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A Comparative Study to Evaluate the Efficacy of Microscope Assisted Versus Endoscope Assisted Tympanoplasty.

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ABSTRACT

Background: Tympanoplasty is a common surgery for chronic otitis media. Few studies have looked at the outcomes of microscope assisted (MT) and endoscope assisted (ET) tympanoplasty. Aim: The study aims to analyze the results of endoscope and microscope assisted approaches for tympanoplasty in patients with chronic otitis media. Outcomes were intra-operative and post operative complications as well as functional outcomes (i.e. improvement in hearing as assessed by pure tone audiometry)/. **Methods:** This study was conducted at a tertiary care hospital. It included 100 subjects – 50 each in Microscope assisted tympanoplasty (MT) and endoscope assisted tympanoplasty (ET) assisted group. Study participants included those with chronic otitis media with central perforation and dry ear for 4 weeks. All the subjects underwent Type 1 tympanoplasty using either endoscopic or microscopic technique. The subjects were assigned to the above two groups alternatively. The key outcomes assessed were time taken for surgery (incision to closure), comfort level of the patient (by measuring pain score), proportion with graft rejection in both the groups and improvement in hearing. **Results:** We found that endoscope assisted surgery (ET) led to improvement in bone and air conduction and decreased air bone gap, compared to microscope assisted tympanoplasty (MT). There was a 15.5 dB improvement in MT group while the corresponding improvement in ET group was 16.8 dB (P=0.04). The mean improvements in post-operative air conduction were 29.8 dB and 26.1 dB respectively in ET and MT groups (P=0.02). The post-operative air bone conduction gap was 9.9 dB and 7.8 dB respectively in MT and ET groups (P=0.03). We also observed significantly reduced intra-operative pain scores and post-operative pain scores in those who were operated using endoscopy. **Conclusion:** The endoscope assisted tympanoplasty offers better outcome than microscope assisted approach and is a better choice for surgery.

Keywords: Tympanoplasty, Microscope, Endoscope.

INTRODUCTION

Tympanoplasty is a surgical procedure that is used for repair of the tympanic membrane.[1] It is one of the commonest operations performed on the middle ear. Since the introduction of tympanoplasty in the 1950s, various surgical techniques have been developed for closure of tympanic membrane perforation.[2] In the surgical repair of tympanic membrane perforations, several variables need to be considered such as size of perforation, eustachian tube function, state of the mucosa, wound healing and degree of pneumatisation.[3]

Introduction of operating microscope significantly enhanced surgical results by improving the accuracy of the technique. However, the operating microscope provides magnified images in a straight line extending from the objective lens. As a result of this, many deep recesses within the temporal bone cannot be visualized directly without the surgeon making efforts to increase surgical exposure.[4] Temporalis fascia is widely used with reported success rates of around 80% to 90% in patients who undergo primary tympanoplasty with a microscope assisted approach.[4] Post-auricular skin incision is the most widely used approach for microscope assisted tympanoplasty. This conventional procedure has often resulted in surgical scar and significant pain to the patient.[5]

The use of rigid endoscope in the management of dry central perforation of the tympanic membrane represented a significant advance in middle ear surgery. The introduction of endoscopy into middle ear has opened up new opportunities for minimally invasive temporal bone surgery.[5] The magnified vision provided the ability to change rapidly from close up to wide angled and the possibility of an all-

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round vision just by rotating the angled scopes are indispensable advantages of the endoscope. Consequently, the deep anterior canal wall, anterior recess, anterior marginal perforations, sinus tympani, facial recess, hypotympanum and attic are visualized by rotating the angled scopes.[6]

Endoscopes therefore offer the surgeon the capability of wide fields of view with minimal exposure, looking behind the obstructions or overhangs, and peering into recesses with much less requirement for surgical exposure than demanded by conventional techniques.[6,7] Additionally, surgical morbidity and operating time can also be substantially reduced. Advantages of endoscope assisted ear surgery, compared to the conventional microscope assisted surgery, include avoiding endaural and postauricular incisions, minimal dissection of the soft tissue and angled view that helps in avoiding bone dissection.[8] Transcanal approach is the most commonly used approach for endoscopic assisted tympanoplasty. Endoscopic approach has resulted in decreased incidence of residual and recurrences during surgeries for cholesteatoma removal.[8] However, endoscopic surgery has several disadvantages which include one hand technique, difficulty during bleeding and risk of thermal damage.[9]

Very few studies have been conducted till date to correlate the outcomes of microscope assisted and endoscope assisted tympanoplasty. Hence this comparative study largely deals with intra-operative and post operative complications as well as functional outcomes in a series of patients who underwent endoscope assisted tympanoplasty and microscope assisted tympanoplasty using temporalis fascia graft.

Aims and objectives

1. To assess and compare the time taken in the surgery, comfort level of the patient (reflected by pain scores), graft acceptance rates in each technique (i.e. microscope assisted & endoscope assisted tympanoplasty).
2. To assess and compare the hearing improvement by each of the technique.
3. To assess and compare the complications produced by each of the technique.

MATERIALS AND METHODS

This study was planned to study and define the indications, contraindications, limitations and advantages of microscope assisted and endoscope assisted tympanoplasty. This study was conducted at a tertiary care hospital. It included 100 subjects – 50 each in Microscope assisted tympanoplasty (MT) and endoscope assisted tympanoplasty (ET) assisted group. All the patients who presented signs and symptoms suggesting CSOM were submitted to an assessment protocol, supervised by the same examiner based on a guided history taking, specific physical exam (otoscopy and rhinoscopy), audiogram, Examination under Microscope done to better visualize the tympanic membrane perforation.

Inclusion criteria

1. Patients attending the OPD of the tertiary care hospital at which the study was conducted.
2. Those with central perforation.
3. Dry ear for 4 weeks

Exclusion criteria

1. Persistent discharging ear
2. Sclerosed mastoid on imaging
3. Any patients deemed to require a mastoid exploration

The subjects attending the OPD with the diagnosis of Chronic suppurative otitis media with central perforation were included in this study as per above inclusion and exclusion criteria.

All the subjects underwent Type 1 tympanoplasty using either endoscope or microscope assisted technique. The subjects were assigned to the above two groups alternatively. The surgeries were performed under sedation with intramuscular Phenothiazine. Local infiltrative anesthesia was provided by infiltration with 1% Xylocaine with 1: 100,000 adrenalin. Sutures were removed on post operative day 7. All the subjects were followed up after 7 days, 21 days, 8 weeks, 12 weeks and 16 weeks and the results were compared for the two groups.

Microscope assisted tympanoplasty

Modified post aural William Wilde's incision was made and temporalis fascia graft was harvested. Posterior meatotomy was performed and a tympanomeatal flap was elevated with attachment left from 9 to 11 O' clock in left ear and 1 to 3 O'clock in right ear .The handle of Malleus was denuded ad the graft was wrapped around it and placed medially with gelfoam placed in both middle ear and external auditory canal after flap reposition.

Endoscope assisted tympanoplasty

Temporalis fascia was harvested from a separate incision above the ear well inside the hairline. Under endoscopic visualization, tympanomeatal flap was elevated to the same extent as in microscope assisted tympanoplasty and graft was placed medial to the handle of Malleus. Gelfoam was placed in middle ear and external auditory canal after flap repositioning.

Pure tone audiometry

The audiometry was done following standard protocol. Pure tone Audiogram is done in every selected patient, comprising the following frequencies: 250, 500, 1000, 2000, 3000, 4000, 6000

and 8000 Hz in all the patients who presented satisfactory clinical control of otorrhea, and who were the candidates for the surgical procedure, which gave an assessment of the degree of hearing loss and its type. For calculation of average of hearing loss (air conduction threshold) three frequencies were selected. They were: 500, 1000 and 2000 Hz. These frequencies were selected because they represent speech frequency range and elevation of threshold in these frequencies will be clinically significant. Pure tone threshold audiometry has become the standard procedure for describing hearing sensitivity; therefore, pure tone audiometry had been used for assessment of hearing level in this study.

Sample size

A total of 100 subjects were included in the study. 50 subjects underwent microscope assisted tympanoplasty and 50 underwent endoscope assisted tympanoplasty. All the patients underwent underlay tympanoplasty.

Parameters assessed

The parameters assessed were as follows:

1. Pre-operative degree of hearing loss (based on Pure Tone Audiometry)
2. Time taken for surgery (incision to closure)
3. Comfort level of the patient (by measuring pain score)
4. Proportion with graft rejection in both the groups
5. Improvement in hearing (based on Pure Tone Audiometry)

Data analysis

Data were double entered in excel and any discrepancies were resolved. Mean with standard deviation and proportions were calculated for continuous and categorical variables respectively. T-test was used to compare means and chi-square test was used to compare proportions among the two groups. A P-value of less than 0.05 was considered statistically significant. All analyses were done in STATA version 13.0.

RESULTS

A total of 100 subjects were included in the study, out of which 50 underwent microscope assisted tympanoplasty (MT) and another 50 had endoscope assisted tympanoplasty (ET). The mean age of patients was 29.9 years and 32.4 years respectively in MT and ET group (Table 1). This difference was not statistically significant. The proportion of male patients in the MT group was 54% while that in the ET group was 46.0%. There were no significant differences in the pre-operative bone conduction level among the two groups (Table 1). While the pre-operative bone conduction hearing loss was 15.9 dB in the MT group, it was 16.5 dB in the ET group (P-value 0.37). The pre-operative air conduction hearing loss was 37.7 dB in the MT group and 39.5 dB in the ET group. The pre-operative air bone conduction gap was 23.3 dB in the ET group and 21.7 dB in the MT group [Table 1].

Table 1: Baseline demographic and clinical characteristics of the study subjects (N=100).

	Microscope assisted tympanoplasty (N=50)	Endoscope assisted tympanoplasty (N=50)	P-value
Mean (SD) age in years	29.9 (10.3)	32.4 (10.6)	0.23
Sex Male Female	 27 (54.0%) 23 (46.0%)	 23 (46.0%) 27 (54.0%)	0.42
Pre-operative bone conduction hearing loss Mean (SD) (in decibles; dB)	15.9 (2.4)	16.5 (2.9)	0.37
Pre-operative air conduction hearing loss Mean (SD) (in decibles; dB)	37.7 (3.3)	39.5(4.8)	0.03
Pre-operative air bone conduction gap Mean (SD) (in decibles; dB)	21.7 (2.6)	23.3 (3.6)	0.01

*Denotes statistical significance at P<0.05

The observed that improvements in post-operative bone conduction among the two groups of patients was statistically significant [Table 2]. There was a 15.5 dB improvement in MT group while the corresponding improvement in ET group was 16.8 dB (P=0.04). Similarly, there was a significant improvement in post-operative air conduction in those that received ET, compared to those that underwent MT. The mean improvements were 29.8 dB and 26.1 dB respectively in ET and MT groups (P=0.02). The post-operative air bone conduction gap was 9.9 dB and 7.8 dB respectively in MT and ET groups and this difference was also statistically significant (P=0.03) [Table 2]. We did not observe any significant difference in mean operating time and proportion with graft rejection among the two groups. There was a significant difference in the intra-operative and post-operative pain score among the two groups, with lower pain scores in the ET group at both the time points [Table 2]. The mean intra-operative pain score for MT group was 1.72 while that of ET group was significantly lower i.e. 0.54 (P=0.001). For the post-operative pain score at one week, the mean score was 0.36 and 0.12 respectively for MT and ET groups (P=0.001)

Table 2: Comparison of postoperative characteristics among the study subjects who received microscope and endoscope assisted tympanoplasty (N=100).

	Microscope assisted tympanoplasty (N=50)	Endoscope assisted tympanoplasty (N=50)	P-value
Post-operative improvement in bone conduction Mean (SD) (in decibles; dB)	15.5 (2.0)	16.8 (2.4)	0.04*
Post-operative improvement in air conduction Mean (SD) (in decibles; dB)	26.1 (4.5)	29.8(4.2)	0.02*
Post-operative air bone conduction gap Mean (SD) (in decibles; dB)	9.9 (3.8)	7.8 (3.1)	0.03*
Mean operating time (in minutes)	60.0 (9.3)	61.8 (8.5)	0.32
Proportion with graft acceptance (%)	46 (92.0%)	48 (96.0)	0.40
Mean (SD) intra-operative pain score	1.72 (1.2)	0.54 (0.2)	0.001*
Mean (SD) post-operative pain score after 1 week	0.36 (0.5)	0.12 (0.3)	0.001*

*Denotes statistical significance at P<0.05

DISCUSSION

This study was undertaken with the objective of determining the merits and demerits of the endoscope compared to microscope assisted tympanoplasty surgery. We found that endoscope assisted surgery led to improvement in bone and air conduction and decreased air bone gap, compared to microscope assisted tympanoplasty. Also, we observed significantly reduced intra-operative pain scores and post-operative pain scores in those who were operated using endoscopy. The use of endoscope in ear surgery has increased and includes middle ear tumor, ossiculoplasty, tympanoplasty, and cochlear implantation. Several meta-analyses and review articles of endoscope assisted ear surgery support the safety of the approach, with minimal morbidity evident.[10,11] Since endoscopic technique is minimally invasive and has the advantage of angled view thus it can avoid mastoidectomies, external incisions, and soft tissue dissection in selected cases as compared with the conventional microscope assisted approach. However, endoscope assisted surgery has several disadvantages which include one hand technique, difficulty during bleeding and risk of thermal damage.[12] The endoscope also lacks sufficient microscopic magnification and focus. In the endoscopic approach, instruments may crowd the ear canal, and the endoscope may become frequently or heavily contaminated with blood. Endoscopic surgery offers 2D images, and 2D images lack depth perception; thus, lifting the graft to make contact with the edge of the perforation is difficult.[13] However, improvements in full high-definition camera systems can provide much more delicate endoscopic views with better contrast to minimize these problems.

In spite of these limitations of the endoscope assisted surgery, the current data indicate that endoscope assisted tympanoplasty can be successfully performed and that it has significantly shorter operation time than the microscope assisted tympanoplasty.[14] In our study, we, however, found that the mean operating time for both the techniques was similar. Studies have shown significant hearing improvement after endoscope assisted ear surgeries and the same is being observed in our study.[15,16] We found that those operated using endoscope had higher post-operative bone and air conduction compared to those operated using microscope assisted technique. Although not statistically significant, we achieved a very high graft success rate of 96% in those who underwent endoscope assisted tympanoplasty, compared to 92% in microscope assisted tympanoplasty. Therefore, we suppose that the endoscope assisted technique could be helpful for eradication of pathologic processes in the middle ear, such as granulation tissue or adhesion, as well as cholesteatoma.

Our study findings were similar to previous studies. Yadav SP et al studied endoscope assisted myringoplasty carried out in 50 patients aged 18-45 years, using temporalis fascia graft.[17] Over all graft uptake and improvement in conductive deafness as air bone gap closure was achieved in 80% of cases and they concluded that endoscope assisted tympanoplasty is equally effective, less morbid and very cost effective in small central perforation. In our study also improvement in bone conduction, air conduction and air bone gap was better in endoscope assisted group. Raj A et al. performed endoscope assisted transcanal tympanoplasty and compared the outcomes with that of microscope assisted tympanoplasty.[5] They showed that graft uptake is 90% in endoscopic method and 85% in microscopic method but there was no significant difference between the gain in the air bone gap in either group. Our study however found a significant difference in gain in air bone gap in the endoscope assisted group.

Study conducted by Harugop AS et al on comparison of endoscope assisted tympanoplasty and microscope assisted tympanoplasty concluded that surgical outcome of endoscope assisted tympanoplasty was comparable to the conventional microscope assisted tympanoplasty but in terms of post-operative recovery the patient in endoscope assisted group had better result.[18] Karchuketo TS

studied the endoscope assisted tympanoplasty with different sized perforation & concluded that the post-operative air bone gap was less than 10 dB in 90% cases.[9] Hence endoscope assisted tympanoplasty is reliable and simple procedure with the benefit of minimal trauma to the healthy tissue. Ahmed El-Guindy (Tanta, Egypt) has evaluated the role of the rigid endoscope in the management of 36 cases of dry central perforation of the tympanic membrane.[19] The graft take rate was 91.7% and air bone gap was closed to less than l0 dB and these findings are similar to what we found in our study. Comparing the complications in the patients who got operated by microscope and endoscope assisted technique respectively, our study showed no statistical significant difference between the two. Similar observations were made in two separate studies by Tarabichi M et al and Usami S et al.[6,20]

CONCLUSION

In summary, the endoscope assisted technique is a minimally invasive technique with higher success rate compared to microscope assisted surgery. However it is a one handed technique and needs more training as compared to conventional method. Panoramic, wide angle, and magnified view provided by endoscope helps provide uninterrupted scenario and therefore overcomes most of the disadvantage of microscope assisted surgery. In our study endoscope assisted surgery provided better results in terms of hearing improvement and graft acceptance compared to microscope assisted technique. Loss of depth perception and one handed technique are some of the disadvantage of endoscope that can be overcomed with practice. Thus, endoscope assisted tympanoplasty can be a good alternative of conventional microscope assisted tympanoplasty.

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