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Change in Dizziness Handicap After Vestibular Schwannoma Excision

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Objective: To evaluate the change in dizziness handicap after translabyrinthine vestibular schwannoma excision.
Study Design: Prospective administration of the Dizziness Handicap Inventory preoperatively and at 3 and 12 months postoperatively; retrospective review of case notes.
Setting: A tertiary referral neuro-otology clinic.
Patients: A total of 100 consecutive patients who had vestibular schwannomas excised between June 1998 and November 2001 and who had completed Dizziness Handicap Inventories preoperatively and at 3 and 12 months postoperatively.
Interventions: Translabyrinthine excision of a unilateral sporadic vestibular schwannoma; preoperative and postoperative generic vestibular rehabilitation exercises.
Main Outcome Measures: Dizziness Handicap Inventory scores.
Results: For most patients, dizziness handicap does not worsen postoperatively. However, for those in whom it does, dizziness handicap becomes significantly worse between preoperative and 3-month postoperative time points but then does not continue to decline. Tumor size, sex, and magnitude of preoperative canal paresis significantly affect the degree of change in handicap. Age, the presence of central vestibular system abnormalities, and the nature of the patient's principal presenting symptom have no effect on this handicap change.
Conclusions: These findings help the clinician in counseling the patient preoperatively about dizziness handicap to be expected postoperatively. In particular, the clinician is now able to take an informed and positive stance in the event of a severe canal paresis preoperatively. **Key Words:** Vestibular schwannoma—Acoustic neuroma—Dizziness handicap.

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The incidence of dizziness in patients with vestibular schwannoma has been reported as between 49% and 66% (1–4), although it is the principal presenting symptom in only 10% to 19% of cases (1,3,4). Several previous studies have looked at quality of life after vestibular schwannoma excision (5–10), at the incidence of postoperative dizziness handicap and dysequilibrium (1,2,6), and at rates of vestibular compensation after vestibular schwannoma excision (11–13). However, the authors are unaware of any previous studies looking at how dizziness handicap changes after vestibular schwannoma excision. The aim of the present study was to evaluate this handicap change using the Dizziness Handicap Inventory (DHI), a well-validated and widely used questionnaire (14).

PATIENTS AND METHODS

This study was comprised of a consecutive series of 170 patients with unilateral sporadic vestibular schwannoma admitted for the excision of their tumor between June 1998 and November 2001.

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Questionnaire administration

Each patient was asked to complete a DHI preoperatively. This questionnaire was administered either at admission (usually the day before the patient's operation) or at a dedicated preadmission clinic (usually 1 month preoperatively). Patients in this latter group were given the flexibility to complete this questionnaire at any stage before surgery.

Patients were then sent a DHI at both 3 months and 12 months postoperatively and asked to return them in a prepaid envelope. The first 100 patients who had their vestibular schwannoma removed via the translabyrinthine approach and who completed DHIs at both 3 and 12 months were taken as the cohort for the present study (6 patients were omitted for failure to complete the 12-month questionnaire). This study group was specifically selected for homogeneity in surgical method and approach. All of these patients had been given a sheet of generic vestibular rehabilitation exercises and instructed in these preoperatively.

Vestibular assessment

Patients underwent a vestibular assessment preoperatively, wherever possible (either at admission or in the dedicated preadmission clinic). This vestibular assessment consisted of the following tests: the modified Clinical Test for Sensory Interaction of Balance (mCTSIB) (15), gaze test, saccades, smooth pursuit, head shake test, and caloric test. The latter five tests were recorded with electronystagmography (ENG) using the ICS Chartr system (ICS Medical, Illinois, U.S.A.).

A fall or fall reaction in any condition of the mCTSIB test led that patient to be identified as having poor functional compensation status. The presence of significant peripheral-type gaze-evoked nystagmus or a directional preponderance on caloric testing resulted in the patient being identified as having poor physiological compensation status. Canal paresis and directional preponderance were identified as significant if 25% or greater.

Other parameters

The other parameters used in the analysis were recorded by retrospective analysis of the patients' case notes. Tumor size was determined by measurement of maximum tumor diameter on magnetic resonance imaging (MRI) (T1-weighted scans with gadolinium DTPA enhancement), including the intracanalicular portion. This will usually be the mediolateral diameter along the line of the internal auditory canal.

Statistical analysis

StatView (version 4.5) statistical software was used to perform nonparametric statistical tests. The analysis of DHI scores used total scores rather than the emotional, functional, and physical subscales. This is because previous studies have shown by factor analysis that the original subscale structure of the DHI is of questionable validity (16). Comparison of continuous variables was made using the Wilcoxan signed-rank test and the Kruskal-Wallis test. Categorical variables were analyzed using the χ^2 test. A 5% level of significance was used.

RESULTS

The study group

A consecutive series of 100 patients who had a translabyrinthine excision of their vestibular schwannoma and had completed DHIs preoperatively and at both 3 and 12 months postoperatively. This group consisted of 60 men and 40 women with an overall mean age of 56 years (SD, 11.7 years). Fifty-five patients had left-sided tumors and 45 had right-sided tumors. Thirty-eight patients had tumors <1.5 cm, 33 had tumors between 1.5 and 2.4 cm, 17 had tumors between 2.5 and 3.4 cm, 10 had tumors between 3.5 and 4.4 cm, and 2 had tumors larger than 4.4 cm. The principal presenting symptom was progressive hearing loss in 67 patients, sudden hearing loss in 8, tinnitus in 11, imbalance in 10, vertigo in 1, and facial weakness in 3.

Preoperative vestibular assessment results

The preoperative presentation of balance symptoms was recorded. Fifty-three patients presented with unsteadiness or dysequilibrium, 8 presented with rotary vertigo, and 39 were asymptomatic with respect to balance.

A total of 93 patients underwent the mCTSIB test (15) as a means of assessing functional compensation status. Five were not well enough to undergo testing. Of these 93 patients, 53 (57%) failed the test and were therefore identified as having poor functional compensation status.

Ninety-four patients underwent vestibular assessment using ENG. Caloric testing was completed in 86 of these patients (again, if a patient did not undergo testing, it was for reasons of poor health status). The vestibular test findings are summarized in Table 1.

TABLE 1. *Summary of vestibular assessment results*

Test result	No. patients (%)
Unilateral Peripheral (i.e., significant canal paresis) only	54 (63)
Bilateral peripheral (bilateral canal paresis)	1 (1)
Central only	3 (3)
Unilateral peripheral and central	6 (7)
Normal	22 (26)

Central findings were found to have a significant effect on preoperative functional compensation status, in that patients without central abnormalities were more likely to be in functional compensation ($\chi^2 = 95.2$, $p < 0.0001$). Conversely, tumor size did not have a significant effect on functional compensation status ($\chi^2 = 6.51$, $p = 0.5909$). As one might expect, patients with central abnormalities were more likely to be those with larger tumors ($\chi^2 = 24.6$, $p = 0.0018$).

DHI results

Frequency distributions for total DHI scores (preoperatively, 3 months postoperatively, and 12 months postoperatively) are given in Figure 1, which clearly illustrates the nonparametric nature of this data. In view of this, nonparametric statistical tests were used for all subsequent analyses.

Median total DHI scores, with their interquartile ranges, are given in Table 2. A significant difference was found between preoperative and 3-month scores (Wilcoxan signed-rank test, $p < 0.0001$) and between preoperative and 12-month scores (Wilcoxan signed-rank test, $p = 0.0002$). There was no significant difference between 3-month and 12-month scores (Wilcoxan signed-rank test, $p = 0.5800$). Therefore, on average, dizziness handicap will worsen significantly in the first 3 postoperative months but then will not significantly change.

Analysis was performed to look at possible drivers of significant change. For an individual's DHI score to have changed significantly, the change has to be at least 18 points (14). Data were therefore recoded, and the number of patients experiencing a significant change in DHI scores (Table 3) was used in subsequent analyses. This 18-point criterion was used rather than looking at the change in DHI scores as a continuous variable, because the authors felt that by using the 18-point criterion, the clinical significance as well as the statistical significance of results would be ensured.

Although, on average, dizziness handicap worsens significantly in the first 3 postoperative months, it is clear

TABLE 2. *Descriptive statistics for total DHI scores*

DHI	Median	IQR	Minimum	Maximum
Preoperative	14	30	0	80
3 months postoperative	18	31	0	94
12 months postoperative	21	33	0	86

IQR, interquartile range.

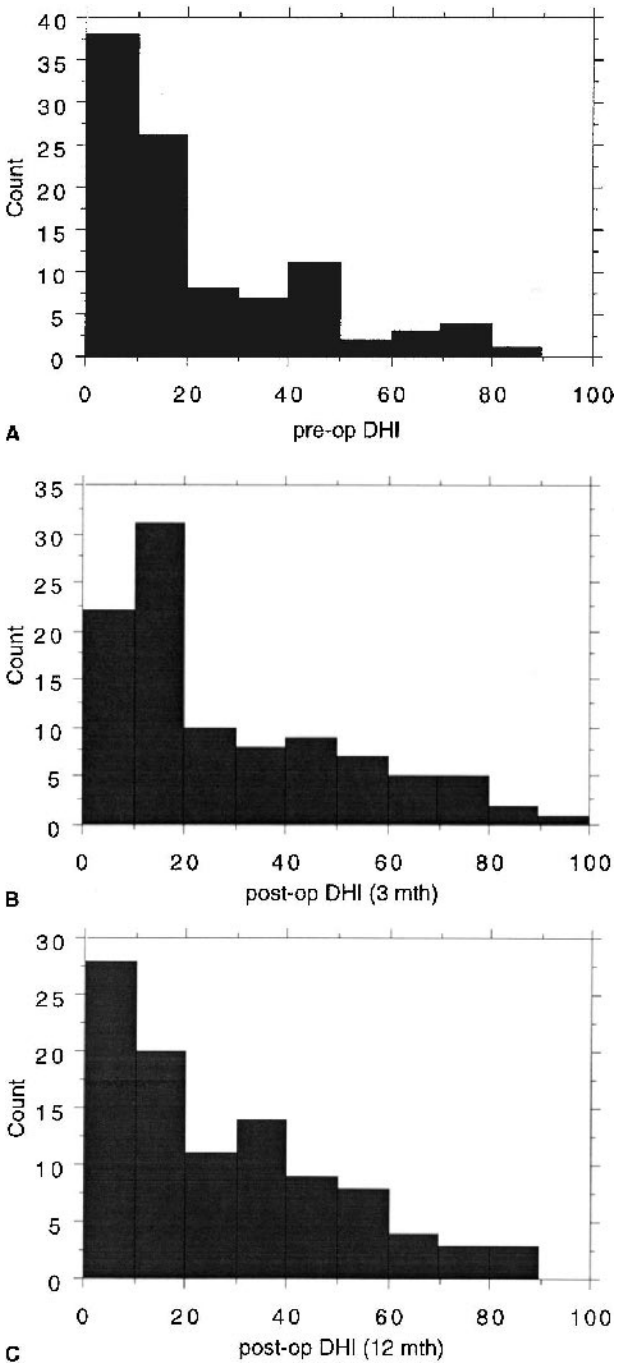

FIG. 1. Frequency distributions for total DHI scores. *A*, Preoperative DHI scores. *B*, DHI scores 3 months postoperatively. *C*, DHI scores 12 months postoperatively.

from Table 3 (when this 18-point criterion is used) that 73% of patients actually have no significant change in their DHI scores. Hence, for most patients, dizziness handicap does not worsen postoperatively. However, for those in whom it does, this worsening occurs in the first 3 postoperative months and not thereafter.

Age was not found to be a significant factor affecting change in DHI scores (Kruskal-Wallis test, $p > 0.05$). Sex was found to be a significant parameter, but only for the change occurring between preoperative and 3-month DHI scores ($\chi^2 = 6.58$, $p = 0.0373$) (Table 4). The effect of tumor size was found to be significant for both preoperative to 3-month changes ($\chi^2 = 18.4$, $p = 0.0184$) and preoperative to 12-month changes ($\chi^2 = 16.9$, $p = 0.0312$) but not for 3-month to 12-month changes ($\chi^2 = 9.06$, $p = 0.3376$). The trend here was for patients with smaller tumors to have no change in their handicap scores. The few patients showing an improvement in their scores had a variety of tumor sizes with no clear trend. Patients with a greater canal paresis preoperatively were found to be significantly more likely to have a significant improvement in DHI scores. This was true for preoperative to 3-month changes (Kruskal-Wallis test, $p = 0.0196$) and preoperative to 12-month changes (Kruskal-Wallis test, $p = 0.0048$) but not for 3-month to 12-month changes (Kruskal-Wallis test, $p = 0.2591$).

None of the following parameters were found to have any effect on DHI change over any of the three time intervals (χ^2 test, $p > 0.05$): functional compensation status, presence of central signs on vestibular testing, and the patient's principal presenting symptom.

TABLE 3. *The number of patients with significant changes in DHI scores*

Change period	Significantly better	No change	Significantly worse
Preoperative to 3 mo postoperative	7	73	20
Preoperative to 12 mo postoperative	5	74	21
3 mo postoperative to 12 mo Postoperatively	11	81	8

DISCUSSION

The present study found the incidence of preoperative dysequilibrium to be 53% and poor functional compensation status to be 57%, which is in close agreement with the previous findings of this unit (14). However, in contrast to this previous study and to another study looking at postoperative dysequilibrium (2), the present study showed that central ENG findings have an adverse effect on preoperative functional compensation status. This is perhaps what one might expect, because central vestibular system abnormalities are likely to affect the brain's ability at vestibular compensation. This finding is also in

TABLE 4. *The relationship of sex to significant changes in DHI scores, from preoperative to 3 months postoperatively*

Gender	Significantly better	No change	Significantly worse
Female	6	27	7
Male	1	46	13

agreement with a previous study that actually advocates the use of central vestibular system abnormalities as a predictive variable of persistent postoperative dysequilibrium (1). Tumor size was not found to have an effect on functional compensation status, a finding that is supported by previous studies (1,11,17).

In most patients, dizziness handicap does not worsen postoperatively, However, for those in whom it does, significant differences were found between preoperative and 3-month DHI scores and between preoperative and 12-month DHI scores but not between 3-month and 12-month scores. A patient's dizziness handicap, therefore, on average, becomes significantly worse during the time period up to and including the third postoperative month but does not continue to worsen after this time. It is unfortunate that the present study does not tell us more about the time course of this decline in DHI scores; in retrospect, it might have been useful to have asked patients to complete postoperative questionnaires more frequently during this 3-month period.

Recoding the changes in DHI scores using the 18-point criterion (14) enabled possible drivers of significant change to be explored. Tumor size was found to have a significant effect on the preoperative to postoperative handicap change. This is interesting when placed in context with other studies that have looked at actual postoperative dysequilibrium rather than changes in this (1,6,11). Tumor size, therefore, seems to affect the process of vestibular compensation but not the final prognosis. Sex was also found to be an important parameter, in that men were found to be less likely to get better during the first 3 postoperative months and were more likely to become significantly worse. This again is somewhat at variance with Driscoll et al. (1), who found that female sex was related to persistent postoperative dysequilibrium, but in agreement with Lynn et al. (6), who found that more men than women report postoperative dysequilibrium.

Patients showing a significant improvement in DHI scores between preoperative and postoperative measures were more likely to be those with a greater canal paresis preoperatively. This finding is in agreement with El-Kashlan et al. (2), who found magnitude of canal paresis to be negatively correlated with postoperative symptom scores and the DHI emotional and physical subset scores. Intuitively, one might have expected this result, because patients who already have a significant peripheral vestibular system lesion on the side of the vestibular schwannoma have less function to lose during surgery. The brain will therefore not have as great a change in peripheral vestibular function to compensate for as it would have done had vestibular function been normal preoperatively. Confirming this relationship between canal paresis and change in dizziness handicap helps the clinician greatly in counseling the patient preoperatively about dizziness handicap to be expected postoperatively. He or she is now able to take an informed and positive stance in the event of a severe canal paresis preoperatively.

Age was not found to be a significant factor in change of DHI scores, which again is at variance with Driscoll et al. (1), who reported that increasing age was associated with higher rates of persistent dysequilibrium. It should be emphasized, however, that the present study and that of Driscoll et al. are measuring two entirely different parameters. The older patients in the study by Driscoll et al. may have had poorer balance before surgery. If this poor balance continued postoperatively, then these patients would demonstrate little handicap change between preoperative and 3-month postoperative measures.

Although the presence of central vestibular system abnormalities has a significant effect on preoperative compensation status, it does not significantly affect change in dizziness handicap after vestibular schwannoma excision. This is of note when considered with the findings of Driscoll et al. (1), in which the presence of central vestibular system abnormalities was found to be strongly associated with postoperative dysequilibrium. This variance is again likely to be because the present study is looking at change in handicap rather than at postoperative handicap. Central vestibular system abnormalities therefore seem to affect postoperative compensation status but not the change in dizziness handicap, possibly because dizziness handicap in patients with central abnormalities is poorer preoperatively. The present study has therefore shown that patients with central findings are likely to have a poorer functional compensation status preoperatively, and by looking at handicap change, we now know that this is unlikely to change postoperatively.

CONCLUSION

The present study has shown that for most patients, dizziness handicap does not worsen postoperatively. However, for those in whom it does, dizziness handicap becomes significantly worse between preoperative and 3-month postoperative time points but then does not continue to decline. Tumor size, sex, and magnitude of preoperative canal paresis significantly affect the degree of change in handicap. Age, the presence of central vestibular system abnormalities, and the nature of the patient's principal presenting symptom have no effect on handicap change. These findings help the clinician in counseling the patient preoperatively about expected dizziness handicap postoperatively. In particular, the clinician is now able to take an informed and positive stance in the event of a severe canal paresis preoperatively.

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