



Radical Removal of Recurrent Malignant Meningeal Tumors of the Cavernous Sinus in Combination with High-Flow Bypass

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■ **BACKGROUND:** Meningiomas or solitary fibrous tumors arising from the cavernous sinus (CS) are usually treated with radiosurgery to control growth. Surgical removal of cavernous tumors is indicated only for tumors extending outside the CS. However, even after adequate treatment, the tumor may exhibit recurrence or malignant transformation. We report a treatment option for recurrent meningeal tumors of the CS.

■ **METHODS:** In 4 patients with CS tumors that exhibited regrowth after multiple operations and radiosurgery, radical removal in combination with high-flow bypass was performed, and a vascularized muscle flap was used for reconstruction. One patient had a radiation-induced atypical meningioma, 2 patients had transformed atypical meningiomas, and 1 patient had a frequently recurring solitary fibrous tumor.

■ **RESULTS:** No local recurrence was observed in any patients during a follow-up period of 13–41 months. In all patients, a Karnofsky performance scale score of >80 on admission was maintained at >70 at the final follow-up evaluation.

■ **CONCLUSIONS:** Radical removal in combination with high-flow bypass provides favorable results and maintains quality of life in patients with recurrent CS meningeal tumors.

INTRODUCTION

Skull base meningiomas are challenging to resect completely and are associated with a higher recurrence rate than meningiomas that do not involve the skull base (6). Although the use of skull base approaches has facilitated maximal tumor resection with minimum morbidity, the overall rate of gross total resection of cranial base meningiomas is 53.0%, with morbidity and mortality rates of 17.9% and 0.9%, respectively (3). Meningiomas or solitary fibrous tumors (SFT) originating from the cavernous sinus (CS) are usually treated with radiosurgery to control growth while preserving cranial nerve function of the parasellar area. Because tumor remnants hidden along the cranial nerves and infiltrating the adventitia of the internal carotid artery (ICA) can result in high morbidity, surgical intervention is contraindicated for asymptomatic and radiologically stable tumors (2, 7, 9, 11). Direct surgery is currently reserved for tumors outside of the CS. Radiosurgery for the treatment of CS tumors yields adequate outcomes, improving cranial nerve function in 50%–67% of cases with an 84%–100% 5-year progression-free survival rate (10, 15). However, the growth of World Health Organization (WHO) grade II or III meningiomas is difficult to control, leading to high risk of tumor recurrence.

Treatment options for CS meningiomas that are malignant or recur after radiosurgery are controversial (3). Surgical resection of the tumors, with carotid artery bypass if necessary, is a possible treatment for postirradiation or

Key words

- Cavernous sinus
- High-flow bypass
- Meningioma
- Radical removal
- Skull base

Abbreviations and Acronyms

- CS:** Cavernous sinus
- ICA:** Internal carotid artery
- KPS:** Karnofsky performance scale
- RA:** Radial artery
- RAM:** Rectus abdominis muscle
- SFT:** Solitary fibrous tumor
- WHO:** World Health Organization

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Table 1. Demographic Data

Case Number	Age (years)/ Sex	Previous Treatment	Initial Surgery	Pathology		MIB-1 Index	De Novo or Transformed
				Previous	Final		
1	36/M	Craniotomy ×6	4 years ago	Atypical meningioma	Atypical meningioma	25%	De novo (RT induced)*
2	63/F	Craniotomy ×2 IMRT ×1	4 years ago	Meningothelial meningioma	Atypical meningioma	30%	Transformed
3	44/M	Craniotomy ×10 GKS ×1	19 years ago	SFT	SFT	14%	
4	60/F	Craniotomy ×2 IMRT ×1	2 years ago	Meningothelial meningioma	Atypical meningioma	5%	Transformed

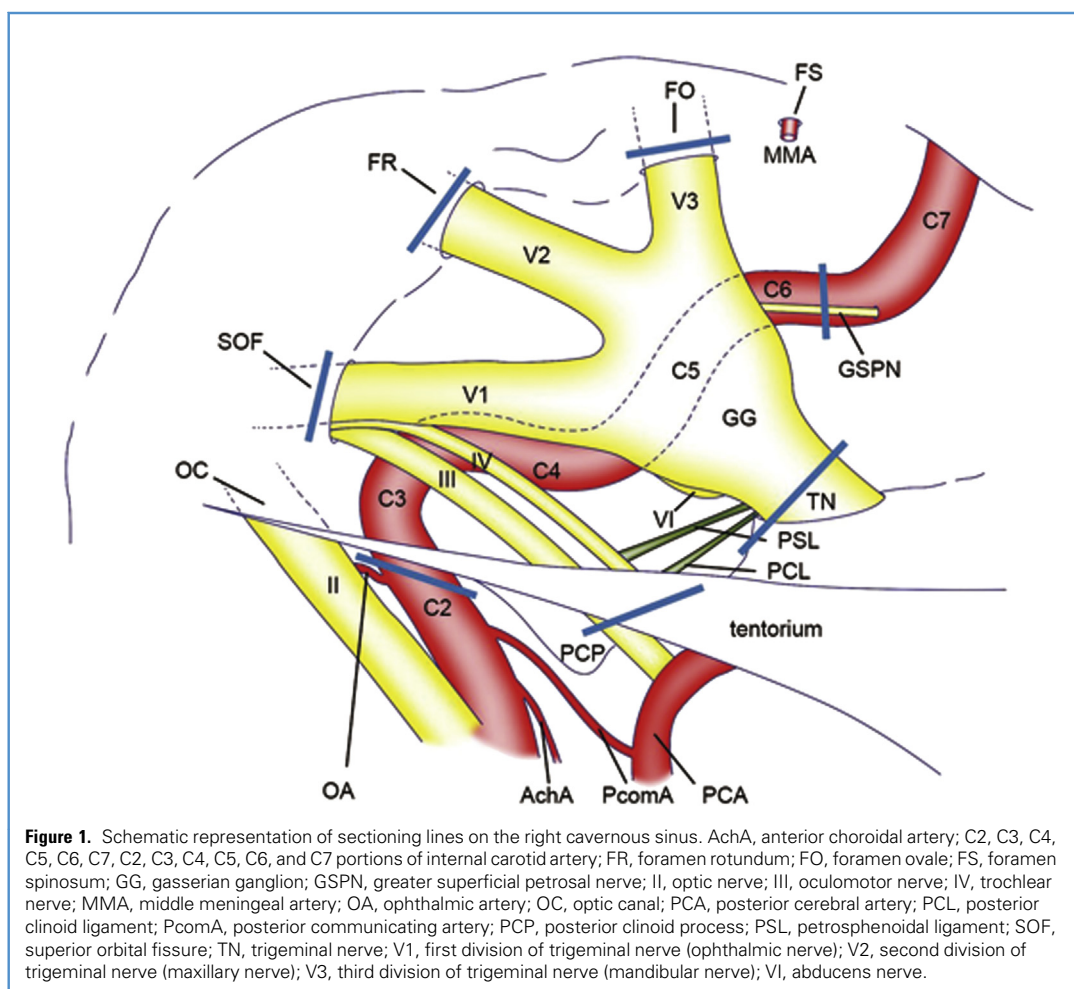
M, male; F, female; IMRT, intensity-modulated radiation therapy; GKS, Gamma Knife surgery; SFT, solitary fibrous tumor; RT, radiation therapy.
*Whole-body irradiation was performed 22 years ago because of leukemia.

recurrent tumors (3). This study explored the role of radical removal with high-flow bypass and transplant of a free vascularized rectus abdominis muscle (RAM) flap for the treatment of recurrent and malignant CS meningeal tumors with aggressive features.

MATERIALS AND METHODS

Patient Population and Summary

The study population consisted of 184 patients with intracranial meningeal tumors who had undergone 316 surgeries within the



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