

Abstract

Objective:

To compare post-operative audiometric outcomes for the two prevailing surgical approaches for isolated malleus/incus fixation—ossicular mobilization with preservation of the ossicular chain (OCM) and disruption and reconstruction of the ossicular chain (OCR).

Data Sources:

A search was conducted of PubMed, Scopus, and CINAHL in English in December 2016.

Study Selection:

Papers presenting original data regarding post-operative audiometric outcomes in patients who underwent surgical treatment for malleus/incus fixation with a mobile and intact stapes were included.

Data Extraction:

A risk of bias assessment was performed on the 14 selected papers and a tier system was developed.

Data Synthesis:

Meta-analysis was accomplished by comparing pooled rates of surgical success by Chi-square test and calculating odds ratios by logistical regression. Analysis was performed using Revman5 and R software.

Conclusions:

Analysis of the literature revealed no differences in audiometric outcomes between OCM and OCR in patients with isolated malleus/incus fixation. A large, prospective study comparing both short- and long-term hearing results for OCM and OCR in this population may identify whether a difference in outcomes exists between the two approaches.

Introduction

Osseous fixation of the malleus/incus is an uncommon but significant cause of conductive hearing loss. Isolated malleus/incus fixation is currently treated surgically by one of two techniques: ossicular chain mobilization (OCM) or ossicular chain reconstruction (OCR). OCM involves lysing the bony fixations with a drill or laser but leaving the architecture of the ossicular chain intact. OCR involves removing the malleus head and the incus and reconstructing the ossicular chain.

Both of the OCM and OCR techniques are used today, but there is no general consensus as to which one produces better outcomes. In this study, we examined post-operative audiometric outcomes in patients with isolated malleus/incus fixation who underwent either OCM or OCR in attempt to detect a difference between the two techniques. Our hypothesis is that surgical techniques that preserve the ossicular chain will have better hearing results since they more closely approximate normal physiologic function.

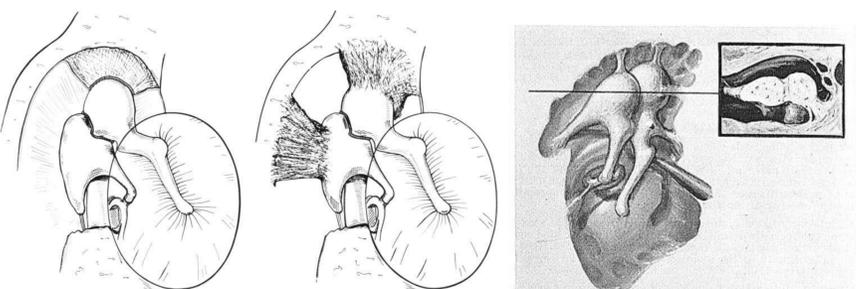


Figure 1. A) Isolated malleus fixation, B) fixation of malleus and incus (from Tos, 1970)

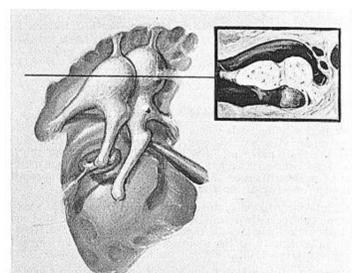


Figure 2. Common site of epitympanic malleus fixation (from Armstrong, 1976)

Materials and Methods

A systematic review was performed using PubMed, Scopus, and CINAHL. Inclusion criteria were the following: live human subjects, original patient data, outcomes presented as either ABG or % with ABG <10, outcomes for each treatment group presented separately, and a mobile and intact stapes for all patients.

Studies were classified into tiers based on pertinence to the objective of this review, favoring those with raw patient data and direct comparison of both techniques. Studies were also subjected to a risk of bias assessment.

Meta-analysis compared studies in 2 distinct ways:

1. Surgical results were pooled for each technique and a Chi-square test was performed. Success was defined as post-operative ABG <10 dB
2. Results from the 6 studies that directly compared OCM and OCR were analyzed with an odds ratio using surgical success as a binary outcome

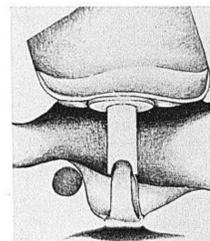


Figure 3. Partial ossicular replacement prosthesis (PORP) (from Emmett, 1978)

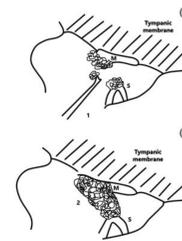


Figure 4. Manubriostapedioplasty (from Sennaroglu, 2015)

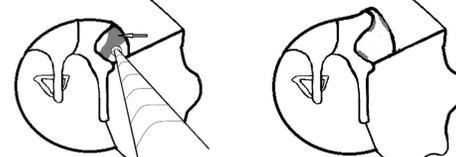


Figure 5. Ossicular chain mobilization with bone drill (from Sakalli, 2015)

Results

The initial literature search retrieved 390 articles, 14 of which were selected for this review. A total of 391 patients were studied, 42% underwent OCM and 58% underwent OCR.

In pooled surgical results, surgical success was achieved in 46.4% of OCM patients and 37.6% of OCR patients. On Chi-square test, there was no statistical significance between these two groups.

For 6 studies (147 patients) that directly compared OCM and OCR, cumulative odds ratio was 0.74 (95% CI 0.32-1.62, p=0.45), favoring OCM but not statistically significant.

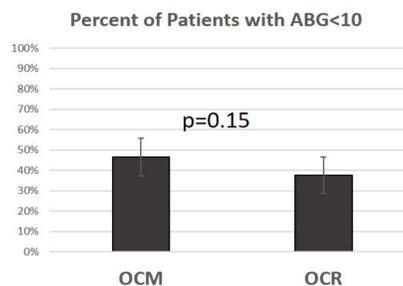


Figure 6. Post-operative hearing outcomes: percent of patients with post-operative air-bone gaps less than 10 dB, used here as a marker of surgical success.

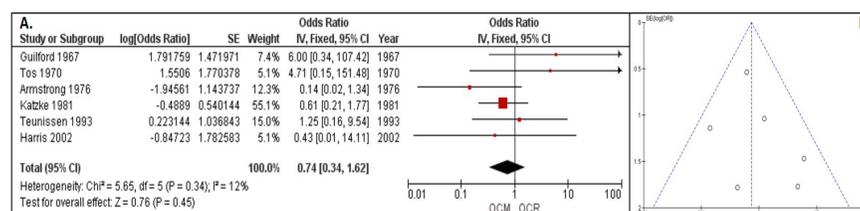


Figure 7. A) Odds ratios comparing OCM and OCR surgical outcomes in 6 studies that studied both surgical methods. B) Funnel plot demonstrating heterogeneity of this analysis

Discussion

There are several decades of literature on both types of surgery, but no accepted consensus exists on which is superior. This review attempts to summarize the literature and compare the two surgical strategies, but there are several inherent limitations that make this difficult. Studies took place over 50 years with operations performed at different institutions by different surgeons. Different techniques were used within each subgroup, with more advanced techniques utilized in the more recent studies.

Conclusion

The current literature describes the use of both OCM and OCR techniques for the surgical management of isolated malleus/incus fixation. This systematic review of retrospective studies found no significant differences in audiometric outcomes between the two techniques but the overall power of this meta-analysis is low. A large prospective randomized controlled trial could help identify whether one of the techniques yields superior long-term hearing results.

References

1. Subotic R, Mladina R, Risavi R. Congenital bony fixation of the malleus. *Acta Otolaryngol* 1998;118(6):833-6
2. Vincent R, Lopez A, Sperling NM. Malleus Ankylosis: A Clinical, Audiometric, Histologic, and Surgical Study of 123 Cases. *Am J Otol* 1999;20:717-25
3. Seidman MD, Babu S. A new approach for malleus/incus fixation: no prosthesis necessary. *Otol Neurotol* 2004;25:669-73
4. Katzke D, Plester D. Idiopathic malleus head fixation as a cause of a combined conductive and sensorineural hearing loss. *Clin Otolaryngol Allied Sci* 1981;6(1):39-44
5. Armstrong BW. Epitympanic malleus fixation: correction without disrupting the ossicular chain. *Laryngoscope* 1976;86(8):1203-8
6. Tos M. Bony fixation of the malleus and incus. *Acta Otolaryngol* 1970;70:95-104
7. Teunissen E, Cremers CWRJ. Surgery for congenital anomalies of the middle ear with mobile stapes. *Eur Arch Otorhinolaryngol* 1993;250:327-331
8. Harris JP, Mehta RP, Nadol JB. Malleus fixation: clinical and histopathological findings. *Ann Otol Rhinol Laryngol* 2002;111(3 Pt 1):246-54
9. Guilford FR, Anson BJ. Osseous fixation of the malleus. *Trans Am Acad Ophthalmol Otolaryngol* 1967;71(3):398-407
10. Martin C, Oletski A, Prades JM. Surgery of Idiopathic malleus fixation. *Otol Neurotol* 2009;30:165-9
11. Albu S, Babighian G, Trabalzini F. Surgical Treatment of Tympanosclerosis. *Am J Otol* 2000;21:631-5
12. Tierney JF, Stewart LA, et al. Practical methods for incorporating summary time-to-event data into meta-analysis. *Trials*. 2008;8:16. doi: 1745-6215-8-16 [pii].
13. Higgins J, Green S. 7.7.7.3 standard errors from confidence intervals and P values: Ratio measures. *Cochrane Handbook for Systematic Reviews of Interventions*. The Cochrane Collaboration. 2011.
14. Betty RK, Jonathan A. Essential medical statistics. Kirkuwood and Jonathan AC Sterne: Blackwell Science Ltd. 2003;414:425.
15. Deeks J, Higgins J, Altman D. 9.5. 2. identifying and measuring heterogeneity. *The Cochrane handbook for systematic reviews of interventions*. Version. 2011;5(0).
16. Sakalli E, Celikyurt C, Guler B, et al. Surgery of isolated malleus fixation due to tympanosclerosis. *Eur Arch Otorhinolaryngol* 2015;272(12):3663-7
17. Shea JJ. Plastipore total ossicular replacement prosthesis. *Laryngoscope* 1976;86(2):239-40
18. Goldenberg RA, Emmet JR. Current Use of Implants in Middle Ear Surgery. *Otol Neurotol* 2001;22(2):145-52
19. Sennaroglu L, Gungor V, et al. Manubrio-stapedioplasty: new surgical technique for malleus and incus fixation due to tympanosclerosis. *Laryngol Otol* 2015;129:587-90
20. Stankovich MD. Hearing results of surgery for tympanosclerosis. *Eur Arch Otorhinolaryngol* 2009;266(5):635-40
21. Emmett JR, Shea JJ. Surgical treatment of tympanosclerosis. *Laryngoscope* 1978;88(10):1642-8
22. Celik H, Felek SA, et al. The effect of mobility of ossicles and surgical approach on hearing results in patients with tympanosclerosis. *Mediterr J Otol* 2008; 184-190