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Hearing outcomes after incudo-stapedial rebridging versus partial ossicular replacement prosthesis in chronic suppurative otitis media

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Abstract

Aim: To evaluate the early postoperative hearing results after Incudo-stapedial rebridging versus partial ossicular replacement prosthesis application in cases of incudo-stapedial discontinuity due to chronic suppurative otitis media.

Study Design: A prospective randomized comparative clinical trial.

Place and Duration of Study: Otolaryngology Department, Tanta University, Egypt from January 2018 to June 2021.

Methodology: Inclusion criterion was cases with CSOM with ABG more than 30 dB and adequate cochlear reserve. Study population were sixty consecutive cases with incudo-stapedial erosion more than 2-millimeter gap. Thirty of them were candidates for incudo-stapedial rebridging using tragal cartilage strip graft and glass ionomer bone cement. The other thirty patients were candidates for PORP. Tympanoplasty was done for each case of the two groups.

Main Outcome Measures: hearing assessment following surgical procedures.

Results: Postoperative air conduction significantly decreased compared to baseline in each group. By comparing the results of both techniques, pre and postoperative air conduction were insignificantly different.

ABG significantly decreased postoperatively compared to baseline in each group. By comparing between both techniques, pre and postoperative ABG were insignificantly different.

Conclusions: Among chronic suppurative otitis media patients with ossicular erosion, our study showed that PORP and cartilage graft with glass ionomer bone cement effectively improved hearing levels when used for the reconstruction of the incudostapedial joint during tympanoplasty.

Keywords: Ossiculoplasty, PORP, Incudostapedial rebridging, Middle ear prosthesis

1. Introduction

Ossicular chain serves as an acoustic transformer to match the impedance of the air to the much higher impedance of the cochlear fluids ^[1]. Both types of chronic suppurative otitis media may lead to erosion of the ossicular chain. This propensity for ossicular destruction is much greater in cases of atticofurrow type, due to the presence of cholesteatoma and granulations ^[2]. The lenticular process and long process of the incus is the most vulnerable part of whole ossicular chain to necrosis because it has a proximal narrow pedicle ^[3].

The proposed mechanism for erosion in chronic middle ear inflammation is due to overproduction of cytokines, Tumor necrosis factor (TNF) alpha, interleukin-2, fibroblast growth factor, and platelet derived growth factor, which promote hyper vascularisation, osteoclast activation and bone resorption causing ossicular damage ^[3].

Hearing outcomes following ear surgery in patients with chronic suppurative otitis media depend on experience of the surgeon, pathology in the middle ear and extent of disease influence the choice of treatment procedure ^[4].

In the past, eradication of disease was the primary target in the treatment. Since the first half of the 20th century, hearing protection or restoration has also become a second priority of treatment ^[5].

Reconstruction of the ossicular chain can be performed using autologous cartilage, bone, or synthetic materials such as vinylacryl, polyethylene, gold, plastipore, hydroxyapatite, bioglass and titanium ^[6].

The aim of this work is to evaluate the early postoperative hearing results after Incudo-stapedial rebridging versus partial ossicular replacement prosthesis application in cases of incudo-stapedial discontinuity due to chronic suppurative otitis media.

2. Material and Methods

This was a prospective randomized comparative clinical trial which was carried out from January 2018 to June 2021 in ENT department, Tanta university hospital. Study population were sixty consecutive cases with incudo-stapedial erosion more than 2-millimeter gap. Thirty of them were candidates for incudo-stapedial rebridging using tragal cartilage strip graft and glass ionomer bone cement. The other thirty patients were candidates for PORP. Tympanoplasty was done for each case of the two groups. We included cases with CSOM with ABG more than 30 dB and adequate cochlear reserve. We excluded cases with only hearing ear, extensive cholesteatoma, moderate to severe SNHL.

Statistics were performed using STATA version 13 (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, Texas).

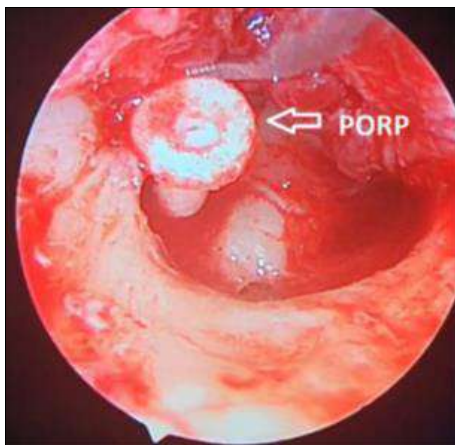


Fig 1: Right ear. PORP application over the head of the stapes

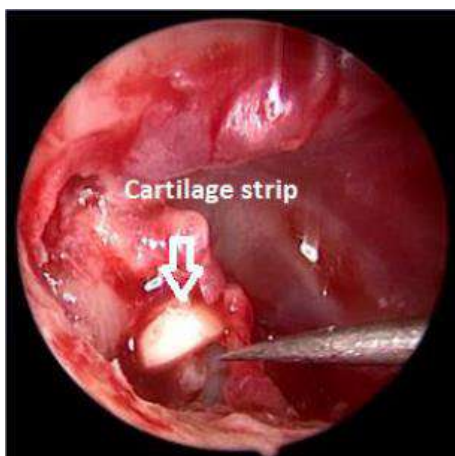


Fig 2: Right ear. Endoscopic view showing a cartilage strip between eroded long process of incus and head of stapes

3. Results

In this study, 83 patients were assessed for eligibility, 12 patients did not meet the criteria and 11 patients refused to participate in the study. The remaining 60 patients were randomly allocated into two groups (30 patients in each

group). All patients were followed-up and analyzed statistically. Age, sex, affected side and duration of disease were insignificantly different between both groups. Regarding time of operation, it was significantly delayed in patients who underwent incudo-stapedial rebridging compared to those who had PORP (P value <0.001).

There was a significant positive correlation between duration of disease and preoperative ABG of the studied patients ($r=0.623$, $p<0.001$).

Postoperative bone conduction was insignificantly different compared to baseline in each group.

Postoperative air conduction significantly decreased (improvement of hearing) compared to baseline in each group (P values <0.001). By comparing the results of both techniques, pre and postoperative air conduction were insignificantly different.

ABG significantly decreased postoperatively compared to baseline in each group (P values <0.001). By comparing between both techniques, pre and postoperative ABG were insignificantly different.

4. Discussion

According to our results, there was a significant positive correlation between duration of disease and preoperative ABG of the studied groups ($r=0.609$, $p<0.001$). Carrillo *et al.*,^[7] analyzed the likelihood ratios and predictive values of preoperative ABG levels on the presence of gross ossicular discontinuity (OD) among chronic suppurative otitis media (CSOM) patients to conclude that wide ABG at higher frequencies suggested presence of OD. They found that ABG levels of greater than 30 dB at 2 kHz and greater than 40 dB at 4 kHz increased the probability of OD from 33 to 51 to 89% to conclude that wide ABG at higher frequencies suggested presence of ossicular discontinuity.

In the present study, ABG significantly decreased postoperatively compared to baseline in each group (P values <0.001). Our results are in the same line with Hameed *et al.*,^[8] evaluated improvement in hearing by incudostapedial reconstruction using conchal cartilage interposition graft in tympanoplasty. A statistically significant improvement in air conduction by 15.14 dB was found after undergoing incudostapedial reconstruction using conchal cartilage ($p<0.001$). In agreement with our results, Polanik *et al.*,^[9] conducted a retrospective study to evaluate changes in low and high frequency ABG following ossiculoplasty. Reconstruction materials included: cartilage (N = 4), hydroxyapatite cement (N = 5), and partial or total ossicular replacement prostheses (N = 20 and N = 8, respectively). In the cartilage group ABG improved from 24.2 to 18.3 (-5.8) and in the PORP from 29.4 to 20.3 (-9.2). In our study, postoperative bone conduction was insignificantly different compared to baseline in each group. By comparing the results of both techniques, pre and postoperative bone conduction were insignificantly different. Hameed *et al.*,^[8] in agreement with our findings, observed no statistically significant change in bone conduction (p value > 0.05) pre and postoperatively in patients with incudostapedial reconstruction using conchal cartilage. Comparably, Baylancicek *et al.*,^[10] results highlighted that postoperative bone conduction was insignificantly different compared to baseline in bone cement vs partial PORP in cases of incudostapedial discontinuity. Further, by comparing between the results of both techniques, pre and postoperative bone conduction

were insignificantly different (all $P > 0.05$).

In the current study, postoperative air conduction was significantly decreased compared to baseline in each group (P values < 0.001). By comparing between the results of both techniques, pre and postoperative air conduction were insignificantly different. In consistent with our findings, Hameed *et al.*,^[8] reported a statistically significant improvement in air conduction by 5.14 dB was found after undergoing incudostapedial reconstruction using conchal cartilage ($p < 0.001$). Baylancicek *et al.*,^[10] confirmed our results as their investigation's findings displayed an improvement in air conduction in BC group from 41.34 ± 15.94 to 20.53 ± 11.09 and in PORP with insignificant difference between both groups.

Based on our results, we can suggest that both PORP and cartilage graft accompanied with glass ionomer bone cement exhibit excellent comparable outcomes in terms of hearing improvement in cases with incudo-stapedial discontinuity due to chronic suppurative otitis media.

Study limitations

Two limitations to this study were small sample size, and short follow up period.

5. Conclusion

Among chronic suppurative otitis media patients with ossicular erosion, our study showed that PORP and cartilage graft with glass ionomer bone cement effectively improved hearing levels when used for the reconstruction of the incudostapedial joint during tympanoplasty. The majority of the patients in both groups witnessed significant improvement in ABG, speech reception threshold and air conduction with postoperative hearing gain within 10 to 20 dB and marginal complication.

Competing interests

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Authors' Contributions

The first author designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. The second and the third authors managed the analyses of the study. The fourth author managed the literature searches. All authors read and approved the final manuscript.

Consent

All authors declare that a written informed consent was obtained from the patients for this study. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

Ethical approval

The study gained Ethical Committee approval from School of Medicine, Tanta University, Egypt.

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