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Original Research Article

A comparative study of endoscopic assisted versus conventional middle ear and mastoid surgery at a tertiary care teaching hospital

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ABSTRACT

Background: Objectives were to compare outcomes, intra operative visualization and operative time duration in endoscopic assisted vs conventional middle ear and mastoid surgery.
Methods: This prospective comparative study was conducted in 50 patients; among them 25 cases were of endoscope assisted middle ear surgery and 25 cases with conventional microscopic middle ear surgery. A 4 mm diameter, 18 cm long rigid, zero-degree endoscope and operating microscope was used. Primary outcomes include mean average pre and post operative air-bone (A-B) gap, hearing thresholds, intra operative visualization and duration of surgery.
Results: Mean A-B gap closure for endoscopic assisted tympanoplasty was 12.76±6.00 dB, while it was 8.38±5.78 dB for non-endoscopic assisted tympanoplasty. The results were comparative. Mean intra-operative time duration for endoscopic assisted tympanoplasty was 70.23±4.17 min, while it was 77±9.80 min for non-endoscopic assisted tympanoplasty with statically significant difference between both groups (p=0.03). Graft uptake rate for endoscopic assisted tympanoplasty was 92.31% while it was 84.62% for non-endoscopic assisted tympanoplasty. Residual cholesteatoma remnant on endoscopy was found in 43.66% cases out of 12 mastoidectomy cases performed via endoscopic assistance.
Conclusions: The endoscope can be successfully applied to ear surgery for most of the ear procedures with a reasonable success rate both in terms of perforation closure and hearing improvement and with minimal exposure. Wide-field zero, 30 or 70° endoscope sallow visualization of hidden anatomic spaces and working around corners i.e., epitympanum, hypotympanum and retro tympanum for safe removal of cholesteatoma.

Keywords: Air-bone gap, Cholesteatoma, Endoscopic, Tympanoplasty, Mastoidectomy

INTRODUCTION

Ear surgery in modern otology has been changed a lot both in the scope and character of surgery after the introduction of the binocular operating microscope. The endoscope increases the surgeon's understanding of the disorder of cholesteatoma and its extension through the temporal bone and provides a wide field of view of the middle ear during the surgery compared to the microscope.[1] Rigid endoscopes with angles ranging from 0 to 70° and diameters of 2.7 to 4 mm are used for endoscopic ear surgery.

Benefits of using endoscopes in surgery are well described and relate mainly to their portability and ability to provide clear, high-quality images.[2] Endoscopes can also be used in theatre and the outpatient setting. In particular, the benefits for middle ear surgery include the ability to visualize poorly seen structures, such as the hypotympanum and sinus tympani, which are often an obstacle during the open technique approach. In addition,

their use via the permeatal approach in bypassing a narrow isthmus can provide direct access and a wide view into the middle ear for surgery. Benefits of using an endoscope can therefore decrease operating time due to the reduction in time need to gain access into the middle ear cleft and the subsequent closure at the end of the procedure.[3] The disadvantages of endoscopes used in ear surgery include operator dependence (especially in relation to the one-handed technique), restricted views from narrower endoscopes (e.g.; 2.7 mm as compared to 4 mm), the ability to manage complications such as bleeding within a narrower operating field, loss of depth perception, limited magnification, and the need for further training in their use.[2] Furthermore, when used solely in a permeatal approach, the surgeon must use a one-handed technique for instrumentation and there may be difficulty passing other instruments alongside, even in wide ear canals. Certainly, there is no scope for using the operating drill in its present form.[3] Endoscopic ear surgery can be applied to a variety of operations including; grommet insertion, myringoplasty, attic retractions, cholesteatoma surgery, stapedectomy, benign neoplasms of the middle ear and neuro-otological procedures.[4] In this region of Rajasthan very few studies were reported for middle ear surgery. This study was planned to compare outcomes, intra operative visualization and operative time duration in endoscopic assisted vs conventional middle ear surgery.

METHODS

This prospective comparative study was conducted in 50 patients; among them 25 cases were of endoscope assisted middle ear surgery and 25 cases with conventional microscopic middle ear surgery in RNT medical college, Udaipur, Rajasthan only after taking permission from institutional ethics committee. Informed consent was taken from all the patients.

Inclusion criteria

Cases of chronic otitis media, inactive mucosal disease for tympanoplsty, cases of chronic otitis media, active or inactive squamosal disease for mastoidectomy and patients with the age between 10 to 60 years were included.

Exclusion criteria

Cases of chronic otitis media with active discharge, patients with sensorineural hearing loss and patients with any other medical condition leading to unfit for the surgery e.g., cardiovascular disease was excluded from the study.

Data collection was carried out prospectively for endoscopic cases and non-endoscopic cases where all cases were performed within a one-year period (February 2017-February 2018).

Endoscope assisted tympanoplasty

All endoscope assisted tympanoplasty were done through the permeatal route. All were purely endoscopic and at no point of time the microscope was used. All patients had a 2 cm incision in the hairline, above the superior attachment of pinna to harvest the temporalis fascia graft. The endoscope was introduced through the external auditory canal and the edges of the perforation were freshened with a sickle knife. An incision was taken 5 mm from the tympanic annulus from 6'clock to 12'clock position with a circular knife. The tympanomeatal flap was elevated and kept superiorly with the flag knife and circular knife. Middle ear was visualized and ossicular status was checked (Figure 1). Dried temporalis fascia was placed by underlay technique and the tympanomeatal flap was replaced. Gel foam was placed to stabilize the graft.

Endoscope assisted cholesteatoma surgery

After completing surgery with conventional microscopic approach middle ear hidden areas were visualized by using endoscope and remaining disease was cleared with help of endoscope.

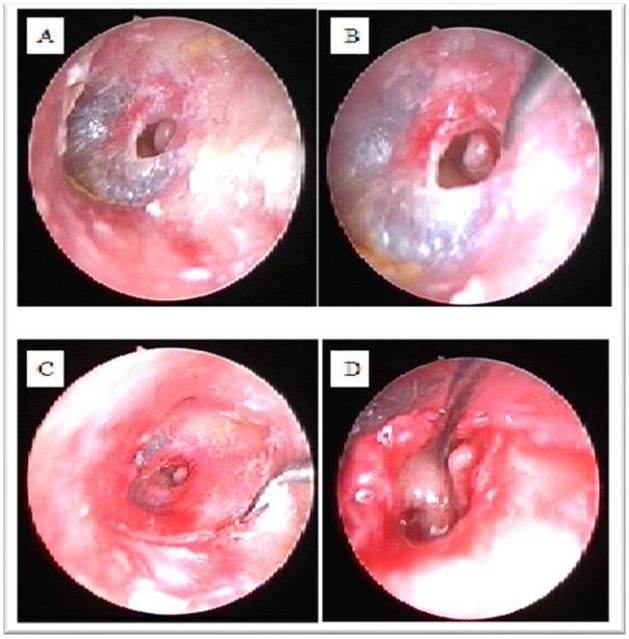

Figure 1 (A-D): Trans canal endoscopic view showing central perforation, trans canal endoscopic view freshening the margins of the perforation, trans canal endoscopic view showing elevation of the tympanomeatal flap and trans canal endoscopic view of incudo-stapedial joint and round window reflex.

Sutures were removed on 7th day. A 4 mm diameter, 18 cm long rigid, zero-degree endoscope and operating microscope was used in all ear surgery cases. Every patient was evaluated in an outpatient setting after 15 days, one month, two month and three months. On every

visit, patients were asked about subjective improvement in hearing and watched for development of any complications. Audiometric evaluation (PTA) was made at third postoperative month in every patient. Primary outcomes include mean average pre- and post-operative air-bone gap hearing thresholds. Intra operative visualization and duration of surgery was noted. Pre- and post-operative audiometric data using both air and bone conduction threshold (at 500 Hz, 1 KHz, 2 KHz frequencies) was compared.

Statistical analysis

The data was presented as number (percentage) or mean ± standard deviation wherever appropriate. Suitable statistical test was used to analyze the data. P<0.05 was considered significant.

RESULTS

Out of 25 cases; tympanoplasty was performed in 13 patients and mastoidectomy (canal wall up/canal wall down) performed in 12 patients both groups (Table 1).

In patient of endoscopic assisted tympanoplasty mean pre operative A-B gap was 29.61±10.19 dB while post operative mean A-B gap was 16.85±8.28 dB. In patient of non-endoscopic assisted tympanoplasty mean pre operative A-B gap was 25.76±9.82 dB while post operative mean A-B gap was 17.38±10.56 dB. In present study mean pre operative A-B gap was 40.11±3.13 dB and 35.76±4.42 dB for endoscopic assisted mastoidectomy and non-endoscopic assisted mastoidectomy respectively. While post operative mean A-B gap was 32.18±5.71 dB and 27.92±6.14 dB for endoscopic assisted mastoidectomy and non-endoscopic assisted mastoidectomy respectively (Table 2).

Table 1: Distribution of cases according to procedure.

Procedures	Endoscopic assisted, (Group A)	Non-endoscopic assisted, (Group B)
Tympanoplasty	13	13
Mastoidectomy	12	12
Total	25	25

In present study mean A-B gap closure for endoscopic assisted tympanoplasty was 12.76±6.00 dB, while 8.38±5.78 dB for non-endoscopic assisted tympanoplasty. Mean A-B gap closure for endoscopic assisted Mastoidectomy was 7.93±4.16 dB, while 7.84±3.27 dB for non endoscopic assisted mastoidectomy (Table 3).

In present study mean intraoperative time duration for endoscopic assisted tympanoplasty was 70.23±4.17 min, while 77±9.80 min for non-endoscopic assisted tympanoplasty. Mean intraoperative time duration for endoscopic assisted Mastoidectomy was 151.92±14.30 min, while 147.17±13.18 min for non-endoscopic assisted mastoidectomy (Table 3).

Table 2: A-B gap in tympanoplasty cases and mastoidectomy cases.

Variables	Pre operative (A-B gap) dB (Mean±SD)	Post operative (A-B gap) dB (Mean±SD)	Pre operative (A-B gap) dB (Mean±SD)	Post operative (A-B gap) dB (Mean±SD)
	Tympanoplasty cases		**Mastoidectomy cases**	
Endoscopic assisted (Group A)	29.61±10.19	16.85±8.28	40.11±3.13	32.18±5.71
Non-endoscopic assisted (Group B)	25.76±9.82	17.38±10.56	35.76±4.42	27.92±6.14
P value	0.18	0.84	<0.001*	<0.01*

*Significant.

Table 3: A-B gap closure at 3-month follow-up.

Variables	Closure (A-B gap) dB (Mean±SD)	P value	Intra-op duration (mins) (Mean±SD)	P value
Endoscopic assisted tympanoplasty	12.76±6.00	0.07	70.23±4.17	0.03*
Non-endoscopic assisted tympanoplasty	8.38±5.78		77.00±9.80	
Endoscopic assisted mastoidectomy	7.93±4.16	0.95	151.92±14.30	0.40
Non-endoscopic assisted mastoidectomy	7.84±3.27		147.17±13.18	

*Significant.

Residual cholesteatoma remnants on Endoscopy was found in 5 cases (43.66%) out of 12 mastoidectomy cases performed via endoscopy assistance. Residual cholesteatoma remnants was found in sinus tympani in 4 cases and in anterior attic space in one case.

Graft uptake rate for endoscopic assisted tympanoplasty was 92.31% while 84.62% for non-endoscopic assisted tympanoplasty. In present study dry cavity achieved in 91.67% (n=11) cases endoscopic assisted mastoidectomy (Group A) while 83.33% (n=10) in non-endoscopic assisted mastoidectomy cases.

DISCUSSION

The main objective of CSOM surgery is to achieve symptomatic relief, relieve drainage, rehabilitate hearing and minimize complication. The main advantages of the microscopic approach are stereo vision and bimanual handling. However, despite providing direct exposure, microscope requires frequent adjustment and may still not be sufficient when encountering protruding structures, particularly the anterior wall. Hidden area that cannot be seen under microscope can be better observed via thin rigid endoscope with different angles.[5]

In present study mean pre operative A-B gap was 29.61±10.19 dB and 25.76±9.82 dB for endoscopic assisted and non-endoscopic assisted tympanoplasty respectively. There were no significant differences between the two groups (p=0.18). Huang et al in 2016 studied 100 ears of 95 patients who underwent tympanoplasty and found similar results. Pre operative A-B gaps were 21.4±10.6dB and 21.6±11.2 dB, for non-endoscopic assisted tympanoplasty and endoscopic assisted tympanoplasty respectively. There were no significant differences between the 2 groups (p=0.93).[6]

In present study post operative mean A-B gap was 16.85±8.28 dB and 17.38±10.56 dB for endoscopic assisted tympanoplasty and non-endoscopic assisted tympanoplasty respectively. There were no significant differences between the two groups (p=0.84). Kumar et al in 2015 studied 60 patients 30 with conventional microscopic approach tympanoplasty and 30 with endoscopic assisted tympanoplasty and found similar results. Mean post- operative A-B gap was 16.03 dB and 15dB for conventional microscopic and endoscopic assisted myringoplasty respectively. There were no significant differences between both the two groups.[7]

In present study mean A-B gap closure for endoscopic assisted tympanoplasty was 12.76±6.00 dB, while 8.38±5.78 dB for non-endoscopic assisted tympanoplasty. There was no significant difference between both groups (p=0.07). Kanona et al in 2015 studied 70 patients and found similar results. There was a significant difference between pre- and post-operative mean air-bone gaps in both surgical groups (p=0.02).[2] They reported the mean A-B closure in the range of 10-30 dB in both groups that is supporting our study.

In present study mean intraoperative time duration for endoscopic assisted tympanoplasty was 70.23±4.17 min, while 77±9.80 min for non-endoscopic assisted tympanoplasty. There was a significant difference between both groups (p=0.03). Kanona et al in 2015 found similar results. They reported the shorter mean operating times in group A as compared to group B (non-endoscope assisted surgery), 85.8 min vs 107.8 min for group A vs B respectively.[2] Endoscopic tympanoplasty can take longer time duration than microscopic group in initial phase due to learning curve and less practice of surgeon with single handed surgery.

In our study graft uptake rate for endoscopic assisted tympanoplasty was 92.31%, while 84.62% for non-endoscopic assisted tympanoplasty which showed better outcome in endoscopic assisted group. Choi et al in 2016 reported graft success rate in the endoscopic tympanoplasty and microscopic tympanoplasty group was 100% and 95.8%, respectively, which was not statistically significant (p=0.304).[8] Hence graft uptake rate in endoscopic tympanoplasty were comparable to microscopic tympanoplasty.

In our study mean pre operative A-B gap was 40.11±3.13 dB and 35.76±4.42 dB for endoscopic assisted mastoidectomy and non-endoscopic assisted mastoidectomy respectively. While post operative mean A-B gap was 32.18±5.71 dB and 27.92±6.14 dB for endoscopic assisted mastoidectomy and non-endoscopic assisted mastoidectomy respectively. There was no significant difference between both groups. Mean A-B gap closure for endoscopic assisted mastoidectomy was 7.93±4.16 dB, while 7.84±3.27 dB for non-endoscopic assisted Mastoidectomy. There was no significant difference between both groups. Kanona et al also reported similar results; the mean A-B closure in range of 10- 30 dB and no significant difference between both groups.[2]

In our study mean intra operative time duration for endoscopic assisted mastoidectomy was 151.92±14.30 min, while 147.17±13.18 min for non-endoscopic assisted mastoidectomy. There is slightly higher time duration in endoscopic group because in endoscopic group endoscope was used after completion of work with microscope. Kanona et al reported mean operating time was shorter in group A (endoscopic) compared to group B (microscopic), 171 min *vs* 217.2 min respectively. Since total number of operations were not equal (n=15 vs n=10), it is unreliable to claim the difference between these figures is of clinical significance.[2]

In our study residual cholesteatoma remnant on endoscopy was found in 43.66%. Sajjadi et al present a retrospective chart review of 249 primary cholesteatoma cases and found similar results.[9] The objective was to evaluate the effectiveness of otoendoscopy in reducing the cholesteatoma remnant at the time of primary surgery. Endoscopy at the time of primary operation revealed a 22% incidences of hidden cholesteatoma remnants despite apparent total microscopic eradication in close cavity cases and, and 10% in open cavity cases.

Intra-operative endoscopic evaluation of patients with cholesteatoma has clearly demonstrated a significant reduction in "immediate remnants" of cholesteatoma at the time of the primary operation. However endoscopic resection of cholesteatoma following detailed microscopic surgery has reduced incidence of residual cholesteatoma. Sinus tympani remain a hot spot for residual cholesteatoma despite removal of the posterior ear canal wall.

In present study dry cavity achieved in 91.67% cases in endoscopic assisted mastoidectomy while 83.33% in non-endoscopic assisted mastoidectomy cases. This shows comparable results in both groups. Cholesteatoma can vary in anatomical spread and severity of disease. In widespread, severe cases, canal wall up mastoidectomy or modified radical mastoidectomy can be performed. Our case series shows a variation in the number of these procedures between both groups. Performing mastoidectomy exclusively with an endoscope is impossible, and therefore drawing comparisons between these groups is difficult, as the endoscope will not have been used during a proportion of surgery in endoscopic assisted.

The endoscopic technique in ear surgery undoubtedly gives better quality images and access to blind sacs around the middle ear space that would otherwise not have been visualized adequately using a microscope, irrespective of surgical approach. It is minimally invasive thus providing better cosmetic in patients who do not wish to have a scar.[2]

In present study, with the use of endoscope a postauricular incision was not required in any of the cases and the procedure could be completed satisfactorily through the trans-canal route in all the patients of endoscopic assisted tympanoplasty which is rarely possible with microscope. We were able to directly access the incudostepedial joint and ossicular continuity without bone curettage which is not possible in microscope alone.

Limitations

Main limitation was the small number in each group, with regard to the power of the study, alongside the groups being somewhat heterogeneous in the group of mastoids and tympanoplasty surgery. However, we need to group the surgeries into a grading from simple to complex and these groupings certainly serve to follow this. The groupings, like the above point, serve to illustrate the possibilities of the endoscope rather than to compare the surgeries themselves.

CONCLUSION

This study concluded that the endoscope can be successfully applied to ear surgery for most of the ear procedures with a reasonable success rate both in terms of perforation closure and hearing improvement and with minimal exposure. It offers an advantage of minimal exposure, thereby avoiding unnecessary incisions on the patient.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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