

Criteria for hearing preservation in acoustic schwannoma surgery: The concept of useful hearing

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Abstract

In the quest for hearing preservation in patients with acoustic schwannomas it is essential that surgeons do not lose sight of the concept of 'useful' hearing. There is an important difference between hearing preservation which pleases the surgeon and that which will be appreciated by the patient.

Tumour size, pure tone audiogram average differences between ears and speech discrimination scores have been recorded in a series of 114 patients with unilateral acoustic schwannomas. Criteria for useful hearing are presented in terms of pure tone audiogram average difference and speech discrimination scores.

There were 11 patients (10 per cent) with a speech discrimination score of 50 per cent or more, a pure tone audiogram average difference of 30 dB or better and a tumour size of no more than 2 cm. Only one patient (0.9 per cent) had a speech discrimination score of 50 per cent or more, a pure tone audiogram average difference of 20 dB or better and a tumour size of no more than 1 cm.

It is concluded that hearing preservation techniques may be applicable to between 1 and 10 per cent of patients with unilateral acoustic schwannomas.

Introduction

Hearing conservation in patients undergoing surgery for the removal of acoustic tumours appears to be the new challenge for otoneurosurgeons and rates of preservation of hearing appear to be on the increase. However as Sanna *et al.* (1991) have pointed out there is a sad lack of uniformity in the reporting of the results of this surgery. Many papers fail to define what is meant by hearing preservation and many are couched in the poorly defined subjective observations of the surgeon rather than substantiated by pre- and post-operative audiometry. The concept of preservation of 'useful' hearing must be recognized. 'Useful' hearing may be defined as that which the patient appreciates. Recent studies of the results of tympanoplasty suggest that the success of surgery is best assessed by comparing the post-operative threshold difference between the two ears, rather than the pre- and post-operative hearing in the operated ear. In this study of a series of patients with a proven acoustic schwannoma we have considered the pre-operative pure tone difference between the ears, the speech audiometric parameters and tumour size in an attempt to define the proportion of patients who might have benefited from attempted hearing preservation.

Patients and methods

Information was collected from patient records of over 200 acoustic schwannoma cases which have been treated by a team approach by members of the University Departments of Otolaryngology and Neurosurgery at Manchester Royal Infirmary, UK.

Information collected included details of the pure tone audiogram (PTA) hearing levels for the right and left ears at 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. Maximum speech discrimination scores and speech reception thresholds for both ears were noted and tumour size was also recorded.

Results

A total of 212 patient records were studied. Exclusions from the study included six bilateral cases and 92 cases with incomplete data. The number of patients with all data complete and therefore entered into the study was 114. The missing data were almost without exception the speech audiogram parameters which were unfortunately not always recorded in patients who were referred from other centres with a radiological diagnosis already made, and with a severe pure tone hearing loss.

Tumour size

There were 61 patients (54 per cent) with a tumour of 2 cm or less and 23 (20 per cent) with a tumour 1 cm or less (Fig. 1).

Pure tone audiogram difference

The difference in the average pure tone audiogram hearing level between the two ears over the frequencies of 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz showed 15 patients with a difference of 20 dB or better and 25 with a difference of 30 dB or better (Fig. 2).

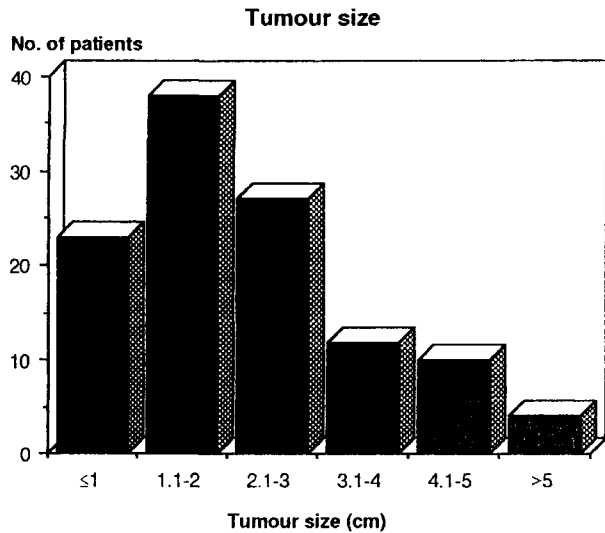


Fig. 1

Range of tumour size in 114 patients with acoustic schwannomas.

Speech discrimination

A maximum speech discrimination of 50 per cent or better was obtained in 57 patients (50 per cent) (Fig. 3).

Selection criteria

The number of patients regarded as potential candidates for hearing preservation depends on consideration of the pure tone audiogram, the maximum speech discrimination score and tumour size. This figure varies according to the stringency with which the selection criteria are applied (Fig. 4). It will be seen that if a 30 dB pure tone difference and a 50 per cent speech discrimination score are taken as the criteria there were 11 patients with a tumour of 2 cm or less and only three patients with tumours of 1 cm or less. If the pure tone criterion is tightened to 20 dB these figures drop to six and one respectively.

Discussion

As techniques have evolved in acoustic schwannoma

surgery various problems have been overcome. One major problem was post-operative facial nerve function. It is now taken for granted that the majority of patients will have an intact and functioning facial nerve at the end of the procedure although there may be some temporary weakness (Lye *et al.*, 1982). Of course there are still a proportion of patients who need further surgery such as a facial-hypoglossal anastomosis to improve a permanent palsy. Surgeons are now increasingly trying to preserve hearing as well as the function of the facial nerve (Dutton *et al.*, 1991).

In the quest for hearing preservation in acoustic schwannoma surgery, surgeons must keep in mind the concept of 'useful' hearing. There is an important difference between hearing preservation which pleases the surgeon and that which is useful to and appreciated by the patient. How can we define what is useful hearing?

It is helpful to consider the lessons learned from tympanoplasty surgery with regard to the post-operative hearing results and the appreciation of this by the patient. Recent studies have shown that for the patient to report a good hearing result following a tympanoplasty the hearing in the operated ear must be improved to within 30 dB and preferably 15 dB of the better ear (Gatehouse, in press). In the case of surgery for acoustic schwannomas the demands are likely to be more stringent. Whereas with tympanoplasty the hearing problem is usually one of attenuation alone, in the case of an acoustic schwannoma there is the added difficulty of poor discrimination and other distortion due to neural damage. The cochlear nerve does not require a large population of intact neurons to transmit relatively simple pure tone messages. Speech requires a disproportionately greater number of healthy neurons capable of coping with the complex coding involved. For this reason the speech discrimination score in a patient with a neural lesion is much worse than in a patient with the same degree of cochlear deafness (Schuknecht and Woellner, 1955). A maximum speech discrimination score of 50 per cent is needed for adequate hearing (Ramsden, 1987). If patients can hear 50 per cent of the words and understand the context of the conversation they can often fill in the gaps. A large proportion of patients undergoing tympanoplasty do not have normal hearing in

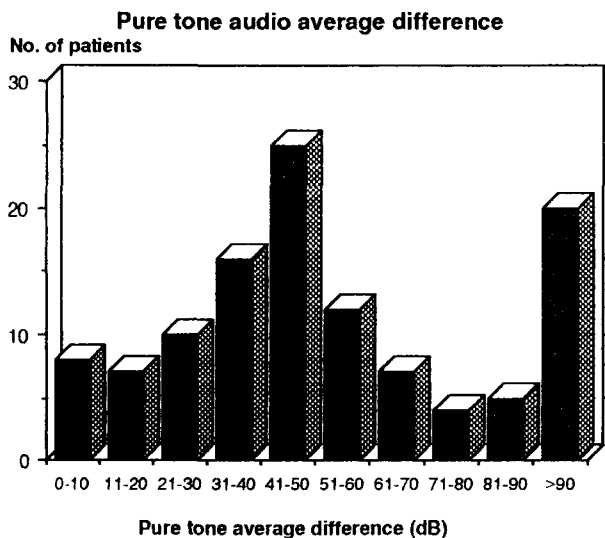


Fig. 2

Pure tone audio average differences between normal and affected ears in 114 patients with acoustic schwannomas.

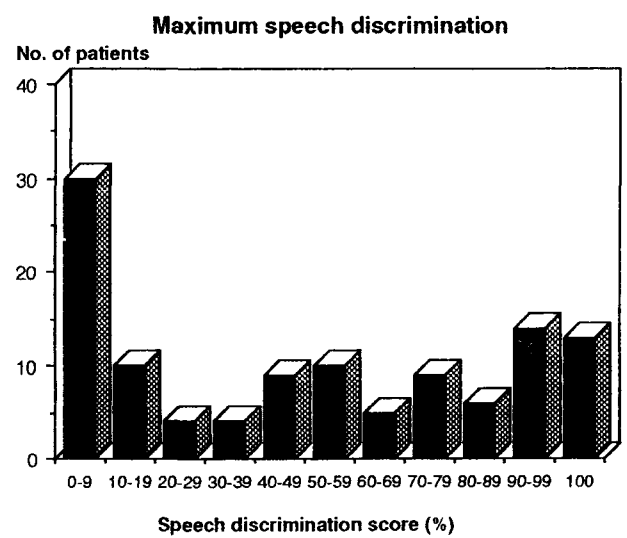


Fig. 3

Maximum speech discrimination scores in 114 patients with acoustic schwannomas.

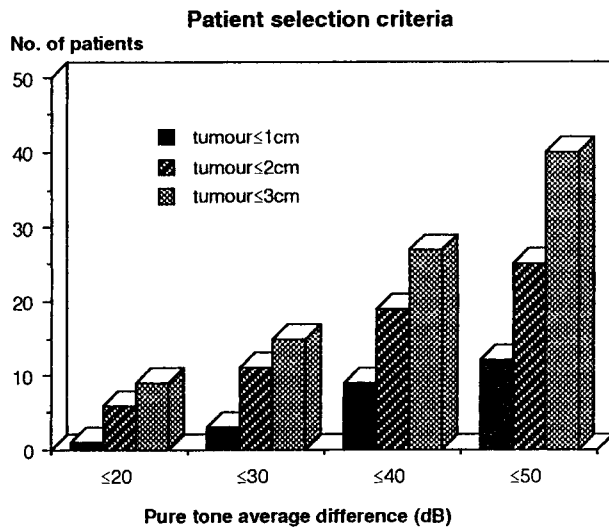


Fig. 4

Criteria for preservation of useful hearing in acoustic schwannoma patients with speech discrimination scores of 50 per cent or better. It can be seen that as the tumour size and pure tone average difference decrease so too does the number of patients suitable for preservation of useful hearing.

the 'good' ear, whereas the great majority of acoustic schwannoma patients do. These factors increase the probability that hearing preservation in acoustic schwannoma surgery while possibly satisfying the surgeon, will fall short of the patient's expectations. Some would argue that any level of hearing can be usefully preserved and that such hearing may even improve post-operatively. Shelton and House (1990) observed hearing improvement after hearing preservation techniques in 8.5 per cent of their patients. However, they found no pre-operative factors that could predict this post-operative improvement and concluded that patients should not be selected for hearing preservation techniques on the basis of an anticipated post-operative hearing improvement. It has also shown that hearing preservation techniques are most successful with the smaller tumours. Baldwin *et al.* (1990) found tumour size to be the only indicator of likely successful hearing preservation in 47 cases in whom hearing preservation was attempted.

When considering the possible advantages of hearing preservation one has to weigh against this the possible problems arising from a more technically complex and hence longer procedure and the known risks of leaving tumour behind in the attempt to preserve cochlear nerve function and avoid opening the inner ear. A recent histological study has shown that in nine out of 12 specimens of intact acoustic schwannomas, there was no clear cleavage plane between tumour and cochlear nerve and on microscopic examination cochlear nerve fibres were found to be surrounded by tumour cells at a point beyond the assumed nerve-tumour interface (Forton *et al.*, 1990). It has however, also been shown that incomplete resection may give a very low regrowth rate, at least over a mean five year follow up (Kemink *et al.*, 1991).

Some patients with a large degree of distortion from the affected ear notice that after surgery and loss of their hearing in the ear with the tumour their overall hearing improves because the distortion from the affected ear no longer interferes with the hearing from their 'good' ear.

The continuing development of hearing preservation techniques is important and should not be dismissed. This study has shown that in the unilateral case between one and 10 per cent of patients (depending on the criteria used for patient selection) may have useful pre-operative hearing suitable for the use of a hearing preservation technique. In bilateral cases, these techniques may be particularly important although there is still argument over the best management. Hearing preservation techniques are advocated by some while the tumour is still small (Hughes *et al.*, 1982), whereas others would preserve the second tumour (and with it the hearing) until rising intracranial pressure necessitated surgery, and then carry out a subtotal removal in order to preserve some useful hearing (Morrison, 1975). In the bilateral case, the same strict selection criteria for hearing preservation techniques do not apply. Any sort of potentially aidable hearing that one can retain in the first ear may subsequently prove to be of immense value in the event of a total hearing loss occurring on the opposite side.

Conclusions

There is an important difference between hearing preservation which pleases the surgeon and that which is useful to the patient. Claims for hearing preservation must be substantiated with pre- and post-operative pure tone and speech audiometry. A standard method of reporting hearing preservation results would enable valid comparisons to be made between series reported by different authors.

Preservation of useful hearing in patients with unilateral acoustic schwannomas may only be applicable to between one and 10 per cent of patients depending on the stringency of the selection criteria. The advantage of preservation must be weighed against the known risks of incomplete tumour removal.

The importance of hearing preservation may lie more in the management of bilateral tumours.

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Key words: Neuroma, acoustic; Hearing preservation