

# Management of Cavernous Sinus Involvement in Sinonasal and Ventral Skull Base Malignancies



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## KEYWORDS

- Cavernous sinus • Skull base tumor • Sinonasal and ventral skull base malignancy
- Surgical approach • Technical nuances • Cerebral revascularization

## KEY POINTS

- For a malignant tumor involving the cavernous sinus, the approach must be individualized to optimize the treatment strategy. Often a combination of surgical approaches is necessary for optimal resection of aggressive ventral skull base malignancies with cavernous sinus involvement, including frequent collaboration between the disciplines of otorhinolaryngology and neurosurgery.
- To confirm the diagnosis in cases of inconclusive radiological impressions or suspicious-looking lesions, use of minimally invasive approaches aided with stereotactic neuronavigation is helpful.
- Once the diagnosis is confirmed, and if the patient is healthy and has no metastatic disease, aggressive surgical resection may be indicated, especially if the removal of the cavernous sinus lesion may result in total tumor resection.
- For patients with more advanced and recurrent malignant disease, whereby carotid preservation would prevent a meaningful resection, en bloc resection of the tumor and cavernous sinus with cerebrovascular revascularization may be justified.
- Frequently, en bloc resection will require cavernous sinus exenteration, including sacrifice of the cavernous internal carotid artery, possible high-flow extracranial-to-intracranial bypass, and placement of a vascularized pedicled flap for ventral skull base reconstruction along with adjuvant chemotherapy and radiotherapy to effectively eradicate the microscopic tumor remnants.



Video content accompanies this article at <http://www.oto.theclinics.com>.

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## INTRODUCTION

Sinonasal and ventral skull base malignancy refers to tumors arising from the nasal cavity, paranasal sinuses, orbit, salivary glands, and soft tissue and bone along the ventral skull base.<sup>1,2</sup> This broad spectrum of malignant diseases includes, but is not limited to, nasopharyngeal squamous cell carcinoma, adenoid cystic carcinoma, lymphoma, chordoma, chondrosarcoma, hemangiopericytoma, malignant meningioma, osteosarcoma, rhabdomyosarcoma, adenocarcinoma, mucoepidermoid carcinoma, acinic cell carcinoma, undifferentiated carcinoma, clear cell carcinoma, liposarcoma, and esthesioneuroblastoma.<sup>1,2</sup> These lesions spread to the cavernous sinus (CS) either directly (83.2%) via the superior orbital fissure, inferior orbital fissure, foramen rotundum, and foramen ovale or through metastasis (16.8%) via perineural extension or hematogenous or lymphatic spread.<sup>3</sup> Malignant tumors of the nasal cavity and paranasal sinuses are rare, accounting for 0.2% to 0.5% of all cancer cases and only 3.0% of malignant tumors in the head and neck region.<sup>4</sup> According to the Surveillance, Epidemiology, and End Results database of all reported sinonasal malignancies between 1973 and 2006, the cumulative incidence of sinonasal malignancy was 0.556 cases per 100,000 population per year; the most common sites of origin were the nasal cavity (43.9%) and the maxillary sinus (35.9%).<sup>2</sup> CS involvement by sinonasal and ventral skull base malignancies carries dismal prognosis overall, because it precludes radical oncological resection in many instances.<sup>1,5,6</sup> However, the overall and progression-free survival in a particular malignant ventral skull base tumor case with CS involvement depends on many factors besides the extent of resection, which include tumor burden, pathologic conditions, presence of metastasis, positive tumor margins, and age of patients. Aggressive surgical resection followed by adjuvant chemotherapy and radiotherapy offers the best possible chance of prolonging overall survival in most sinonasal and ventral skull base malignancies.<sup>7,8</sup>

Since the seminal articles by Ketcham and colleagues<sup>9,10</sup> in 1963 and 1966 detailing the role of surgery in intracranial involvement of head and neck malignancy, innovation of radical surgical resection procedures for the eradication of malignant ventral skull base tumors is arguably one of the most important advancements in the treatment of head and neck malignancy in the past half century. Besides the use of conventional open transcranial and transfacial approaches to achieve the surgical goal of oncologic resection, minimally invasive endoscopic approaches have been applied more recently to selected patients with reasonable outcomes.<sup>11–13</sup> It was not uncommon in the past that malignant skull base tumors were considered inoperable. With advancement in skull base microneurosurgery, availability of better endoscopic devices, expertise in cerebral revascularization, more effective hemostatic agents, and improved ventral skull base reconstruction techniques, the collective opinion of the neurosurgical community has changed from this conventional thinking. More aggressive groups preferred piecemeal removal of tumor, including parts extending into the CS proper<sup>14</sup>; however, the oncological principle of en bloc resection was still not realized until the pioneering efforts of Sekhar and Moller,<sup>15</sup> Saito and colleagues,<sup>1</sup> and others.<sup>16,17</sup> This review discusses the current surgical strategies, their indications, techniques, nuances, advantages, limitations, and complications of operative approaches for CS involvement of malignant ventral skull base tumors.

## SURGICAL MANAGEMENT

Since the pioneering work of Parkinson<sup>18</sup> and others,<sup>19–21</sup> more refined intradural and extradural transcranial surgical approaches have been described to access CS lesions; more recently, the extended endonasal/transmaxillary endoscopic approaches

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