

# Subfrontal Schwannoma Extended Broadly to Nasal Cavity Treated by Gamma Knife Radiosurgery Following Surgical Excision: A Case Report

Soo Hee Kim<sup>1</sup>, Jung Hwan Lee<sup>1</sup>, Soon Ki Sung<sup>2</sup>, Chang Hwa Choi<sup>1</sup>

<sup>1</sup>Department of Neurosurgery, Pusan National University Hospital, Busan, Korea

<sup>2</sup>Department of Neurosurgery, Pusan National University Yangsan Hospital, Yangsan, Korea

**Received** March 17, 2017

**Revised** August 16, 2017

**Accepted** August 21, 2017

## Correspondence

Chang Hwa Choi

Department of Neurosurgery,  
Pusan National University Hospital,  
179 Gudeok-ro, Seo-gu, Busan 49241,  
Korea

**Tel:** +82-51-240-7257

**Fax:** +82-51-244-0282

**E-mail:** chwachoi@pusan.ac.kr

Subfrontal schwannomas are rarely reported. They are usually found only in the subfrontal area, but some extend to the nasal cavity. In these cases, prevention of postoperative cerebrospinal fluid (CSF) leakage through thinned or eroded anterior skull base is important. A 51-year-old female with anosmia and mild nausea was diagnosed as subfrontal extraaxial mass with nasal cavity extension. This mass was initially thought to be an olfactory groove meningioma. We performed a bifrontal craniotomy for surgical excision. We did not totally remove the tumor, as we wanted to prevent a skull base defect. The histopathological diagnosis was a schwannoma. There was no postoperative complication such as CSF leakage. The residual tumor was treated with gamma knife radiosurgery. The nasal cavity mass has not grown as of five years after radiosurgery.

**Key Words** Schwannoma; Olfactory nerve; Cerebrospinal fluid leakage.

## INTRODUCTION

Schwannomas are slowly growing nerve sheath tumors, and can arise from any nerve containing Schwann cells [1]. However, schwannomas at the subfrontal area are rarely reported because the Schwann cell layer lacks in olfactory or optic nerves [1,2]. Moreover, there are few cases of olfactory schwannomas extending broadly to nasal cavity. We present this unusual case that was treated successfully by gamma knife radiosurgery following surgical excision.

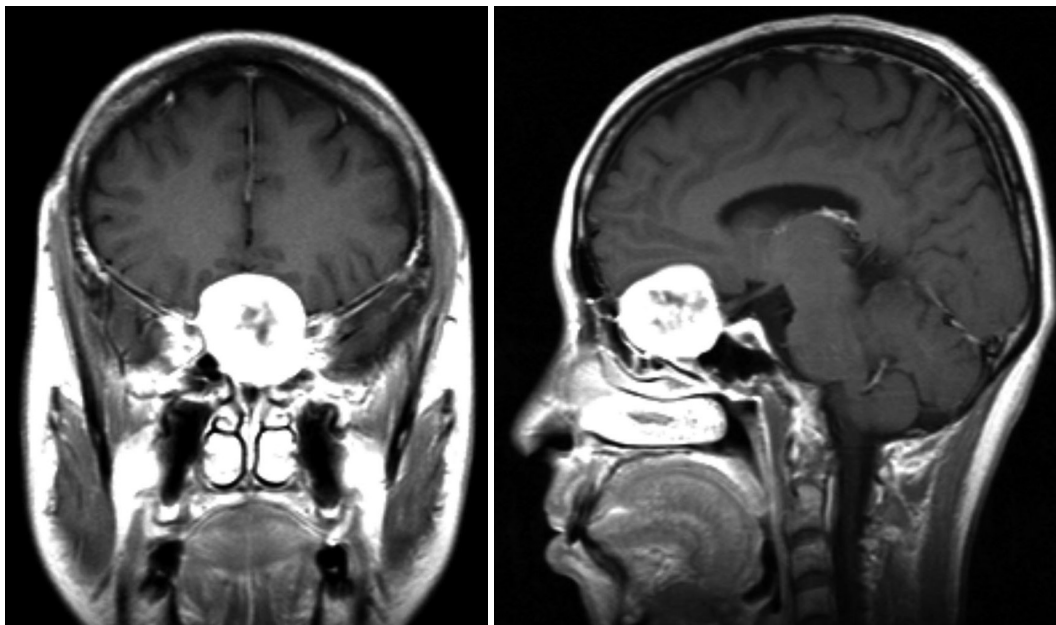
## CASE REPORT

A 51-year-old female patient visited our institution due to anosmia and mild nausea. There was no other neurologic deficit or sign of increased intracranial pressure. Magnetic resonance imaging (MRI) of brain revealed a 3.5 cm-sized sub-

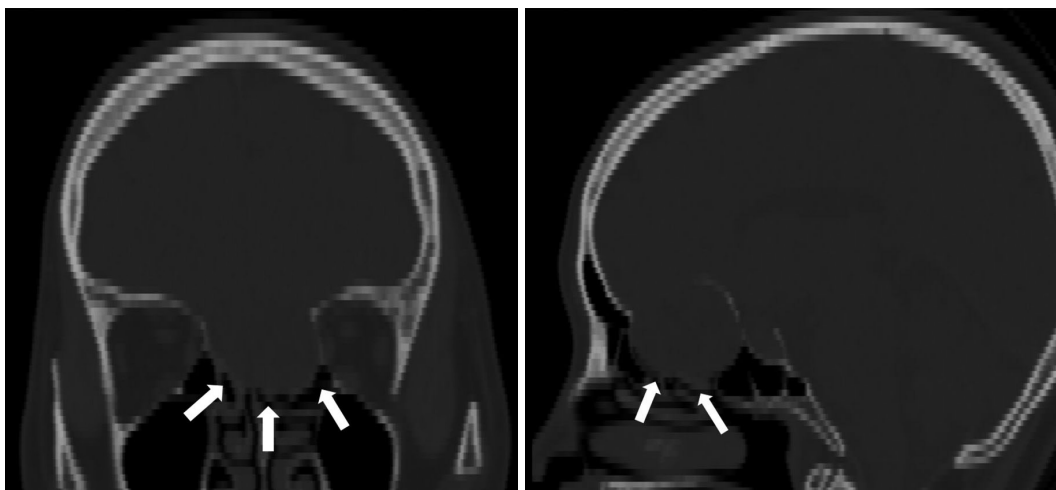
frontal extraaxial mass resembling an olfactory groove meningioma (Fig. 1). The mass was extended to nasal cavity. Brain computed tomography (CT) scans showed that the anterior skull base had a defect or was very thinned (Fig. 2). We performed a bifrontal craniotomy for surgical excision. We found that the mass was not related to the dura. Both olfactory nerves were compressed by the tumor and displaced to superolateral area of the tumor. The tumor was very hard, therefore was removed in piece. After internal decompression of the tumor, the remnant tumor at the anterior skull base and clinoid process were removed. We tried to find the tumor origin site, but could not. The tumor could not be totally removed, as we wished to prevent a skull base defect. The histopathological diagnosis was schwannoma (Fig. 3). There were no postoperative complications such as cerebrospinal fluid (CSF) leakage. Follow-up MRI at postoperative a day revealed some mass over the distorted anterior skull base (Fig. 4A). The residual tumor was treated with gamma knife radiosurgery one month postoperatively. The marginal radiation dose was 23.5 gray at 50% isodose line. The nasal cavity mass has not grown as of five years after radiosurgery (Fig. 4B).

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Copyright © 2017 The Korean Brain Tumor Society, The Korean Society for Neuro-Oncology, and The Korean Society for Pediatric Neuro-Oncology



**Fig. 1.** Coronal and sagittal magnetic resonance imaging with gadolinium shows an extra-axial mass at anterior cranial fossa. The tumor extends to the nasal cavity. However, the tumor does not extend to the optic canal. Neither olfactory nerves is identified.



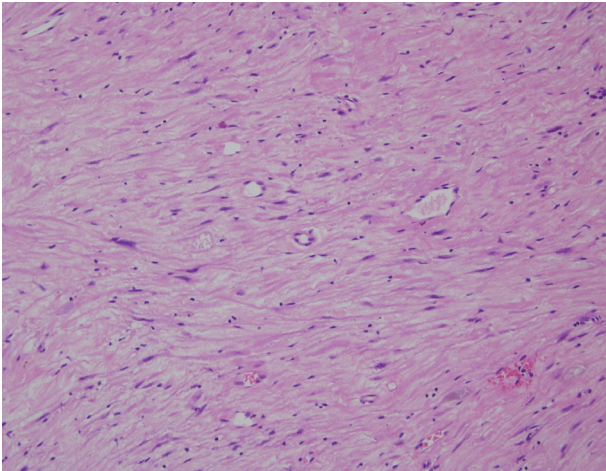
**Fig. 2.** Coronal and sagittal reconstruction images of computed tomography scan reveal bony thinning or erosion on anterior skull base (white arrows).

## DISCUSSION

The first consideration in the differential diagnosis of a large and enhancing subfrontal mass in adult is a meningioma [2,3]. Subfrontal or olfactory groove schwannomas, which are exceedingly rare, are difficult to be distinguished from meningiomas by imaging only [2]. Amador et al. [4] mentioned that the distinction point between schwannoma and meningioma is the adjacent bone state. Schwannomas cause a little more bony erosion, whereas meningiomas tend to cause hyperostosis. In our case, bony erosion and a defect were identified on MRI and CT scans, but we did not expect this tumor

to be a schwannoma because subfrontal schwannomas were rarely reported [1-3]. Neuroblastoma, squamous cell carcinoma, adenocarcinoma, and metastases should be also considered in the differential diagnosis in adults with a tumor involving both the nasal cavity and anterior skull base. These tumors are more aggressive, therefore more extensive resection is required [3].

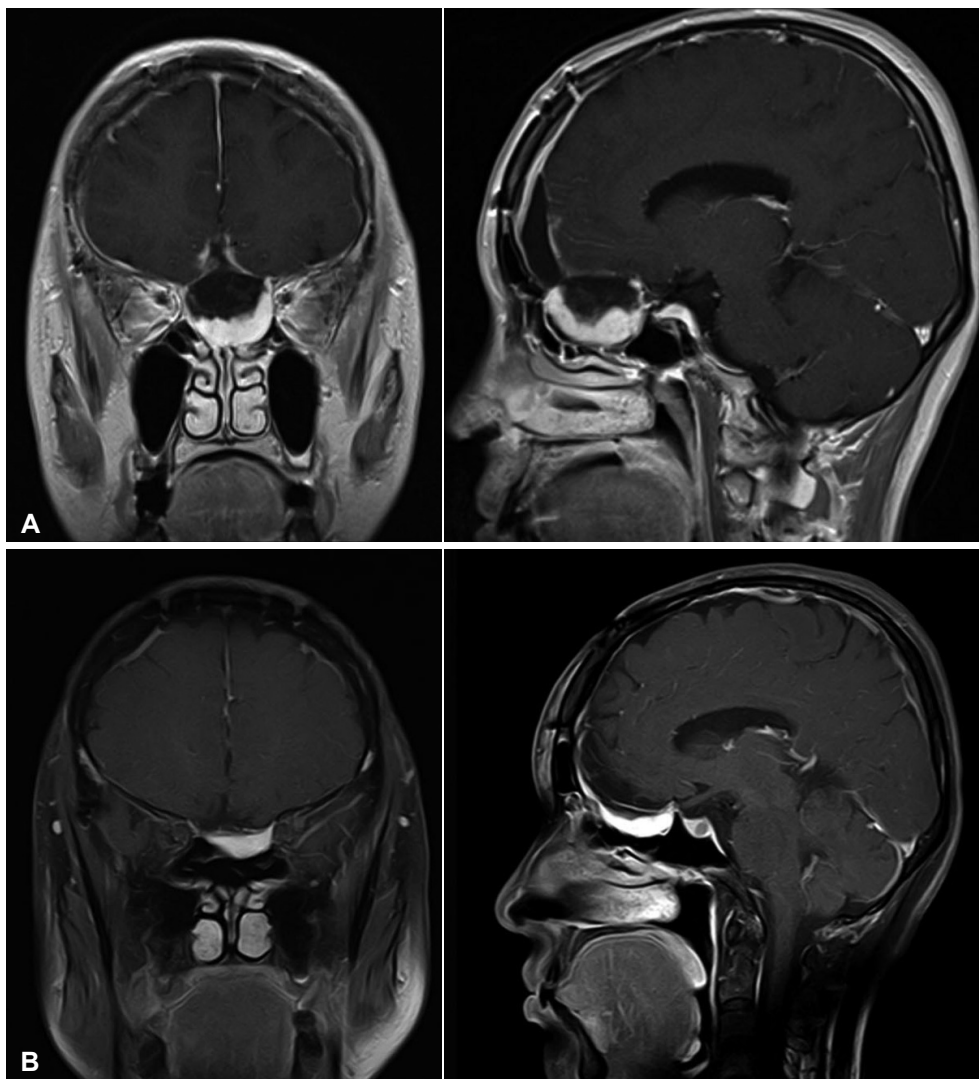
Total surgical excision is accepted as the best treatment of schwannoma [1]. Subfrontal schwannomas extending to nasal cavity can be treated by total surgical excision with skull base reconstruction [3,5]. Some authors use transnasal endoscopic resection to remove subfrontal schwannomas extend-



**Fig. 3.** Photomicrographs of the tumor show spindle-shaped cells with elongated nuclei and pale eosinophil cytoplasm. Pathologic diagnosis is schwannoma (hematoxylin and eosin staining,  $\times 400$ ).

ing to nasal cavity with small skull base defect [2,6]. We planned to treat this tumor by gamma knife radiosurgery following subtotal surgical excision without skull base reconstruction, because the thinned or eroded anterior skull base was very wide. We expected a very high risk of CSF leakage despite skull base reconstruction techniques or sealing products. We performed radiosurgery as planned, because the tumor control rate of schwannoma after radiosurgery is high [7,8]. There was no complication and the tumor is well controlled as of five years postsurgery.

The olfactory nerve does not have a Schwann cell layer [1,9]. Therefore, schwannoma cannot arise from this nerve theoretically. There are two types of hypotheses for the origin of sub-frontal schwannoma: developmental and non-developmental [1,9]. The developmental hypothesis suggests an origin from aberrant Schwann cells, multipotent mesenchymal cells, or



**Fig. 4.** MRIs after one day and five years postoperatively. A: Postoperative MRIs with gadolinium at postoperative a day show a remnant mass at the thinned skull base. B: MRIs with gadolinium after five years reveal no tumor growth and widening of nasal cavity. The tumor is well controlled. MRI, magnetic resonance imaging.

displaced neural crest cells of Schwann cells within the central nervous system parenchyma. The non-developmental hypothesis suggests that subfrontal schwannomas originate from Schwann cells in the perivascular nerve plexus surrounding cerebral blood vessels, meningeal branches of the trigeminal nerve, or anterior ethmoidal nerves innervating the anterior cranial fossa [1,9]. Adachi et al. [10] proposed another classification of subfrontal schwannomas according to location of origin: the olfactory site (from olfactory groove or cribriform plate) or others (from non-olfactory sites). In our case, we could not confirm the origin of the subfrontal tumor because of the remnant mass over the anterior skull base.

In conclusion, this is a rare case of subfrontal schwannoma extending broadly to the nasal cavity. We treated this rare tumor by gamma knife radiosurgery following subtotal surgical excision. In general, the best treatment method of schwannoma is total excision. However, radiosurgery following subtotal excision is another good treatment option, if a large skull base defect is likely after total excision of a subfrontal schwannoma.

#### Conflicts of Interest

The authors have no financial conflicts of interest.

#### Acknowledgments

This work was supported by a two year Research Grant of Pusan National University (20150147).

#### REFERENCES

1. Kim DY, Yoon PH, Kie JH, Yang KH. The olfactory groove schwannoma attached to the cribriform plate: a case report. *Brain Tumor Res Treat* 2015;3:56-9.
2. Kanaan HA, Gardner PA, Yeane G, et al. Expanded endoscopic endonasal resection of an olfactory schwannoma. *J Neurosurg Pediatr* 2008; 2:261-5.
3. Bezircioglu H, Sucu HK, Rezanko T, Minoğlu M. Nasal-subfrontal giant schwannoma. *Turk Neurosurg* 2008;18:412-4.
4. Amador AR, Santonja C, Del Pozo JM, Ortiz L. Olfactory schwannoma. *Eur Radiol* 2002;12:742-4.
5. Choi YS, Sung KS, Song YJ, Kim HD. Olfactory schwannoma-case report. *J Korean Neurosurg Soc* 2009;45:103-6.
6. Liu JK, Eloy JA. Expanded endoscopic endonasal transcribriform approach for resection of anterior skull base olfactory schwannoma. *Neurosurg Focus* 2012;32 Suppl 1:E3.
7. Elsharkawy M, Xu Z, Schlesinger D, Sheehan JP. Gamma Knife surgery for nonvestibular schwannomas: radiological and clinical outcomes. *J Neurosurg* 2012;116:66-72.
8. Puataweepong P, Dhanachai M, Hansasuta A, et al. Clinical outcomes of intracranial nonvestibular schwannomas treated with linac-based stereotactic radiosurgery and radiotherapy. *Asian Pac J Cancer Prev* 2016; 17:3271-6.
9. Yamahata H, Hirahara K, Tomosugi T, et al. Subfrontal schwannoma mimicking neuroblastoma: case report. *Skull Base Rep* 2011;1:59-64.
10. Adachi K, Yoshida K, Miwa T, Ikeda E, Kawase T. Olfactory schwannoma. *Acta Neurochir (Wien)* 2007;149:605-10.