Position and Course of Facial Nerve and Postoperative Facial Nerve Results in Vestibular Schwannoma Microsurgery

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■ OBJECTIVE: **To investigate the variation in the position and course of the facial nerve (FN) in patients undergoing vestibular schwannoma (VS) microsurgery by the keyhole retrosigmoid approach and the relationship between FN position and postoperative facial results.**

■ METHODS: **The series consists of 100 patients who underwent VS microsurgery during a 5-year period in whom the position and course of the FN could be confirmed by direct stimulation. The course of the FN was classified into 4 patterns according to its position: anterior (ventral) surface of the tumor (A), anterior-superior (AS), anterior-inferior (AI), and dorsal (D).**

■ RESULTS: **The distribution of patterns was as follows: AS in 48 cases, A in 31, AI in 21, and D in zero. For tumors <1.5 cm, the AS pattern was most common (68.4%). For tumors ≥1.5 cm, the proportion of A and AI positions increased (31.4% and 25.5%). Significant differences were observed between position and course patterns of the FN and postoperative nerve results. Patients with AS and AI patterns had better House-Brackmann FN function compared with patients with the A pattern ($P < 0.05$). Moreover, in tumors >3.0 cm, the FN tended to adhere strongly to the tumor capsule, and postoperative facial deficits were more frequent ($P < 0.05$).**

■ CONCLUSIONS: **The AS pattern was most common for smaller VSs. The A position and course and adhesion of the FN to the tumor capsule were the 2 factors most strongly associated with worse postoperative FN result.**

INTRODUCTION

The aims of vestibular schwannoma (VS) microsurgery are safe tumor resection, hearing preservation when preoperatively socially useful, and preservation of facial nerve (FN) function. In recent years, operative results have improved significantly using dedicated microsurgical instruments and technologies, and, in particular, the incidence of FN palsy is quite low in the hands of expert skull base teams.[1-12] In general, during VS microsurgery, surgeons remove the tumor while confirming the position of the FN, the course of which is known to vary according to tumor size, site of origin, and degree of adhesion.[1-3,5,7-9,11,12] Accurate preoperative identification of the anatomic position and course of the FN is difficult even with current advances in magnetic resonance imaging (MRI) technology; the only method currently available is confirmation under microscope with repeated intraoperative FN stimulation. In this study, the associations of FN position and course patterns in VS and its adhesion to tumors and postoperative FN palsy were investigated in a series of 100 consecutive cases.

Key words
- Facial nerve
- Facial nerve adhesion
- Facial nerve position
- Facial nerve preservation
- Retrosigmoid approach
- Vestibular schwannoma

Abbreviations and Acronyms
A: Anterior
AAO-HNS: American Academy of Otolaryngology—Head and Neck Surgery
ABR: Auditory brainstem response
AI: Anterior-inferior
AS: Anterior-superior
D: Dorsal
EMG: Electromyography
FN: Facial nerve
HB: House-Brackmann
MRI: Magnetic resonance imaging
VS: Vestibular schwannoma

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MATERIALS AND METHODS

Subjects were 100 patients undergoing surgery for VS by the keyhole retrosigmoid approach between July 2010 and July 2015 (47 women and 53 men; mean age, 49.4 years; mean tumor size, 24.1 mm). Total or near-total (99%) or subtotal (90%) removal of the tumor was attempted in all cases and obtained in 90 cases, and the FN was anatomically preserved in 94 cases. According to the House-Brackmann (HB) scale,[13] a preoperative HB II–HB IV FN palsy was present in 2 cases. All procedures were performed by the senior author (L.M.) with intraoperative FN monitoring and intraoperative auditory brainstem response monitoring for hearing preservation in AAO-HNS class A or B cases.[14] The data obtained included patient age, tumor size, preoperative and postoperative FN function, and extent of adhesions between the FN and the tumor capsule.

The course of the FN was classified into 4 patterns according to its position (Figure 1): anterior (ventral) surface of the tumor (A), anterior-superior or ventral-cranial (AS), anterior-inferior or ventral-inferior (AI), and dorsal (D). In very large tumors, the patterns could not be fit completely, and the course in the vicinity of the internal auditory canal—where adhesions were the strongest and separation was most difficult—was evaluated.

Normal (HB I) facial function was present preoperatively in 98 patients. In addition, the FN was anatomically preserved at surgery in all but 4 of 98 cases. FN outcome was reported on the HB scale, and the results are recorded as early (approximately 7 days after surgery) and late (minimum 6 months after surgery).

Strong or less strong adhesion between the tumor and FN was evaluated during the procedure by the first author and was correlated with the maximum diameter of VS and results. The surgeon's impression had a major influence when evaluating the degree of adhesion of the FN to the tumor, as there is no scale for its classification. Less strong adhesion was defined as situations in which the FN could be separated from the tumor relatively easily with blunt dissection by dedicated microdissectors; strong adhesion was defined as situations in which it was difficult to separate the capsule from the nerve, requiring sharp dissection with microscissors.

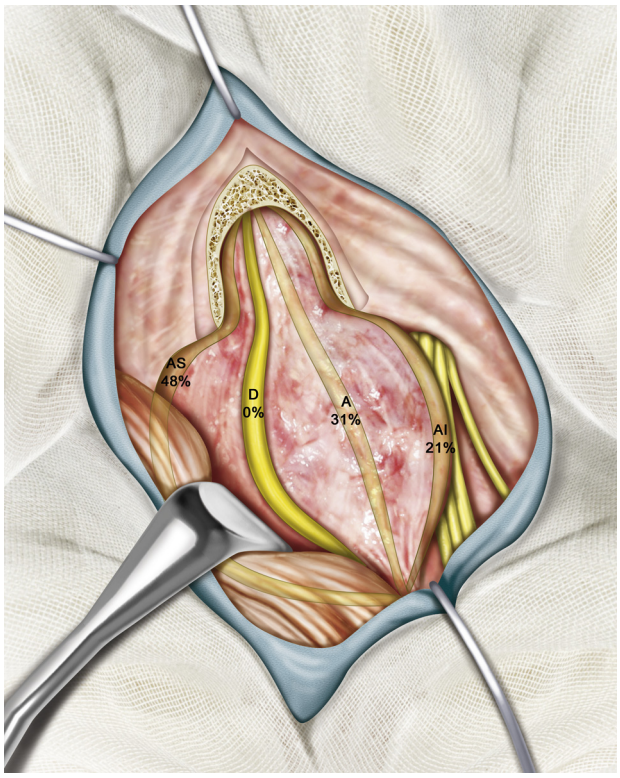

Figure 1. Possible position of facial nerve in 100 consecutive vestibular schwannomas. AS, anterior-superior; D, dorsal; A, anterior; AI, anterior-inferior.

Determination of Tumor Size

All patients underwent MRI ≤1 month before admission. Tumor was measured in 3 spatial dimensions (on axial and coronal MRI section planes), and tumor size was estimated considering its main diameter, including the part of tumor extending into the internal auditory canal.

FN Function

FN function was assessed preoperatively (clinically and with electromyography [EMG]) and 1 week and ≥6 months postoperatively using HB classification (HB I, normal; HB VI, total paralysis).[9]

Audiologic Data

In patients selected for hearing preservation (AAO-HNS class A or B),[3] audiologic examinations were performed preoperatively and 1 week and 6 months postoperatively by pure tone audiometry, auditory brainstem response (ABR), and monosyllabic speech audiograms.

Intraoperative Procedures

Monitoring of FN and Cochlear Nerve. In all cases, FN EMG monitoring was used during all surgical procedures (Nimbus i-Care 100 intraoperative neurophysiologic monitoring; Newmedic division of Hemodia, Labège, France), with electrodes inserted in orbicularis oris and orbicularis oculi muscles. FN stimulation was performed with a monopolar (on surface of tumor) or bipolar (close to the nerve) stimulator, starting from ≥2 mm amp (on the capsule, for nerve course localization) to 0.3–0.05 mm amp (directly on the nerve, for confirmation of function).

Each patient selected for hearing preservation underwent ABR audiometry (Nicolet Viking III; VIASYS NeuroCare, Madison, Wisconsin, USA) the day before surgery. In the last 15 cases, we used ABR neuromonitoring evoked with CE-Chirp stimuli (Eclipse EP15 ABR system; Interacoustics A/S, Middelfart, Denmark).[15] According to AAO-HNS classification, 43 patients belonged to class A or B, with reproducible responses that allowed continuous intraoperative ABR monitoring of cochlear nerve.

Retrosigmoid Approach. All operations were performed by the retrosigmoid approach with the patient in lateral position.[16] A continuous lumbar drain was placed in larger tumors and was left in place for 3–4 days, for cerebellar detension during