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Orbital Skull Base Reconstruction with Temporalis Muscle: The Sphenoid Keyhole Technique

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Abstract

Keywords

- ▶ skull base
- ▶ orbital reconstruction
- ▶ sphenoid key-hole

The temporalis flap is a common flap used in head and neck reconstruction. In this article, the authors present a new modification of the use of the temporalis muscle flap for orbital skull base reconstruction with the use of a sphenoid keyhole. This technique confers multiple advantages in reducing the arc of rotation and providing a tension-free reconstruction of the orbital skull base.

In 1895, the temporalis flap was first utilized by Lentz after resection of the condylar neck for temporomandibular joint ankylosis.¹ Shortly after 1898, Golovine used the temporalis flap to reconstruct an orbital defect after exenteration.² Since its innovation, the temporalis flap has demonstrated excellent versatility for reconstructive ability for several head and neck areas.^{3–5} The temporalis muscle is fan-shaped and is located lateral to the temporal fossa. It travels deep to the zygomatic arch where it inserts onto the coronoid process and ascending ramus of the mandible.⁵ The muscle has an abundant blood supply from the anterior and posterior deep temporal arteries, and accessory supply from the middle temporal artery.^{1,4} The temporal fascia consists of two layers: the temporoparietal fascia (TPF)—a continuation of the superficial musculoaponeurotic system, and the deep temporal fascia. The temporal branch of the facial nerve lies deep to the TPF after passing cephalic to the zygomatic arch. The knowledge of this relevant anatomy is imperative to avoiding injury.⁵

The temporalis muscle is commonly used for skull base reconstruction.^{3,5,6} It has multiple advantages over other pedicle flaps such as the trapezius, deltopectoral, and pectoralis major flaps due to its minimal bulk, short distance to defect, small arc of rotation, and minimal morbidity to the donor site. However, challenges surrounding muscle length, arc of rotation around the lateral orbital wall, and tension can preclude the use of this flap, and sometimes subject the patient to more morbid options such as free tissue transfer.

The temporalis muscle flap has also been used to repair orbital exenteration defects. The bulk of the muscle is ideal in filling the orbital cavity.⁷ Menon et al described the use of the temporalis muscle to reconstruct an orbital exenteration cavity through a transorbital approach.⁸

In this article, we present a new modification for the use of the temporalis muscle flap for orbital skull base reconstruction with the use of a sphenoid keyhole. This technique confers multiple advantages in reducing the arc of rotation and providing a tension-free reconstruction of the orbital skull base.

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Methods

Surgical Technique

An orbital roof defect was created after orbital exenteration and open craniofacial resection of an olfactory neuroblastoma involving the orbit. The defect spanned from orbital apex to the anterior table of the frontal sinus in the anterior–posterior dimension; and from the zygomatic bone to the ethmoid skull base in the medial–lateral dimension. A small dural defect was initially repaired with DuraGen. To reconstruct the overlying skull base defect, the temporalis muscle flap was chosen. An incision was made over the right temporal region and the temporalis muscle was exposed. Another incision was made overlying the superficial temporal fat pad to preserve the frontal branch of the facial nerve. Dissection was then carried within the superficial temporal fat pad toward the zygomatic arch. After exposure of the entire muscle, the portion of the temporalis muscle flap needed for the reconstruction of the defect was elevated from the temporal fossa. The zygomaticosphenoid suture line is palpated and a fluted burr was then used to create a keyhole with a 2 cm diameter in the greater wing of the sphenoid bone (►Fig. 1). Care was taken to avoid injury to the underlying dura. The temporalis muscle was then passed through the keyhole, and sutured to the frontal bone anteriorly, and dura posteromedially in tension-free fashion using 4–0 Vicryl sutures (►Figs. 2 and 3). The remainder of the temporalis muscle was used to fill the exenteration defect. The donor site was closed in layers over a 10 Fr Jackson-Pratt drain.

Results

This patient's skull base defect over the orbit was effectively treated with the temporalis muscle flap. There was no leakage of cerebrospinal fluid from this defect. There was slight bleeding from the medial edge of the muscle flap, indicating good vascularity to the flap. The patient subsequently recovered and received adjuvant radiation therapy, which was unfortunately complicated by skull base osteor-

adionecrosis requiring debridement and reconstruction with an anterolateral thigh free flap.

Discussion

There are a few technical points that should be considered when utilizing this technique. A coronal incision is typically used to access the temporalis flap. This access incision also allowed us to access the skull base defect and the resection cavity. The temporalis flap should be elevated completely off the temporal fossa, all the way down to the coronoid process. This maneuver minimizes tension later on in the reconstruction. Furthermore, the sphenoid keyhole must be made wide enough to prevent strangulation of the muscle flap. The greater wing of the sphenoid is bordered by the frontal and parietal bones superiorly and the temporal bone posteriorly. It is important to palpate the sphenotemporal suture line and drill anteriorly to this. More importantly, care must be taken to avoid damage to the underlying dura when making the keyhole through the greater wing of the sphenoid.

Indications for this procedure include skull base defects that cannot be closed with a pericranial flap due to a need for muscle bulk, inability to perform free tissue transfer due to patient comorbidity or surgeon comfort level, needing an additional layer of stabilization of dural repair, and a need to fill an orbital exenteration defect. This technique is also applicable in reconstructing a skull base defect without orbital exenteration. This technique is different from merely bringing the temporalis through the zygomatic bone in the lateral orbital wall as has been previously described. We are able to gain additional length and a tension-free closure with the sphenoid keyhole technique. The exact additional length that can be gained varies from patient to patient, based on the length and bulk of the temporalis muscle itself. We are able to obtain roughly 5 cm additional length using this technique. The hardy, pedicled, vascularized nature of this flap also confers additional advantages in withstanding postoperative radiation therapy.

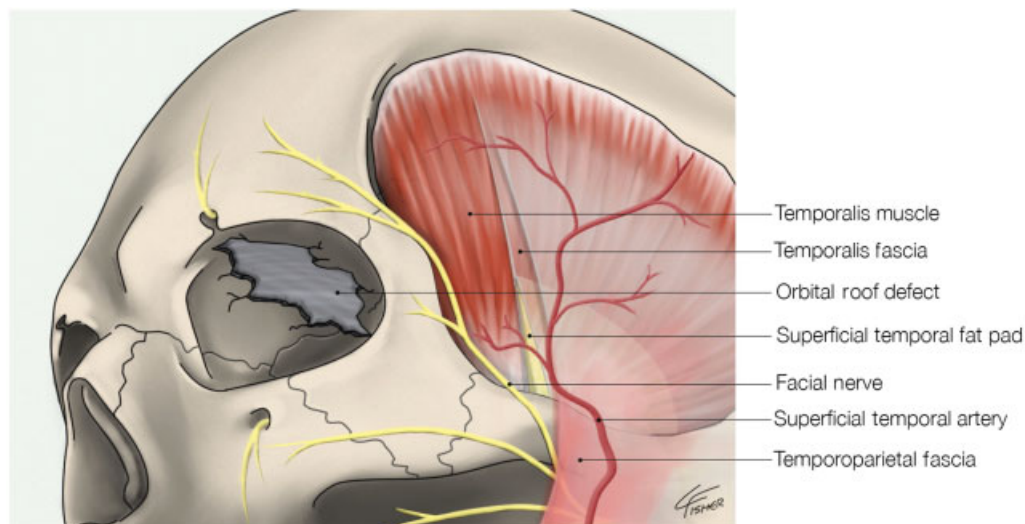


Fig. 1 Schematic showing an orbital roof (skull base) defect with exposed dura. The temporalis muscle is shown.

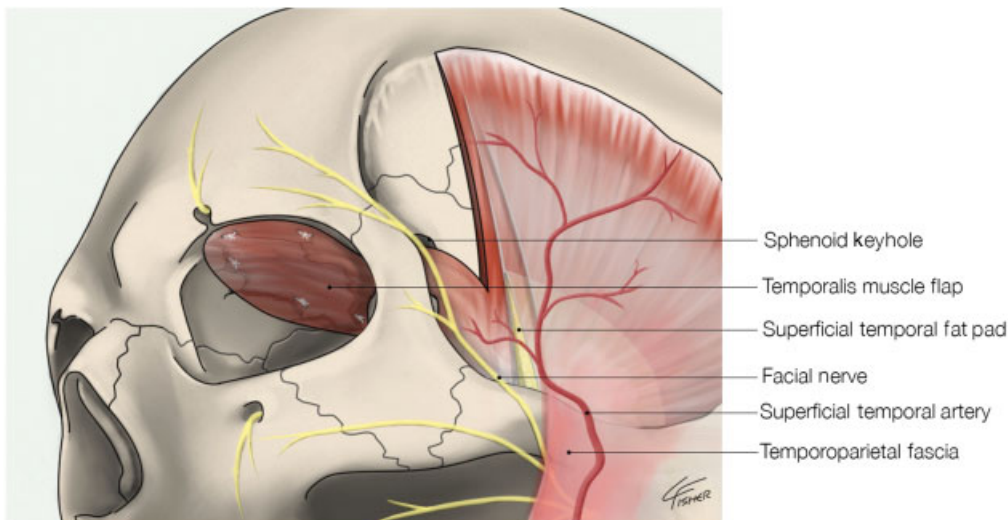


Fig. 2 Schematic showing the temporalis tunneled through a 2 cm keyhole in the greater wing of the sphenoid, and covering the skull base defect.

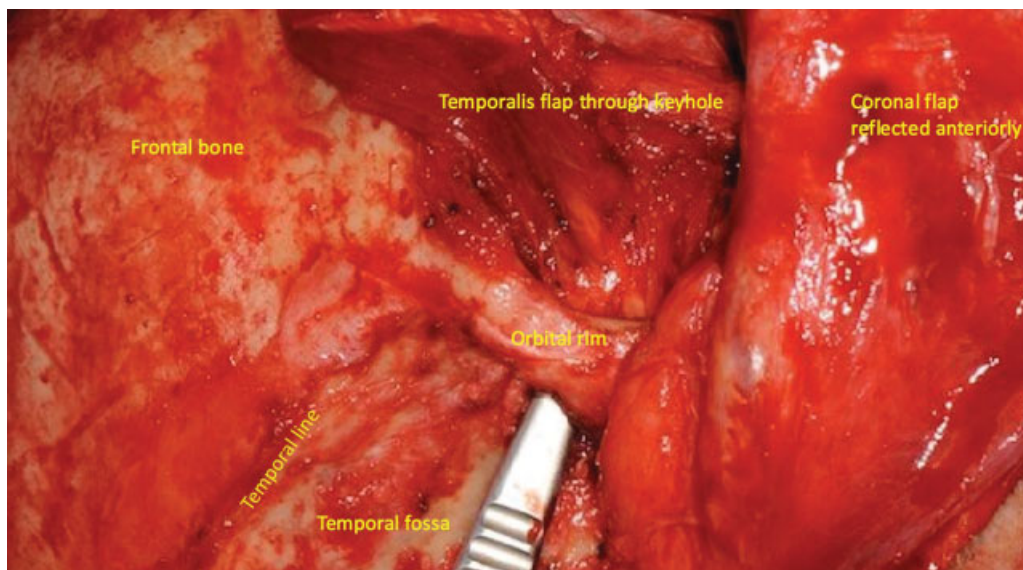


Fig. 3 Intraoperative picture showing coronal flap reflected anteriorly, and temporalis flap tunneled through the sphenoid keyhole to cover the skull base defect.

Donor site morbidity, asymmetry, and hollowing are common complications of temporalis muscle flap surgery. This site can be rehabilitated using multiple methods including bovine cartilage, silastic implants, titanium, polyethylene, polyetheretherketone, methyl methacrylate, and hydroxyapatite.⁹ Secondary lipotransfer can also be considered to achieve symmetry and soften the appearance of the donor site.

The main limitation of this procedure is the size of the defect. The medial extent of the skull base defect appears to be a limiting factor in the utilization of this flap. Bilateral pedicled temporalis flap has been used to reconstruct the palate and frontal sinus defects,^{10,11} but we are yet to utilize it for repairing total skull base defects. Middle cranial fossa defects have also been reconstructed with a temporalis muscle flap.¹²

Conclusion

The temporalis flap with the sphenoid keyhole technique is a safe maneuver in reconstructing orbital skull base defects. Its main advantages are decreasing the arc of rotation of the temporalis flap and facilitating a tension-free closure.

Conflict of Interest

None.

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