

## REVIEW

# Results of endoscopic middle ear surgery for cholesteatoma treatment: a systematic review

## *Risultati della chirurgia endoscopica dell'orecchio medio per il trattamento del colesteatoma: una revisione sistematica*

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## SUMMARY

Traditional surgery for cholesteatoma of the middle ear is performed by microscopic approaches. However, in recent years endoscopic instrumentation, techniques and knowledge have greatly improved, and in our opinion endoscopic surgical techniques will gain increasing importance in otologic surgery in the future. The aim of this study was to focus on outcomes obtained using endoscopic surgery for the treatment of middle ear cholesteatoma. A systematic review of the literature was performed. A total of 7 articles comprising 515 patients treated exclusively with endoscope or with a combined technique were found. During post-surgical follow-up, 48 (9.3%) patients showed a residual or recurrent pathology. Despite the small number of patients analyzed in our review, the outcomes of this technique appear to be promising. In particular, concerning the rates of recurrences and residual disease, endoscopic middle ear surgery appears to guarantee similar results in comparison to classic microscopic approaches with the advantage of performing minimally invasive surgery.

KEY WORDS: Cholesteatoma • Endoscopic ear surgery • Recurrence • Residual

## RIASSUNTO

*La chirurgia tradizionale per il colesteatoma dell'orecchio medio è praticata mediante approcci microscopici. Comunque durante gli anni più recenti la strumentazione endoscopica, le tecniche, e la coscienza sono nettamente migliorate, e secondo il nostro parere in futuro, le tecniche di chirurgia endoscopica acquisiranno importanza nella otocirurgia. L'obiettivo di questo studio è stato quello di focalizzare i risultati ottenuti mediante l'uso della chirurgia endoscopica nel trattamento del colesteatoma dell'orecchio medio. È stata eseguita una revisione sistematica della letteratura. Sono stati trovati un totale di sette articoli che comprendevano 515 pazienti trattati esclusivamente con l'endoscopia o con una tecnica combinata. Complessivamente durante il follow-up post chirurgico, 48 (9,3%) pazienti hanno mostrato una recidiva o un residuo di malattia. Nonostante il piccolo numero di pazienti analizzati nella nostra revisione, i risultati di questa tecnica sembrano essere promettenti. In particolare, riguardo alle percentuali di recidive e residui di malattia, la chirurgia endoscopica dell'orecchio medio sembra garantire risultati simili a confronto di quelli ottenuti con i classici approcci microscopici avendo però anche il grande vantaggio di poter eseguire una chirurgia mini invasiva.*

PAROLE CHIAVE: Colesteatoma • Chirurgia endoscopica • Recidiva • Residuo

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## Introduction

Surgical management of cholesteatoma is still a controversial issue. Classic concepts are based on microscopic surgical management, as is the traditional classification of open tympanoplasties-canal wall down (CWD) and closed tympanoplasties-canal wall up (CWU), depending on the preservation of the posterior ear canal wall. The choice between these two techniques is based on a number of factors, although in most cases, the main factors influencing the definitive attitude toward surgical management of cholesteatoma are experience, personal beliefs and confidence of each surgeon with each technique.

Starting in the 1990s, operative endoscopy was introduced in otologic surgery <sup>1</sup>, and significantly changed not only

surgical concepts <sup>2</sup> but also anatomic and physiologic concepts <sup>3</sup>, and has become increasingly popular during the last 15 years.

Since the introduction of this instrument, the concept of a minimally invasive approach in middle ear surgery is changing. Endoscopic middle ear surgery can offer some advantages compared to the traditional microscopic technique, guaranteeing excellent visualization of mesotympanic structures and direct visual control of hidden areas such as anterior epitympanic spaces, retrotympanum and protympanum.

Nonetheless, when a new technique is introduced, evaluation of results is essential to its acceptance by the scientific community. The aim of present paper was to

perform a systematic literature review, which may help to better understand the results associated with endoscopic techniques (both used exclusively and in combination with microscopic approaches) in treatment of cholesteatoma.

## Materials and methods

### Search strategy

This systematic review sought to answer the question: is endoscopic ear surgery effective in treatment of middle ear cholesteatoma? A structured search of the literature was performed on PUBMED with the following search terms: “middle ear cholesteatoma” and “endoscopic ear surgery”.

After running the above-search terms, abstracts and titles were obtained. The titles and abstracts of the search results were screened and articles eligible for further review were identified.

Inclusion criteria for abstracts were:

- article describing the results of endoscopic ear surgery (alone or in association with the operating microscope) for treatment of middle ear cholesteatoma;
- English language;
- original papers.

Exclusion criteria for abstracts were:

- clearly unrelated pathologies of the ear;
- no original analysis (e.g. reviews) or animal or other basic science laboratory studies.

The full texts of the articles identified were obtained for a second screening, in order to select studies for inclusion.

Inclusion criteria for full-text articles identified were:

- diagnosis of middle ear cholesteatoma;
- use of endoscopic middle ear surgery alone or combined with microscopic techniques;

Exclusion criteria for full-text articles identified were:

- lack of definitive diagnosis of cholesteatoma;
- lack of sufficient clinical data;
- redundant cohorts of patients that were already reported by the same authors.

A further manual check was performed on the references included within articles. The final number of articles included in the present review was identified, and the main information was extracted and summarized.

## Results

Running the above-search string in PubMed, 72 articles were identified. After an initial check, full-text retrieval and manual cross-checking of references included within the articles, 7 studies, published between 2002 and 2013 (comprising a total of 515 patients and 517 surgeries overall) clearly met inclusion criteria and were chosen for the analysis (Table I).

All articles analyzed only patients suffering from middle ear cholesteatoma with no history of previous ear surgeries. The disease status at last control was available in all patients, and the mean follow time was 23.4 months (range, 11-43 months). Analyzing the articles chosen for our review, it can be noted that three authors (Tarabichi, Migirov and Barakate) exclusively performed transcanal endoscopic surgeries, while in the other five reports a combined technique was also applied if necessary.

**Table I.** Main characteristics of the selected studies.

Authors	Year	N. patients	Mean age	Type of surgery		Residual	Recurrence	Mean follow-up (months)
				Exclusive endoscopic transcanal TPL	Microscopic TPL assisted by endoscopy			
Ayache et al. <sup>23</sup>	2008	80	N/A	0	80	11	N/A	17
Marchioni et al. <sup>22</sup>	2013	146	N/A	120	26	7	4	31
Badr-El-Dine <sup>24</sup>	2002	92	N/A	0	92	2	3	11
Tarabichi <sup>7</sup>	2004	69	N/A (4-51)	69	0	0	5	43
Migirov et al. <sup>25</sup>	2011	30	N/A	30	0	0	0	12
Barakate and Bottrill <sup>26</sup>	2008	66	18 (5-63)	68*	0	10	4	16
Presutti et al. <sup>27</sup>	2008	32	34	6	26	2	0	34
Total N.		515		293	224	32	16	

N/A: not available; TPL: tympanoplasty; \*68 operations performed on 66 patients.

Overall, exclusive endoscopic management of the pathology was obtained in 293 (57%) cases, while 224 (43%) operations were performed with a combined technique.

During the follow-up period, a total of 48 patients showed residual pathology: in particular, 32 patients had residual disease, while 16 patients presented with a recurrence of cholesteatoma.

## Discussion

The exposure and visualization of the entire middle ear space are sometimes difficult using only microscopic vision. With recent advances in minimally-invasive surgery, the use of the endoscope has led to new treatment options for middle ear pathologies<sup>4,5</sup>. Moreover, the anatomy of the middle ear is particularly complex and an endoscopic approach represents an improvement with regard to the anatomic concepts of this region because it guarantees round-the-corner views of hidden areas such as the sinus tympani, facial recess, anterior epitympanic spaces, attic, hypotympanum and protympanum<sup>6</sup>. Cholesteatoma surgery primarily aims to eradicate the disease process and provide the patient with a safe and dry ear. The main problems regarding attic cholesteatoma removal are residual and recurrence. The former is due to insufficient primary resection of the epidermal matrix, and classically presents a pearl-like aspect. Insufficient resection may be due to a very fine epidermal matrix or middle-ear inflammation, in addition to limited exposition of hidden areas such as the epitympanic space and sovratubal recess. Actually, the view during microscopic surgery is defined and limited by the narrowest segment of the ear canal; this basic limitation has forced surgeons to create a parallel port through the mastoid to gain keyhole access to the attic. Despite the illumination and magnification offered by the operating microscope, it has distinct limitations.

The persistence of physiopathologic phenomena that determined cholesteatoma development, presents as a new attic retraction that requires a further surgical approach to avoid the reformation of attic cholesteatoma.

Recurrence consists in a new, dangerous tympanic retraction pocket caused by inadequate reconstruction of the scutum and tympanic loss of substance inducing persistence of the physiopathologic process of middle-ear depression.

While recurrence can be diagnosed otoscopically, residual cholesteatoma is classically independent of the eardrum and only surgical revision can determine definite diagnosis; this is the rationale of second look procedures, in addition to functional issues.

This review focuses on surgical improvements related to the mini-invasive treatment of middle ear cholesteatoma. At the moment, the main treatment options for this pathology are two basic, well-standardized microscopic surgical

procedures: canal wall-down (CWD) and the canal wall-up (CWU) mastoidectomy with tympanoplasty. Both these traditional approaches to the attic have mainly provided limited access through postauricular mastoidectomy, with many surgeons using the ear canal to access the anterior part of the attic<sup>7</sup>. The intact canal wall approach has traditionally been favoured for its simpler postoperative care and maintenance<sup>8</sup>. Moreover, by preserving the anatomy of the middle ear, the cavity is permitted to get wet and, thereby, does not limit patients in future activities<sup>9</sup>.

However, many surgeons have noted high rates of recurrent and residual disease using this approach, and thus advocate a staged or 'second-look' procedure that occurs months to years after the first<sup>10,11</sup>. Because of these disadvantages, others prefer to remove the posterior canal in their treatment of cholesteatoma<sup>12,13</sup>. This group conjectures that improved visualization of the disease and affected middle ear anatomy, including the sinus tympani and anterior attic that are the most frequent sites of residual cholesteatoma in traditional intact canal wall surgery<sup>14,15</sup>, result in greater long-term disease-free states.

Although open tympanoplasty decreases the rate of recurrence, nevertheless, in our opinion, the removal of the posterior canal does not always ensure complete visualization of sinus tympani that often remain hidden from surgical view. This situation may strongly be connected with the high rate of residual disease observed after this procedure. These observations suggest that there is no single procedure to treat all cases of cholesteatoma, and that the otologic surgeon should be flexible in choosing a procedure depending on the individual case.

Literature data show that recurrent cholesteatoma is still observed in nearly 20% of CWU tympanoplasties, with an overall relapse rate of up to 70%, while open techniques are often accredited with a rate of residual disease of less than 7% and nearly no recurrent disease<sup>16</sup>.

Gaillardin et al.<sup>17</sup> after a mean follow-up of 48 months (range, 24-96 months) found a rate of residual disease of 25% considering cholesteatomas in 113 ears operated with a closed canal wall-up tympanoplasty. Mishiro et al.<sup>18</sup> described recurrent cholesteatoma in 19.4% of ears treated with closed tympanoplasty. Haginomori et al.<sup>19</sup> performed 85 canal wall-down tympanoplasties and observed 18 (21%) residual cholesteatomas after 1 year at second-look. Over a follow-up period ranging from 4 to 15 years (mean follow-up, 8 years), de Zinis et al. observed only 4 (2.1%) residual cholesteatomas and no recurrent cholesteatomas among 189 ears treated with CWD tympanoplasty for cholesteatoma of the middle ear. Nevertheless, 17 patients (9.0%) developed small keratin pearls, while recurrent otorrhoea and mastoid cavity granulation tissue formation occurred in 10 cases (5.2%). Sanna et al.<sup>20</sup> evaluated 222 cases of cholesteatomas operated with their modified Bondy's technique: they reported a pearl-like residual cholesteatoma in 7.4% of ears, while

no recurrence was discovered over a mean follow-up of 7.8 years (range, 5-16 years).

In their meta-analysis performed on 13 studies including a total of 4720 patients, Tomlin et al.<sup>21</sup> demonstrated that, when realized as a single-stage surgery, an intact canal wall approach to cholesteatoma treatment has nearly 3 times greater likelihood of recurrence than a canal wall down surgery.

In general, only 2 of the studies reported no significant differences between the two techniques, while 11 of the 13 data sets statistically favoured the canal wall down approach. However, the rate of cholesteatoma recurrence depends not only on the follow-up period, surgical methods and surgical techniques, but also in the methods used for statistical analysis. For this reason, Mishiro et al.<sup>18</sup> analyzed the recurrence rate of cholesteatoma after 345 interventions of tympanoplasty (n = 113, CWD; n = 232, CWU) using Kaplan-Meier survival analysis. After a mean follow-up period of 5 years, the recurrence rate (comprising residual and recurrent cholesteatomas) was 11.8% although the authors underlined how the follow-up rates of patients decreased during the time after surgery (93.3% after 1 years, 78.3% after 3 years, 70.1% after 5 years).

In our opinion, this observation represents an important point of view that authors should always keep in mind to obtain a more correct analysis of surgical outcomes. In fact, the data of many reports may be affected/altered by the number of patients who dropped out from clinical follow-up.

Regarding the data in our review, the high rate of exclusive endoscopic transcanal procedures performed (57%) should be noted in comparison of the lower rate of combined approaches requiring mastoidectomy (43%). Another point of interest is the rate of residual disease and recurrences that appear lower compared to data reported in the literature for canal wall up interventions performed exclusively by mean microscopy. These promising results seem to confirm the usefulness of the endoscope in terms of outcomes.

The main limitations related to the seven studies analyzed in our review are the short time of follow-up and the limited number of patients treated by the authors. In fact, with the exception of Tarabichi et al.<sup>7</sup> there is no report showing a follow-up greater than three years, and only Marchioni et al.<sup>22</sup> reported a cohort larger than 100 patients. In general, both these issues are closely connected with the recent introduction of endoscopic middle ear surgery that needs more time to reach a sufficient number of cases and an adequate time of follow-up.

Nevertheless, from studies analyzed in our review, the endoscope appears to allow an important reduction of unnecessary mastoidectomies in cases of cholesteatoma limited to the middle ear cavity, favouring the increase of exclusive transcanal middle ear surgeries. Moreover, in cases of pathologies involving the mastoid, endoscopic assistance may promote the choice of canal wall up proce-

dures limiting the rate of recurrences and residual disease typically associated with this approach.

## Conclusions

On the basis of literature data, canal wall down tympanoplasty still remains the most effective procedure in preventing recurrent disease after a single-stage surgery. Nevertheless, because the surgical approach depends on patient preference and lifestyle factors, the maintenance of posterior ear canal should be achieved in young patients, and the endoscopic technique may represent an important tool in obtaining this aim. Our review appears to confirm the importance of this tool in middle ear surgery. Obviously further reports are still needed to confirm and integrate this initial data, increasing the number of patients and organizing an accurate follow-up method to avoid the "drop out" issues.

## References

- 1 Thomassin JM, Duchon-Doris JM, Emram B, et al. *Endoscopic ear surgery. Initial evaluation*. Ann Otolaryngol Chir Cervicofac 1990;107:564-70.
- 2 Marchioni D, Alicandri-Ciufelli M, Molteni G, et al. *Ossicular chain preservation after exclusive endoscopic transcanal tympanoplasty: preliminary experience*. Otol Neurotol 2011;32:626-31.
- 3 Marchioni D, Alicandri-Ciufelli M, Molteni G, et al. *Selective epitympanic dysventilation syndrome*. Laryngoscope 2010;120:1028-33.
- 4 Marchioni D, Villari D, Alicandri-Ciufelli M, et al. *Endoscopic open technique in patients with middle ear cholesteatoma*. Eur Arch Otorhinolaryngol 2011;268:1557-63.
- 5 Marchioni D, Alicandri-Ciufelli M, Gioacchini FM, et al. *Transcanal endoscopic treatment of benign middle ear neoplasms*. Eur Arch Otorhinolaryngol 2013;270:2997-3004.
- 6 Marchioni D, Alicandri-Ciufelli M, Piccinini A, et al. *Inferior retrotympanum revisited: an endoscopic anatomic study*. Laryngoscope 2010;120:1880-6.
- 7 Tarabichi M. *Endoscopic management of limited attic cholesteatoma*. Laryngoscope 2004;114:1157-62.
- 8 Tos M, Lau T. *Hearing after surgery for cholesteatoma using various techniques*. Auris Nasus Larynx 1989;16:61-73.
- 9 Nikolopoulos TP, Gerbesiotis P. *Surgical management of cholesteatoma: the two main options and the third way - atticotomy/limited mastoidectomy*. Int J Pediatr Otorhinolaryngol 2009;73:1222-7.
- 10 Ho SY, Kveton JF. *Efficacy of the 2-staged procedure in the management of cholesteatoma*. Arch Otolaryngol Head Neck Surg 2003;129:541-5.
- 11 Syms MJ, Luxford WM. *Management of cholesteatoma: status of the canal wall*. Laryngoscope 2003;113:443-8.
- 12 Nyrop M, Bonding P. *Extensive cholesteatoma: long-term results of three surgical techniques*. J Laryngol Otol 1997;111:521-6.
- 13 Quaranta A, Cassano P, Carbonara G. *Cholesteatoma surgery:*

- open vs closed tympanoplasty*. Am J Otol 1988;9:229-31.
- 14 Hulka GF, McElveen JT Jr. *A randomized, blinded study of canal wall up versus canal wall down mastoidectomy determining the differences in viewing middle ear anatomy and pathology*. Am J Otol 1998;19:574-8.
  - 15 Palva T. *Surgical treatment of chronic middle ear disease. II. Canal wall up and canal wall down procedures*. Acta Otolaryngol 1987;104:487-94.
  - 16 de Zinis LO, Tonni D, Barezzani MG. *Single-stage canal wall-down tympanoplasty: long-term results and prognostic factors*. Ann Otol Rhinol Laryngol 2010;119:304-12.
  - 17 Gaillardin L, Lescanne E, Morinière S, et al. *Residual cholesteatoma: prevalence and location. Follow-up strategy in adults*. Eur Ann Otorhinolaryngol Head Neck Dis 2012;129:136-40.
  - 18 Mishiro Y, Sakagami M, Okumura S, et al. *Postoperative results for cholesteatoma in children*. Auris Nasus Larynx 2000;27:223-6.
  - 19 Haginomori S, Takamaki A, Nonaka R, et al. *Residual cholesteatoma: incidence and localization in canal wall down tympanoplasty with soft-wall reconstruction*. Arch Otolaryngol Head Neck Surg 2008;134:652-7.
  - 20 Sanna M, Facharzt AA, Russo A, et al. *Modified Bondy's technique: refinements of the surgical technique and long-term results*. Otol Neurotol 2009;30:64-9.
  - 21 Tomlin J, Chang D, McCutcheon B, et al. *Surgical technique and recurrence in cholesteatoma: a meta-analysis*. Audiol Neurootol 2013;18:135-42.
  - 22 Marchioni D, Villari D, Mattioli F, et al. *Endoscopic management of attic cholesteatoma: a single-institution experience*. Otolaryngol Clin North Am 2013;46:201-9.
  - 23 Ayache S, Tramier B, Strunski V. *Otoendoscopy in cholesteatoma surgery of the middle ear: what benefits can be expected?* Otol Neurotol 2008;29:1085-90.
  - 24 Badr-el-Dine M. *Value of ear endoscopy in cholesteatoma surgery*. Otol Neurotol 2002;23:631-5.
  - 25 Migirov L, Shapira Y, Horowitz Z, et al. *Exclusive endoscopic ear surgery for acquired cholesteatoma: preliminary results*. Otol Neurotol 2011;32:433-6.
  - 26 Barakate M, Bottrill I. *Combined approach tympanoplasty for cholesteatoma: impact of middle-ear endoscopy*. J Laryngol Otol 2008;122:120-4.
  - 27 Presutti L, Marchioni D, Mattioli F, et al. *Endoscopic management of acquired cholesteatoma: our experience*. J Otolaryngol Head Neck Surg 2008;37:481-7.

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