Craniofacial Reconstruction Following Oncologic Resection

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KEYWORDS

• Skull base surgery • Microvascular free flap • Facial nerve reconstruction • Prosthesis
• Osseointegrated implants

KEY POINTS

- The goals of craniofacial reconstruction following skull base surgery include creating a watertight dural seal, providing a barrier between the dura and the aerodigestive tract, supporting the orbit, and restoring facial appearance and function.
- Classifying skull base lesions into regions based on key anatomic structures helps to predict the reconstructive needs and outcomes.
- Repair and rehabilitation of the facial nerve, if resected, must be considered in the reconstructive approach.
- Prosthetic rehabilitation may be the most appropriate way of replacing resected facial structures such as the eye, nose, or ear, or may be used while awaiting autologous tissue reconstruction.

INTRODUCTION

Neoplasms involving the skull base are among the most challenging tumors to treat. The complex anatomy of the region makes resection difficult and places the patient at risk for major complications, such as cerebrospinal fluid (CSF) leak, meningitis, and osteomyelitis. Craniofacial reconstructions that minimize the risks for such complications as well as restore facial appearance and function have become a critical part of most skull base surgeries (**Box 1**). Although, historically, skull base resections were associated with poor outcomes, advances in reconstruction, which minimize complications, loss of function, and disfigurement, concomitant with advances in oncologic resection, radiation, chemotherapy, and diagnostic and interventional radiology, have substantially decreased the morbidity as well as increased the efficacy of skull base tumor treatment.

The objective of this article is to describe an algorithm for defects encountered following skull base resection, focusing primarily on microvascular free flap reconstruction. Although local flaps remain useful for a few specific indications, microvascular free flaps are now used for most skull base reconstructions.[1,2] Unlike local flaps, which are limited in reach and volume, free flaps permit virtually unlimited degrees of freedom in their placement and can be tailored precisely with respect to size and tissue type (eg, bone, muscle, adipose tissue, skin).[3,4] Techniques for treating facial nerve paralysis are also discussed because the facial nerve is frequently resected in skull base surgeries. Finally, prosthetic rehabilitation

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Box 1
Goals of skull base reconstruction

1. Protect the dura and prevent CSF leaks.
2. Create a separation between the intracranial cavity and the aerodigestive tract.
3. Cover the nerves and blood vessels of the neck and skull base with well-vascularized tissue.
4. Support the orbit.
5. Separate the nasal cavity from the oral cavity.
6. Restore speech and swallowing function.
7. Support eyeglasses and prosthetics.
8. Restore facial nerve function.
9. Eliminate dead space and restore facial contour.

of face, which allows restoration of delicate facial features in ways that may be more expedient, more straightforward, or, at times, even more aesthetic than reconstruction with autologous tissues, is addressed.

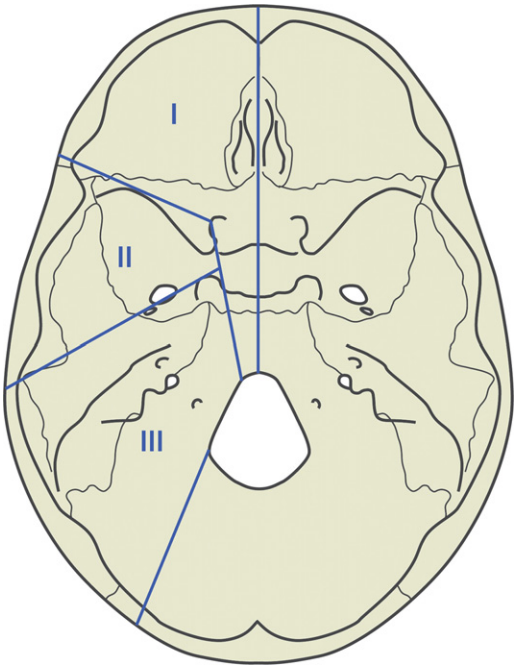

Fig. 1. Skull base regions.

CLASSIFICATION

Oncologic skull base defects can be broadly defined as those occurring from resection of tumors arising from or involving the floor of the anterior, middle, or posterior cranial fossae. These resections involve removal of cranial bone, with or without incision of the dura. The classification system described by Irish and colleagues[5] remains the most useful for describing skull base tumors because it communicates the general location of the defects and predicts the reconstructive challenges associated with a given region of the skull base (**Fig. 1**).

Briefly, region I involves defects from tumors arising from the orbits and sinuses, those extending into the anterior cranial fossae, and those originating in the clivus or extending as far posteriorly as the foramen magnum. Region II defects result from tumors originating from the lateral skull base, primarily the infratemporal and pterygopalatine fossae, which may extend into the middle cranial fossa. Region III defects are almost all associated with tumors arising from the ear, parotid, or temporal bone, and may extend into the middle or posterior cranial fossae.

REGION I

Region I resections may involve the central or lateral anterior cranial fossa, or both. Central region I tumors often originate from the ethmoid and sphenoid sinuses or the cribriform plate, as is the case with esthesioneuroblastomas. Tumors in region I are usually resected with an anterior craniofacial approach, resulting in a communication of the nasal cavity with the intracranial space. Skull base defects restricted to the upper nasal cavity can be reconstructed with a pericranial flap or a galea-frontalis flap, transposed to line the floor of the anterior cranial fossa.[5] Sizable defects that encompass the external nose, forehead, and/or orbit, are usually best reconstructed with a free flap.

Nasal reconstructions are usually addressed separately from the skull base. Such reconstructions are delicate, multistaged procedures using local flaps, such as the paramedian forehead flap, and auricular or costal cartilage grafts. Reconstruction is usually delayed for many months following the conclusion of adjuvant radiation therapy, if given, to avoid fibrosis and contracture of the reconstructed nose. Prostheses are another option for nasal reconstruction that often produce an even better aesthetic result than autologous tissues and do not require multiple operations (see later discussion).

Lateral region I tumors may arise from orbital or periorbital structures and frequently involve orbital exenteration or orbitomaxillectomy. In orbital exenterations that spare the medial and inferior orbital walls, a thin fasciocutaneous free flap,