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Original Article

Comparative Study of the Outcomes of Tympanoplasty by the Conventional Microscopic and Endoscopic Techniques

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Abstract

Introduction: Chronic otitis media, a highly prevalent middle ear disease, poses problems of recurrent ear discharge and hearing impairment. Tympanoplasty is the surgical remedy, and its outcome varies with the surgical technique used. The introduction of the operating microscope improved the accuracy of the technique; however, difficulty in visualization of certain areas of the middle ear including the anterior and posterior epitympanic spaces and sinus tympani made it necessary for frequent adjustments in either the microscope or the patient's head. This made endoscopic tympanoplasty a more favorable technique for better visualization of hidden areas in the middle ear cavity with effective removal of disease.

Purpose: This study, therefore, aimed to correlate the outcome of tympanoplasty by microscopic and endoscopic methods comparing the advantages and disadvantages of both.

Methods: This is a prospective cohort study done on patients undergoing tympanoplasty type I at the Department of ENT, Government Medical College, Kozhikode, from January 2016 to January 2017. They were divided into two groups: Group A tympanoplasty type I by conventional microscopic techniqueand Group B by endoscopic technique respectively. Intraoperatively, the duration of surgery and postoperatively, the graft uptake and hearing improvement were assessed.

Results: In our study with 40 patients, 20 each undergoing tympanoplasty by microscopic and endoscopic techniques, it was found that the graft uptake was 95% in both the groups. There was a significant difference between the two groups in duration of surgery, with a shorter duration in the endoscopic group. There were two cases of wound infection in Group A which was not statistically significant. There was significant improvement in hearing in both groups, but the difference was not statistically significant.

Conclusion: The endoscopic technique is an effective alternative to the conventional microscopic method but requires more training. The advantages with endoscope include that it is less invasive, less morbid, provides better visualization and better cosmetic results with the definite advantage of shorter duration of surgery in well trained hands. The disadvantages include the learning curve, loss of one hand in holding the endoscope and difficulty in cases of bleeding.

Key words: Conventional microscopic technique, Endoscopic technique, Type I tympanoplasty

INTRODUCTION

Chronic otitis media (COM) is a chronic inflammatory disease of the middle ear and mastoid that often results in partial or total loss of the tympanic membrane (TM) and ossicles, leading to conductive hearing loss that can range in severity up to 60 dB. It is an important public health problem with substantial economic and societal costs. Tympanoplasty, the commonly performed surgery, involves eradication of disease in the middle ear, repair of perforated TM, and restoration of the hearing mechanism. The outcome of tympanoplasty varies with surgical technique used such as overlay versus underlay graft placement, type of canal incisions for tympanomeatal flap, placement of vascular strip incision, and no canal incision technique.[1-3] Meticulous use of technique rather than the type of technique determines the outcome.[4]

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The introduction of the operating microscope resulted in drastic improvement in the results of tympanoplasty due to improvement in the accuracy of the technique.[5] Transcanal tympanoplasty can be performed with both microscope and endoscope. However the binocular nature of vision and availability of both hands for surgery makes the microscopic technique, even today the widely preferred one for tympanoplasty. However, as the microscope gives a magnified image in a straight line, visualization and removal of middle ear pathology, especially that of retrotympanum, attic, and hypotympanum, require frequent adjustments of microscope or patient's head and may also necessitate curettage of posterior canal wall, scutum, and canaloplasty.

The transcanal endoscopic tympanoplasty gained popularity in recent years being less invasive with a wider field of vision and short operating time. Endoscopically, the typical transcanal approach is possible by elevating a tympanomeatal flap, thus avoiding unnecessary incisions and soft tissue dissections. The endoscopes also provide better visualization of hidden areas in the middle ear cavity including the anterior and posterior epitympanic spaces, sinus tympani, facial recess, and hypotympanum. Only one-hand surgery is feasible with the endoscopic technique which mandates training for acquiring skill. Even a small amount of blood can totally obscure the view of operating field by soiling the scope. In addition, endoscopes could make direct injury and thermal damage by the light source.[6]

There is a need of reliable data to correlate the outcome of tympanoplasty by microscopic and endoscopic methods and also compare the advantages and disadvantages of these methods; hence, this study helps to compare the two different techniques in performing tympanoplasty.

Aims and Objectives

The aim of this study is to compare the outcome of type I tympanoplasty by microscopic and endoscopic methods and to study the advantages and disadvantages of each method.

The objectives of the study are as follows:

- To compare the percentage of graft uptake in both the groups.
- To compare the improvement in hearing in both the groups.
- To evaluate the advantages and disadvantages of each technique.

METHODOLOGY

Type of the Study

This was a prospective cohort study.

Study Setting

Patients undergoing type 1 tympanoplasty at the Department of ENT, Government Medical College, Kozhikode, from January 2016 to January 2018 were assessed for the inclusion and exclusion criteria and included in the study after getting informed written consent.

Inclusion Criteria

The following criteria were included in the study:

- Patients with unilateral COM mucosal inactive disease.
- Patients with small-to-moderate central perforation.
- Patients with demonstrable conductive hearing loss (air bone gap [ABG] >15 dB).
- Patients with age group of between 15 and 45 years.

Exclusion Criteria

The following patients were excluded from the study:

- Patients with bilateral disease and/or COM mucosal active disease
- Patients with subtotal or total perforation.
- Patients with conductive hearing loss >40 dB.
- Patients with mixed hearing loss or sensorineural hearing loss.
- Patients with comorbidities likely to impede outcome of surgery such as diabetes.
- All revision cases.

The study was conducted on 40 patients undergoing tympanoplasty type I after getting approval from the Institutional Research Committee and Institutional Ethics Committee.

The study population constituted patients with unilateral COM mucosal disease, above 15 years of age who presented to the ENT outpatient department in the specified period with complaints of ear discharge, hearing loss or both. All patients included in the study had a benign central perforation in the pars tensa of the tympanic membrane and were treated sufficiently to ensure a dry ear at least 6 weeks prior to the surgery. They underwent complete evaluation including otoscopic examination, tuning fork tests and pure tone audiometry. The patients were all counselled and those willing for surgery; tympanoplasty type I were then considered for the study

After getting written informed consent, patients satisfying the inclusion criteria were divided into two groups: Group A undergoing tympanoplasty type I by conventional microscopic technique and Group B by endoscopic technique respectively.

After pre-operative evaluation including detailed ENT examination, tuning fork tests, pure tone audiometry, and routine blood investigations, all patients underwent surgery

under local anesthesia. Injection Glycopyrrolate 0.2 mg, injection Promethazine 12.5 mg, and injection Pentazocine 30 mg intravenously were used for premedication. In Group A, postauricular approach and, in Group B, transcanal approach were used. Temporalis fascia was used as graft material in all patients which was harvested intraoperatively. In Group B, a 3-cm incision was made above the temporal line for harvesting the graft and incision was closed after getting the graft. In all patients, graft was kept as underlay after elevating the tympanomeatal flap.

Intraoperatively, the duration of surgery and, postoperatively, the occurrence of any complication were noted in each case. All the patients were followed up for 6 months, and the graft uptake and hearing improvement were assessed. Pure tone audiometry was performed at 3 and 6 months, and the hearing improvement was noted.

A statistical analysis of the data was done using Statistical Package for the Social Sciences software version 18. Qualitative data were compared using Chi-square test. Quantitative data were compared using independent *t*-test. $P < 0.05$ was considered as statistically significant.

RESULTS

A total of 40 patients were included in the study with 20 subjects in each Group A (C: conventional microscopic) and Group B (E: endoscopic). Of the 40 subjects, 23 (57.5%) were females and 17 (42.5%) were males. There were 12 (60%) females in Group A and 11 (55%) females in Group B. There was no difference between the two groups with respect to sex as $P = 0.749$ [Figure 1].

Mean age of the subjects in Groups A and B was 26.6 ± 7.92 and 28.2 ± 8.2 years, respectively. There was no difference between the two groups with respect to age as $P = 0.534$ [Figure 2].

Mean pre-operative pure tone average (PTA) in Groups A and B was 31.15 ± 4.9 dB and 30.89 ± 5.03 dB, respectively. Mean pre-operative ABG in Groups A and B was 18.14 ± 4.77 dB and 19.81 ± 4.23 dB, respectively. There was no difference between the two groups with respect to pre-operative PTA and ABG with $P = 0.869$ and 0.249, respectively [Table 1].

Mean duration of surgery in Groups A and B was 48 ± 6.05 min and 32.3 ± 5.18 min, respectively. This difference in duration of surgery was statistically significant with $P = 0.00$ [Figure 3].

Mean post-operative PTA at 3 months in Groups A and B was 17.14 ± 5.34 dB and 16.47 ± 4.49 dB, respectively, and at 6 months was 16.72±5.11 dB and 16.05 ± 4.37 dB, respectively. Mean post-operative ABG at 3 months in

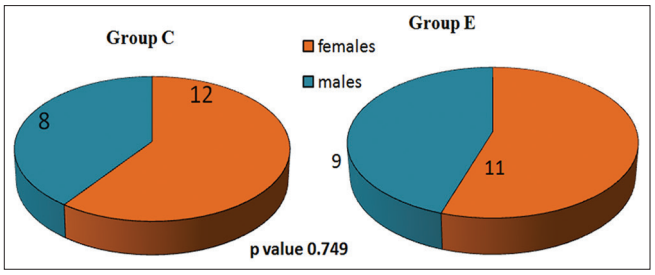

Figure1: Comparison of sex distribution

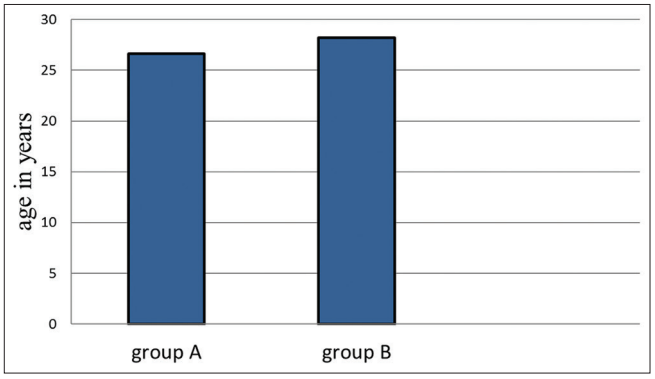

Figure 2: Comparison of mean age

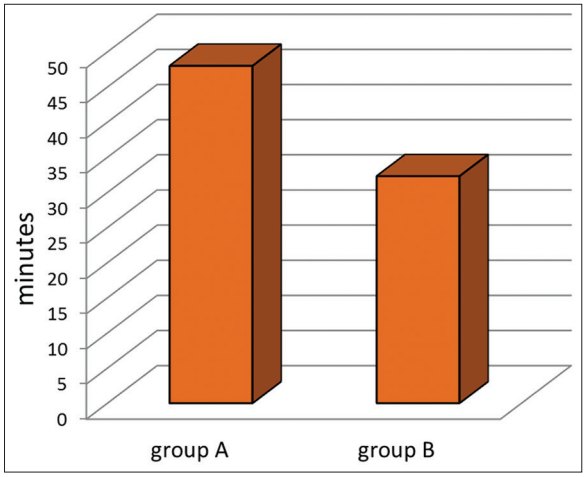

Figure 3: Comparison of the duration of surgery

Table 1: Comparison of pre-operative PTA and ABG

Group	Mean	Standard deviation	Standard error mean	*P* value
Pre-PTA				
A	31.145	4.870	1.089	0.869
B	30.885	5.027	1.124	
Pre-ABG				
A	18.135	4.767	1.066	0.249
B	19.805	4.231	0.946	

PTA: Pure tone average, ABG: Air bone gap

Table 2: Comparison of post-operative PTA and ABG

Group	Mean	Standard deviation	Standard error mean	*P* value
PTA-3				
A	17.140	5.335	1.193	0.670
B	16.470	4.494	1.005	
PTA-6				
A	16.72 0	5.112	1.143	0.658
B	16.050	4.366	0.976	
ABG-3				
A	8.470	5.042	1.128	0.896
B	8.650	3.422	0.765	
ABG-6				
A	8.550	4.777	1.068	0.867
B	8.330	3.533	0.750	

Groups A and B was 8.47 ±5.04 dB and 8.65 ±3.42 dB, respectively, and at 6 months was 8.55 ± 4.78 dB and 8.33 ± 3.53 dB, respectively. There was no difference between the two groups with respect to post-operative PTA and ABG at 3 and 6 months (Table 2).

Graft uptake was 95% in both the groups. There were two cases of wound infection in Group A which was not statistically significant ($P = 0.147$).

DISCUSSION

COM is a highly prevalent disease of the middle ear, especially in the developing countries. COM mucosal disease is characterized by permanent perforation of TM with or without inflammation of the middle ear and variable degree of ossicular destruction, which affects the normal physiology of hearing. A chronically draining ear and impaired hearing affect the quality of life. Since the introduction of tympanoplasty, a variety of graft materials and surgical techniques have been developed to close the perforation in the TM. The introduction of operating microscope has significantly improved the accuracy of the technique and, hence, the outcome. However, it has many limitations. Minimally invasive otologic surgery has recently been developed with the use of endoscope.

Microscope provides magnification in a straight line. Variations of the external auditory canal such as tortuosity, stenosis, and bony overhangs hamper the view of the TM when visualized through the microscope. Therefore, a need to manipulate the patient's head or the microscope repeatedly to visualize all the parts of the TM[7] or sometimes canaloplasty has to be done. The wide angle of the zero degree scope visualizes the entire TM in a single frame.[8] With the angled endoscope, the areas which are difficult to visualize such as hypotympanum, anterior tympanic perforation, sinus tympani, and facial recess can be easily visualized. A high-resolution and relatively clear images can be obtained through the endoscope. The use of endoscope allows transcanal approach, thus avoids postaural or endaural incision and soft tissue dissection, and hence, reduces intraoperative bleeding, operating time, post-operative pain, infection, and visible scar. For harvesting temporalis fascia graft, only 3-cm incision above the hairline is required. The monitor used during endoscopic surgery provides visual content of the procedure for training purposes.[9] Unlike the microscope, the endoscope is easily transportable and, hence, is ideal for use in ear surgery camps in remote places. Endoscope is cost effective compared to microscope. There are still many advantages of microscopic ear surgery. It provides binocular vision along with an excellent magnified surgical view. Using a microscope, two-hand surgery is possible, which is extremely useful to remove blood from the operation field.

The endoscope holds the greatest promise in tympanoplasty and cholesteatoma surgery.[10] It has some disadvantages also. It is a one-handed surgical technique. This becomes, especially, cumbersome when there is excessive bleeding. The learning curve is difficult and needs training. Even a small amount of blood can obscure the view of operating field by soiling the scope, so good hemostasis is mandatory. There are two major safety concerns with the use of endoscope. One is excessive heat production from the light source which can cause damage to surrounding structures, but this can be avoided with lower settings on the regular light source. Furthermore, the tip of the endoscope requires continuous cleaning with anti-fog solution, which probably helps in cooling the endoscope. Accidental patient movement with secondary direct trauma by the tip of the endoscope is also a matter of concern. However, most of the disadvantages of microscope can be overcome using endoscope. Thus, in this study, comparison of the outcome of type 1 tympanoplasty by microscopic and endoscopic method was done.

In our study, of the 40 patients, 20 underwent microscope-assisted type 1 tympanoplasty (Group A) and 20 underwent endoscope-assisted type 1 tympanoplasty (Group B). The groups were comparable with respect to age and sex. The percentages of graft uptake were equal in both the groups (95%). It is consistent with previous studies. In the study conducted by Huang *et al.*[11] on 100 cases (50 endoscopic and 50 microscopic), the graft uptake was 98% in both the groups. In a similar study by Harugop *et al.*[12] the graft uptake in the endoscopic group was 82% and 86% in the microscopic group. Raj and Meher[13] conducted a study to evaluate the role of rigid endoscope in the management of dry central perforation of TM and to

compare the results of endoscopic myringoplasty with that of microscopic myringoplasty using tragal perichondrium as graft material. 40 patients were divided into two equal groups. In the endoscopic group, there was 90% uptake of graft, and in the microscope group, it was 85%. Yadav *et al*.[14] studied endoscopic-assisted myringoplasty carried out in 50 patients aged 18–45 years. 40 (80%) patients had a successful closure of the TM perforation. Even though there are variations in graft uptake rate in both methods, various studies show that it is not statistically significant.

In our study, there was a significant difference between the two groups in duration of surgery with a shorter duration in the endoscopic group. The mean operating time in Groups A and B was 48 ± 6.05 min and 32.3 ± 5.18 min, respectively. This difference may be due to avoiding the postauricular incision, soft tissue dissection, and wound closure. This result is consistent with previous studies. Huang *et al*.[11] reported that the mean operation times were 75.5 min and 50.4 min in patients undergoing microscopic and endoscopic tympanoplasty, respectively. Choi *et al*.[15] found that mean operation time of the microscopic group (88.9 ± 28.5 min) was significantly longer than the endoscopic group (68.2 ± 22.1 min). There are studies reporting that the endoscopic method is more time-consuming. In the study of Harugop *et al*.[12] mean time of endoscopic and microscopic tympanoplasty operations was found to be 128 min and 106 min, respectively.

Hearing improvement in our study was comparable with other studies. There was a significant improvement in hearing in both groups, but the difference was not statistically significant. In the study by Huang *et al*.,[11] theaverage improvement in ABG in microscopic and endoscopic group was 8.3 dB and 8.9 dB, whereas in our study, it was 9.67 and 11.16 dB, respectively, at 3 months and 10.08 and 11.57 dB, respectively, at 6 months. Raj and Meher[13] reported that the mean ABG gain in patients who had undergone endoscopic myringoplasty was 8.0 dB, while in microscopic group, it was 7.5 dB. Sinha *et al*.[16] conducted a prospective study in 44 patients who underwent type 1 tympanoplasty either using microscope (n = 22) or endoscope (n = 22). Here, the pre-operative PTAs in microscopic and endoscopic groups were 46.3 and 39.7 dB, respectively, whereas in our study, 31.15 and 30.89 dB, respectively. The average improvements in ABG postoperatively were 23.68 and 16.13, respectively, which is more than that of our study. Yadav *et al*.[14] studied endoscopic-assisted myringoplasty carried out in 50 patients aged 18–45 years. The maximum number of patients (30) had an improvement of the magnitude of ABG ranging from 11 dB to 20 dB, similar to our study.

Yadav *et al*.[14] from their study of endoscope-assisted myringoplasty in 50 patients concluded that endoscopic myringoplasty is equally effective, less morbid, and cost-effective in small central perforation, whereas in our study, both methods are equally effective in small as well as in moderate central perforation. In a retrospective study by Choi *et al*.,[15] post-operative pain was also assessed and compared between microscopic and endoscopic groups in which we were not included in our study. Immediate post-operative pain was similar in both the groups; however, pain of 1 day after surgery was significantly less in endoscopic group. In the study by Harugop *et al*.[12] a statistically significant difference in favor of endoscope was found in terms of post-operative return of activity of patients and cosmetic results.

There are limitations for our study; the relatively small sample size and limited study period pose a problem in the generalization of findings. The type of surgery was decided by surgeon's preference. Assessment of post-operative pain and patient satisfaction related to cosmetic result could be included in the study.

CONCLUSION

Tympanoplasty, type I can be performed using either the conventional microscope or the endoscope. The advantages using the endoscope include that it takes shorter duration of time for the surgery, provides better visualization and better cosmetic results. The disadvantages of using the endoscope include learning curve with the technique itself, loss of one hand in holding the endoscope, and difficulty in cases of bleeding. However, endoscopic type 1 tympanoplasty is an effective alternative to conventional microscopic method requiring training and more takers to performing the same.

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