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Audiovestibular Findings Prior to and After Acoustic Neuroma Surgery

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Abstract: We performed a retrospective study of 131 patients who underwent microsurgical removal of statoacoustic neuroma at the University of Wuerzburg. Our goal was to evaluate objective audiovestibular findings prior to and after surgery. Our analysis focused on the evaluation of quantitative parameters in speech and pure-tone audiometry and on the reactivity of the vestibular system.

Keywords: acoustic neuroma; audiometry; vestibular function

Acoustic neuroma surgery has undergone tremendous evolution in the last few decades. In 1941, Dandy [1] remarked, "Paralysis of the facial nerve must usually be accepted as a necessary sequel of the operation." Because smaller acoustic tumors currently are being detected earlier, the situation has improved dramatically, and more and more attention is given to hearing preservation after acoustic neuroma surgery [2,3]. The reported rates of hearing preservation after surgical removal of acoustic neuroma vary between 32% and 39.5% [2]. The critical points seem to be the size of the tumor and excellent preoperative hearing [2–4]. The aim of this study was to assess the results of acoustic neuroma surgery at the University of Wuerzburg as those results related to tumor size, surgical approach, and auditory outcome after the operation.

PATIENTS AND METHODS

We reviewed the results of surgery in 131 consecutive patients (66 male and 65 female). The age of patients ranged between 14 and 82 years, with a mean age 49.5 years. The tumors were grouped according to three sizes (the maximum diameter in the cerebellopontine angle): I, no greater than 2.5 cm (51 cases); II, 2.6–3.5 cm (62 cases); and III, greater than 3.6 cm (8 cases). Examination by NMR with gadolinium was used to establish a tumor size and, therefore, a surgical approach for acoustic neuroma removal. To preserve affected patients' hearing, 71 procedures (54%) were performed via a middle fossa approach; 18 (14%) were performed via a retrosigmoidal approach; and in the remaining 42 (32%), a translabyrinthine approach was used.

Every patient underwent a complete battery of audiovestibular tests [5]: pure-tone audiometry, speech audiometry, brainstem auditory evoked responses, rotatory tests, caloric tests, and craniocorpography. In all, 75 patients (57%) were candidates for hearing preservation, because both their pure-tone average and speech discrimination threshold preoperatively were better than 45 dB, and their speech discrimination scores were better than 70%. These 75 cases of unilateral acoustic neurinomas were analyzed with special reference to the postoperative eighth cranial nerve function.

The patients underwent the following investigations: central nystagmic frequency of postcaloric nystagmus (number of nystagmic beats in 30-sec intervals of acme in postcaloric reaction); lateral body sway (in centimeters); and angular deviation (in degrees). Basely mentioned examinations were accomplished using craniocorpography.

To be able to compare the results gained from different series of various tumor sizes and of different surgical approaches, the identical numerical values were used. Every patient was examined twice, first 5–7 days prior to surgery and, subsequently, 7–10 days after surgery. The long-term follow-up data were not complete, so they are not included in this study.

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Table 1. Audiovestibular Results Prior to and After Acoustic Neuroma Surgery

Approach	Hearing Level			Vestibular Reactivity	
	PTA (dB)	SRT (dB)	SDS (%)	CNF	Σ
Middle fossa	25 of 32	35 of 42	48 of 38	22 of 18	71
Translabyrinthine	69 of 95	61 of 100	100 of 5	5 of 0	48
Retrosigmoidal-suboccipital	29 of 34	32 of 51	46 of 35	28 of 16	12

PTA = pure-tone average; SRT = speech reception threshold; SDS = speech discrimination score; CNF = central nystagmic frequency (number of beats per 30-sec interval).

RESULTS

Mortality was zero, and all patients are without recurrence. The facial nerve was preserved anatomically in all cases. In 26 patients in group I (tumor size <25 mm), the preservation of useful hearing was achieved in 60% (speech reception threshold <50 dB; speech discrimination score >60%). In group II (tumor size 26–35 mm), serviceable hearing was gained in 40%. In group III (tumor size >36 mm), serviceable hearing was gained in only 4%. In 15 patients, hearing was not preserved. In this group, the translabyrinthine approach was used because of the size of the tumor. Audiovestibular profile according to surgical approach is demonstrated in Table 1.

The preservation ratio of the cochlear nerve showed a negative correlation to the tumor size (Table 2). A trend toward higher success rates was seen in intracanalicular tumors.

Aside from absolute values mentioned in Tables 1 and 2, the quality of hearing preservation was divided with regard to the number of patients with preserved hearing abilities after surgery.

The decisive criteria were as follows: Loss of hearing after surgery was less than 40 dB in comparison with values recorded prior to surgery or less than 15 dB by those whose preoperative hearing was worse than 50 dB (pure-tone audiometry; Table 3). Table 4 shows results achieved after the surgical approach.

Table 2. Absolute Values of Cochleovestibular Functions Prior to and After Surgery

Size Group		Hearing Level			Vestibular Reactivity
		PTA (dB)	SRT (dB)	SDS (%)	CNF
I	26	22 of 30	31 of 37	33 of 40	29 of 21
II	39	40 of 47	42 of 51	43 of 52	16 of 11
III	14	68 of 90	79 of 90	20 of 0	8 of 0

PTA = pure-tone average; SRT = speech reception threshold; SDS = speech discrimination score; CNF = central nystagmic frequency (number of beats per 30-sec interval).

DISCUSSION

We demonstrated the relationship among various surgical approaches, size of tumor, and the cochleovestibular profile of affected patients in acoustic neurinoma surgery. Postoperative preservation of hearing is more likely if surgery is performed while the tumor is still small and hearing is still excellent [6]. Under these circumstances, the hearing loss more than likely will be compensated.

The middle cranial fossa approach for acoustic neuromas has been criticized for limited exposure, anatomical surgical difficulty, and increased risk to facial nerve and temporal lobe. The retrosigmoidal approach is familiar to all neurosurgeons and offers a comparable success rate for hearing conservation and probably a superior outcome in terms of facial nerve function as compared with the middle fossa approach. On the other hand, Irving et al. [6] show a more favorable hearing outcome for patients with intracanalicular tumors and tumors that extended up to 1 cm into the CPA and were removed via the middle fossa, as compared with results from the retrosigmoidal approach. The translabyrinthine approach remains the approach of choice when affected patients are not candidates for hearing preservation.

Absolute values relating to cochleovestibular functions and their quantitative relationships prior to and after surgery were presented. One conclusion concerning those values might be that both the middle fossa approach and the suboccipital-retrosigmoidal approach are hearing-saving procedures. This conclusion was echoed by Blevins [12] in 1994.

Table 3. Preservation of Hearing According to Tumor Size

Size Group	PTA	SRT	SDS	Σ
I	60%	55%	58%	26
II	40%	32%	33%	39
III	4%	2%	2%	14

PTA = pure-tone average (dB); SRT = speech reception threshold (dB); SDS = speech discrimination score.

Table 4. Results of Various Surgical Approaches

Approach	PTA	SRT	SDS	Σ
Middle fossa	58%	49%	42%	45
Translabyrinthine	5%	6%	8%	15
Suboccipital-retrosigmoidal	59%	48%	44%	20

PTA = pure-tone average (dB); SRT = speech reception threshold (dB); SDS = speech discrimination score (%).

The dependence of hearing preservation on the size of tumor has been discussed by many authors [2,3,7–11]. The general conclusions that could be drawn are a negative correlation between tumor size and hearing preservation and a positive correlation between tumor size and postoperative decrease in and worsening of the function of the eighth cranial nerve. Postoperative preservation of hearing is more likely to occur if surgery is performed while the tumor is still small and hearing is still excellent [11]. Under these circumstances, the hearing loss more than likely will be compensated. Data gained in this study support these conclusions.

A reasonable chance to retain useful hearing can accrue to affected patients with a small tumor (preferably <1.5 cm), provided that the average hearing level differs from the other ear by no more than 30 dB. In conclusion, hearing preservation can be expected after removal of the acoustic neurinomas under the following situations: hearing acuity of less than 50–60 dB on preoperative pure-tone audiogram; tumor size of less than 20 mm in maximum diameter; preservation of cochlear nerve and of the internal auditory artery during surgery; and avoidance of injury to the labyrinth during the operation. Longer follow-up will be necessary to evaluate hearing preservation after acoustic neuroma surgery.

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