

Endoscopic Versus Microscopic Type I Tympanoplasty for Chronic Otitis Media: A Systematic Review and Meta-Analysis of Graft Uptake, Hearing Outcome and Operative Time

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Received: 22-06-2022 Revised: 11-07-2022 / Accepted: 15-08-2022

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Conflict of interest: Nil

Abstract

Background: Transcanal endoscopic tympanoplasty avoids a postauricular incision and gives a wide view of the tympanic membrane, but it is a one-handed technique. Earlier meta-analyses relied mostly on retrospective series. This review compared endoscopic and microscopic type I tympanoplasty in randomised and prospective comparative studies published before 2023.

Methods: PubMed was searched for studies published up to 31 December 2022. Randomised controlled trials and prospective comparative studies of endoscopic versus microscopic type I tympanoplasty or myringoplasty in chronic otitis media were eligible. Primary outcomes were graft uptake, air-bone gap (ABG) gain and operative time. Risk ratios (RR) and mean differences (MD) were pooled with a DerSimonian-Laird random-effects model. Risk of bias was assessed with RoB 2 or ROBINS-I, and certainty with GRADE.

Results: Of 59 records, 12 studies (9 randomised, 3 prospective) with 991 patients were included. Graft uptake was 94.0% (407/433) with the endoscope and 92.1% (395/429) with the microscope (9 studies; RR 1.03, 95% CI 0.99 to 1.06; $I^2 = 0\%$). The result was unchanged when only randomised trials were analysed (RR 1.01, 0.96 to 1.06). ABG gain did not differ (4 studies; MD -0.91 dB, -3.36 to 1.53; $I^2 = 76\%$). Operative time was shorter with the endoscope (2 studies with SDs; MD -17.0 min, -24.5 to -9.5; $I^2 = 79\%$), and 8 of 9 studies that reported operative time found the endoscopic operation shorter. Studies also reported less postoperative pain, no need for canalplasty and better cosmesis with the endoscopic approach.

Conclusion: Endoscopic type I tympanoplasty gives graft uptake and hearing results similar to the microscopic operation, with a shorter operating time and less morbidity. The certainty of evidence is moderate for graft uptake and low for hearing gain and operative time. Endoscopic tympanoplasty is a reasonable first choice for suitable perforations when the surgeon is trained in the technique.

Keywords: Chronic otitis media; Endoscopic ear surgery; Myringoplasty; Tympanoplasty; Graft uptake; Air-bone gap; Meta-analysis.

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Introduction

Chronic suppurative otitis media is a common cause of preventable hearing loss. A global systematic review estimated an incidence of 4.76 per 1000 people, or about 31 million cases each year, with most of the burden in low-income countries [1]. In the mucosal or inactive form of the disease, type I tympanoplasty (myringoplasty) closes the perforation, stops recurrent discharge and improves hearing. For decades this operation has been done under the operating microscope, usually through a postauricular or endaural approach.

The rigid endoscope offers a different view. It shows the whole tympanic membrane and the anterior parts of the canal without moving the patient or the microscope, and it reaches areas

hidden from the straight line of the microscope, such as an anterior perforation or the hypotympanum [2]. Its drawbacks are one-handed surgery, loss of depth perception and a learning curve [2,3]. A systematic review of endoscopic middle ear surgery found that most of the evidence came from retrospective case series and that data comparing endoscope and microscope outcomes were lacking [4].

Several meta-analyses have since compared the two approaches [5-8]. They found similar graft uptake and hearing results, but they pooled mostly retrospective studies, and their findings on operative time were inconsistent. Many retrospective series compare an early endoscopic experience with an established microscopic

practice, so selection and learning effects are hard to separate [9-11]. This systematic review and meta-analysis therefore compared endoscopic and microscopic type I tympanoplasty for chronic otitis media using only randomised and prospective comparative studies published before 2023. The main outcomes were graft uptake, hearing gain and operative time.

Materials and Methods

Protocol and Reporting: The review was reported according to the PRISMA 2020 statement [12]. The protocol was not registered in advance.

Eligibility Criteria: Studies were included if they met all of the following criteria. (1) Design: randomised controlled trial or prospective comparative study with concurrent groups. (2) Population: patients with chronic otitis media of the mucosal (inactive, tubotympanic) type, or a dry central perforation, undergoing type I tympanoplasty or myringoplasty. (3) Intervention: exclusive endoscopic tympanoplasty, usually by the transcanal route. (4) Comparator: microscopic tympanoplasty by any approach. (5) Outcomes: at least one of graft uptake, hearing gain or operative time. (6) Publication: full report in English in a PubMed-indexed journal, with a publication date up to 31 December 2022. Retrospective studies, case series, studies of cholesteatoma or ossicular reconstruction in which type I data could not be separated, reviews, letters and conference abstracts were excluded.

Information Sources and Search: PubMed was searched on 20 October 2026 for records published up to 31 December 2022. The search combined title terms for the endoscope (endoscope, endoscopic) and the microscope (microscope, microscopic) with tympanoplasty or myringoplasty. Records with a journal issue date after 2022 were excluded at screening.

Study Selection and Data Extraction: Titles and abstracts were screened, and the full text of each potentially eligible report was assessed against the criteria. Selection and data extraction were done by the author, and every extracted value was checked a second time against the source. The following data were extracted: design, number of patients or ears in each group, type of perforation, surgical approach and graft, follow-up, graft uptake, air-bone gap (ABG) before and after surgery or ABG gain, operative time, postoperative pain,

canalplasty and cosmetic outcome. Free full texts were used where available; otherwise data were taken from the abstract. Where graft uptake was reported only as a percentage, the number of successes was calculated from the percentage and the group size. Where residual perforations were reported, graft uptake was taken as the number of ears without perforation at final follow-up.

Risk of Bias Assessment: Randomised trials were assessed with the revised Cochrane tool (RoB 2) [13] and prospective non-randomised studies with ROBINS-I [14]. Judgements were based on the published reports.

Statistical Analysis: Graft uptake was expressed as a risk ratio (RR) and ABG gain and operative time as mean differences (MD), each with a 95% confidence interval (CI). An RR above 1 favours the endoscopic operation, and a negative MD for operative time means a shorter endoscopic operation. Outcomes reported by at least two studies with the required data were pooled with the inverse-variance method and a DerSimonian-Laird random-effects model [15].

Heterogeneity was measured with the I^2 statistic [16]. Continuous outcomes were pooled only when a mean and standard deviation (SD) were given for both groups; other values were summarised descriptively. In the bilateral same-patient trial, ears were treated as independent groups, which gives a conservative estimate.

Sensitivity analyses repeated the graft uptake analysis with randomised trials only and with each study left out in turn. Small-study effects were examined with the Egger test [17], which has low power with fewer than ten studies. Certainty of evidence was rated with GRADE [18]. Analyses were run in Python 3 (NumPy and SciPy), and a p value below 0.05 was taken as significant.

Results

Study Selection: The search found 59 records. After screening, 39 full-text reports were assessed, and 12 studies met the criteria: nine randomised trials [19-27] and three prospective comparative studies [28-30]. Most of the 27 excluded reports were retrospective; one report described as a clinical trial was a retrospective review on full-text reading [11]. The selection process is shown in Figure 1.

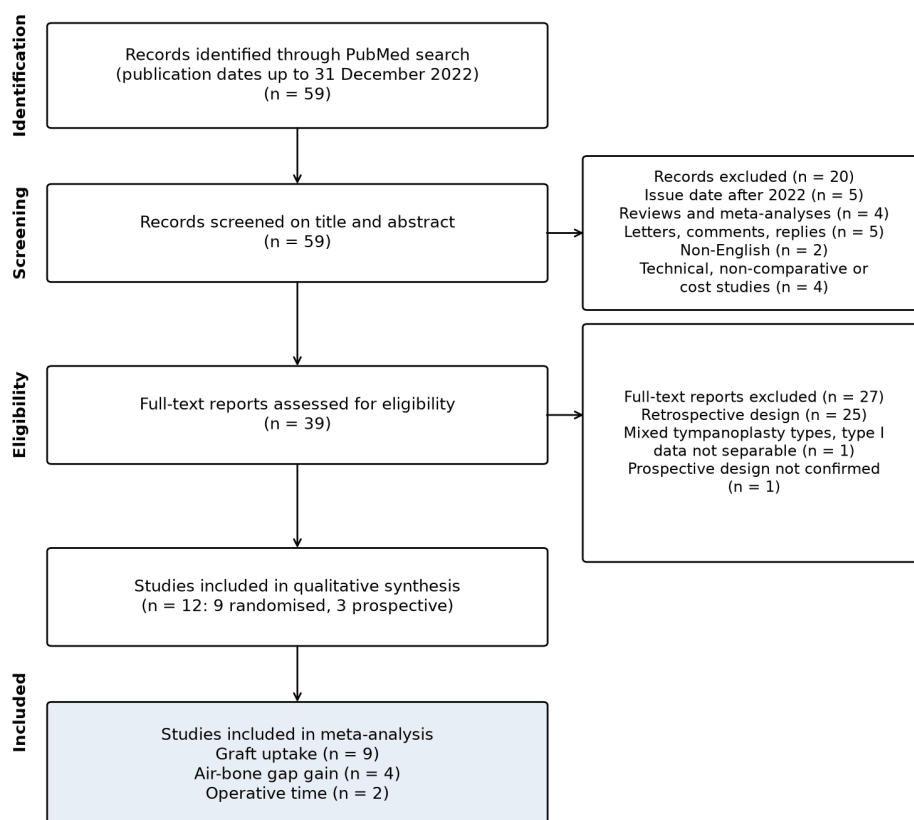


Figure 1: PRISMA 2020 flow diagram of study selection

Characteristics of the Included Studies: The 12 studies included 991 patients. Nine were done in India, and one each in Egypt, Thailand and Turkey. Group sizes ranged from 13 to 156 patients. One trial operated on the two ears of the same 13 patients, one with each technique, six months apart [21]. Most studies used temporalis fascia through a

transcanal endoscopic approach and compared it with a postauricular microscopic approach.

One trial used overlay grafting in both arms for large perforations [22], one compared endoscopic push-through with microscopic underlay grafting for small anterior perforations [23], and one used inlay butterfly cartilage in both arms [25]. Follow-up ranged from three months to one year (Table 1).

Table 1: Characteristics of the included studies

Study	Design	Patients (endoscopic/microscopic)	Population and perforation	Approach and graft	Follow-up
Lade 2014 [19]	Prospective randomised	30/30	Mucosal COM; perforations of all sizes except small or moderate posterior	Transcanal endoscopic underlay vs postaural microscopic; temporalis fascia	24 weeks
Lakpathi 2016 [28]	Prospective comparative	30/30	Age 15 to 55 years; small, medium and large perforations	Endoscopic vs conventional microscopic; temporalis fascia	6 months
Jyothi 2017 [20]	Randomised	60/60	Tubotympanic CSOM; central perforation	Permeatal endoscopic vs postaural microscopic; temporalis fascia	1 year
Kaya 2017 [21]	Randomised, same patients	13 patients (13/13 ears)	Bilateral COM, normal middle ear mucosa	Endoscopic in one ear, microscopic in the other, 6 months apart	Not stated in abstract
Plodpai 2018 [22]	Randomised controlled	34/30 analysed (70)	Large perforations	Overlay technique in both arms	Not stated in abstract

	trial	randomised)			
El-Hennawi 2018 [23]	Open-label randomised trial	28/28	Small anterior perforations	Endoscopic push-through vs microscopic underlay	3 months
Maran 2019 [24]	Randomised	30/30	Age 18 to 60 years; central perforation (COM or trauma)	Permeatal endoscopic vs postaural microscopic	Not stated in abstract
Pal 2019 [29]	Prospective comparative	25/25	Type I tympanoplasty	Permeatal endoscopic vs postauricular microscopic	Not stated in abstract
Ravi 2021 [25]	Randomised controlled trial	25/25*	Small to medium perforations	Transcanal inlay butterfly cartilage in both arms	Not stated in abstract
Desai 2022 [30]	Prospective comparative	156/156	COM with dry perforation	Endoscopic vs microscopic	Not stated in abstract
Deosthale 2022 [26]	Randomised controlled trial	40/40	Dry mucosal COM	Endoscopic vs microscopic type I	6 months
Kappagantu 2022 [27]	Randomised (computer-generated)	30/30	Inactive mucosal COM	Transcanal endoscopic vs postaural microscopic	Not stated in abstract

COM: chronic otitis media; CSOM: chronic suppurative otitis media. *Group sizes inferred from the reported graft success percentages (96% and 92% of 50 patients).

Risk of Bias: All nine randomised trials had some concerns of bias. The method of randomisation and allocation concealment were rarely described, surgeons could not be blinded, and no trial reported a registered protocol in its abstract. One trial lost

six of 70 patients to follow-up [22], and one was open-label [23]. The three prospective studies were at serious risk of bias from confounding, because the approach was chosen rather than allocated at random (Table 2).

Table 2: Risk of bias in the included studies

Study	Tool	Randomisation or confounding	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selection of reported result	Overall
Lade 2014	RoB 2	Some concerns	Low	Low	Some concerns	Some concerns	Some concern
Jyothi 2017	RoB 2	Some concerns	Low	Low	Some concerns	Some concerns	Some concern
Kaya 2017	RoB 2	Some concerns (staged, same patients)	Low	Low	Some concerns	Some concerns	Some concern
Plodpai 2018	RoB 2	Some concerns	Low	Some concerns (6/70 lost)	Some concerns	Some concerns	Some concern
El-Hennawi 2018	RoB 2	Some concerns	Some concerns (open label, different grafting)	Low	Some concerns	Some concerns	Some concern
Maran 2019	RoB 2	Some concerns	Low	Low	Some concerns	Some concerns	Some concern
Ravi 2021	RoB 2	Some concerns	Low	Low	Some concerns	Some concerns	Some concern
Deosthale	RoB 2	Some concerns	Low	Low	Some	Some	Some

2022					concerns	concerns	concern
Kappagant u 2022	RoB 2	Some concerns	Low	Low	Some concerns	Some concerns	Some concern
Lakpathi 2016	ROBINS -I	Serious	Low	Low	Moderate	Moderate	Serious
Pal 2019	ROBINS -I	Serious	Low	No information	Moderate	Moderate	Serious
Desai 2022	ROBINS -I	Serious	Low	Low	Moderate	Moderate	Serious

Judgements are based on the published reports and, where the full text was not available, on the abstract.

Graft Uptake: Nine studies with 862 ears reported graft uptake. The graft took in 407 of 433 ears (94.0%) after endoscopic and 395 of 429 ears (92.1%) after microscopic tympanoplasty. The pooled RR was 1.03 (95% CI 0.99 to 1.06; $p = 0.11$), with no heterogeneity ($I^2 = 0\%$) (Figure 2). In absolute terms, this is about 26 more successful grafts per 1000 ears with the endoscope (5 fewer to 58 more). Restricting the analysis to the seven randomised trials gave an RR of 1.01 (0.96 to

1.06). Leaving out each study in turn gave RRs between 1.01 and 1.03, and none was significant.

The largest weight came from one prospective study [30]; without it, the RR was 1.01 (0.96 to 1.06). The Egger test did not suggest small-study effects ($p = 0.19$). Three further studies stated that graft success was similar with both approaches but did not give numbers that could be pooled [21,27,29].

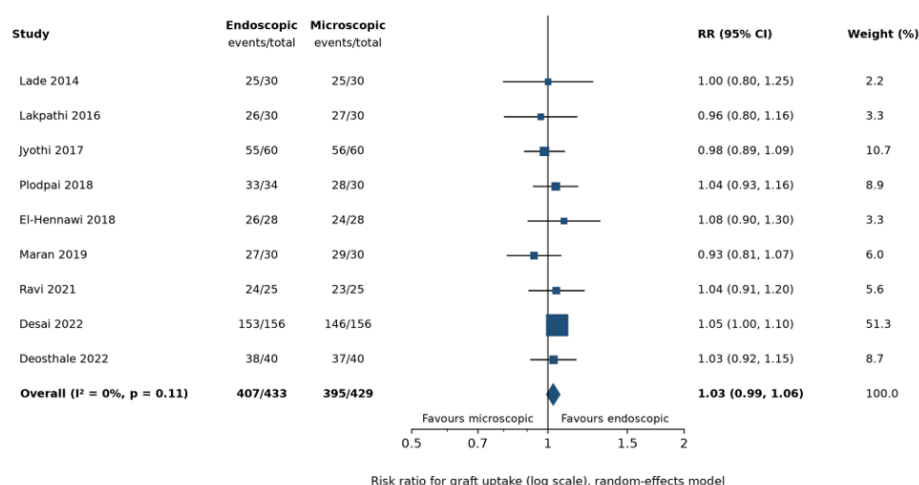


Figure 2: Forest plot of graft uptake after endoscopic compared with microscopic type I tympanoplasty (random-effects model). Squares show study risk ratios, with size proportional to weight; horizontal lines show 95% confidence intervals; the diamond shows the pooled estimate. A risk ratio above 1 favours the endoscopic approach

Hearing Outcome: Four trials reported ABG gain with an SD for both groups [20,21,25,26]. The pooled MD was -0.91 dB (95% CI -3.36 to 1.53; $p = 0.46$), with substantial heterogeneity ($I^2 = 76\%$) (Figure 3). The heterogeneity came from one trial, in which the microscopic group gained 3.4 dB more [20]; without it, the MD was 0.37 dB (-1.13 to 1.87; $I^2 = 0\%$). The other studies reported similar hearing gains with both approaches.

One trial reported a lower postoperative ABG after endoscopic overlay grafting (5.0 vs 10.3 dB) [22], and one reported ABG closure of 11.4 vs 9.2 dB [23]. In another, the mean ABG fell from 28.5 to

18.13 dB with the endoscope and from 32.4 to 16.9 dB with the microscope [19].

Operative Time: Two randomised trials reported operative time with an SD [24,26]. The endoscopic operation was 17.0 minutes shorter (95% CI 9.5 to 24.5; $p < 0.001$; $I^2 = 79\%$) (Figure 3). The direction was the same in the studies that did not give an SD. Mean times were 96.3 vs 136.1 minutes in one study [28] and 37 vs 107 minutes in another [23], and three trials reported a significantly or clearly shorter endoscopic operation [21,25,27], as did one prospective study [29]. Only one prospective study found similar durations [30]. In all, 8 of the 9

studies that reported operative time found a shorter

endoscopic operation.

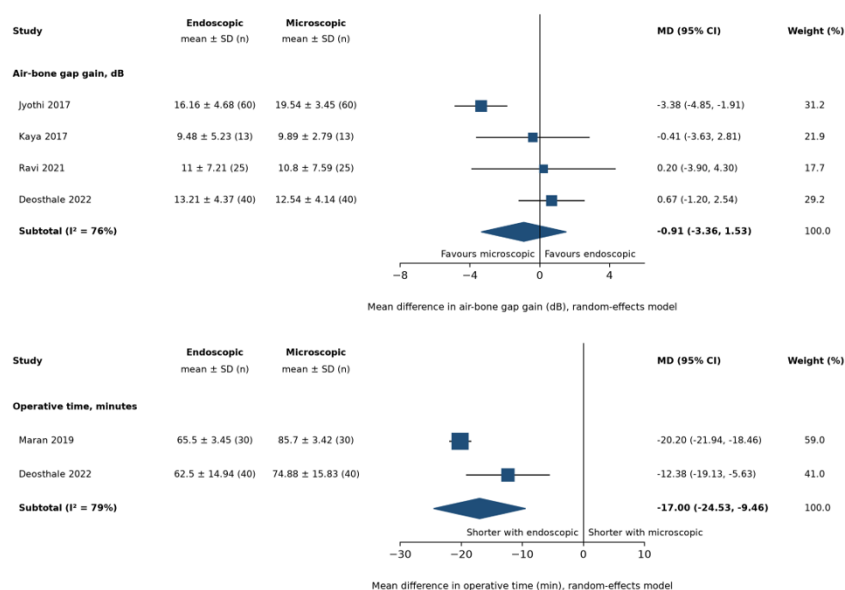


Figure 3: Forest plots of air-bone gap gain (upper panel) and operative time (lower panel) after endoscopic compared with microscopic type I tympanoplasty (random-effects model). MD: mean difference

Other Outcomes: Postoperative pain was lower after endoscopic surgery in every study that measured it [20-22,25,27]. Visual analogue scale scores at 24 hours were 1.7 vs 6.0 in one trial [22], and 2.15 vs 3.76 cm in the same-patient trial [21]. Canalplasty was needed in 5 of 30 microscopic and no endoscopic operations in one trial [19]. In another, canal widening was needed in 45% and an

auxiliary incision in 47.5% of microscopic operations [26].

Cosmetic results were better with the endoscope [19,27,30]. A summary of outcomes in each study is given in Table 3, and the certainty of evidence in Table 4.

Table 3: Outcomes reported in the included studies (endoscopic vs microscopic)

Study	Graft uptake, n/N	Hearing outcome	Operative time, min	Other findings
Lade 2014	25/30 vs 25/30	Mean ABG 28.5 to 18.13 dB vs 32.4 to 16.9 dB	Not reported	Canalplasty 0/30 vs 5/30
Lakpathi 2016	26/30 vs 27/30	Postoperative ABG improved in both; no difference	96.32 vs 136.09	None
Jyothi 2017	55/60 vs 56/60	ABG gain 16.16 $\pm$ 4.68 vs 19.54 $\pm$ 3.45 dB	Not given numerically	Less pain with endoscope
Kaya 2017	Similar (numbers not given)	ABG gain 9.48 $\pm$ 5.23 vs 9.89 $\pm$ 2.79 dB	Shorter with endoscope (p < 0.01)	VAS 2.15 vs 3.76 cm
Plodpai 2018	33/34 vs 28/30	Postoperative ABG 5.0 vs 10.3 dB	Not reported in abstract	VAS at 24 h 1.7 vs 6.0; no canalplasty needed with endoscope
El-Hennawi 2018	26/28 vs 24/28	ABG closure 11.4 vs 9.2 dB	37 vs 107	Blood loss 29 vs 153 mL
Maran 2019	27/30 vs 29/30	Not reported in abstract	65.5 $\pm$ 3.45 vs 85.7 $\pm$ 3.42	Residual perforations in large perforations
Pal 2019	Comparable (numbers not given)	Comparable	Shorter with endoscope	Less morbidity with endoscope
Ravi 2021	24/25 vs 23/25*	ABG gain 11.00 $\pm$ 7.21 vs 10.8 $\pm$ 7.59 dB	Shorter with endoscope	Less pain with endoscope

Desai 2022	153/156 vs 146/156	Hearing gain not different	Similar	Better cosmesis with endoscope; canalplasty with microscope
Deosthale 2022	38/40 vs 37/40	ABG closure 13.21 ± 4.37 vs 12.54 ± 4.14 dB	62.5 ± 14.94 vs 74.88 ± 15.83	Canal widening 45%, auxiliary incision 47.5% with microscope
Kappagantu 2022	Not given numerically	Hearing gain reported for both	Shorter with endoscope	Less pain, fewer complications, better cosmesis with endoscope

ABG: air-bone gap; VAS: visual analogue scale. Values are mean $\pm$ SD where given. *Counts calculated from reported percentages.

Table 4: Summary of findings and certainty of evidence (GRADE)

Outcome	Studies (ears or patients)	Effect (95% CI)	Absolute effect	Certainty and reasons
Graft uptake	9 (862)	RR 1.03 (0.99 to 1.06)	26 more per 1000 (5 fewer to 58 more) [†]	Moderate; risk of bias
ABG gain, dB	4 (276)	MD -0.91 (-3.36 to 1.53)	About 1 dB less with endoscope; not significant	Low; risk of bias and inconsistency
Operative time, min	2 (140)	MD -17.0 (-24.5 to -9.5)	17 minutes shorter with endoscope	Low; risk of bias and inconsistency; same direction in 8 of 9 studies

RR: risk ratio; MD: mean difference. [†]Based on a microscopic-group uptake of 921 per 1000 (pooled microscopic groups).

Discussion

This review pooled only randomised and prospective comparative studies. It found that endoscopic and microscopic type I tympanoplasty gave the same graft uptake and the same hearing gain, while the endoscopic operation was shorter and less painful. The graft uptake result was consistent across studies, with no heterogeneity, and it did not change when the analysis was restricted to randomised trials or when any one study was removed.

These findings agree with earlier meta-analyses that included mostly retrospective data. Tseng and colleagues pooled four studies with 266 patients and found tympanic membrane closure rates of 85.1% and 86.4% (RR 0.98) and similar hearing results [5]. Pap and colleagues pooled 16 studies with 1179 interventions and found no difference in graft uptake (odds ratio 1.21, 0.82 to 1.77) or hearing [7]. Manna and colleagues, with 16 tympanoplasty studies and 1323 ears, also found similar graft success and hearing, with lower canalplasty rates, better cosmesis and shorter operative times with the endoscope [8]. Lee and colleagues pooled 13 studies with 607 endoscopic and 678 microscopic patients [6]. The present review adds evidence from trials published up to 2022, many from India, where the operation is very common, and it reaches the same conclusion with a lower risk of selection bias.

The difference in operative time deserves care. Pap and colleagues found a shorter endoscopic time that was not significant, with very high heterogeneity (I^2

= 99.3%) [7]. In the present review, only two trials gave SDs, and the pooled estimate was heterogeneous. However, 8 of 9 studies found a shorter endoscopic operation, and a large retrospective series reported 49 vs 81 minutes [9]. The saving comes mainly from avoiding the postauricular incision, flap and closure and from avoiding canalplasty. The size of the saving depends on the surgeon. A surgeon trained in microscopic surgery needs a period of practice before endoscopic times become stable [3], and the trials in this review did not report the experience of their surgeons in detail.

Hearing gain was similar. One trial found a larger gain with the microscope [20], but the difference was 3.4 dB and was not seen in the other trials. A difference of this size is unlikely to matter to patients. The endoscopic view may also reduce handling of the chorda tympani; a retrospective series found taste symptoms in 4% of endoscopic and 24% of microscopic operations [10]. Less pain, no postauricular wound and better cosmesis are consistent advantages of the endoscopic approach [4,8]. Against these, the surgeon has only one hand free, depth perception is reduced and bleeding is harder to control [2]. Endoscopic tympanoplasty is therefore best suited to dry perforations in a canal wide enough for the endoscope and instruments.

Strengths and Limitations: The review included only randomised and prospective studies, which reduces selection bias. It also tested the stability of the main result in several sensitivity analyses and rated the certainty of the evidence. It has important limitations. Only PubMed was searched, and only

reports in English published before 2023 were included. Several studies were small, and three were not randomised. Many full texts were not freely available, so some data and the risk of bias judgements came from abstracts. Group sizes in one trial were inferred from the reported percentages [25], and the same-patient trial was analysed as if the ears were independent [21]. Only two trials could be pooled for operative time and four for hearing gain. Graft uptake was assessed at different times, from three months to one year, and the graft material and technique varied.

Conclusion

In randomised and prospective studies published before 2023, endoscopic type I tympanoplasty for chronic otitis media gave graft uptake and hearing results equivalent to microscopic tympanoplasty. The endoscopic operation was shorter, less painful and avoided a postauricular incision.

The certainty of evidence is moderate for graft uptake and low for hearing gain and operative time. Endoscopic tympanoplasty can be offered as a first choice for suitable perforations by trained surgeons. Larger multicentre randomised trials with standard reporting of operative time, hearing and surgeon experience are still needed.

Declarations

Acknowledgement: The author thanks the Department of Otorhinolaryngology (ENT), Civil Hospital, Ahilyanagar, for its support.

Funding: None.

Conflict of Interest: The author declares no conflict of interest.

Author Contribution: Dr. Vajinath Gurvale conceived the review, performed the search, extracted and analysed the data, wrote the manuscript and approved the final version.

Data availability: All data used in this review are available in the published reports of the included studies.

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