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**Original Research Article**

# Comparative study of hearing level pre and post ossiculoplasty in Aseer Central Hospital, Saudi Arabia

**Abdullah M. Assiri[1]*, Ali M. Al-Qannass[2], Tawfiq A. Khurayzi[3], Talat E. Alardi[4]**

Department of Otolaryngology, [1]College of Medicine, Najran University, Najran, [2]Armed Forces hospital, Southern Region, [3]King Fahad Central hospital, Jizan, [4]Aseer Ceneral hospital, Abha, Saudi Arabia

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***Correspondence:**
Dr. Abdullah M. Assiri,
E-mail: mezo106@yahoo.com



## ABSTRACT

**Background:** Achieving successful hearing outcomes following ossiculoplasty in patients with middle ear diseases depend on several factors. Unfortunately, the literature is confusing concerning the middle ear factors and types of pathologic process that are most important in predicting hearing outcome. The objective of the study was to investigate the improvement or deterioration of hearing after ossiculoplasty and identify the possible prognostic factors.
**Methods:** Between January, 2012 and December, 2014, 30 ossiculoplasties were performed and followed up by the first author with the help of other authors in Otolaryngology department, Aseer Ceneral hospital, Abha, Kingdom of Saudi Arabia. The patients were followed up at 6 months, 9 months after the operation and then on a yearly basis. Postoperative hearing outcomes were considered successful if the postoperative air-bone gap was within 20 dB while it was considered not successful if it exceeds 20 dB.
**Results:** The study included 30patients. Their age ranged between 18 and 61 years with a mean of 37.4±10.7 years. Sixty percent of them (n=18) were females and forty percent (n=12) were males. Pre-operative PTA was 37.83±8.97 dB and it decreased to 23.0±12.57 dB postoperatively. This difference was statistically significant ($p<0.001$) with an average change in ABG of 150 dB across the 30 patients. The successful rate was 50%. the only factor proved to be significantly associated with successful ossiculoplasty was the male gender as 75% of makes compared to 33.3% of females patients reported postoperative air-bone gap within 20 dB, $p=0.030$.
**Conclusions:** Successful rate of ossiculoplasty in Asser central hospital is within the globally reported rates. However, further larger prospective study is recommended for better understanding of predictive factors for hearing improvement after ossiculoplasty that may contribute to the surgeon's judgment and the information given to patients.

**Keywords:** Ossiculoplasty, Successful rate, Hearing outcomes, Follow-up, Retrospective

## INTRODUCTION

The natural ossicular chain plays a fundamental role in efficient transport of sound from the environment to the oval window.[1] Middle ear diseases, such as cholesteatoma, chronic otitis media, and trauma, can interrupt this transfer.

The reconstruction of the conductive mechanism is one of the infatuating subjects in surgery of middle ear as regard the ideal implant for the targeted ear with the understanding that the middle ear environment in chronic ear disease is mostly the main factor in determining treatment success.[2,3]

Today, the otologist has a wide array of middle ear implants from which to choose, but may find it difficult to know which works best. Achieving successful hearing outcomes following ossiculoplasty in patients with middle ear diseases depend on several factors. Besides

experience of the surgeon, pathology in the middle ear and extent of disease influence the choice of treatment procedure.[4,5] In addition, the follow-up period and qualities of the prosthesisalsoaffect the outcome of ossiculoplasty. In general, shorttermoutcomes are better than long-term outcomes.[6]

Unfortunately, the literature is confusing concerning the middle ear factors and types of pathologic process that are most important in predicting hearing outcome.

In this study, we retrospectively investigate the improvement or deterioration of hearing after ossiculoplasty and identify the possible prognostic factors.

## METHODS

Between January, 2012 and December, 2014, 30 ossiculoplasties were performed and followed up by the authors in Otolaryngology department, Aseer Central hospital, Abha, Kingdom of Saudi Arabia.

The patients were followed up at 6 months, 9 months after the operation and then on a yearly basis. The clinical background of the patients was recorded in their files. The files were reviewed retrospectively.

In the present study, the four-tone average of 0.5, 1, 2, and4 kHz was used for the mean air conduction (AC) and bone conduction(BC) thresholds, following the recommendations fromthe Committee of Hearing and Equilibrium.[7] The postoperative air-bone gap (ABG) was calculated using the postoperative AC and BC thresholds.

All patients were operated on under general anesthesia using a postauricular approach to allow a consistent intraoperative environment across patients and temporalis fascia was used as a graft for all patients. Autograft incus and partial ossicular replacement prosthesis (PORP) were used for ossiculoplasty if a stapes suprastructure was present. Total ossicular replacement prosthesis (TORP) was used when the stapes suprastructure was absent.

Postoperative hearing outcomes were considered successfulif the postoperative air-bone gap was within 20 dB while it was considered not successful if it exceeds 20 dB.

The postoperative air-bone gap wascalculated using the postoperative bone conduction and postoperative air conduction thresholds.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS, version 20) software. Paired t-test was applied to test for the difference between pre and postoperative pure tone audiometry (PTA). Chi-square and Fisher`s exact tests were utilized to test for the association between different factors and successful postoperative hearing outcomes and p values less than 0.05 were taken as significant.

## RESULTS

The study included 30patients. Their age ranged between 18 and 61 years with a mean of 37.4±10.7 years. Sixty percent of them (n=18) were females and forty percent (n=12) were males. Slightly more than half of them (53.3%) presented with right ear affection whereas the remaining 46.7% presented with left ear affection.

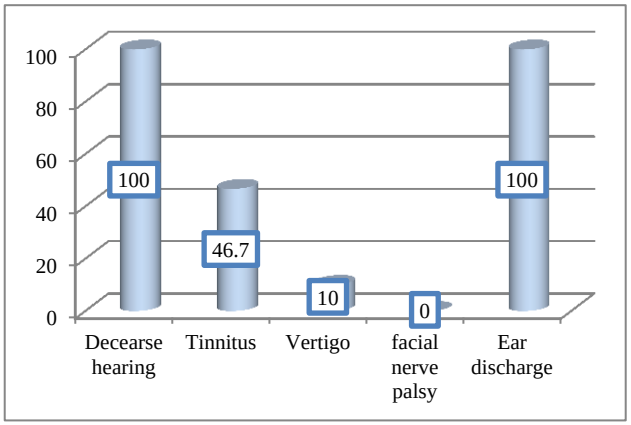


**Figure 1: Preoperative otological symptoms.**

Figure 1 summarizes their preoperative ontological symptoms. All of them presented with decrease hearing and ear discharge whereas 46.7% presented with tinnitus. None of them presented with facial nerve palsy.

**Table 1: Medical background of the participants.**

| | Frequency | % |
|---|---|---|
| **Family history of hearing loss** | 0 | 0.0 |
| **Past history of medical illness** | 7 | 23.3 |
| Hypertension | 1 | 3.3 |
| Bronchial asthma | 2 | 6.7 |
| Hypothyroidism | 1 | 3.3 |
| Diabetes mellitus | 2 | 6.7 |
| GERD/fibromyalgia | 1 | 3.3 |
| **Medication history** | 7 | 23.3 |
| Concor | 1 | 3.3 |
| Inhaler | 2 | 6.7 |
| Thyroxin | 1 | 3.3 |
| Oral hypoglycemic | 1 | 3.3 |
| Insulin | 1 | 3.3 |
| PPI/NSAID | 1 | 3.3 |
| **Past history of ear surgery** | | |
| No | 25 | 83.4 |
| Yes, same side | 1 | 3.3 |
| Yes, other side | 4 | 13.3 |

None of the participants had family history of hearing loss. Medical illness was reported among 7 cases (23.3%) whereas past history of ear surgery was reported among five cases (16.6%) (Table 1).

Pre-operative PTA was 37.83±8.97 dB and it decreased to 23.0±12.57 dB postoperatively. This difference was statistically significant, p<0.001 as seen in figure 2 with an average change in ABG of 150 dB across the 30 patients.

Overall, it is obvious from Figure 3 that the successful rate was 50% whereas non successful outcome was reported among 50% of cases (30% not improved and 20% no change was reported).

**Table 2: Factors associated with successful ossiculoplasty.**

| | Ossiculoplasty | | P value |
|---|---|---|---|
| | Not successful N=15 N (%) | Successful N=15 N (%) | |
| **Age in years** | | | |
| ≤40 (n=19) | 10 (52.6) | 9 (47.4) | 0.705* |
| >40 (n=11) | 5 (45.5) | 6 (54.5) | |
| **Gender** | | | |
| Male (n=12) | 3 (25.0) | 9 (75.0) | 0.030ǂ |
| Female (n=18) | 12 (66.7) | 6 (33.3) | |
| **Tinnitus** | | | |
| No (n=16) | 10 (62.5) | 6 (37.5) | 0.143* |
| Yes (n=14) | 5 (35.7) | 9 (64.3) | |
| **Vertigo** | | | |
| No (n=27) | 14 (51.9) | 13 (48.1) | 0.500ǂ |
| Yes (n=3) | 1 (33.3) | 2 (66.7) | |
| **Past medical illness** | | | |
| No (n=23) | 11 (47.8) | 12 (52.2) | 0.500ǂ |
| Yes (n=7) | 4 (57.1) | 3 (42.9) | |
| **Past surgical ear history** | | | |
| No (n=25) | 11 (44.0) | 14 (56.0) | 0.165ǂ |
| Yes (n=5) | 4 (80.0) | 1 (20.0) | |
| **Affected side** | | | |
| Right (n=16) | 8 (50.0) | 8 (50.0) | 1.00* |
| Left (n=14) | 7 (50.0) | 7 (50.0) | |
| **Preoperative examination** | | | |
| Anterior perforation (n=4) | 1 (25.0) | 3 (75.0) | 0.466* |
| Central perforation (n=13) | 6 (46.2) | 7 (53.8) | |
| Subtotal perforation (n=8) | 5 (62.5) | 3 (37.5) | |
| Total perforation (n=1) | 0 (0.0) | 1 (100) | |
| Posterior perforation (n=4) | 3 (75.0) | 1 (25.0) | |
| **Preoperative speech** | | | |
| Excellent (n=26) | 12 (46.2) | 14 (53.8) | 0.299ǂ |
| Good (n=4) | 3 (75.0) | 1 (25.0) | |
| **Prosthesis** | | | |
| Incus interposition (n=13) | 8 (61.5) | 5 (38.5) | 0.360* |
| PORP (n=1) | 0 (0.0) | 1 (100) | |
| Incus prosthesis (n=9) | 3 (33.3) | 6 (66.7) | |
| Cartilage (n=6) | 4 (66.7) | 2 (33.3) | |
| TORP (n=1) | 0 (0.0) | 1 (100) | |
| **Intraoperative examination**** | | | |
| Eroded incus & long process of incus (n=17) | 7 (41.2) | 10 (58.8) | 0.269* |
| Eroded lenticular process (n=5) | 3 (60.0) | 2 (40.0) | 0.500ǂ |
| Eroded malleus/handle of malleus (n=2) | 2 (100) | 0 (0.0) | 0.241ǂ |
| Ossicles fixation (n=8) | 3 (37.5) | 5 (62.5) | 0.341ǂ |
| Incudostapedial dislocation (n=2) | 2 (100) | 0 (0.0) | 0.241ǂ |
| Tympanosclerosis (n=5) | 4 (80.0) | 1 (20.0) | 0.165ǂ |

*chi-square test; ǂFischer exact test;** more than one finding is possible.

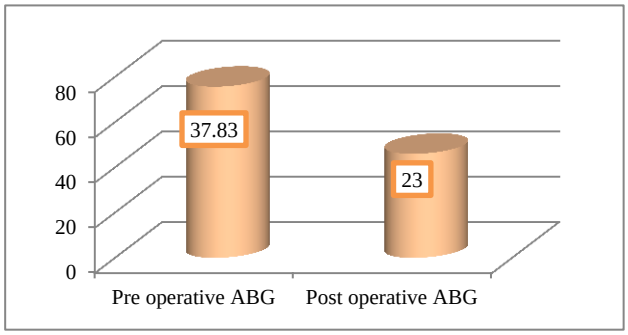


**Figure 2: Comparison between pure tone audiometry (PTA) pre and post-operatively among patients.**

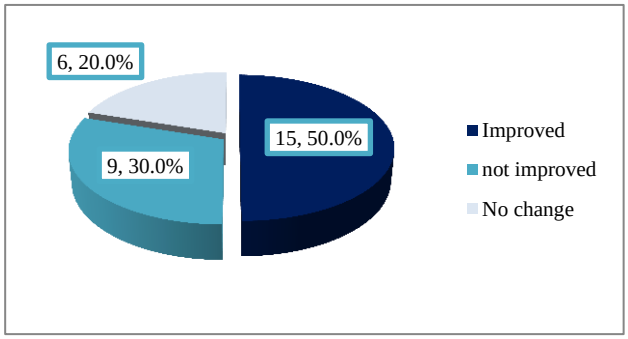


**Figure 3: Post-operative hearing after ossiculoplasty.**

From Table 2, it is evident that the only factor proved to be significantly associated with successful ossiculoplasty was the male gender as 75% of makes compared to 33.3% of females patients reported postoperative air-bone gap within 20 dB, p=0.030. Regarding intra-operative examination findings, the highest successful rate was reported in ossicles fixation (62.2%), followed by Eroded incus and long process of incus (58.8%) whereas it was zero% in eroded malleus/handle of malleus and incudostapedial dislocation. However, this was not statistically significant (p>0.05). As regards type of prosthesis, 100% successful rate was reported in PORP and TORP compared to 33.3% in cartilage and 38.5% in Incus interposition with no significant difference (p>0.05).

## DISCUSSION

Comparison of our results with others carries some difficulties because of some factors. Our study based on a relatively small number of cases and other studies differ from each others in number of cases, duration of follow up as the surgical outcome of ossiculoplastyis dependent on the length of the follow-up period, the studied population and definition of successful ossiculoplasty. In conclusion, comparison of our results with others should be interpreted with caution.

In the current retrospective study, success was defined as an ABG within 20 dB on postoperative 6 months. Out of 30 cases, 15 patients had an ABG ≤20 dB, accounting for an overall success rate of 50.0%. Only one senior surgeon operated on the patients with the help of other juniors. So quality of operating surgery had no influence on success rates achieved. The average change in ABG was 15.0 dB across the 30 patients. In a similar, however prospective study conducted by Chavanet al in Iran, they defined a success as an ABG <25 dB on postoperative Day 90.[8] The overall success rate was 80.0%. Five different surgeons operated on the patients and no statistically significant difference was found on success rates achieved according to operating surgeon (73.7–87.0%). The average change in ABG was 15.76 dB across 80 patients.

In another retrospective study carried out by Uyar et al among patients presented with chronic suppurative otitis media (CSOM), post- ossiculoplasty ABG value was ≤20 dB in 27% of patients and mean hearing gain was 11.9 dB.[9] Mishiro et al studied one hundred ninety-nine patients who underwent ossiculoplasty between 1989 and 2001 by the same surgeon and were followed for more than 5 years. They considered postoperative hearing outcomes successful if the postoperative air-bone gap was within 20dB as we did in the present study. The outcomes after 6 months and 5 years were analyzed. The overall rate of successful outcomes was 61.3%after 6 months and 54.3% after 5 years.[10] The overall success rate of ossiculoplasty was 66.5% at6 months and 50.3% at 5 years among 242 ossiculoplasties for chronic otitismedia performed on 197 patients between 1988 and 1999 in UK.[11] Mishiro et al reported that hearing outcomes were successful in 70.1%of seven hundred twenty patients who underwent ossiculoplasty performed by a single surgeon from January 1, 1989, through December 31, 2006, and who were followed up for longer than 1 year. Hearing outcomes were considered successful if the postoperative air-bone gap was 20 dB or less.[12]

Regarding associated factors with successful ossiculoplasty, it is interesting that the only identified factor was the male sex. However, Vrabec et al did not identify any risk factor in their report and Mills identified only absence of stapes as a risk factor in his study.[13,14] Yung and Vowler reported absence of malleus and otorrhea as significant predictor of unsuccess after a period of 6-months follow-up while at 5-years follow-up, absent malleus, absent stapes, and revision surgery were borderline significant unfavorable factors.[11]

In the present study, intra-operative examination findings were not significantly associated with the successful ossiculoplasty. Partly, due to relatively small number of cases. However, the pathologic condition of the middle ear as a predictor of outcome is also a very confusing issue in the literature. Dornhoffer reported that the pathologic condition associated with the surgical indication was not significant.[15] In contrast, Brackmann et al and Goldenberg found the contribution of the malleus handle to be insignificant.[16,17]

In addition, type of prosthesis was not proved to be a significant predictor for successful ossiculoplastyin the present research. In accordance with our findings, Chavan et al and Yung reported no statistical difference in the use of different types of ossicular implants for ossiculoplasty.[2,8] On the other hand, Gary Jackson et al achieved better results with Teflon TORP than PORP in his study of 141 cases of ossiculoplasty.[18] A wide variety of autografts, homografts, synthetic ossicular grafts, and prostheses have been employed for reconstructing the ossicular chain. With a number of prosthesis being available, comparisons become inevitable. The ideal prosthesis for ossiculoplasty should be compatible, stable, safe, readily available, easily insertable, and capable of yielding optimal sound transmission.[8]

In conclusion, successful rate of ossiculoplasty in Asser central hospital is within the globally reported rates. However, further larger prospective study is recommended for better understanding of predictive factors for hearing improvement after ossiculoplasty that may contribute to the surgeon's judgment and the information given to patients.

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