

ORIGINAL ARTICLE

Endoscopic type 3 tympanoplasty: Functional outcomes in chronic otitis media



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KEYWORDS

Type 3
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Endoscopic ear
surgery

Abstract

Background: Type 3 tympanoplasty is the surgery of choice for middle ear reconstruction in cases where an integral stapes suprastructure and mobile footplate are present.

Objective: The objective of this study was to obtain functional results after endoscopic type 3 tympanoplasty in chronic otitis media.

Materials and methods: Prospective study including 24 patients who underwent endoscopic type 3 tympanoplasty, using PORP for ossicular chain reconstruction (OCR) and cartilage graft for tympanic membrane reconstruction. Audiograms were made preoperatively, and 6 months after surgery.

Results: Dry, closed, self-cleaning ears were obtained in 91.7% of the cases. Mean preoperative air-bone gap (ABG) was 30.4 dB, mean postoperative ABG was 16.7 dB, dB gain of 13.6 dB. ABG closure rate to 20 dB or less of 79.2%, and to 10 dB or less of 29.2%.

Conclusion and significance: Endoscopic tympanoplasty and OCR is a valid option for surgeons who are comfortable with the use of endoscopes for middle ear surgery as it allows improved visualization of the prosthesis and graft placement during middle ear reconstruction.

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PALABRAS CLAVE

Timpanoplastia tipo
3;
Partial ossicular
replacement
protheses;

Timpanoplastia endoscópica tipo 3: resultados funcionales en la otitis media crónica

Resumen

Introducción: La timpanoplastia tipo 3 es la cirugía de elección para la reconstrucción del oído medio en casos donde se encuentra íntegra la supraestructura del estapedio, y hay una platina móvil.

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Reconstrucción de la cadena osicular;
Otitis media crónica;
Cirugía endoscópica de oreja

Objetivos: El objetivo de este estudio es obtener resultados funcionales tras timpanoplastias tipo 3 con abordaje endoscópico.

Materiales y métodos: Estudio prospectivo incluyendo 24 pacientes quienes fueron operados de timpanoplastia tipo 3 endoscópicas, usando una PORP como material de osiculoplastia, y cartilago como injerto de reconstrucción de membrana timpánica. Audiometrías tonales fueron hechas previas a la cirugía y 6 meses posterior a ella.

Resultados: Oídos cerrados, secos y autolimpiantes fueron obtenidos en el 91,7% de los casos. El GAP aéreo-óseo preoperatoria medio fue de 30,4 dB, la misma diferencia media postoperatoria fue de 16,7 dB. La reducción de GAP postoperatoria fue de 13,6 dB. La tasa de cierre de GAP a menos de 20 dB o menos fue del 79,2% y a menos de 10 dB del 29,2%.

Conclusiones: La timpanoplastia y reconstrucción osicular con abordaje endoscópico es una técnica válida y segura cuando es usada por cirujanos que están cómodos con el uso de endoscopios en la cirugía de oído medio, como permite mejor visualización de la colocación de prótesis e injertos durante la cirugía.

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Introduction

The rehabilitation of conductive hearing loss is one of the major challenges for otologic surgeons. Since the 1950s when the surgery of ossicular reconstruction was introduced, it has made more sense to address the hearing problem. The success of the ossicular reconstruction mainly depends on the characteristics of the prosthesis; the ideal prosthesis should be biocompatible, stable, easy to fit, and capable of optimal sound transmission. Although a variety of materials have been used for reconstruction of the ossicular chain, such as autograft, gold prosthesis, ceramic prosthesis, hydroxyapatite, and polyethylene, none of them has proved to have overwhelming superiority over the others.¹

A defect of the long process of the incus is one of the most frequent causes of ossicular discontinuity. There are several etiological factors for incudostapedial joint discontinuity, including chronic middle ear disease with or without cholesteatoma, adhesive otitis media, retraction pockets, tympanosclerosis, and temporal bone trauma. Separation of the incudostapedial joint may lead to conductive hearing loss. Various techniques have been described with which to reconstruct incudostapedial joint continuity, including transposition of a biological autograft or homograft, use of partial ossicular replacement prostheses (PORP) and bone cements.²

Also a recent meta-analysis showed that titanium prosthesis did not show any significant superiority to the non-titanium prostheses in terms of effectiveness and stability, despite the opposite results reported by many investigators.¹

As commented previously, the most frequently seen ossicular problem is a defective or missing incus with an intact and mobile stapes and the malleus handle (60% of all ossicular defects). In cases with intact stapes but defective incus and/or malleus, type 3 tympanoplasties are the procedure of choice according to the Wullstein classification in 1956.³

A recent systematic review made by our group compared the performance between incus transposition technique and PORP for ossicular chain reconstruction (OCR), concluding that there was not difference in decibels (dB) gained after surgery between the two materials, but there was a difference in air-bone gap (ABG) closure rate to less than 20 dB favoring PORP.⁴

In the recent years, a growing number of surgeons support for the use of endoscopes in middle ear surgery, with an increasing number of reports showing a benefit in type 1 and even cholesteatoma surgery.⁵⁻⁷ By providing a wide angle of view and illumination near to the tympanic membrane (TM), endoscopes overcome the limitation of the operating microscope, in which the direct line of sight is blocked by ear canal morphology. Although endoscopes were first recommended for tympanoplasty in the 1990s,⁸ even reasonably recent reports have revealed misgivings about a totally endoscopic technique for tympanoplasty.⁹ With the expanding availability of instruction courses dedicated to endoscopic ear surgery, surgical experiences have been shared internationally allowing endoscopic techniques to be developed to the point where totally endoscopic tympanoplasty has now become a very feasible option, reported even in children's ears.^{5,10-13} Although there is limited evidence, at present, on the influence of endoscopic ear surgery on hearing outcomes in patients undergoing ossicular chain reconstruction.¹⁴

Combining concepts from the reviews from Zhang et al.¹ and Bartel et al.⁴ the aim of this study is to measure functional results after endoscopic type III tympanoplasty, as one stage procedure for tympanoplasty and OCR in adult patients diagnosed with chronic otitis media (COM) with or without cholesteatoma.

Materials and methods

Study design: A prospective study was designed including patients with the following criteria: adult patients; diagnosis

of COM with or without cholesteatoma who required surgical treatment.

Patient criteria: Surgical indication included ears with chronic otitis media with or without cholesteatoma with a preoperative ABG greater than 20 dB. Only ears with an intact stapes suprastructure and a mobile footplate were included. Patients with previous surgeries were included only with canal wall up (CWU) procedures. Previous canal wall down (CWD) procedures were excluded from the study. The AAO-HNS pure tone audiometry (PTA) criteria for hypacusia assessment was used. Mean audiometric results at 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz at air and bone conduction thresholds were obtained preoperatively and 6 months after surgery.

Surgical technique: Standardized surgical technique was performed in all cases by a single senior surgeon. Endoscopic type III tympanoplasty was performed, atticotomy, complete incus and head of the malleus removal, manubrium of the malleus was spared if it was possible. In ears affected with COM with cholesteatoma, disease removal was attempted transcanal in all cases. In cases where mastoid extension of the disease was present, CWU mastoidectomy procedure was done (combined approach). No CWD procedures were included in the study. OCR was performed with a polyethylene PORP. Tympanic membrane reconstruction was performed using a full thickness cartilage with perichondrium in both sides harvested from tragus or auricular conchae. In cases of insufficient coverage, overlay fascia temporalis was added (Fig. 1).

Results

Distribution and surgical approach: A total of 24 ears met inclusion criteria. The mean patient age was 55 years (range, 25–79 yr). The mean length of follow-up was 13.2 months (range, 6–23.8 mo). Nine were diagnosed with COM with cholesteatoma and 15 with COM without cholesteatoma. All 15 cases of COM without cholesteatoma were treated fully with transcanal endoscopic ear surgery (TEES), while in cases of COM with cholesteatoma, 3 were treated fully with TEES and 6 required EES and CWU mastoidectomy (combined approach).

Morphofunctional results (Table 1): Dry ears with no residual perforations were obtained in 22 cases (91.7%); in 14 cases of COM without cholesteatoma (93%); and in 8 out of 9 cases of COM with cholesteatoma (88.9%). Self-cleaning ears were obtained in every patient.

Hearing outcomes (Table 2): Preoperative: mean air conduction PTA was 60.6 dB (SD 14.7); mean bone conduction PTA was 30.2 dB (SD 14.3); mean ABG was 30.4 dB (SD 9.6). **Postoperative:** mean air conduction PTA was 46.4 dB (SD 16.9); mean bone conduction PTA was 29.7 dB (SD 15.9); mean ABG was 16.7 dB (SD 9.1). ABG difference of 13.7 dB (SD 13.0). ABG closure rate to less than 20 dB of 79.2% and ABG closure rate to less than 10 dB of 29.2%. Differences were made regarding the presence or absence of cholesteatoma. In the COM without cholesteatoma group a postoperative ABG of 14.4 dB (SD 8.5) was obtained with a closure rate to less than 20 dB of 93.3% and to less than 10 dB

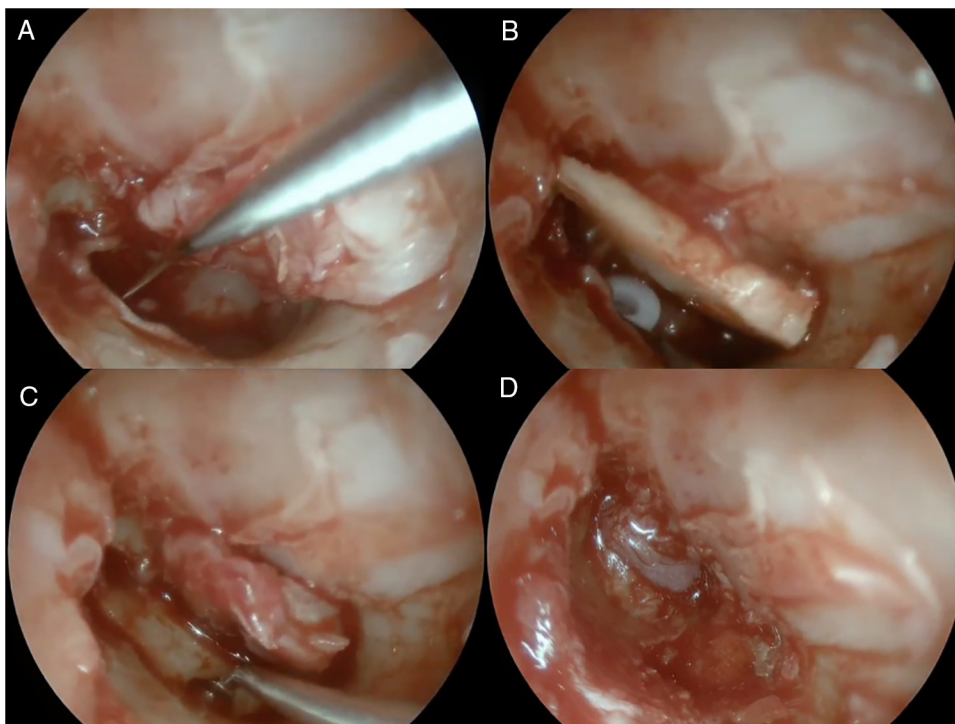


Figure 1 Surgical protocol. (A) Tympanic cavity after ossicular chain and granuloma removal in a chronic otitis media without cholesteatoma of a right ear. (B) Placement of PORP in stapes suprastructure for OCR. (C) Integration of cartilage for tympanic membrane reconstruction. (D) Tympanomeatal flap repositioning.

Table 1 Morphofunctional results.

	Ears	Dry ears	%	Self-cleaning ears	%
COM without cholesteatoma	15	14	93	15	100
COM with cholesteatoma	9	8	88.9	9	100
TEES resection	3	3	100	3	100
Combined approach	6	5	83.3	6	100
Total	24	22	91.7	24	100

COM: chronic otitis media. TEES: transcanal endoscopic ear surgery.

Table 2 Audiometric outcomes.

	Ears	Preop ABG	Postop ABG	dB gain	AGB < 20	%	AGB < 10	%
COM without cholesteatoma	15	33.1	14.4	18.6	14	93.3	6	40.0
COM with cholesteatoma	9	26.0	20.6	5.5	5	55.6	1	11.1
TEES resection	3	25.5	25.7	-0.2	1	33.3	0	0.0
Combined approach	6	26	18	8	4	66.7	1	16.7
Total	24	30.4	16.7	13.6	19	79.2	7	29.2

ABG: air-bone gap. COM: chronic otitis media. TEES: transcanal endoscopic ear surgery.

of 40%. In the COM with cholesteatoma a postoperative ABG of 20.6 dB (SD 9.6) was obtained with a closure rate to less than 20 dB of 55.6% and to less than 10 dB of 11.1%.

Discussion

Reconstruction of the ossicular chain, successful physiological and functional results with long-term stability are still a challenge even for experienced otologists.

The aim of ossicular chain reconstruction is to restore the middle ear conduction mechanism, but if cochlear function is poor particularly with regard to word discrimination or in a monaural patient a hearing aid could another valid option. Type 3 tympanoplasties are performed in cases that had incus defects with normal stapes, by interpositioning a prosthesis between the malleus handle/tympanic membrane and stapes suprastructure.³

Otologic surgeons have used a variety of materials for reconstruction of the ossicular chain; autograft, homograft or allograft materials.¹⁵⁻¹⁸ Most commonly used ossiculoplasty technique and materials in type 3 tympanoplasties are the incus transposition technique and titanium PORPs.

According to a systematic review published by our group as Bartel et al. in 2018, comparing audiometric outcomes in 614 patients with incus transposition technique and 441 patients with PORP technique, results showed that there was no difference in decibels gained between both ossiculoplasty materials, but a better closure rate in air bone gap to less than 20 dB was observed in the PORP group.⁴

In the meta-analysis made by Zhang et al. in 2011, they indicated that the titanium prostheses did not show any significant superiority to the non-titanium prostheses in terms of effectiveness and stability, despite the opposite results reported by many investigators.¹

According to Yawn et al. in 2017, endoscopic ossiculoplasty yields comparable audiometric results and surgical complications to traditional microscopic OCR. An endoscopic OCR is a reasonable option for properly trained surgeons comfortable with the use of endoscopes in the middle ear as it affords increased visualization of the prosthesis at the time of reconstruction.¹⁹

In 2017 Jalali et al. made a meta-analysis comparing tympanic membrane repair with cartilage grafts vs temporal fascia graft. Concluding that the current available evidence suggests the superiority of cartilage grafting over temporal fascia grafting in type 1 tympanoplasty in both adults and children with COM in terms of graft integration, whereas the hearing outcome in the two groups was comparable.²⁰

Yawn in 2017 published a study where the microscope was used to reconstruct the ossicular chain in 31 cases, while an exclusive endoscopic approach was used in other 31 patients. Postoperative control for the prosthesis, there were no significant postoperative differences in bone PTA, air PTA, and ABG between primary and staged ossiculoplasties, or surgical approach. Concluding that there were no significant differences in hearing outcomes with respect to staged ossicular chain reconstruction or whether the endoscope or microscope was used for visualization.¹⁹

Functional results in this study seem to be according to the actual literature. It is important to make a difference cases with or without cholesteatoma as they are completely different diseases. The difference in decibel gain between preoperative ABG and postoperative ABG and their closure rate are important between cases with or without cholesteatoma.

Our study population was small. A multi-institutional study, accounting for several different endoscopic surgeons may be able to provide enough cases to draw more

meaningful conclusions on the safety, efficacy, and audiometric outcomes of endoscopic OCR in chronic otitis media with or without cholesteatoma.

Conclusion

Endoscopic tympanoplasty and OCR is a valid option for surgeons who are comfortable with the use of endoscopes for middle ear surgery as it allows improved visualization of the prosthesis and grafts placement at the time of middle ear reconstruction. Possibly a second stage OCR in cases of COM with cholesteatoma may improve partial OCR audiometric outcomes. We think that more studies are needed to ensure our surgical behavior in front of different scenarios of COM.

Conflict of interest

The authors declare that they have no conflicts of interest.

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