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Comparison of the outcomes of endoscopic versus microscopic approach in cholesteatoma surgery: a randomized clinical study

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Abstract

Background Endoscopic ear surgery is a new, less invasive otologic procedure. Since 1990s, it has been grown in prominence because of anatomical and physiological theories. It offers a view of hidden places, avoids mastoidectomies and endaural vertical and postauricular incisions, and has many other benefits over microscopic surgery. The purpose of this study was to distinguish the difference between the outcomes of microscopic and endoscopic cholesteatoma surgery.

Methods Eighty individuals who were diagnosed with cholesteatoma participated in this randomized clinical research. Patients were randomly allocated into two equivalent treatment groups. One group submitted to tympanoplasty via microscopic ear surgery and the other group had exclusive trans-canal endoscopic ear surgery. All patients had preoperative otomicroscopic and radiologic assessment to ensure cholesteatoma diagnosis. Audiological evaluations were also obtained.

Results There was no discernible difference in the tested groups' operational times, air-bone gaps, or air conduction. The endoscopic surgery group healed significantly more quickly than the microscopic surgery group (5.4 0.5 vs 7.7 0.5 weeks, $p > 0.001$). The frequency of residual lesions (5.0% vs 22.5%, $p = 0.023$) and recurrence (7.5% vs 27.5%, $p = 0.019$) was significantly lower in the endoscopic group of patients.

Conclusions When comparing healing times, rates of residual disease and rates of recurrence, endoscopic surgery clearly outperforms microscopic surgery. The endoscope encourages visualization and magnification of anatomy while being less invasive thanks to its improved picture quality, lighting, and capacity to "see around the corner." Additionally, a significant portion of viable mastoid tissues and healthy mucosa were preserved.

Keywords Endoscopic, Microscopic, Cholesteatoma, Surgery, Chronic suppurative otitis media

Background

Endoscopic ear surgery is a minimally invasive otologic surgery. The popularity of endoscopic ear surgery, which was first performed in the 1990s, has increased as a result of its anatomical and physiological theories [1]. Endoscopic ear surgery has various benefits over microscopic ear surgery, including avoiding mastoidectomies, postauricular incisions, and endaural vertical incisions [2].

Endoscopically, the usual transcanal procedure is possible by elevating a tympanomeatal flap. The posterior and anterior epitympanic spaces, the sinus tympani, the facial recess, and the hypotympanum can all be seen more clearly with the endoscopic technique. After cholesteatoma removal surgery, an endoscopy-mediated method can lessen residual cholesteatomas and recurrences [2].

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Endoscopes and traditional microscopic cholesteatoma elimination are valuable when used together, as has been extensively proven. In addition to procedures for cholesteatoma removal, tympanoplasty has been performed exclusively using an endoscopic method to encourage minimally invasive surgery [3].

But there are several drawbacks to endoscopic surgery. In endoscopic surgery, bimanual interference using both hands is not possible. In addition, endoscopic devices have the potential to injure tissue both directly and indirectly via heat from a light source [4].

Compared to traditional microscopic tympanoplasty, credible data on the efficacy and functional outcome of endoscopic tympanoplasty have been lacking [5].

The goal of this study is to assess and compare the outcomes of primary exclusive endoscopic ear surgery against microscopic ear surgery.

Methods

Eighty patients with chronic suppurative otitis media with cholesteatoma were enrolled in this randomized clinical study. The regional ethics committee approved the research protocol on August 26, 2020, and each patient completed an informed consent form before taking part.

All data generated or analyzed during this study are included in this published article.

Patients were randomly assigned to one of two therapy groups using computer-generated numbers and the sealed envelope method. The first group of patients ($n=40$) underwent microscopic tympanoplasty, while the second group ($n=40$) underwent just trans-canal endoscopic tympanoplasty.

All the patients in this study were put through preoperative otomicroscopic examination, audiological evaluation, and high-resolution CT scan of the petrous bone (Fig. 1). Rigid endoscopes (Storz, Germany) with an angulation of 0, 30, and 45°, a length of 14 cm, and an outer diameter of 3 mm and 4 mm were employed for endoscopic ear surgery and microscope for the microscopic group.

Surgical techniques

Using the endoscopes of ear surgery, the tympanomeatal flap is elevated. Access to the middle ear is completed by elevation of the tympanic anulus preferably in the inferior part pf the canal to prevent ossicles injury then continued superiorly to identify chorda tympani. Identifying the ossicles, round and oval windows, tympanic segment of the Fallopian canal, cochleariform process, and horizontal semicircular canal by removing the bony wall from the external auditory canal's attic section. The head of the malleus and the incus should be removed from degraded osseous structures, and the cholesteatoma matrix should be entirely removed (Fig. 2), performing cartilage tympanoplasty or grafting temporalis fascia using an underlay technique and correctly realigning the tympanomeatal flap. Gel foam was also tightly packed inside the external auditory canal. The same steps were done in the other group but the use of the microscope (Fig. 3). The patients are followed 1 week, 1 month after surgery, and 6 months later. The patients were assessed for hearing, pain, taste perception, and the healing period postoperatively.

Hearing is assessed using audiogram. Pain is scaled against pain assessment scale. The existence or absence of an anomalous subjective taste perception was used to define taste disorders. The healing period was calculated using otomicroscopic analysis and physical examination. It was described as the interval between the surgery, the successful tympanic transplant, and the patient's resumption of regular activities. An

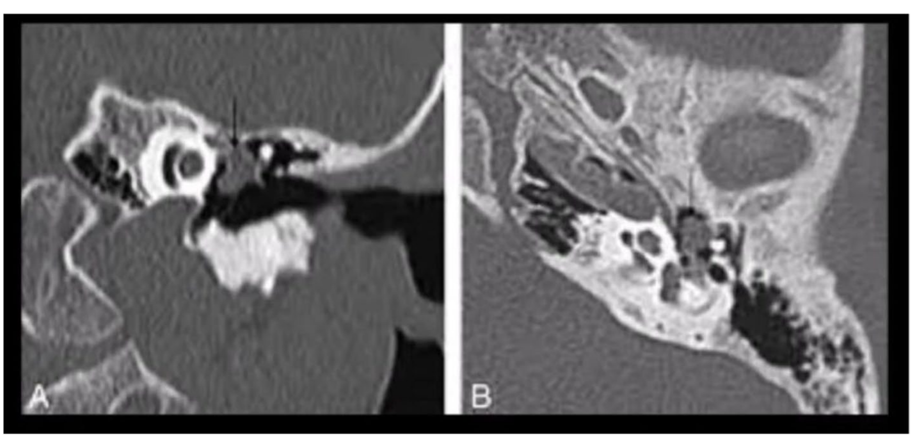

Fig. 1 CT scan of petrous bone shows middle ear cholestetoma. **A** Coronal view. **B** Axial view

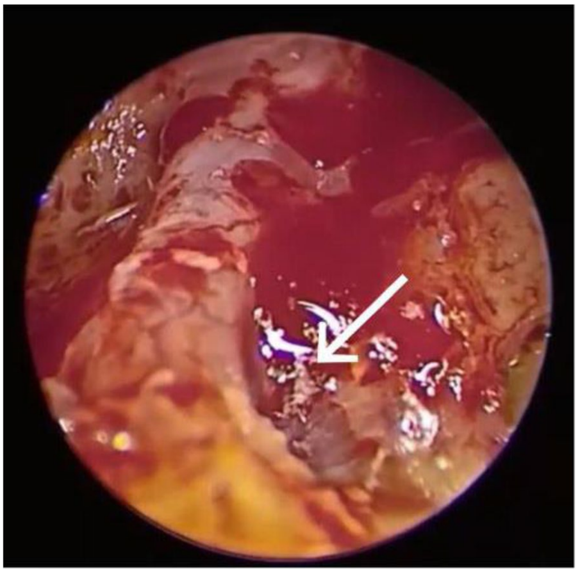

Fig. 2 A 30-degree endoscopic picture, white arrow denote residual cholesteatoma in sinus tympani not seen by microscope

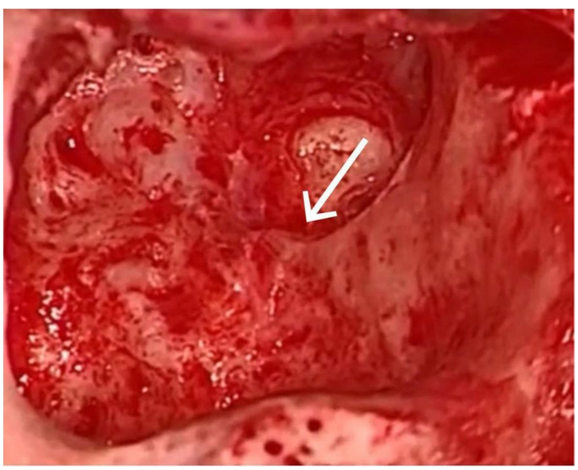

Fig. 3 Radical cavity after complete eradication of cholesteatoma, microscopic view

otomicroscopic examination was performed following surgery, typically every 15 days for the first 3 months and then at 6 months.

Statistical analysis is done using IBM Inc., Chicago, IL, USA's SPSS v26. An unpaired Student's *t* test was used to calculate the mean and standard deviation (SD) of the quantitative variables and compare them between the two groups. The chi-square or Fisher's exact tests were used, as appropriate, to analyze qualitative variables, which were reported as frequencies and percentages (%). Statistical significance was defined as a two-tailed *P* value of 0.05.

Table 1 Comparison between the studied groups regarding the demographic data and preoperative data

	Endoscopic surgery (*n* = 40)	Microscopic surgery (*n* = 40)	**P* value
Age (years)	39.4 ± 11.0	41.3 ± 7.7	0.38
Sex			
Male	28 (70.0)	24 (60.0)	0.35
Female	12 (30.0)	16 (40.0)	
Stage			
Attic	14 (35.0)	11 (27.5)	0.47
Extended	26 (65.0)	29 (72.5)	
AC	26.0 ± 6.9	25.5 ± 6.2	0.73
ABG	27.3 ± 5.5	24.9 ± 6.4	0.08
Otorrhea	12 (30.0)	18 (45.0)	0.17
Facial palsy	-	-	-
Dizziness	10 (25.0)	6 (15.0)	0.26

ABG air–bone gap, *AC* air-conduction, *Significant as *p* value < 0.5

Table 2 Comparison between the studied groups regarding the operative time and healing time

	Endoscopic surgery (*n* = 40)	Microscopic surgery (*n* = 40)	*P* value
Operative time (Hours)	3.0 ± 0.4	3.2 ± 0.6	0.2
Healing time (weeks)	5. 4 ± 0.5	7. 7 ± 0.5	**< 0.001***
ABG	19.6 ± 6.1	20.6 ± 4.7	0.42
AC	20.3 ± 4.4	18.8 ± 4.2	0.12

ABG air–bone gap, *AC* air-conduction

*reflecting the most significant *P* value

Results

The studied groups did not differ significantly in terms of age, sex distribution, or preoperative symptoms such as facial palsy, otorrhea, vertigo, air conduction, or air–bone gap (Table 1).

The mean operative time in the endoscopic surgery group was 3.0 ± 0.4 h in comparison to 3.2 ± 0.6 h in the microscopic surgery group with no statistically significant differences ($p = 0.2$). The short duration of healing was significantly found in the endoscopic surgery group in comparison to the microscopic surgery group (5.4 ± 0.5 versus 7.7 ± 0.5 weeks, $p = < 0.001$). Postoperatively, there were no significant differences between both studied groups regarding ABG (air–bone gap) and AC (air-conduction) (Table 2).

By follow-up, using diffusion-weighted MRI, patients in the endoscopic experienced a significantly lower frequency of residual lesions when compared with patients in the microscopic group (5.0% versus 22.5%, $p = 0.023$). There was a significantly lower recurrence rate in patients submitted to the endoscopic surgery in comparison to those submitted to microscopic surgery (7.5% versus 27.5%, $p = 0.019$) (Table 3).

Discussion

Regarding the operative time, there were no discernible variations between the analyzed groups in the current investigation. While Bae et al.'s study [6] indicated that endoscopic surgery was completed more quickly than microscopic surgery, which is consistent with our findings, other studies revealed that endoscopic surgery took a little bit longer [7].

Several factors influence operative time rather than the surgical technique itself. The complexity of the operated cases, the surgeons' experience, and their learning curve are the most crucial among these variables [7, 8].

Between the endoscopic and microscopic surgical groups, there were no discernible variations in post-operative ABG (19.6 6.1 versus 20.6 4.7 respectively, $p = 0.42$) or AC (20.3 4.4 versus 18.8 4.2, respectively, $p = 0.12$). These outcomes are consistent with earlier research [6, 7].

In this study, 50.0% and 57.5% of the endoscopic and microscopic groups, respectively, reported an aberrant taste experience without statistically significant differences ($p = 0.6$). These findings are consistent with the research of Magliulo and Iannella [7]. They discovered that there was no appreciable statistical difference between the two groups and that a transient abnormal taste sensation occurred in 30% and 40% of the endoscopic and microscopic groups, respectively.

In this study, the group that underwent endoscopic surgery recovered significantly more quickly than the group that underwent microscopic surgery (5.4 0.5 vs. 7.7 0.5 weeks, $p = 0.001$). These outcomes align with the findings of Magliulo and Iannella's [7]. Because the intervention was less invasive, it is expected that the endoscopic groups will heal more quickly.

In the current study, patients in the endoscopic group had a considerably lower frequency of residual lesions (5.0% versus 22.5%, $p = 0.023$) than patients in the microscopic group. These results support a recent meta-analysis that revealed endoscopic surgery patients had a decreased incidence of residual disease [9].

Furthermore, in the study of Sajjadi using endoscopic surgery, the rate of persistent cholesteatoma was 9.7%. The rate of remaining lesions was 8.3% in different research [10].

However, in other comparison investigations, the frequency of residual disease did not significantly differ between the two techniques. According to Marchioni et al. [11] residual illness was found in 19.3% (6 ears) of patients who underwent transcanal endoscopic treatment and in 34.4% (10 ears) of patients who underwent canal wall up microscopic treatment.

In the study by Hunter et al. [12], patients who underwent endoscopic and microscopic examinations experienced residual illness at rates of 20% and 40%, respectively. Another study found that the rate of residual cholesteatoma at second sight was 24% in patients in whom the endoscope was used only for inspection or not at all during initial resection, compared to 23% in patients in whom the endoscopic dissection was carried out [13].

The study by Ohki et al. [14], who used endoscopic inspection of common areas of cholesteatoma recurrence after microscopic ear surgery, demonstrated the benefit of the endoscopic over microscopic technique. According to their research, three of the 13 (23%) patients who underwent canal wall down (CWD) tympanomastoidectomy and six of the 14 (43%) patients who received canal wall up (CWU) tympanomastoidectomy both had residual matrix. The tegmen tympani, the medial scutal surface, the tympanic sinus, and the anterior epitympanic recess were among the sites of a residual matrix.

In the current study, individuals who underwent endoscopic surgery had a considerably lower recurrence rate than those who underwent microscopic surgery (7.5% versus 27.5%, $p = 0.019$). These findings are consistent with the prior meta-analysis of Han et al. [9].

In contrast, neither the investigations by Bae et al., Marchioni et al., nor those by Hunter et al. found any differences in significance between the recurrence rates in the investigated methodologies [6, 11, 12].

Table 3 Comparison between the studied groups regarding residual lesions and recurrent lesions

	Endoscopic surgery ($n = 40$)	Microscopic surgery ($n = 40$)	*P*-value
Complications n (%)	20 (50.0)	23 (57.5)	0.6
Residual lesions n (%)	2 (5.0)	9 (22.5)	**0.023***
Recurrent lesions n (%)	3 (7.5)	11 (27.5)	**0.019***

[*] Significant as *p* value < 0.5

Conclusions

In terms of recovery time, the likelihood of residual disease, and the likelihood of recurrence, endoscopic surgery clearly outperforms microscopic surgery. The endoscope's improved lighting and picture clarity, together with its capacity to "see around the corner," allowed for minimally invasive viewing and magnification of anatomy. Additionally, a sizable amount of functional mucosa and undamaged mastoid tissues are still present.

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Not applicable.

Authors' contributions
MA was mainly involved in doing the surgical part of the research. OA designed the work, acquisition, analysis, and interpretation of the data. MM prepared the patients preoperatively and followed their up postoperatively. AA was responsible for following and obtaining the pathology. All the authors approved the submitted version.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Each patient completed an informed consent form before taking part in the research. The research protocol also approved by ethical committees. The ENT Department, Faculty of Medicine, Cairo University ethics committee and Kasr AlAiny School of Medicine ethics committee approved the research protocol.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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