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MAIN ARTICLE

Endoscopic cartilage tympanoplasty in chronic otitis media

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Abstract

Objectives: The use of endoscopic techniques is becoming more widespread in otological and neuro-otological surgery. One such procedure, endoscopic tympanoplasty, is used in chronic otitis media treatment. This study aimed to analyse the results of endoscopic transcanal cartilage tympanoplasty.

Methods: Data of tubotympanic chronic otitis media patients who underwent transcanal endoscopic type I cartilage tympanoplasty between June 2012 and May 2013 were analysed. The main outcome measures were graft success and hearing improvement.

Results: Graft success rates were 94.3 per cent and 92.5 per cent at post-operative months one and six, respectively. Post-operative air–bone gap values were significantly improved over pre-operative values ($p < 0.01$).

Conclusion: Transcanal endoscopic type I cartilage tympanoplasty is a minimally invasive, effective and reliable surgical treatment option for chronic otitis media.

Key words: Tympanoplasty; Otitis Media; Cartilage; Otologic Surgical Procedures

Introduction

Endoscopic techniques are becoming more widespread in otological and neuro-otological surgery. Whereas endoscopes were previously used only for evaluating and retrieving pouches, they now replace microscopes in many otological and neuro-otological surgical procedures. One such procedure is endoscopic tympanoplasty, which is used to treat chronic otitis media.[1,2] Traditionally, middle-ear microsurgery has been performed using a microscope. The linear field of view of the microscope prevents visualisation of recesses in the middle ear. In contrast, endoscopes provide a wide field of view, enable the surgeon to quickly adjust the viewing angle and can visualise difficult locations such as facial recesses, anterior marginal perforations and sinus tympani.[3,4] Using the endoscopic transcanal approach, many ear operations can be performed through a minimal opening without a postauricular incision. In addition, the wide viewing angle of the endoscope enables all quadrants and parts of the middle ear to be visualised by the surgeon and any observers.[3,5] This study aimed to analyse the results of 53 transcanal endoscopic tympanoplasty procedures in a tertiary referral centre.

Materials and methods

Local ethics committee approval was obtained at the start of the study (number 2014/07). Data of tubotympanic chronic otitis media patients who underwent transcanal endoscopic type I cartilage tympanoplasty between June 2012 and May 2013 was obtained. Patient data on demographics, perforation localisation and size, and audiometric examination results were retrospectively reviewed. Pre- and post-operative pure tone audiometry results at 0.5, 1, 2 and 4 kHz were calculated and analysed.

The following inclusion criteria were applied: no otorrhoea within the last three months, no signs of inflammation or infection during otoscopic examination of the middle-ear mucosa, and no signs of inflammation or infection in mastoid cells, as evaluated in a computed tomographic examination of the temporal bone. The percentage perforation area of the tympanic membrane was used to classify perforation size as small (less than 25 per cent), medium (25 per cent to 75 per cent) and large (more than 75 per cent). All patients were operated on under general anaesthesia with orotracheal intubation and hypotensive anaesthesia. All surgical procedures were performed by the same

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surgeon. Adrenaline (Jetokain, Adeka, Samsun, Turkey) local anaesthesia was used to reduce bleeding. An 18 cm long, 4- or 2.7-mm diameter, 0° endoscope (Karl Storz, Tuttlingen, Germany) was used for the procedure. A pick was used to refresh the tympanic membrane remnant. A lateral circumferential incision was made 4–6 mm laterally from the annulus of membrane tympani and integrated into radial incisions. The tympanomeatal flap was elevated and the manubrium malleus desepitelised. Middle-ear mucosa and ossicular chain mobilisation were assessed. After the procedure, a cartilage graft was harvested from the tragal cartilage. For this, a skin incision was made on the medial side of the tragal cartilage, about 3–4 mm from the posteromedial side of the apex. The cartilage graft with bilateral mucoperichondrium was then excised and 2–3 mm of tragal cartilage was retained on the marginal side for cosmetic reasons. A mucoperichondrial flap was obtained by elevation of the mucoperichondrium on the convex side. The cartilage was excised at a site corresponding to the malleus at the placement (Figure 1). The middle ear was packed with Gelfoam® and the harvested graft was placed in position. The over-underlay technique was used for graft placement: it was performed lateral to the handle of the malleus and medial to the tympanic membrane and annulus. The elevated mucoperichondrium from the convex side of the graft was placed near the external ear canal to prevent medialisation. The tympanomeatal flap was meticulously pulled down toward the graft and the external ear canal. The external ear canal was then packed with Gelfoam® and sterile packs were placed on the external meatus.

The time between endoscopic evaluation of the perforation and packing of the external ear canal with Gelfoam® following grafting was recorded as the surgery duration. All patients were discharged on the first post-operative day.

The follow-up protocol involved changing the ear packs on post-operative day 7, followed by pack removal and antibiotic ear drop prescription on post-operative day 14.

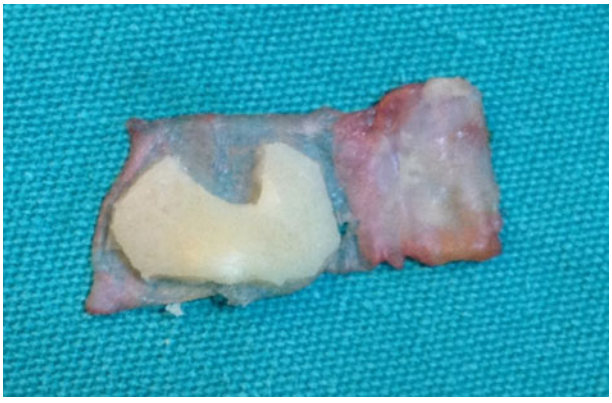

FIG. 1
Photograph showing a chondroperichondrial graft with a notch for the malleus.

The grafting procedure was considered successful if no perforation was seen at post-operative microscopy or endoscopy evaluation (Figure 2). Hearing was evaluated using pure tone audiometry at post-operative months one and six.

Statistical analysis

Patient demographics, pre-operative perforation size and localisation, surgery duration, pre-operative audiometry test results, cartilage graft success rates and post-operative audiometry test results were analysed using Student's and paired sample *t*-tests. In the first analysis, paediatric (i.e. less than 18 years of age) and adult groups were analysed separately. However, the results were similar for both groups, so they were combined for the final analysis. The results for each age group are included in the results section.

Results

Data from 53 patients were analysed: 19 male (35.8 per cent) and 34 female (64.2 per cent) patients. The mean age (± standard deviation) was 30.2 ± 12.1 years (range 10–58 years). Surgery was performed on the right ear for 23 patients (43.4 per cent) and the left ear for 30 patients (56.6 per cent). Five perforations (9.4 per cent) were small (less than 25 per cent of the overall area), 41 (77.4 per cent) were medium (25–50 per cent) and 7 (13.2 per cent) were large (more than 50 per cent). Most perforations were located in the anterior quadrant ($n = 39$; 73.6 per cent). The mean pre-operative air-conduction pure tone average was 36.9 ± 12.2 dB nHL (range 18–74 dB nHL) and the mean air–bone gap was 24.4 ± 7.4 dB nHL (range 9–43 dB nHL). The mean surgery duration was 49.4 ± 8.1 minutes (range 40–80 minutes). Mean follow-up duration was 21.6 ± 3.4 months (range 15–27 months).

The graft uptake success rate was 94.3 per cent (50 out of 53 ears) in the first post-operative month and 92.5 per cent (49 out of 53 ears) in the sixth post-operative month. The graft uptake success rate was 100 per cent in the paediatric group ($n = 9$) and 93.2 per cent in the adult group ($n = 44$) in the first post-operative month ($p > 0.05$). The graft uptake success rate was 100 per cent in the paediatric group and 91 per cent in the adult group in the sixth post-operative month ($p > 0.05$).

The air-conduction pure tone average progressively and significantly decreased during the first and sixth post-operative months (26.4 ± 9.8 and 22.8 ± 8.7 dB nHL, respectively) compared with pre-operative recordings ($p < 0.01$; Figure 3). The air–bone gap progressively and significantly decreased during the first and sixth post-operative months (16.7 ± 5.8 and 13.8 ± 5.8 dB nHL, respectively) compared with pre-operative values ($p < 0.01$; Figure 4). The mean air–bone gap reduction during these periods was 7.4 ± 7.5 and 10 ± 7 dB nHL, respectively.

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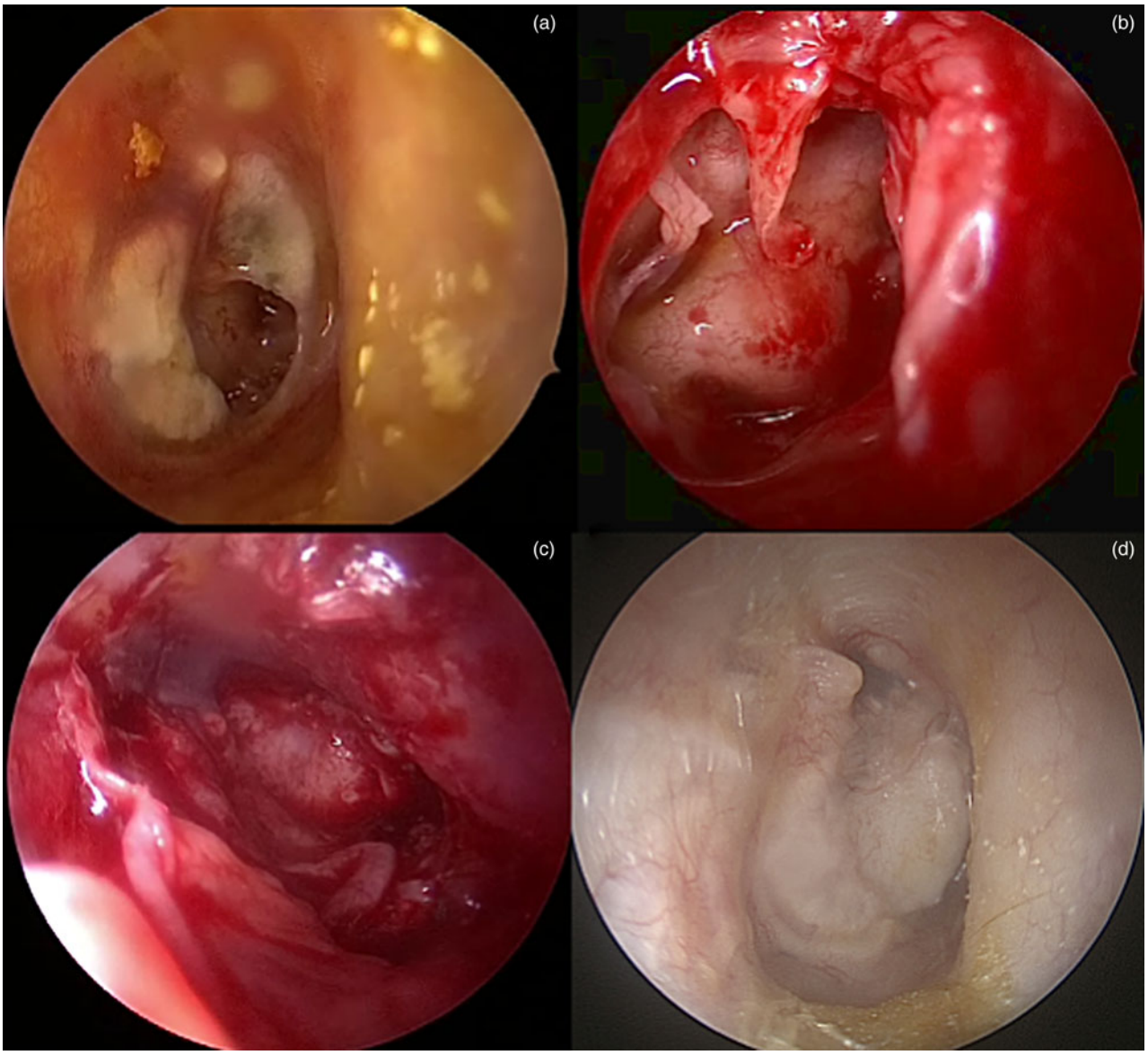

FIG. 2

Photographs showing (a) a pre-operative view of the perforated tympanic membrane, (b) an intraoperative view of the middle ear, (c) an intra-operative view of the tympanic membrane after grafting and (d) a post-operative view of the tympanic membrane at six months.

All surgical procedures were completed using the 4-mm diameter endoscope, and there was no need to use the microscope. In two cases, when checking graft placement in the anterior quadrants, protrusion of the anterior wall of the external auditory canal complicated the procedure; therefore, the 2.7-mm diameter endoscope was used. The wide viewing angle of the endoscope made canaloplasty unnecessary.

No major complications were found in the early and late post-operative periods. In the early post-operative period, minor complications were temporary partial taste loss in one patient, temporary facial nerve paralysis secondary to the local anaesthetic effect in one patient, and nausea and vomiting in three patients (all were treated with anti-emetics). In the late post-operative period, only one patient had a minor complication: partial stenosis, which closed off less than 25 per cent of the external ear canal. This was treated with local dressings.

Discussion

Endoscopes have been used for diagnosing and treating ear diseases since the 1960s. More recently, endoscopes have been mainly used as support tools in microscope-aided surgery in cholesteatoma patients.[2,3] In 1992, El-Guindy reported the first case of endoscopic miringoplasty.[6] Subsequently, Raj and Meher in 2001, Yadav *et al*. in 2009, Ayache in 2013, and Dündar *et al*. in 2014 published reports on endoscopic surgery.[2,4,7,8] The most widely used grafts in tympanoplasty are made from the temporal muscle fascia, perichondrium and cartilage. The temporal muscle fascia graft is used most widely in endoscopic tympanoplasty. There is insufficient data on the outcomes of cartilage

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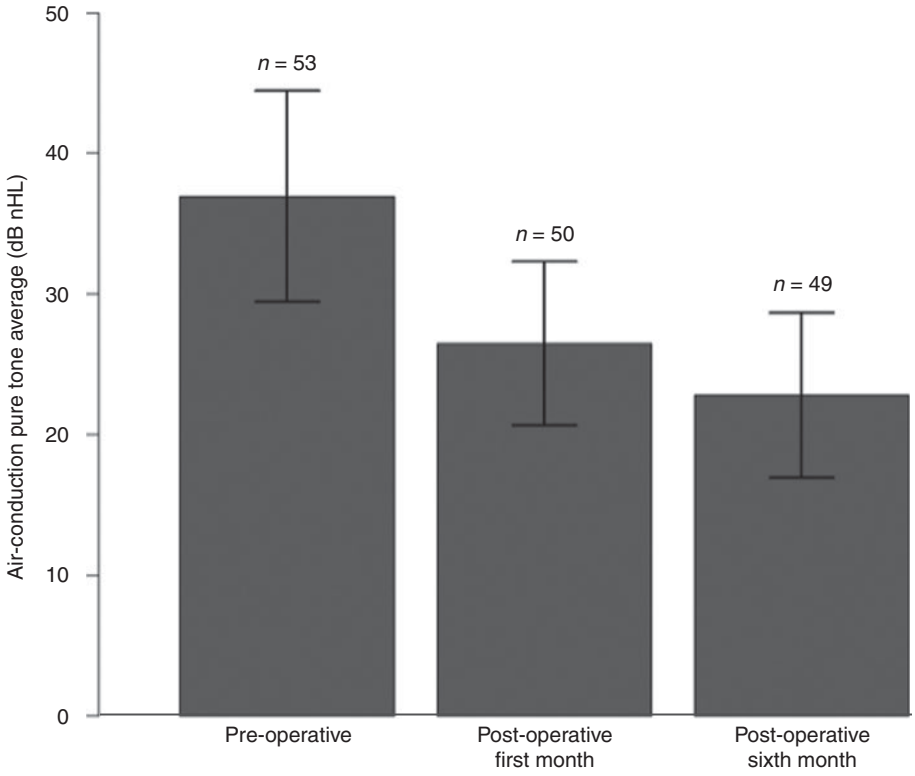

FIG. 3
Graph showing pre- and post-operative air-conduction pure tone average results. Data are the mean ± standard deviation.

grafts in endoscopic tympanoplasty.[2] Dündar *et al*. compared the results of endoscopic and microscopic type 1 tympanoplasty performed using boomerang-shaped chondroperichondrial grafts in children; they found no significant difference in the success rates. This study used chondroperichondrial tragal cartilage grafts.

Tympanoplasty success is determined by the degree of perforation closure and hearing improvement. Rates

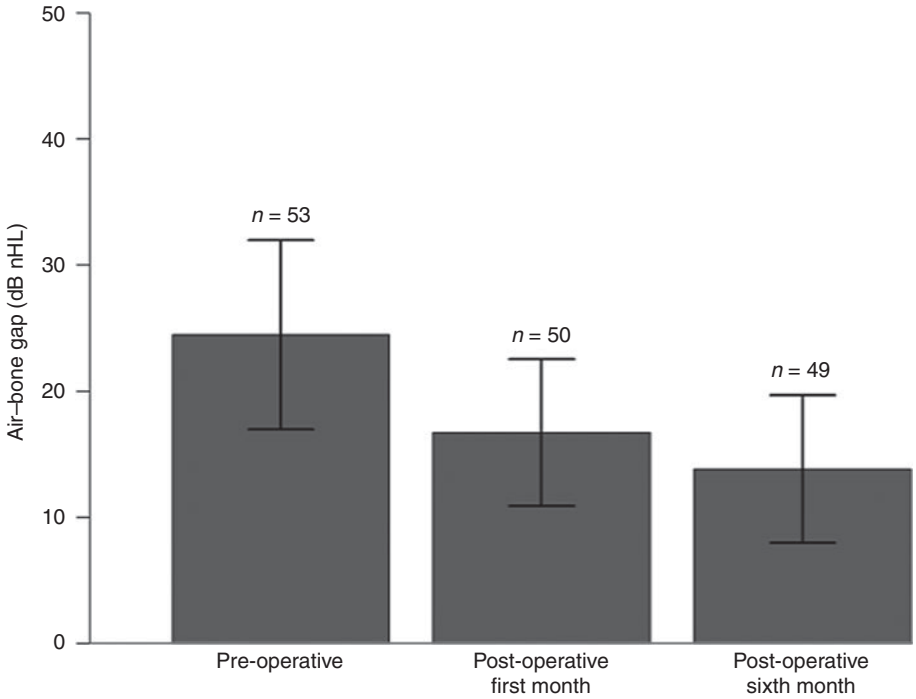

FIG. 4
Graph showing the average pre- and post-operative air–bone gap results. Data are the mean ± standard deviation.

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of successful endoscopic tympanoplasty grafts of between 80 per cent and 90 per cent were reported until 2009; this has increased to 96 per cent in recent years.[2,4,7,8] These figures relate to endoscopic type I tympanoplasty and myringoplasty. We perform different forms of endoscopic ear surgery, including fat or butterfly myringoplasty, ossiculoplasty, stapedectomy, and limited attic cholesteatoma (in decreasing frequency). Surgery is not offered to patients presenting with inflamed middle-ear mucosa or otorrhoea. Medical treatment or mastoidectomy is provided for otorrhoea that is unresponsive to medical treatment. Therefore, such patients were excluded from this study.

The graft success rate in endoscopic type I tympanoplasty was similar to those previously reported for similar patient groups. This has probably increased in recent years because of increased camera and monitor resolution. However, the endoscopic technique has some disadvantages: the view is two-dimensional and one of the surgeon's hands is occupied by the endoscope.[3,5,9] Three-dimensional endoscopes have already been introduced into abdominal surgery. The use of this technology plus a flexible holder for the endoscope may help overcome these disadvantages.

When we first started performing endoscopic ear surgery four years ago, the microscope was kept ready in the operating theatre in case it was needed. However, after the first 8–10 endoscopic operations, the microscope was considered unnecessary because the type I tympanoplasty could be performed using only the endoscope. It was sometimes necessary to use a 2.7-mm endoscope to check graft placement. The wide viewing angle of the endoscopes was sufficient to avoid a need for canaloplasty and there were no related complications such as anterior blunting. The endoscopic technique is now offered to all patients, although microscopic type I tympanoplasty is also routinely performed for medical resident education.

- **Endoscopic techniques are becoming popular in otological and neuro-otological surgery**
- **The wide viewing angle of endoscopes makes canaloplasty unnecessary in type I tympanoplasty**
- **Transcanal endoscopic type I cartilage tympanoplasty is a minimally invasive, effective and reliable chronic otitis media treatment**

Thermal injury due to heat of the light source is a concern in endoscopic ear surgery, although no case of sensorineural deafness due to thermal injury has been reported. We have not observed thermal injury when using a light-emitting diode light source. However, the endoscope tip is cleaned with an anti-fogging solution every two to three minutes for cooling. The endoscopic technique is minimally invasive, and post-operative bleeding or pain requiring treatment was not found. All patients were discharged within 24 hours. The main limitation of this study is the lack of comparison with data obtained using classical tympanoplasty procedures.

Conclusion

Transcanal endoscopic type I cartilage tympanoplasty is a minimally invasive, effective and reliable surgical treatment option for chronic otitis media.

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