# Improved Postoperative Facial Nerve and Hearing Function in Retrosigmoid Vestibular Schwannoma Surgery Significantly Associated with Semisitting Position

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■ OBJECTIVE: **The pros and cons of semisitting positioning (SSP) versus lateral, horizontal positioning (LP) during retrosigmoid vestibular schwannoma (VS) surgery, especially concerning postoperative cranial nerve and brain stem preservation, are under continuous discussion.**

■ METHODS: **In a single-center retrospective cohort study, 30 VSs operated on in SSP compared with 30 operated on in LP with comparable demography were analyzed. During SSP surgery, transesophageal echocardiographic monitoring for venous air embolism was used continuously. Electrophysiologic cranial nerve monitoring was used in both groups.**

■ RESULTS: **Length of surgery was significantly different between both groups: 183 minutes mean in SSP surgery versus 365 minutes mean in LP surgery ($P = 0.0001$). Postoperative rates of facial palsy and hearing loss were also significantly different. Six months postoperatively, 63% had normal facial nerve function after SSP surgery, whereas in LP surgery, 40% had no facial palsy ($P = 0.02$). Hearing preservation rate was also significantly different: 44% in SSP surgery compared with 14% in LP surgery who had preserved hearing ($P = 0.006$). Because of cerebrospinal fluid leaks, there were 3 operative revisions in the LP group (10%) and 1 (3.3%) in the SSP group. A clinically insignificant venous air embolism rate was found in 3.3% of patients (1/30) during SSP surgery. The neurologic outcome after 6 months was 1.2 on the Rankin Scale in the LP group and 1.0 in the SSP group, with zero mortality.**

■ CONCLUSIONS: **SSP compared with LP surgery was associated with significantly shorter operation time and better facial and cochlear nerve function in VS surgery postoperatively, without differences in complication rates.**

## INTRODUCTION

The main goal of vestibular schwannoma (VS) surgery is to remove the tumor completely and preserve hearing and normal facial movement. Thus, monitoring intraoperative cochlear and facial nerve function has become state of the art.[1,2] However, there is an ongoing discussion about the advantages and disadvantages of different ways of surgical positioning. Concerning postoperative cranial nerve and brain stem preservation, especially in large VSs, the semisitting position (SSP) was used with some advantages compared with surgery in the lateral position (LP) for many years.[3-6] However, because of potentially severe complications for surgery in SSP, many neurosurgical centers in Europe and the United States have even discontinued using SSP for posterior fossa surgery.[7-9] Nevertheless, higher facial and cochlear nerve preservation rates and fewer neurologic complications for SSP in posterior fossa surgery have been reported.[3,6,10,11] The highest hearing and facial nerve preservation

**Key words**
- Facial nerve preservation
- Hearing preservation
- Lateral position
- Semisitting position
- Vestibular schwannoma surgery

**Abbreviations and Acronyms**
**ASA**: American Society of Anesthesiologists
**CSF**: Cerebrospinal fluid
**FU**: Follow-up
**GR**: Gardner Robertson Scale
**HB**: House-Brackmann Scale
**IAC**: Internal auditory canal
**LP**: Lateral surgical position
**PFO**: Patent open foramen ovale
**SSP**: Semisitting surgical position
**TEE**: Transesophageal echocardiography
**VS**: Vestibular schwannoma

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rates ever reported in the literature were generated during surgery in SSP.[12-14]

To address this discussion, the aim of our study was to investigate the differences in postoperative outcome in a large cohort of patients operated on in LP compared with those surgically treated in SSP. Special emphasis was placed on facial nerve function, hearing preservation, and general neurologic outcome as well as postoperative anesthesiologic and surgical complications.

## METHODS

Between January 2013 and December 2014, 60 consecutive patients were surgically treated for VS using a suboccipital retrosigmoid approach at the Neurosurgical Department, University Hospital Erlangen. Their records were retrospectively reviewed. Thirty patients were operated on in LP and another 30 were operated on using SSP (**Figure 1**). The applied technique of SSP surgery was recently described in detail in a previous study performed at our institution.[5] All demographic data of the investigated patients are summarized in **Table 1**. The mean age of the total population of 60 patients with VS was 50.6 years (range, 17–78 years). In the LP group, the mean age was 52.5 years (range, 17–72 years). In the SSP group, the mean age was 48.8 years (range, 27–78 years), with no significant differences between both groups. The male/female ratio was 18:12 in the LP group and 16:14 in the SP group. The mean diameter of the VS was not significantly different between both groups: mean 24.9 mm (range, 5–40 mm) in the LP group and mean 20.7 mm (range, 8–50 mm) in the SSP group (**Figure 3**). The preoperative American Society of Anesthesiologists (ASA) score was also insignificantly different in both groups: mean 1.96 in the LP group (3 patients, ASA 1; 25 patients, ASA 2; 2 patients, ASA 3) and mean 1.8 (6 patients, ASA 1; 24 patients, ASA 2) in the SSP group. The patients were operated on by 3 experienced neurosurgeons (K.R., O.G., and M.B.). All patients were treated according to a standardized institutional protocol, which regulated preoperative investigations (audiogram, vestibular testing, 1.5-T magnetoresonance tomography, computed tomography with bone window of the cranial base) as well as postoperative standards of care including 1 night in the intensive care unit and 7–10 days in the inpatient clinic and regular outpatient follow-up (3 months and every year with audiograms, vestibular testing, and 1.5 T magnetic resonance imaging). In every patient, the goal was to resect the tumor totally.

### Anesthesiologic Management

Anesthesiologic management of the patients was reported in detail in a former study performed by our group.[5] Anesthesia was induced using intravenous administration of fentanyl 2 µg/kg and a bolus of either propofol 2 mg/kg or etomidate 0.2 mg/kg. Orotracheal intubation was facilitated by rocuronium 0.6 mg/kg. After intubation, the lungs were ventilated with an oxygen-air mixture ($F_{IO_2}$ [fraction of inspired oxygen] 40%–50%), and minute volume ventilation was set to obtain an end-tidal carbon dioxide pressure ($E_{TCO_2}$) between 30 and 40 mm Hg.

Anesthesia was maintained either by using a continuous infusion of propofol 6–8 mg/kg/hour or inhalational administration of sevoflurane with a maximum concentration of 1 MAC. Supplemental administration of opioids included repetitive boluses of fentanyl or continuous infusion of remifentanil or sufentanil titrated to effect. Standard monitoring included electrocardiography, pulse oximetry, invasive blood pressure, capnography, and central venous pressure via a catheter inserted into the right jugular or subclavian vein. Monitoring of venous air embolism was accomplished using transesophageal echocardiography (TEE) (Hewlett-Packard Sonos 4500, 3-MHz probe [Hewlett-Packard, Andover, Massachusetts, USA]). The TEE probe was positioned to obtain a view of the right ventricular inflow-outflow tract. Venous air embolism was defined as a sudden and sustained decrease of $E_{TCO_2}$ of more than 4 mm Hg without a change in minute volume ventilation, a typical sound on precordial Doppler ultrasonography or detection of any air in the right atrium by TEE. Any occurrence of hemodynamic impairment (decrease of blood pressure) or worsening of oxygenation (decrease of $S_{PO_2}$ [oxygen saturation as measured by pulse oximetry] or $P_{O_2}$ [partial pressure of oxygen]) as measured by arterial blood gas analysis was documented.

### Patient Positioning

Although we have extensive experience in SSP surgery at our institution, the standard patient positioning for VS surgery had

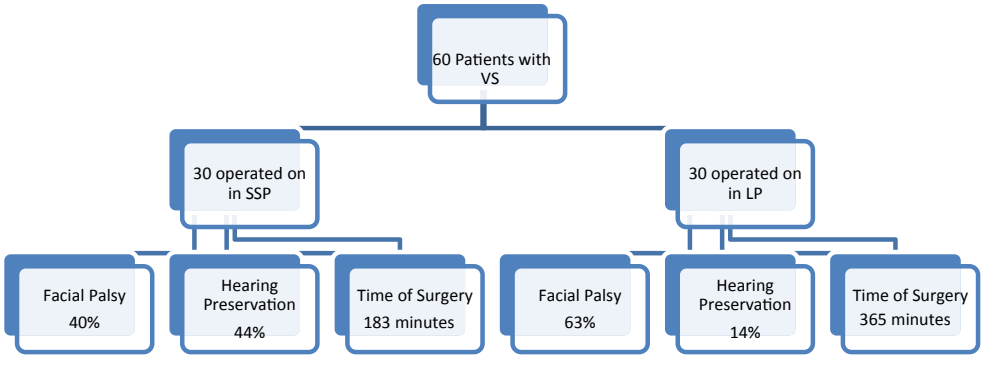


**Figure 1.** Retrospective single-center cohort study for patient positioning in vestibular schwannoma surgery. Thirty patients operated on in the lateral position were compared with 30 patients operated on in the semisitting position. VS, vestibular schwannoma; SSP, semisitting patient position; LP, lateral patient position.