery by either endoscopic or microscopic technique and results were analyzed.
Results: There were 60 patients in the study between 11-65 years with mean age of 28.85±10.87 years in which were 28 females and 32 were males. All patients were divided into 2 groups in which 30 underwent endoscopic and 30 underwent microscopic type 1 tympanoplasty. In this 46.7% of the patients had left ear conductive hearing loss whereas 31.7% of patients had right ear conductive hearing loss and 21.7% of the patients had bilateral conductive hearing loss which included 22 small perforations, 33 medium size perforations and 5 large perforations of pars tensa.
Conclusions: We conclude that endoscope can be a better alternative for microscope in type 1 tympanoplasty as it provides a wide panoramic view, less operating time and hospital stay with negligible scar post operatively.

Keywords: Endoscope, Microscope, Tympanoplasty, Pure tone audiometry

INTRODUCTION

Chronic suppurative otitis media (CSOM) attributes to 71.6% of hearing impairment in which most of them only have central perforations without any ossicular erosion or middle ear pathology.[1,2] These Patients present usually either as recurrent ear discharge or as reduced hearing or as both. With advent of better antibiotics, the control over disease pathology has been successful with absolute reduction in ear discharge. Thus, only thing is to bring back hearing to near normal which remains main objective through repair of perforation i.e., myringoplasty or tympanoplasty. Tympanoplasty has evolved over a period of time from use of pig's bladder in the past to present era of using temporalis fascia graft.[3,4] Thus providing better hearing mechanism, avoiding complications as well as recurrence. Traditionally over the decades, tympanoplasty has been done using an operating microscope. Despite the continuous technical advancements, the basic optical principles of the microscope and their limitations like limited visualization, frequent adjustment of head and

microscope still persisted. To overcome these problems and to improve outcomes, endoscopes were tried. But there are insufficient explanations to conclude which technique is better for type 1 tympanoplasty. Hence the study was conducted to compare and analyse the endoscopic technique with conventional microscopic technique for performing type 1 tympanoplasty.

METHODS

This is a prospective study consisting of 60 patients. It was done at Basaweshwara teaching and general hospital, Kalaburgi from December 2015 to June 2017 after institutional ethical clearance was obtained. Patients attending ENT outpatient department with the chief complaints of ear discharge and hearing impairment were evaluated. Those patients more than 11 years of age with CSOM having dry central perforation of the tympanic membrane with conductive hearing loss and willing for surgery only were included in the study after taking a written and informed consent. Patients with tubotympanic CSOM in active stage, marginal or attic perforations, SNHL, patients with otitis externa, otomycosis, uncontrolled diabetes mellitus, ossicular fixation, cholesteatoma, ossicular discontinuity, revision cases and those who are unfit for were excluded from the study. Tuning fork tests and pre-operative pure tone audiogram were done to know site & degree of hearing loss. In endoscopic tympanoplasty Hopkins II 17 cm long rigid endoscope (4 mm wide) 0 degree, with light source and stryker HD 1188 3 chip camera along with monitor has been used. In microscopic tympanoplasty Karl Zeiss OPMI 1 FC microscope with 250 mm objective lens has been used.

Pre-operative routine investigations along with bilateral x ray mastoid were done which is required for surgery. Patients were randomly selected either for endoscopic tympanoplasty or for the microscopic tympanoplasty. All the patients were given short intravenous anaesthesia using dexmeditomedine 1µg/kg loading dose and 0.2 µg/kg as maintenance dose throughout the procedure. The area was painted. In both group plester technique of infiltration was preferred. Postaural and endomeatal infiltration was done with 2% lignocaine with adrenaline (1:1,00,000), if required 0.5% bupivacaine was used.

In endoscopic ear surgery, endoscope tip is dipped in savlon for defogging; the scope is inserted through the external auditory meatus. Any bleeding is a source of additional difficulty; therefore, great care was taken to avoid canal skin abrasions and canal hematomas. Local anaesthesia (xylocaine 1% with 1:100000 adrenaline) was infiltrated in four walls of canal. In endoscopic surgery edges of the perforation were freshened. Vertical incision was taken at 6 O'clock and 12 O'clock and both were joined by horizontal incision about 6 mm away from the annulus on canal wall. Tympanomeatal flap elevated and middle ear entered under the annulus near postero inferior quadrant first as the attachment of the annulus tympanicus to sulcus tympanicus is less adherent. Middle ear was inspected for the any pathology and round window reflex was elicited, visualized around in all walls of middle ear for any pathology, temporalis fascia graft was harvested by taking a 2 cm incison in the superior part of post auricular groove. Harvested graft was dried and cut according to required shape. Then it was placed by underlay technique. Gel foam was used in middle ear and EAC to secure graft. Finally, incision of 2cm taken for harvesting graft in post auicular groove was closed with 3-0 vicryl suture.

In microscopic ear surgery, post-auricular wilde's incision was taken. Temporalis graft was harvested. Then soft tissue was separated and periosteum was elevated. Posterior canal wall was elevated, perforated and edges of the perforation were freshened. Vertical incision was taken at 6 o'clock and 12'o clock and both were joined by horizontal incision about 6 mm away from the annulus on canal wall. Tympanomeatal flap elevated and middle ear was inspected for the any pathology and round window reflex was elicited. Harvested graft was dried and cut according to required shape. Then it was placed by underlay technique. Gel foam was used in middle ear and EAC to secure graft. Finally, post auicular groove was closed with 3-0 vicryl suture.

In both cases mastoid dressing was done. Intra operative parameters like approach, visualization, duration of surgery, procedural complications and Post-operative parameters such as post-operative hospital stay, graft uptake, wound healing are measured. After the surgery a regular follow-up for 6 months was done in all the patients for hearing assessment, graft uptake and for any complications. Pure tone audiometry was done at the end of 1st, 3rd and 6th month to know the improvement in the hearing. After all this assessment, a correlation between the endoscopic and microscopic type1 tympanoplasty will be done.

Post-operative instructions were given to patients. Antibiotics, analgesics, decongestants and antiemetics (if nausea) were given for a week. Keep operated ear up while sleeping. Don't sneeze, strain or cough for 2 weeks. No head bath for a week. Avoid flight travel for a month. Do not use ear plugs for 6 weeks. Avoid nose blowing or valsalva manoeuvre for 6 weeks. Do not do strenuous activity or weight lighting for 4 weeks.

POD2 dressing done and patient is discharged and advised with follow up dates. The 6th month follow up findings were taken up for the analysis. The patients were followed up with following parameters. Graft acceptance at sixth month or longer - categorized as either intact tympanic membrane or failure. Postoperative hearing levels at sixth month - post operative average pure tone hearing improvement at 500 Hz, 1000 Hz and 2000 Hz as the method to assess the hearing as well as to compare with preoperative hearing levels. These were grouped as

less than or equal to 10 dB, 11 to 20 dB, 21-30 dB and above 30 dB.

Statistical analysis

The data was entered in microsoft office 2010 excel sheet. Quantitative variables such as age, gender, type of surgery was expressed in terms of descriptive statistics such as mean and standard deviation as required. The statistical significance was set at 5% ($p<0.05$). Chi-square test of significance was employed to test for association between factors. Fischer's exact test was employed when the expected cell-frequency are very small (less than 5). Z test was employed to test association between the surgery and visualization.

RESULTS

There were 60 patients in the study between 11-65 yrs with mean age of 28.85±10.87 years in which were 28 females and 32 were males. All patients were divided into 2 groups in which 30 underwent endoscopic and 30 underwent microscopic type 1 tympanoplasty. In this 46.7 % of the patients had left ear conductive hearing loss whereas 31.7% of patients had right ear conductive hearing loss and 21.7% of the patients had bilateral conductive hearing loss which included 22 small perforations, 33 medium size perforations and 5 large perforations of pars tensa. Otoscopy was done at every visit to see for retraction or residual perforation. Graft uptake was present in 59 cases except 1 case of residual central perforation in microscopic group which healed subsequently.

Table 1: Distribution of patients in endoscopic and microscopic type 1 tympanoplasty based on the central perforation.

Surgery	Central perforation						Total
	Small anterior N (%)	Small posterior N (%)	Small inferior N (%)	Medium anterior inferior N (%)	Medium posterior inferior N (%)	Large N (%)	
Endoscopic	1 (3.3)	5 (16.7)	4 (13.3)	18 (60.0)	0 (0.0)	2 (6.7)	30 (100.0)
Microscopic	6 (20.0)	2 (6.7)	4 (13.3)	12 (40.0)	3 (10.0)	3 (10.0)	30 (100.0)
Total	7 (11.7)	7 (11.7)	8 (13.3)	30 (50.0)	3 (5.0)	5 (8.3)	60 (100.0)

Chi-square value (χ^2) = 9.257, df= 5, Fischer exact value (p value)=0.05.

Table 2: Comparison between endoscopic and microscopic type 1 tympanoplasty based on the duration of surgery (in minutes).

Surgery	Duration of surgery			Total
	30-60 mins	61-90 mins	91-120 mins	
	N (%)	N (%)	N (%)	N (%)
Endoscopic type 1 tympanoplasty	29 (96.7)	1 (3.3)	0 (0.0)	30 (100.0)
Microscopic type 1 tympanoplasty	10 (33.3)	16 (53.3)	4 (13.3)	30 (100.0)
Total	39 (65.0)	17 (28.3)	4 (6.7)	60 (100.0)

Chi-square value (χ^2) = 26.49, df= 2, Fischer exact value (p value)=0.001.

Table 3: Intraoperative visualization of different areas of middle ear through endoscope and microscope.

Visualization	Type of surgery	Number of patients	Z test value	P value
Eustachian tube	Endoscope	30	0.000	1.000
	Microscope	30		
Attic area	Endoscope	30	48.17	0.001
	Microscope	2		
Sinus tympani	Endoscope	30	19.17	0.001
	Microscope	14		
Tympanic annulus	Endoscope	30	0.019	0.06
	Microscope	25		
Round window niche	Endoscope	30	11.13	0.008
	Microscope	19		
Ossicular chain	Endoscope	30	14.14	0.001
	Microscope	17		

Table 4: Comparison between endoscopic and microscopic type 1 tympanoplasty based on the postoperative hospital stay.

Surgery	Postoperative hospital stay				Total
	1 day	2 days	3 days	4 days	
	N (%)	N (%)	N (%)	N (%)	N (%)
Endoscopic type 1 tympanoplasty	5 (16.6)	19 (63.3)	6 (20.0)	0 (0.0)	30 (100.0)
Microscopic type 1 tympanoplasty	0 (0.0)	9 (30.0)	16 (53.3)	5 (16.6)	30 (100.0)
Total	5 (8.3)	28 (46.6)	22 (36.6)	5 (8.3)	60 (100.0)

Chi-square value (χ^2) = 12.97, df= 3, Fischer exact value (p value)=0.0004.

Table 5: Comparison between endoscopic and microscopic tympanoplasty based on post-operative improvement in hearing.

Surgery	Postoperative improvement (preoperative PTA-postoperative PTA at 6 min)			Total
	0-10 db	11-20 db	21-30 db	
	N (%)	N (%)	N (%)	N (%)
Endoscopic	2 (6.7)	24 (80.0)	4 (13.3)	30 (100.0)
Microscopic	3 (10.0)	24 (80.0)	3 (10.0)	30 (100.0)
Total	5 (8.3)	48 (80.0)	7 (11.7)	60 (100.0)

Chi-square value (χ^2) = 0.343, df= 2, Fischer exact value (p value)=0.842.

Table 6: Mean hearing loss pre and postoperatively in patients who have undergone endoscopic/microscopic type 1 tympanoplasty.

Surgery	Mean preoperative PTA (dBHL)	Mean postoperative PTA (dBHL at 6 m)	't' test	P value
Microscopic type 1 tympanoplasty	32.47±4.79	16.35±2.22	16.12	0.001
Endoscopic type 1 tympanoplasty	33.33±4.44	16.65±1.81	19.05	0.001

The chart shows significant improvement in both types of tympanoplasties.

Majority of the middle ear areas like attic area, sinus tympani, ossicular chain which were clearly visualized under endoscope and found to be significant (<0.05).

DISCUSSION

Conventionally, middle ear surgery was performed under the guidance of a microscope. The main advantage of the microscopic approach is that it provides a stereo-view and allows bimanual operation. But microscopy provides a linear view; visualization of deep recesses of the middle ear is not always possible. If the external ear canal is narrow or blocked by protruding bone, a middle ear operation can be performed only after surgical widening of the canal. Also, there is unnecessary excessive tissue handling through postauricular incision in case of microscopic type 1 tympanoplasty.

Endoscopes can provide magnified views of the surgical field. Microscopes require image adjustment during operation, whereas back and forth movements of the endoscope can easily produce close-up and angled images when needed. Moreover, rotational movement of angled endoscopes can provide panoramic images of the deep and hidden regions of the middle ear. An endoscopic approach to the middle ear can improve visualization of structures, such as the tubal orifice, incudo-stapedial joint and round window niches. Advantages of the endoscopic approach include shorter operation time, reduced exposure to anaesthetic agents and associated side effects, and improved surgeon concentration.[5] The endoscopic approach is less invasive, as it does not require postaural incision or canaloplasty. Compared with the microscopic approach, an endoscopic approach is associated with less postoperative bleeding and pain, and it provides improved cosmetic outcomes.[6]

In our study, there were 60 patients with 30 each in endoscopic and microscopic tympanoplasty group between age group of 15-60 yrs of age.[7,8] Most of the studies have similar age group of patients suggesting that this disease is prevalent in wide range of age group with no gender predominance.

In Patients who were selected for the study, 3 weeks period of dry ear was ensured prior to the surgery, as it is generally believed that a wet ear has a direct bearing on the graft take up rate. If there was active ear discharge at presentation patients were treated with appropriate antibiotics according to culture and sensitivity of discharge which reduces the period of active infection and also the complications caused by any organism if improperly or empirically treated.[9,10]

Patients with tubotympanic CSOM with only conductive hearing loss were included in the study because previous endoscopic surgeries suggested either incomplete clearance or recurrence if there was atticoantral disease thus causing bias in results of type 1 tympanoplasty. Revision cases will need more time as previous surgery would have created fibrosis thus affecting overall results.

Variations of external auditory canal like stenosis, tortuosity, bony overhangs etc. hamper the visualization of tympanic membrane through microscope for which either we need to manipulate the patients head or the microscope repeatedly, even canaloplasty has to be done to visualize overall tympanic membrane and other middle ear structure like attic, Eustachian tube opening, round window, stapes footplate, facial recess, and hypotympanum. Thus, these all increase the operating time, Wullestein.[11]

In sharp contrast, the endoscope brings the surgeon's eye to the tip of the scope through a wide angled zero-degree scope to visualize the entire tympanic membrane thus avoiding the need to frequently adjust the patients head or to do canaloplasty thereby saving operative time.[12,13]

Similar observations were made in two separate studies by Tarabichi and Usamiet et al.[14,15] In Lakpathi et al study of 60 patients showed duration of surgery was markedly reduced with endoscopic approach than microscopic approach.[16]

Similarly in our study we were able to visualize, document most of the structure in each wall of middle ear which were hardest to reach and visualize if disease were present in such areas through microscope thus increasing the capability of surgeon to clear disease from these areas and achieving better results in tympanoplasty which was documented in other studies also.[17]

Thus, in terms of operating time from the incision to closure of wound till last suture in microscopic tympanoplasty and from initial endoscopic visualization till the last gel foam kept in the external auditory canal in endoscopic tympanoplasty was taken as the duration. In Lakpathi et al study took mean duration of 96.32 mins for endoscopic tympanoplasty and 136.09 mins for microscopic tympanoplasty.[16] In another study by Anoop took mean duration of 90 mins for endoscopic tympanoplasty and 120 mins for microscopic tympanoplasty.[17] In Dunder et al study, the mean operative duration in endoscopic tympanoplasty was significantly lower than that in microscopic tympanoplasty (51.37 vs. 67.03 min, respectively). In Haung et al study, the average operation time in microscopic tympanoplasty was 75.5 minutes, compared to 50.4 minutes in endoscopic tympanoplasty which was very significant ($p<0.0001$).[5] In our study mean duration of surgery in endoscopic tympanoplasty (50.13 mins) was much less as compared to microscopic tympanoplasty (73.23 mins) thus reducing the duration of exposure of patient to anesthetic drugs and side effects, minimizing surgeons time with similar results.

Hospital stay and wound healing are other important aspects which none other studies have highlighted as these are important in reducing the morbidity of the patient and early return to his daily activities. Wound healing was faster in endoscopic tympanoplasty group as the wound was small and scar which was formed was also not seen in all the patients comparable with other study.[18] Patient was discharged as soon as giddiness and pain was reduced, which were much less in endoscopic tympanoplasty group as there was minimal intraopossicular handling while elevation of graft and round window reflex confirmation thus reducing the giddiness and reduced pain because of minimal tissue dissection to harvest graft.

In Choi et al study, graft success rate in the endoscopic tympanoplasty and microscopic tympanoplasty group were 100% and 95.8%, respectively, the values were not significantly different ($p=0.304$).[19] In Satyawati et al study the success rate regarding perforation closure was 91.5%, Bhatia et al showed 82% graft uptake, Yadav et al accounting for an 80% success rate.[20,21] In Anoop et al study, in the endoscopic group, there was 90% uptake of graft and in microscopic group it was 85%.[17] In Thirumaran et al study, the graft uptake rate was 93.3% in the endoscopic group, whereas it was 90% in the microscopic group.[22] In Dhakeshwar et al study, percentage of graft uptake to nearly 100 %.[23] In Lela et al study, the transcanal microscope-assisted endoscopic myringoplasty had a 100% rate of surgical success for closure of tympanic membrane defects in children.[24] In our study graft uptake overall was same except in one case of microscopic tympanoplasty which had residual anterior quadrant perforation probably because of recurrent allergic nasal infection in this patient which was treated later with fat graft myringoplasty. Our study had much better results because the patients with dry perforation were treated with antibiotics 2 days prior to surgery to create a sterile environment during surgery and prevent any sort of infection postoperatively along with proper graft placement avoiding any chance of displacement of graft which were reasons of successful graft uptake in case of type 1 tympanoplasty in both groups, suggesting the importance of technique of graft used and placement by underlay method.

One of the important outcomes which every patient expects is best hearing which cannot be compromised with any procedure. In terms of hearing results (Table 7).

Table 7: Comparison of PTA in various studies.

Study	PTA - in terms of air bone gap (in dB HL)	Endoscopic type 1 tympanoplasty		Microscopic type 1 tympanoplasty	
		Preoperative	Postoperative	Preoperative	Postoperative
		N (%)	N (%)	N (%)	N (%)
Harugop et al[18]	0–10	0 (0)	23 (46)	0 (0)	10 (20)
	11–20	20 (40)	22 (44)	20 (40)	35 (70)
	21–30	28 (56)	5 (10)	30 (60)	5 (10)
Lakpathi et al[16]	0–10	0 (0)	14 (46)	0 (0)	7 (25)
	11–20	12 (40)	13 (44)	12 (40)	19 (65)
	21–30	15 (50)	3 (10)	18 (60)	3 (10)
	31-40	3 (10)	0 (0)	0 (0)	0 (0)
In our study	0–10	0 (0)	22(73.3)	0 (0)	20 (66.6)
	11–20	6 (20)	8 (26.6)	9 (30)	10 (33.3)
	21–30	24 (86.6)	0 (0)	21 (70)	0 (0)

That there is no difference in the hearing outcome of both groups because the repair remains the same even though method to do it are different but during repair placing the graft in proper position helps to reduce the medialization or lateralization of graft/graft failures thus posing impact on long term overall results.

Type 1 tympanoplasty is a procedure of least complications. But some studies have shown certain complications like graft failure, infections, sensory neural hearing loss, ossicular discontinuity, facial nerve palsy, chorda tympani damage, external auditory canal stenosis, serous otitis media, perichondritis, retraction of tympanic membrane and tinnitus. Sade et al showed 11 % incidence of retracted tympanic membrane in successful myringoplasties using temporalis fascia graft.[25] Glasscocket al reported 1% incidence of EAC stenosis in his study.[26] Siraj and Mohammad showed 2% incidence of sensory neural hearing loss with temporalis fascia graft.[27] Packer et al observed one case of debilitating tinnitus post operatively which was associated with sensorineural hearing loss.[28]

Among the above-mentioned complications only graft failure was noted in our study in one case of microscopic tympanoplasty which had residual anterior quadrant perforation probably because of recurrent allergic nasal infection in this patient which was treated later with fat graft myringoplasty. These complications were even least as mentioned by Karhuketo.[29]

Thus, advantages of the endoscope include: a wide angle of view, endoscopic view includes the whole tympanic ring and ear canal at same time. Complete view of middle ear, tympanic membrane, and ear canal without the need for continuous repositioning of the surgeon's head and the microscope. Better visualization of structures that are parallel to the axis of microscope. The 30˚ and wide 0˚ provide excellent visualization of structures such as ear canal without any incision as in microscope (postauricular, end aural incisions). Visualization of hidden structures such as anterior tympanic membrane perforation and sinus tympani, facial recess, attic, and hypotympanum thus help in training students 45. Operation time is shorter. Provide less postoperative pain and sooner recovery with good cosmetic results.

Disadvantages of the endoscope include: the loss of depth perception and binocular vision, this is easily compensated with experience. One handed surgical technique.

CONCLUSION

From our study we concluded that endoscope can be a better alternative for microscope in type 1 tympanoplasty as it provides a wide panoramic view, less operating time and hospital stay with negligible scar post operatively.

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