International Journal of Otorhinolaryngology and Head and Neck Surgery
Rathod J et al. Int J Otorhinolaryngol Head Neck Surg. 2020 Oct;6(10):1787-1792
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20203990

Original Research Article

Correlation between microscopic and endoscopic approach to tympanoplasty: a comparative study

Jitendra Rathod, Reena Vare, Annju Thomas*

ENT Department, MGM Medical College Aurangabad, MGMIHS, Navi Mumbai, India

Received: 24 August 2020
Revised: 08 September 2020
Accepted: 09 September 2020

***Correspondence:**
Dr. Annju Thomas,
E-mail: annjuthomas@gmail.com

ABSTRACT

Background: The objective of the study was to evaluate the role of endoscopes in the management of dry central perforations of the tympanic membrane, compare the visualization of middle ear anatomy, time taken for the procedure and each step of the surgery and preoperative and postoperative hearing results/improvement.
Methods: Fifty patients of chronic suppurative otitis media without cholesteatoma who came to ENT OPD at MGM medical college and hospital Aurangabad were included. They were divided into 2 groups with 25 patients each. Group A underwent microscopic approach to tympanoplasty and group b underwent endoscopic approach to tympanoplasty. Patients were assessed pre and postoperatively after 7 days, 14 days, 1 month, 3 months and 6 months with postoperative audiometry in the third month.
Results: There was an improvement in the post-operative audiometry air bone gap (ABG) in both the groups. The operative time for group A was comparatively lesser than group B. Residual perforation were detected in one patient in group A at postoperative months 3 and 6, and for group B at postoperative month 3 and in two patients at postoperative month 6.
Conclusions: A shorter operative duration is an advantage of microscopic tympanoplasty technique. One handed technique is one of the disadvantages of endoscope. The endoscopic approach gave better results in terms of easy visualization of the entire tympanic membrane and ossicular system. Tympanoplasty using endoscope was found to be an effective method for management of dry central perforations of the tympanic membrane.

Keywords: Microscopic, Endoscopic, Tympanoplasty

INTRODUCTION

Chronic suppurative otitis media (CSOM) is a long standing infection of a part or whole of the middle ear cleft characterized by ear discharge with or without a tympanic membrane perforation.[1] CSOM is a common disease that can have serious complications due to incorrect and inadequate treatment.[1] The surgical management for CSOM without cholesteatoma is tympanoplasty. Tympanoplasty is an operation to eradicate the disease in the middle ear and reconstruct the hearing mechanism with or without tympanic membrane grafting.[2] It was introduced in the 1950s.[3] Different types of grafts and surgical approaches are used in treatment of a perforated tympanic membrane. Temporalis fascia and perichondrium are commonly used, and successful results can be achieved in 80% to 90% in patients who undergo tympanoplasty with a microscopic approach.[4] Microscopic tympanoplasty mostly require soft tissue dissection and post auricular incision and is considered an effective procedure for patients with chronic suppurative otitis media, especially in large or anterior tympanic membrane perforation as well as anterior bony overhang.[5] Endoscopic ear surgery, first tried in the 1990s, has become popular with anatomic and physiologic concepts.[6,7] Post auricular incisions can be avoided in

endoscopic ear surgeries.[5] Hidden areas like the sinus tympani, facial recess, hypotympanic and epitympanic regions can be visualized better using an endoscope.[8,9] However, endoscopic surgery has several disadvantages. One-hand surgery which cumbersome; in case of a massive bleeding, the endoscopic view is obstructed by blood.[10-20] There could be a direct injury or thermal damage by light source.[20,21] In our study we try to compare the results of endoscopic and microscopic tympanoplasty in terms of visualization, operative time, post-operative pain, success rate of graft uptake and post-operative audiologic improvement.

METHODS

A comparative study was planned and performed on tertiary care centre at MGM Medical college and hospital Aurangabad from November 2015 to April 2017. Patients which presented with CSOM without cholesteatoma to ENT OPD at our tertiary care centre, during the period of November 2015 to April 2017. Age group inclusion was 21 years to 50 years. Sample size for the study was 50. Patients were divided into 2 groups and 25 in each group. Simple random allocation was done using lottery system followed by counselling of the patient for the procedure to be performed. Those patients agreeing for the procedure were enrolled in the study. All patients with safe CSOM, with conductive hearing loss, Small to Moderate perforation, between age 21-50 years were included in the study. Patient with large perforation, ossicular chain discontinuity, recurrent or residual discharge requiring revision surgery, sensorineural or mixed hearing loss, cholesteatoma was excluded from the study. After the approval from ethics committee, patients falling into the inclusion criteria were chosen for the study. Details of cases were recorded including history and clinical examination with detailed otoscopic examination using Heinz mini 5000 LED otoscope and microscopic and endoscopic examination preoperatively and postoperatively. The microscope used for the study was Ziess binocular microscope. The endoscope used for the study was zero-degree Storz endoscope, Seventy degree Storz endoscope, Thirty degree Hawk endoscope. All patients were subjected to preoperative and postoperative (3rd month) pure tone audiometry. Patients were assigned to group A (microscopic approach to tympanoplasty) and group B (endoscopic approach to tympanoplasty). A total 50 paper chits were made from number 1 to 50. Out of which numbers 1-25 were for Group A and 26-50 were for group B. Each patient satisfying the criteria were made to pick a chit with the number. Based on the number mentioned in the chit, the patient was allocated with the respective group. Patient is counselled regarding the procedure and study to be performed. Once patient gives consent for the surgery patient is enrolled in the study. The chit once picked up by a patient was discarded after being allocated to a group. The surgery was done under local with intravenous sedation by postaural route for conventional microscopic assisted method and endomeatal for endoscopic assisted method. A 2 cm incision in the hair or an extension of the endomeatal incision anteriorly upto the attachment of the helix to harvest the temporalis fascia graft for endoscopic assisted group, whereas in the conventional microscope technique a 5 cm long post aural incision was taken through which temporalis could be harvested. In both the methods the postauricular/ endomeatal wound was closed by suture material vicryl 3-0. Intra-operative time taken for surgery and visualization of structures was noted. Healing of tympanic membrane and improvement in PTA was recorded postoperatively. The data was collected and tabulation was done in MS Excel and statistical analysis was done using SPSS version 21.

RESULTS

In our study of 50 ears, primarily we observed and analysed rate of graft success, hearing gain and air bone gap, time taken for surgery and visualization. The age group ranged from 18-47 years (Table 1). In the study, 18 ears (36%) were in the age group 21 to 30 years, 14 ears (28%) in the age group of 31 to 40 years and 18 ears (36%) in the age group of 41 to 50 years. Sex distribution elicited 16 ears (32%) were of males and 34 (68%) were of females (Table 2). Out of the total 16 males, 6 belonged to group A and 10 to group B. Out of the total 34 females, 19 belonged to group A and 15 belonged to group B. In the study, we have divided the perforations of the tympanic membrane into 4 categories depending on the location, i.e., anterior, posterior, central and subtotal (Table 3). Site of perforations: 18 ears (36%) were observed to have anterior perforations, 6 ears (12%) were observed to have posterior perforations, 6 ears (12%) were observed to have central perforations and 20 ears (40%) were observed to have subtotal perforations. Out of the 18 anterior perforations, 6 belonged to group A and 12 to group B. Out of the 6 posterior perforations, 5 belonged to group A and 1 to group B. Out of the 6 central perforations, 3 belonged to group A and 3 belonged to group B. Out of the 20 subtotal perforations, 11 belonged to group A and 9 to group B (Table 4). Twenty-five cases underwent tympanoplasty by microscopic approach (group A) and the remaining 25 cases underwent tympanoplasty by endoscopic (group B). In group A where patient underwent tympanoplasty by microscopic approach, 24 out of 25 ears (96%) showed successful graft uptake, while 1 ear (4%) showed residual perforation. In group B where patients underwent tympanoplasty by endoscopic approach 23 out of 25 ears (92%) showed graft success, while 2 ears (8%) showed residual perforation. The chi-square statistic is 0.3546. The p value was 0.5515. df was 1; $p>0.05$ was considered as not significant. In group A, 8 out of 25 patients required canaloplasty since middle ear structures couldn't be visualized. In group B 1 out of 25 patients required canaloplasty as middle ear structures were easily visualized by the endoscope (Table 5). In group A the mean air bone gap, pre and post-operative was 36.16 and

28.48 respectively. In group B the mean air bone gap, pre- and post-operative was 35.2 and 27.68 respectively.

Table 1: Age distribution.

Age group (years)	Number of patients (%)
21-30	18 (36)
31-40	14 (28)
41-50	18 (36)
Total	50 (100)

Table 2: Sex distribution.

Gender	Total	Group A	Group B
Male	16	6	10
Female	34	19	15

Table 3: Perforation site.

Site of perforation	Total	Group A	Group B
Anterior	18	6	12
Posterior	6	5	1
Central	6	3	3
Subtotal	20	11	9

Chi Square test: 4.76; df: 3; p>0.05; not significant.

Table 4: Graft success rate.

Type of surgery	Success N (%)	Failure N (%)	Total
Group A	24 (96)	1 (4)	25
Group B	23 (92)	2 (8)	25

Chi Square test: 4.76; df: 3; p>0.05; not significant.

Table 5: Visualization.

Canaloplasty	Group A	Group B
Canaloplasty done	8	1
Canaloplasty not done	17	24

Chi-square test: 6.6396; df: 1; p=0.009974; significant at p<0.05

The hearing gain in group A and group B was 7.68 and 7.52 respectively. There was not much significant difference in the two groups (Table 6).

Table 6: Hearing gain.

Variables	Group A (AB Gap)	Group B (AB Gap)
Pre-operative	36.16	35.2
Post-operative	28.48	27.68
Hearing gain	7.68	7.52

Chi-square test: 0.0062; p=0.937184; not significant.

The average time taken for surgery in group A was 117 minutes (60-150 minutes). The average time taken for surgery in group B was 151.32 minutes (90-180 minutes) (Table 7). The average time taken for postauricular wound healing in group A was 22.48 (7-30 days). The average time taken transmeatal wound healing in group B was 8.4 days (7-14 days) (Table 8). The time take for wound healing in group A and group B had no significant difference.

Table 7: Time taken for surgery.

Variables	Group A	Group B
Minimum time (minutes)	60	90
Maximum time (minutes)	150	180

Chi-square test: 1.2468; p=0.264173; not significant.

Table 8: Time taken for wound healing.

Variables	Group A	Group B
Minimum days	7	7
Maximum days	30	14

Chi-square test: 1.5201; p= 0.21761; not significant.

DISCUSSION

The main objective in treatment of chronic suppurative otitis media is to achieve symptomatic relief, relieve drainage, rehabiliting hearing and minimize complications. In our study out of 50 patients 25 (group A) underwent microscopic tympanoplasty and 25 (group B) underwent endoscopic tympanoplasty. It was observed that the results of male and female distribution and site of perforation was not significant. The graft success rate was 96% in group A and 92% in group B which was not significant. The mean air bone gap, pre- and post-operative were 36.16 and 28.48 respectively in group A. In group B the mean air-bone gap, pre- and post-operative was 35.2 and 27.68 respectively. Postoperative pain was lesser and cosmesis was better in group B. Time taken for surgery in group A, average 117 minutes was comparatively lesser than group B average, 151.32 minutes but it was not statistically significant. Visualization was better in Group B as compared to Group and requirement of canaloplasty was lesser. In a study by Choi et al graft uptake in the endoscopic tympanoplasty was 100% and microscopic tympanoplasty was 95.8% the values were not significantly different.[5] Pre and postoperative audiometric results including bone and air conduction thresholds and air-bone gap were not significantly different between the groups.[5] Ahmed et al in a study of 100 patients concluded that there was no statistically significant difference in either graft uptake or post-operative audiological gain in the patients undergoing myringoplasty by endoscope assisted and microscope assisted technique.[22] Sinha et al noted that the graft uptake was 95% in microscopic tympanoplasty and 90% in endoscopic tympanoplasty which was not significant. [23] The postoperative air bone gap improvement in microscopic group was 23.68 dB and 16.13 dB in endoscopic group which was not significant.[23] Shoeb et al observed that graft healing was

93.33% in both endoscopic and microscopic assisted surgeries.[24] Kumar et al concluded that graft uptake was 86% (26/30) in microscopic myringoplasty and 83% (25/30) in endoscopic myringoplasty.[25] The hearing gain postoperatively was 13.96 dB in microscopic myringoplasty and 15.03 dB in endoscopic myringoplasty.[25] Thus the surgical outcome of endoscopic myringoplasty in terms of hearing improvement and graft uptake was comparable to the conventional microscope assisted myringoplasty.[25] A study conducted by Raj et al compared the outcomes of endoscopic transcanal myringoplasty and myringoplasty using microscope in 40 patients divided into 2 equal groups of 20 patients each.[26] There was no significant changes in hearing improvement post-operatively with respect to air bone gap in both the groups, graft healing was 90% in endoscopic surgery and 85% in microscopic surgery.[26] Yadav et al in their study of 50 patients studied about the endoscopic myringoplasty, grafting material used was temporalis fascia.[27] Graft uptake and improvement in air-bone gap was achieved in 80% of cases, they concluded that endoscopic myringoplasty is equally effective in small central perforation, however it is not effective in large perforation.[27] In our study also there was no significant difference in graft uptake and preoperative and postoperative air-bone gap. Microscopic and endoscopic tympanoplasty are equally effective. Study conducted by Harugop et al on a comparative study of endoscopy assisted myringoplasty and microscopy assisted myringoplasty concluded that in terms of cosmesis patients in endoscope group had better results.[28] Kumar et al presented that all patients in endoscopic group rated their cosmetic result as excellent.[25] In the conventional group 10 (33.3%) rated their cosmetic result excellent, 16 (53.3%) rated their cosmetic results satisfactory and 4 (13.3%) rated their cosmetic results as poor, therefore concluded that cosmesis in the postoperative endoscopic group was better than that of microscopic group.[25] In our study we noted that there was no postoperative visible scar in group B. The group A patients were left with a postauricular scar. Hence cosmetic results were better was better in group B. The time taken for the wound to heal in the group B was between 7-14 days and time taken for the wound to heal in the group A was between 7-30 days which was not significant. According to a study by Dundar the endoscopic tympanoplasty offered a wide and clean surgical view with minimal canal incision.[29] Ahmed et al presented that in endoscopic myringoplasty there was better visualization of the ossicular chain in patients with canal over hang. Hence there was less need for canaloplasty.[22] Lade et al in their study of 30 patients mentioned canaloplasty was done in 5 and external auditory canal curettage was done in 4 patients who undwent microscopic myringoplasty, but the 30 patients who underwent the endoscopic myringoplasty didn't require canaloplasty.[30] They concluded that the visualization of endoscopic tympanoplasty was better than that of microscopic tympanoplasty.[30] In a study conducted by Furukawa et al the circumference of the perforation could not be confirmed with a microscope before denuding in 12.0% of cases.[31] Furthermore, the entire perforation was not visible in 20.0% of cases after refreshing the edges.[31] In contrast, endoscopy can show the entire tympanic membrane in one field with clear visualization of the perforation edges, even when the ear canal is narrow or protruding.[31] In our study, we obtained results similar to those of the mentioned above. In our microscopic procedure, curettage of the chordal crest was performed to assess the ossicular system, and in few patients, canaloplasty was performed due to the prominence of the anterior wall. However, patients who underwent the endoscopic transcanal procedure hardly required extra interventions involving the external auditory canal. Dundar et al presented that time taken by microscopic tympanoplasty was more than that of endoscopic tympanoplasty, it could be due to time take for postauricular wound suturing.[29] Ahmed H observed the operative time for endoscopic myringoplasty was 49.76±3.18 minutes and 62.37±3.69 minutes for the microscope assisted.[22] In a study by Ghaffar et al, the mean operative time was 62.85 minutes for 34 patients who underwent endoscopic tympanoplasty.[32] In our study, the mean operative time among the 25 ears that received the endoscopic approach was 151.32 minutes, compared to 117 minutes for the microscopic approach; there was no significant difference in the two groups. The time taken for elevating the tympanomeatal flap and placing graft was comparatively more in endoscopic tympanoplasty because of the one hand technique and due to the inability to use the instruments and suction at the same time. Need for endoscope holder and special instruments (like micro suction elevator/ circular knife with suction) arises in endoscopic surgery, but this can be overcome with practice.[33] Karhuketo et al presented that there was least trauma to the normal tissues by endoscopic technique.[34] It was also presented that the perforation closure rate was 80%, and postoperative improvement of ABG was 7dB.[34] Furukawa presented that the perforation closure rate of the 25 ears that underwent endoscopic myringoplasty was of 84.0% with only one case of residual perforation. In our study residual perforation was seen in only 1 patient in microscopic approach and in 2 patients in endoscopic approach. Badr-El-Dine concluded that incorporating the endoscope into the surgical procedure contributes much to the concept of minimally invasive surgery.[35] Kakehata et al studied that the endoscopic method does not require extensive surgical exposure or drilling.[36] Tarabichi studied the endoscopic transcanal middle ear surgery and concluded that the wide angle view provides access to the middle ear cavity, sinus tympani, facial recess, epitympanum and hypotympanum.[37] In our study also it was recorded that visualization was better without any other invasive techniques in endoscopic tympanoplasty. Ayache reported a graft success rate of 96% in endoscopic tympanoplasty.[38] The graft success rate by endoscopic tympanoplasty in our study was 92%. Fabinyi et al concluded in their study that middle ear endoscopy should be considered a useful adjunctive or alternative method to microscopic surgical exploration for middle

ear pathology.[39] The duration of the operation is an important parameter in terms of the duration of anesthesia, the surgeon's concentration, and the increased risk of iatrogenic complications.[39] In our study the endoscopic approach gave results equal to those of the microscopic approach in terms of the cosmetic appearance, pain level, graft uptake and post-operative air-bone gap improvement. It was noted that visualization was better in endoscopic approach and very few patients required canaloplasty. However, endoscopic approach has several disadvantages, including a lack of sufficient microscopic magnification and focus, the need to perform one handed operations because the surgeon must use one hand to hold the endoscope, frequent contamination of the surgical site secondary to bleeding, and instrument crowding within the surgical area.[40] Endoscopic surgery offers 2D images, and 2D images lack depth perception thus, lifting the graft to make contact with the edge of the perforation will be difficult. However, improvements in full high-definition camera systems can provide much more delicate endoscopic views with better contrast to minimize these problems.[40]

CONCLUSION

Post-operative outcomes in terms of graft uptake and hearing improvement for both endoscopic and microscopic tympanoplasty were good and excellent tools for tympanoplasty. Very few cases required canaloplasty due to wide angle view and easy visualization of hidden areas by endoscopes. Post-operative cosmetic appearance is better in endoscopic tympanoplasty with no post auricular scar. Operative time in endoscopic tympanoplasty with comparison to microscopic tympanoplasty was not significant with almost equal results. In endoscopic technique one hand is occupied with endoscope it becomes difficult to use suction and instruments simultaneously which can be overcome by practice or by using an endoscope holder. Endoscopic 2D images lack depth perception. Operating with both hands and binocular vision are advantages of microscopic surgeries. Tympanoplasty using endoscope was found to be an effective method for management of dry central perforations of the tympanic membrane with results almost comparable to tympanoplasty done by using operating microscope.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Dhingra PL. Cholesteatoma and chronic suppurative otitis media. In: Diseases of the ear, nose and throat. 6th ed. Amsterdam: Elsevier; 2014:68.
2. Dhingra PL. Mastoid surgeries. In: Diseases of the ear, nose and throat. Diseases of the ear, nose and throat. 6th ed. Amsterdam: Elsevier; 2014:356.
3. Zollner F. The principles of plastic surgery of the sound-conducting apparatus. J Laryngol Otol. 1955;69(10):637-52.
4. Dornhoffer JL. Hearing results with cartilage tympanoplasty. Laryngoscope. 1997;107(8):1094-9.
5. Choi N, Yangseop N, Woori P, Jung JL, Sunhyun Y, Ji EC, et al. Comparison of endoscopic tympanoplasty to microscopic tympanoplasty. Clincal and Experimental Otorhinolaryngology. 2017;10(1):44-9.
6. Thomassin JM, Duchon-Doris JM, Emram B, Rud C, Conciatori J, Viloq P. Endoscopic ear surgery: initial evaluation. Ann Otolaryngol Chir Cervicofac. 1990;107(8):564-70.
7. Marchioni D, Alicandri-Ciufelli M, Piccinni A, Genovese E, Presutti L. Inferior retrotympanum revisited: an endoscopic anatomic study. Laryngoscope. 2010;120(9):1880-6.
8. Ayache S, Tramier B, Strunski V. Otoendoscopy in cholesteatoma surgery of the middle ear: what benefits can be expected?. Otol Neurotol. 2008;29(8):1085-90.
9. Migirov L, Shapira Y, Horowitz Z, Wolf M. Exclusive endoscopic ear surgery for acquired cholesteatoma: preliminary results. Otol Neurotol. 2011;32(3):433-6.
10. Thomassin JM, Korchia D, Doris JM. Endoscopic-guided otosurgery in the prevention of residual cholesteatomas. Laryngoscope. 1993;103(8):939-43.
11. Good GM, Isaacson G. Otoendoscopy for improved pediatric cholesteatoma removal. Ann Otol Rhinol Laryngol. 1999;108(9):893-6.
12. Presutti L, Marchioni D, Mattioli F, Villari D, Matteo AC. Endoscopic management of acquired cholesteatoma: our experience. J Otolaryngol Head Neck Surg. 2008;37(4):481-7.
13. Badr-el-Dine M. Value of ear endoscopy in cholesteatoma surgery. Otol Neurotol. 2002;23(5):631-5.
14. Tarabichi M. Endoscopic management of limited attic cholesteatoma. Laryngoscope. 2004;114(7):1157-62.
15. Marchioni D, Mattioli F, Matteo AC, Presutti L. Endoscopic approach to tensor fold in patients with attic cholesteatoma. Acta Otolaryngol. 2009;129(9):946-54.
16. Tarabichi M. Transcanal endoscopic management of cholesteatoma. Otol Neurotol. 2010;31(4):580-8.
17. Marchioni D, Villari D, Matteo AC, Piccinini A, Presutti L. Endoscopic open technique in patients with middle ear cholesteatoma. Eur Arch Otorhinolaryngol. 2011;268(11):1557-63.
18. Presutti L, Gioacchini FM, Matteo AC, Villari D, Marchioni D. Results of endoscopic middle ear surgery for cholesteatoma treatment: a systematic review. Acta Otorhinolaryngol Ital. 2014;34(3):153-7.
19. Dundar R, Kulduk E, Soy FK, Aslan M, Hanci D, Muluk NB. Endoscopic versus microscopic approach

to type 1 tympanoplasty in children. Int J Pediatr Otorhinolaryngol. 2014;78(7):1084-9.
20. Kozin ED, Gulati S, Kaplan AB, Lehmann AE, Remenschneider AK, Landegger LD. Systematic review of outcomes following observational and operative endoscopic middle ear surgery. Laryngoscope. 2015;125(5):1205-14.
21. Bottrill I, Perrault DF, Poe D. In vitro and in vivo determination of the thermal effect of middle ear endoscopy. Laryngoscope. 1996;106(2):213-6.
22. Ahmed A, Alam S, Hashmi SF, Hasan SA. A Prospective study comparing the results of endoscope assisted versus microscope assisted myringoplasty. Global Journal of Otolaryngology. 2016;1(4):5-9.
23. Sinha M, Hirani N, Khilnani AK. Comparison of endoscopic underlay and microscopic underlay tympanoplasty: a prospective research at a tertiary care centre in Gujarat. International Journal of otorhinolaryngology and Head and neck surgery. 2017;3(4):9-15.
24. Shoeb M, Gite V, Samir B, Shashikant M. Comparison of surgical outcomes of tympanoplasty assisted by conventional microscopic method and endoscopic method. Int J Otorhinolaryngol Head Neck Surg. 2016;2(4):184-8.
25. Kumar M, Kanaujia SK, Singh A. Comparative study of endoscopic vs conventional myringoplasty. Int J Otorhinolaryngol Clin. 2015;7(3):132-7.
26. Raj A, Ravi M. Endoscopic transcanal myringoplasty- a study. Indian J Otolaryngol Head Neck Surg. 2001;53(1):47-9.
27. Yadav S P Aggarwal N, Julaha M, Goel A. Endoscope assisted myringoplasty Singapore med J. 2009;50(5):510-2.
28. Harugop AS, Mudhol RS, Godhi RA. A comparative study of endoscope assisted myringoplasty and micrsoscope assisted myringoplasty. Indian J Otolaryngol Head Neck Surg. 2008;60(4):298-302.
29. Dundar R, Kulduk E, Soy FK, Aslan M, Hanci D, Muluk NB, et al. Endoscopic versus microscopic approach to type 1 tympanoplasty in children. Int J Pediatr Otorhinolaryngol. 2014;78(7):1084-9.
30. Coskun BU, Cinar U, Seven H, Ugur S, Dadas B. The effects of the incision types in myringoplasty operations on cosmesis. Eur Arch Otorhinolaryngol. 2006;263(9):820-2.
31. Furukawa T, Watanabe T, Ito T, Kubota T, Kakehata S. Feasibility and advantages of transcanal endoscopic myringoplasty. Otol Neurotol. 2014;35:140-5.
32. Ghaffar S, Ikram M, Zia S, Raza A. Incorporating the endoscope into mid-dle ear surgery. Ear Nose Throat J. 2006;85:593-6.
33. Jaimin P, Ranjan GA Yogesh G, Rahul, Jayman R, Pokhraj PS. Endoscopic tympanoplasty vs microscopic tympanoplasty in tubotympanic csom: a comparative study of 44 cases; International J Res Med Sc. 2015;3(8):1953-7.
34. Karhuketo TS, Ilomäki JH, Puhakka HJ. Tympanoscope-assisted myringoplasty. ORL J Otorhinolaryngol Relat Spec. 2001;63(6):353-8.
35. Badr-El-Dine M. Value of ear endoscopy in cholesteatoma surgery. Otology & Neurotology. 2002;23:631-5.
36. Kakehata S, Futai K, Sasaki A, Shinkawa H. Endoscopic transtympanic tympanoplasty in the treatment of conductive hearing loss: early results. Otol Neurotol. 2006;27(1):14-9.
37. Muaaz T. Endoscopic transcanal middle ear surgery: Indian J Otolaryngol Head Neck Surg. 2010; 62(1):6-24.
38. Ayache S. Cartilaginous myringoplasty: the endoscopic transcanal procedure. Eur Arch Otorhinolaryngol. 2013;270:853-60.
39. Fabinyi B, Klug C. A minimally invasive technique for endoscopic middle ear surgery. European Arch Oto-Rhino-Laryngology. 1997;254:S53-4.
40. Mohindra S, Panda NK. Ear surgery without microscope; is it possible. Indian J Otolaryngol Head Neck Surg. 2010;62:138-41.

Cite this article as: Rathod J, Vare R, Thomas A. Correlation between microscopic and endoscopic approach to tympanoplasty: a comparative study. Int J Otorhinolaryngol Head Neck Surg 2020;6:1787-92.