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*Case Report*

# Posterior location of the facial nerve on vestibular schwannoma: Report of a rare case and a literature review

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Received: 16 July 2024
Accepted: 19 August 2024
Published: 27 September 2024

**DOI**
10.25259/SNI_586_2024

**Quick Response Code:**

## ABSTRACT

**Background:** Posterior location of the facial nerve in relation to vestibular schwannoma (VS) is extremely rare.

**Case Description:** An elderly man presented with the right cerebellopontine angle (CPA) syndrome. Magnetic resonance imaging showed the partly cystic and partly solid right CPA lesion extending to the internal auditory meatus. Seventh nerve monitoring showed the facial nerve on the posterior surface of the tumor. At surgery, the facial nerve was seen on the posterior surface of the tumor under the microscope. Partial excision of the tumor was done with preservation of the facial nerve both anatomically and electrophysiologically.

**Conclusion:** The posterior location of the facial nerve should be anticipated in all patients with VS. The surgical strategy must be altered appropriately to preserve the facial nerve.

**Keywords:** Dorsal, Facial nerve, Posterior, Tumor, Vestibular schwannoma

## INTRODUCTION

The most common location of the facial nerve on the surface of a vestibular schwannoma (VS) is ventral.[1,3,11] Posterior location of the facial nerve on the surface of the tumor is reported to be between 0.6% and 3.8%.[1,6,10] In this illustrative case report, we present a case of large VS with the posterior location of the facial nerve. The surgical strategy in this situation to preserve the facial nerve both anatomically and physiologically is discussed. Even though the posterior location of the facial nerve on the surface of VS has been reported previously, ours is the second illustrative case of the posterior location of the facial nerve on these tumors after the first illustrative case report by Jung *et al.*[5] in 2021.

## CASE REPORT

A 66-year-old man presented with ataxia, intermittent vertigo, and projectile vomiting of 1-month duration. He had decreased hearing in the left ear for 1 year. His psychiatric history was

significant for phobia. On examination, he had a left lower motor neuron type facial paresis (House and Brackmann grade II), decreased hearing on the left side and positive left cerebellar signs. Magnetic resonance imaging (MRI) of the brain showed a left cerebellopontine angle lesion of size 3 × 2.3 × 1.8 cm, which was partly solid and partly cystic with extension into the internal auditory meatus (IAM) [Figure 1]. The lesion was displacing the cerebellum and distorting the 4$^{th}$ ventricle. A preoperative audiogram showed left-sided severe mixed hearing loss, sensorineural loss at high frequencies, and right-sided minimal to mild sensorineural hearing loss. With a diagnosis of cystic VS, he underwent left retromastoid suboccipital craniotomy, partial excision of the lesion with electrophysiological monitoring, and preservation of the facial nerve both anatomically and physiologically.

Before beginning tumor resection, stimulation of the posterior surface of the tumor demonstrated good electromyography responses from all three electrodes (frontalis, orbicularis oculi, and orbicularis oris). The stimulation was repeated with different current strengths. All stimuli gave excellent responses. Even though the facial nerve was not visible at first look, its visibility became better under high magnification of the microscope. The nerve was located on the posterior surface of the tumor at its center, extending between the IAM laterally and the brainstem medially. The features that helped to identify the facial nerve clearly under high magnification were the following (i) the color of the nerve, which was different from that of the tumor, (ii) a thin subarachnoid space was identified on the superior and inferior border of the nerve all along its course as the arachnoid layer extended between the tumor and the facial nerve, and (iii) the vasa nervorum of the facial nerve was seen running parallel to its course as opposed to the haphazard course of the tumor vessels on the tumor surface [Figure 2].

The surgical strategy was to preserve the facial nerve and partial removal of the tumor, as the patient and his caregivers did not want postoperative facial nerve palsy, given his psychiatric history. Tumor was debulked from its superior and inferior poles until the ventral arachnoid was seen, sparing the facial nerve, retaining a small sheet of tumor on the ventral surface of the nerve. We then gently removed the center and the venteroanterior aspect of the tumor that was located ventral to the facial nerve and hidden by it with the aid of curved instruments. During this portion of the tumor removal, we made sure that no traction was applied to the nerve and the facial nerve integrity was confirmed with intermittent facial nerve stimulation. No attempt was made to remove the tumor from the IAM or the portion of the tumor that was stuck to the immediate ventral surface of the facial nerve. A computed tomography scan done postoperatively showed partial excision of the tumor.

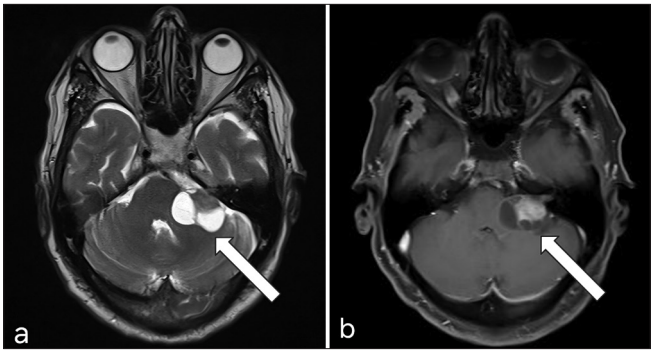


**Figure 1:** (a) T2-weighted axial magnetic resonance imaging (MRI) image showing a partly solid and partly cystic cerebellopontine angle (CPA) lesion (white arrow) extending to the left internal auditory meatus (IAM) and (b) Contrast-enhanced axial MRI image showing a partly solid and partly cystic CPA lesion (white arrow) extending to the left IAM. The solid component of the lesion is seen enhancing with contrast.

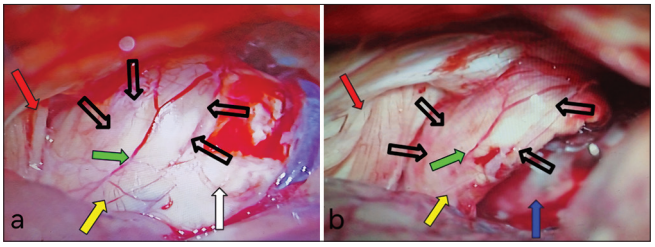


**Figure 2:** (a) Intraoperative images before resection of the tumor showing the tumor (white arrow), facial nerve (yellow arrow) on the posterior surface of the tumor, the vasa nervorum on the facial nerve (green arrow), the thin subarachnoid space (empty black arrows) identified along the superior and inferior borders of the facial nerve, and the ninth-tenth nerve complex (red arrow), and (b) Intraoperative images after resection of the tumor showing the facial nerve (yellow arrow) on the posterior surface of the tumor, the vasa nervorum on the facial nerve (green arrow), the thin subarachnoid space (empty black arrows) identified along the superior and inferior borders of the facial nerve, the ninth-tenth nerve complex (red arrow), and the resection cavity (blue arrow).

## DISCUSSION

The ideal treatment of large VS remains controversial.[12] The goal of surgery for VSs is maximal cytoreduction with functional preservation of cochlear and facial nerves, improving or maintaining the quality of life of patients.[9,12,14]

Cystic VS is generally larger and grows more rapidly than solid VS.[4] A larger tumor size is associated with higher rates of facial nerve dysfunction.[4,14] Therefore, facial nerve palsy is more commonly seen in cystic VS.[4] Early excision of these tumors results in more favorable outcomes.[4] Good surgical outcomes depend on various factors such as tumor size, surgical approach, surgeon's experience, and the surgical technique.[12,14]

Facial nerve preservation is a vital step in the resection of these tumors.[2] Hence, it is important to study the location of the facial nerve on the surface of the tumor both before and during tumor resection.[1,2,13] With advancements in microsurgical techniques and intraoperative monitoring, the preservation of the facial nerve with total removal of tumor has improved significantly in the recent past.[1] Some studies have shown the usefulness of preoperative diffusion tensor imaging in predicting the location of the facial nerve on the surface of these tumors with an intraoperative concordance as high as 91%.[3]

VS commonly arises from the superior vestibular nerve and rarely from the inferior vestibular nerve, and it is difficult to determine its nerve of origin.[6,10] Normally, patients with VS present with hearing loss[6] with relatively normal facial muscle function, which calls for the utmost importance in preserving the facial nerve function during surgery.[8] The facial nerve can be densely adhered, thinned out, deformed, or even infiltrated in large tumors.[2]

**Relation of the facial nerve on the surface of tumor**

Normally, in the IAM, the facial nerve is located in the anterosuperior quadrant, the superior vestibular nerve in the posterosuperior quadrant, the inferior vestibular nerve in the posteroinferior quadrant, and the cochlear nerve in the anteroinferior quadrant.[6] Due to its location, it is not surprising that the facial nerve is commonly seen on the ventral surface of VS.[8,10] However, the relative position of the facial nerve on the surface of the tumor varied in published series.[8,10] Posterior location of the facial nerve on the surface of VS is reported, but rare.[1,5,7,8,10]

Sampath *et al.*[10] reported a large series with 1006 patients with VS and found that the most common location of the facial nerve on the surface of the tumor was anterior. Among patients with the anterior location of the facial nerve, the nerve was located in the anterior middle third in 41.4%, followed by an anterior and superior third in 34.4% of patients and an anterior and inferior third in 5.1%. The nerve was located in the superior pole in 14.4%, the inferior pole in 2.6%, and the posterior surface in 2.1% of patients. A retrospective study by Bae *et al.*[1] on 163 patients with VS showed that the most common location of the facial nerve on the surface of the tumor is ventral and superior in 55.8%, followed by ventral and central in 35%, ventral and inferior in 8.6%, and dorsal in 0.6%.[1] They also found that in tumors <2 cm in diameter, the most common location of the facial nerve was ventral and central and in those >2 cm in diameter, it was ventral and superior.[1] Sameshima *et al.*[8] reviewed 356 patients with VS and found that the most common location of the facial nerve on the surface of the tumor was ventrocentral in 52% of patients. Other sites were ventrorostral in 38.5% of cases, ventrocaudal in 5.3%, rostral in 2.8%, caudal in 1.1%, and dorsal in 0.3% of cases. Sameshima *et al.*[8] observed that when the size of the tumor was <1.5 cm, the nerve was commonly on its ventrocentral surface; however, when the size of the tumor increased to 3 cm, the facial nerve ran in severely distorted courses such as rostral, ventrocaudal, caudal, or dorsal surfaces. In 2016, a retrospective study conducted by Nejo *et al.*[7] reviewed and classified 556 cases of VS on the basis of the location of the facial nerve on the surface of these tumors. They divided the cases into dorsal and non-dorsal groups. The non-dorsal group comprised 96.2% of patients. The most common location of the facial nerve among the non-dorsal group was identified to be ventral in 37.6%, followed by rostroventral in 25.5%, rostral in 15.8%, caudoventral in 15.5%, and caudal in 1.4% patients.

**Posterior location of the facial nerve**

Sampath *et al.*[10] identified 21 (2.1%) patients in whom the facial nerve was located on the posterior surface of the VS. He subclassified the posteriorly located seventh nerve into that located posterosuperior, posteromiddle, and posteroinferior. In their series, the incidence of the posterior location of the facial nerve with tumors with maximal dimensions < 2 cm, 2.5–4 cm, and > 4 cm were 1.6%, 2.5%, and 2.6%, respectively.[10] Bae *et al.*[1] found the dorsal location of the nerve in 1 (0.6 %) patient. Sameshima *et al.*[8] found the posterior location of the facial nerve on the surface of the tumor in 1 (0.3%) of their 356 patients. Nejo *et al.*[7] found that the facial nerve was placed dorsally in 3.8% of patients. He subdivided this group into rostrodorsal (2.3%), central–dorsal (0.5%), and caudodorsal (0.9%).[7]

Reviewing the literature, we could identify only one article that illustrates the posterior location of the facial nerve on the surface of VS.[5] In this article, the authors have not elaborated on the intraoperative microsurgical anatomy as to how to identify the facial nerve on the posterior surface of the tumor, as described in our article. The surgical technique of the authors needs appreciation as they describe how the tumor within the IAM is removed.[5]

Sameshima *et al.*[8] observed that the adhesion of the tumor to the facial nerve was stronger in larger tumors when the facial nerve ran in grossly distorted patterns, such as on the rostral, ventrocaudal, caudal, or dorsal surfaces of the tumor. The cause of a relatively bad prognosis of facial nerve function in these patients is due to excessive manipulation of the nerve during surgery, as the nerve is located between the surgeon and the tumor. Nejo *et al.*[7] felt that dorsal placement of the facial nerve was associated with incomplete tumor resection and a higher rate of retreatment as compared to cases where the facial nerve was placed non-

dorsally. Preoperatively, the dorsal placement of the facial nerve was successfully predicted in only two cases. MRI thin slice constructive interference in steady state images taken preoperatively accurately predicted dorsal orientation of facial nerve (FN) in two cases; seven additional cases were identified during the postoperative retrospective review and eight cases with unidentifiable FN in a study of 17 instances of dorsally located FN tumor resections.[7] We believe that in our case, the tumor, along with its cyst during its formation, would have twisted the facial nerve from its normal anterosuperior aspect to the posterior aspect.

## CONCLUSION

This case reiterates the fact that even though rare, surgeons should anticipate the posterior location of the facial nerve on the surface of VS. Electrophysiological stimulation of the posterior surface of the tumor should be done before tumor resection in all cases to look for the facial nerve. In the case of electrophysiology indicating posterior location of the FN, careful inspection of the posterior surface of the tumor should be completed under high magnification with microscopy. Careful microsurgical dissection should be done to achieve maximal cytoreduction of the tumor, preserving the facial nerve. If the nerve is seen in the center of the tumor, as seen in our case, the tumor should be approached superior and inferior to the nerve.

### Ethical approval

The Institutional Review Board approval is not required.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

### Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

## REFERENCES

1. Bae CW, Cho YH, Hong SH, Kim JH, Lee J, Kim CJ. The anatomical location and course of the facial nerve in vestibular schwannomas : A study of 163 surgically treated cases. J Korean Neurosurg Soc 2007;42:450-54.
2. Choi KS, Kim MS, Kwon HG, Jang SH, Kim OL. Preoperative identification of facial nerve in vestibular schwannomas surgery using diffusion tensor tractography. J Korean Neurosurg Soc 2014;56:11-5.
3. Gerganov VM, Giordano M, Samii M, Samii A. Diffusion tensor imaging-based fiber tracking for prediction of the position of the facial nerve in relation to large vestibular schwannomas. J Neurosurg 2011;115:1087-93.
4. Han JH, Baek KH, Lee YW, Hur YK, Kim HJ, Moon IS. Comparison of clinical characteristics and surgical outcomes of cystic and solid vestibular schwannomas. Otol Neurotol 2018;39:e381-6.
5. Jung GS, Duarte JF, de Aragão AH, Vosgerau RP, Ramina R. Dorsal displacement of the facial nerve in vestibular schwannoma surgery. Neurosurg Focus Video 2021; 5:V9.
6. Mastronardi L, Fukushima T, Campione A, editors. Advances in vestibular schwannoma microneurosurgery: Improving results with new technologies. Cham: Springer International Publishing; 2019.
7. Nejo T, Kohno M, Nagata O, Sora S, Sato H. Dorsal displacement of the facial nerve in acoustic neuroma surgery: Clinical features and surgical outcomes of 21 consecutive dorsal pattern cases. Neurosurg Rev 2016;39:277-88; discussion 288.
8. Sameshima T, Morita A, Tanikawa R, Fukushima T, Friedman A, Zenga F, *et al*. Evaluation of variation in the course of the facial nerve, nerve adhesion to tumors, and postoperative facial palsy in acoustic neuroma. J Neurol Surg Part B Skull Base 2012;74:39-43.
9. Samii M, Gerganov VM, Samii A. Functional outcome after complete surgical removal of giant vestibular schwannomas: Clinical article. J Neurosurg 2010;112:860-7.
10. Sampath P, Rini D, Long DM. Microanatomical variations in the cerebellopontine angle associated with vestibular schwannomas (acoustic neuromas): A retrospective study of 1006 consecutive cases. J Neurosurg 2000;92:70-8.
11. Sartoretti-Schefer S, Kollias S, Valavanis A. Spatial relationship between vestibular schwannoma and facial nerve on three-dimensional t2-weighted fast spin-echo MR images. AJNR Am J Neuroradiol 2000;21:810-6.
12. Starnoni D, Giammattei L, Cossu G, Link MJ, Roche PH, Chacko AG, *et al*. Surgical management for large vestibular schwannomas: A systematic review, meta-analysis, and consensus statement on behalf of the EANS skull base section. Acta Neurochir (Wien) 2020;162:2595-617.
13. Taoka T, Hirabayashi H, Nakagawa H, Sakamoto M, Myochin K, Hirohashi S, *et al*. Displacement of the facial nerve course by vestibular schwannoma: Preoperative visualization using diffusion tensor tractography. J Magn Reson Imaging 2006;24:1005-10.

14. Zhang Z, Nguyen Y, Seta DD, Russo FY, Rey A, Kalamarides M, *et al*. Surgical treatment of sporadic vestibular schwannoma in a series of 1006 patients. Acta Otorhinolaryngol Ital 2016;36:408-14.

**How to cite this article:** Bahuleyan B, Patel VT, Anto M, Hessel SE, Ramesh RK, Girish KM, *et al*. Posterior location of the facial nerve on vestibular schwannoma: Report of a rare case and a literature review. Surg Neurol Int. 2024;15:345. doi: 10.25259/SNI_586_2024