Original article

Comparison between the conventional methods and Glasgow Benefit Plot in evaluating subjective hearing results after myringoplasty.

P. Rayamajhi, H. Bhattarai, B. K. Sinha, R. P. Shrivastav

Department of Otorhinolaryngology and Head and Neck Surgery, Tribhuvan University, Institute of Medicine, Maharajgunj, Kathmandu, Nepal.

Correspondence to: Dr P. Rayamajhi, Department of Otorhinolaryngology and Head and Neck Surgery, TU, IOM, Kathmandu, Nepal.

Background: To compare the Conventional methods with Glasgow Benefit Plot in evaluating subjective hearing results after myringoplasty.

Materials and Methods: Patients above 17 years of age with the diagnosis of Chronic Suppurative Otitis Media-tubotympanic type undergoing Myringoplasty at TU Teaching Hospital from January 2004 to July 2005 were included in the study. The pre and postoperative Pure Tone Audiometry (PTA) was performed and evaluated. The postoperative subjective hearing status of the patients was recorded as improved, same or worsened. Objectively, the postoperative hearing was assessed in terms of Air Bone Gap closure, Air Conduction Threshold improvement and Glasgow Benefit Plot. The objective methods were then compared with the postoperative subjective hearing status of the patients.

Results: The association between the Air Bone gap closure and the postoperative subjective hearing status was not statistically significant. The association between the Air Conduction threshold improvement and the postoperative subjective hearing status was statistically significant. The association between the Glasgow Benefit Plot and the postoperative subjective hearing status was also statistically significant.

Conclusion: The study showed that the Air Conduction threshold improvement and the Glasgow Benefit plot are better parameters for evaluating subjective hearing results after myringoplasty than the Air Bone gap closure.

Key words: Glasgow Benefit Plot, myringoplasty, Pure Tone Audiometry (PTA)

Introduction

After myringoplasty, the success of surgery is evaluated in terms of graft uptake and hearing improvement. Conventionally, the commonly used criteria for hearing improvement are closure of Air Bone gap or the improvement in Air Conduction threshold[5]. The newer method which is also used to assess the hearing improvement is the Glasgow Benefit Plot[1-4].

Glasgow Benefit plot is a graphical method of reporting surgical results using a pair of coordinate axes. The X-axis represents the average Air Conduction threshold in the nonoperating ear. The Y-axis represents the average Air Conduction threshold in the ear to be operated. 30dB Air Conduction threshold is taken as the normal cutoff limit. Patients fall into one of the three preoperative groups (1-3) and four postoperative groups (a-d) as shown in figure 1[1]. Joining the pre and postoperative data produces a vertical line, the length of the line representing the improvement in air conduction; the benefit depends on the area of the graph in which the line ends as shown in (Fig. 1[1]).

Preoperative group 1

Patients in this group have unilateral hearing impairment and thus, asymmetrical thresholds. The most beneficial goal is to move them into postoperative category a and give bilateral normal thresholds.

Potential changes from preoperative impairment group to postoperative impairment category, representing different types of benefit.

Fig. 1: Glasgow Benefit Plot: preoperative and postoperative impairment categories

Preoperative group 2

Patients in this group have bilateral hearing impairments and asymmetric thresholds. Here there are three potential outcomes representing benefits from operating on a single ear. The best potential outcome is to move the patients into postoperative category b and give them unilateral normal hearing. Another possible but less beneficial, outcome is to move them into postoperative category c and make the operated ear the better hearing ear. A third possibility is to move them into postoperative category d: the patients will remain bilaterally impaired but the poorer hearing ear has similar hearing as the nonoperated ear. This might be a minor benefit to the patients**.**

Preoperative group 3

Here, the patients have bilateral symmetrical impairments. Thus, patients can go to category b (unilateral normal hearing) and category c (the operated ear becomes the better ear).

Though there have been previous studies regarding the graft uptake and hearing improvement after myringoplasty from technical point of view, there have been no studies assessing the postoperative functional improvement in the patients' hearing and comparing the Conventional methods and the Glasgow Benefit plot in measuring post-myringoplasty subjective hearing results in Nepal.

Materials and Methods

The study was conducted in the department of ENT & Head and Neck Surgery from January 2004 to July 2005. Patients of both sexes, more than 17 years of age needing myringoplasty, with conductive or mixed hearing loss in PTA evaluation were included in the study. The patients with the Air Conduction Threshold less than 30 dB and those with postoperative graft uptake failure were excluded.

The Pure Tone Audiometry test done within seven days prior to the operation was accepted. The test was performed through Air Conduction and Bone Conduction mode. The Air Conduction threshold and the Bone Conduction threshold averages were calculated by taking the averages of 500, 1000 and 2000 Hz frequencies.

Follow up after myringoplasty was done specifically at the 10^{th} week (Shrestha [8]). Regarding the graft uptake, it was noted whether the graft take-up was total (successful graft uptake) or whether there was perforation (failures). The patients with total rejection of the graft, residual perforation or even the pinhole-sized perforation were taken as graft failures and were excluded from the study[9]. The postoperative subjective hearing status of the patients was noted as improved, same or worsened.

Regarding the Conventional methods for the assessment of hearing, the Air Bone gap closure and the Air Conduction threshold improvements were assessed. For the assessment of Air Bone gap closure, the cut off was taken as 10 dB. Patients with the postoperative Air Bone gap closure within 10 dB were taken as having hearing improvement postoperatively (Browning et al[1], Anthony et al[5]). The Air Conduction threshold improvement was the other Conventional methods used and 30 dB was taken as the cutoff limit. The postoperative Air Conduction threshold improvement of d"30 dB was taken as to give significant hearing improvement.

The pre and the postoperative pure tone air conduction averages were assessed and the patients were divided into pre and postoperative Glasgow categories. The patients falling into postoperative group 'a' and 'b' were regarded as to have hearing improvement and those in the group 'c' and 'd' were regarded as to have no hearing improvement, postoperatively.

The results were analyzed using computer software SPSS. The p value of <0.05 were considered to be statistically significant.

Results

Total of 104 patients were analyzed. The graft uptake rate was 90%. The greater magnitude of the patients (80.8%) was in the age group of 18-30 years with male to female ratio of 1.8:1.

Regarding the postoperative subjective hearing status, 74

Table 1. Association between the postoperative Air-bone gap closure and postoperative subjective hearing status (n=104):

Postoperative Air bone gap closure (dB)	No. of patients with postoperative subjective hearing improvement	No. of patients without postoperative subjective hearing improvement	Total
	No. (%)	No. (%)	No. (%)
³ 10dB	19 (65.5%)	10 (34.5%)	29 (100%)
< 10dB	55 (73.3%)	20 (26.7%)	75 (100%)
Total	**74 (71.2%)**	**30 (28.8%)**	**104 (100%)**

P=0.43 (>0.05) Distribution not significant statistically

Table 2. Association between the postoperative Air Conduction threshold and postoperative subjective hearing status (n=104).

Postoperative Air Conduction threshold (dB)	No. of patients with postoperative subjective hearing improvement	No. of patients without postoperative subjective hearing improvement	Total
	No. (%)	No. (%)	No. (%)
£30 dB	62 (83.8%)	12 (16.2%)	74 (100%)
> 30 dB	12 (40%)	18 (60%)	30 (100%)
Total	**74 (71.2%)**	**30 (28.8%)**	**104 (100%)**

P=0.00001 (<0.05). Distribution statistically significant.

(71.2%) had hearing improvement, 29 (27.9%) had same hearing and 1 (1%) had worsened hearing. There were 67 (64.4%) patients in Glasgow preoperative group 1, 12 (11.5%) in group 2 and 25 (24%) in group 3. Among the Glasgow postoperative group, there were 53 (51%) in group 'a', 35 (33.6%) in group 'b', 10 (9.6%) in group 'c' and 6 (5.8%) in group'd'.

The association between the various audiometric averages and the postoperative subjective hearing status is as shown in the following figures and tables.

Fig. 2: Association between the Glasgow postoperative groups and the postoperative subjective hearing mprovement (n=74)

P=0.00000009 (<0.05). Distribution statistically significant

Fig. 3: Association between the Glasgow plot and the patients without postoperative subjective hearing improvement (n=30)

P=0.001 (<0.05). Distribution statistically significant

Discussion

Assessment of hearing status postoperatively is commonly being done in various centres by conventional methods like Air Bone gap closure and improvement in Air Conduction threshold. No study so far has been done in our country by using newer methods like Glasgow Benefit Plot.

In this study, the minimum air conduction threshold was taken as 30 dB which is taken as a socially acceptable hearing. This cutoff point was also used by Browning et al and Jon et al. The authors stated that doing surgery with

the aim of hearing improvement in patients with the air conduction threshold below 30 dB is not practical. Joshi et al[3] used 40dB as the cutoff limit for the socially acceptable hearing and this had increased the number of patients with hearing improvement in their study.

Similarly, for the postoperative hearing assessment by Air Bone gap closure, closure within 10 dB postoperatively was taken as the criteria of improvement in the present study. Various authors like Browning et al and Vartiainen et al[2] have used this cutoff limit of 10 dB closure as the criteria of significant hearing improvement. But, Black et al and Frade et al[10-11] have been lenient in using 20 dB closure as the cut off limit, for labeling patients as those with improved hearing.

From the present study it was concluded that the postoperative Air Bone gap closure had no significant association with the postoperative subjective hearing status. Similar study showing the correlation between the postoperative Air Bone gap and postoperative subjective hearing status was done by Anthony et al[7] where 60% of the patients with the postoperative Air Bone gap closure of ≤10 dB had postoperative subjective hearing benefit.

In the present study significant association was seen between the postoperative Air Conduction threshold and the subjective hearing status. In a study by Anthony et al[7] in various middle ear surgeries, they had concluded that the incidence of postoperative subjective hearing improved with the increasing magnitude of Air Conduction and was 100% when there was 30 dB or more reduction in the Air Conduction threshold.

In the present study, the association between the Glasgow postoperative groups was made with the postoperative subjective hearing status in both the hearing improved and not improved cases. Szymanski et al in their study on his 153 post stapedectomy patients, found that the postoperative subjective hearing improved cases were 79% in group 1 going to group a, 46% of group 2 and 37% group 3, going into postoperative group b. Compared to their study, our study had better subjective hearing improvement results.

Browning et al, on analyzing his 41 stapedectomy/ stapedotomy patients found that 70% (7/10) of those in group 1, 27% (3/11) of those in group 2 and 42% (8/19) of those in group 3 achieved the aim of postoperative subjective hearing improvement. Thus, it was seen that our study had a better correlation of the Glasgow Plot with the postoperative subjective hearing improvement. It may be because, in our study, the number of the patients in group 1 going into postoperative group was much more, thus providing more patients with the bilateral normal hearing.

Hence, Air Conduction threshold improvement and Glasgow Benefit plot can both be used to assess the postoperative subjective hearing benefit with the greater reliability. Further, Glasgow plot can also be used to predict the possibilities of the outcome to patients preoperatively. The study can be more reliable and useful if done in a larger population. It can also be done in other middle ear surgeries apart from myringoplasty.

Conclusion

The Air Bone gap closure didn't show significant association with postoperative subjective hearing improvement. The Air Conduction threshold improvement and the Glasgow Benefit Plot showed highly significant association with the postoperative subjective hearing improvement. The Glasgow Benefit Plot showed highly significant association with the postoperative subjective hearing improvement indicating it to be a better indicator than the Air conduction threshold improvement.

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