The temporalis muscle flap: A useful adjunct in reconstruction of combined defects of the upper and lower eyelids

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BACKGROUND: Eyelid reconstruction following oncological resection remains a challenge. Multiple techniques have been described for isolated upper or lower eyelid defects.

OBJECTIVE: To describe the use of the temporalis flap for reconstruction of an eyelid defect involving both the upper and lower eyelids.

METHODS: Excision of a basal cell carcinoma was performed. This resulted in full-thickness defects of the upper and lower eyelids, the lateral canthus including upper and lower canthal tendons, the upper right mid-face, temple, lateral two-thirds of the eyebrow and forehead. The tumour was found to be adherent to bone and dissecting deeply into the lateral orbital cavity as well as along the orbital roof.

RESULTS: The lateral orbital rim was reconstructed using the pre-bent titanium mesh implant. A temporalis muscle flap allowed for draping over the reconstructed orbital rim and to provide reconstruction of the tarsal plates of the upper and lower eyelids. The remaining large cutaneous defect, which involved more than half of the lower eyelid, was reconstructed using a large Mustarde cervical facial rotation flap.

CONCLUSIONS: The temporalis muscle flap provides abundant well vascularized tissue and has been described for head and neck reconstruction. A novel technique allows reconstruction of both the upper and lower eyelids using the temporalis muscle in combination with local flaps.

Key Words: Eyelid reconstruction; Temporalis flap

Reconstruction of complex eyelid defects presents a challenge. Composite defects that involve both the upper and the lower eyelid, or that extend deeply to involve the lateral canthus and the bony orbit, are particularly difficult to repair. Under these circumstances, the temporalis muscle flap provides vascularized tissue, which can be used in restoring structural support to the lid complex.

The temporalis region provides several regional flaps. The temporalis muscle is a type III (Mathes and Nahai classification) fan-shaped muscle with its origin in the temporal fossa. It receives its blood supply from the anterior and posterior deep temporal arteries, which are obtained to further assess muscle extent. It showed soft tissue abnormalities within the right lateral orbit involving the preseptal soft tissues extending posteriorly along the lateral margin of the lateral rectus by 1 cm. This extended in the superior muscle complex anteriorly. Heterogeneous T2 signal and enhancement was also present within the superior extraconal space extending above the superior muscle complex nearly reaching the medial orbit. Extent of involvement of the rectus muscle was difficult to assess; however, the proximal insertion of both muscles were presumed affected. The lateral orbital wall was not separately symmetrical from the soft tissue mass lesion. Intracanal contents and globe appeared unremarkable. No bone marrow or temporal fossa abnormality was identified.

In the present article, we present a case of recurrent basal cell carcinoma involving the upper and lower eyelids, underlying bone as well intraorbital tissues requiring a major resection and complex reconstruction involving the temporalis muscle flap.

CASE PRESENTATION

An 80-year-old man presented to clinic with a history of basal cell carcinoma. It was initially located on the right temple and was excised eight years previously. This tumour was aggressive and recurrent following two previous excisions and a full course of radiotherapy. The last surgical procedure involved an excision of temporal soft tissues down to temporalis muscle and skin graft.

On presentation, he had a painful, crusted, indurated lesion with a cutaneous component visible over the right lateral orbital wall (Figure 1). It affixed the upper eyelid to the superolateral orbital rim. The lesion extended into the anterior orbit but he had no symptoms suggestive of intracanal orbital invasion. Visual acuity, eye motility, pupillary reactivity, exophthalmometry and eye pressure were normal. The lateral orbital rim was skeletonized, the superficial temporal fat pad was deficient and the anterior one-half of the temporalis muscle had previously been partially resected and resurfaced with skin graft.

The right brow descent was due to both paralytic and cicatricial etiologies. There was grade 6/6 palsy of the right frontalis muscle and the brow could not be distracted upward with direct palpation. A computed tomography scan (Figure 2) revealed a skin lesion in the right frontal scalp, measuring 11 mm × 3 mm. There was thinning of the skin overlaying the right temporal scalp and lateral orbital region likely from previous surgery. Nonspecific thickening of the right frontotemporal scalp was also visualized. There was increased soft tissue density in the region of the right lacrimal bed, measuring approximately 23 mm × 7 mm. This abutted the superolateral margin of the right globe and extended slightly into the supraorbital soft tissues, preseptal tissue and possibly the lateral rectus muscle. No permeative or destructive changes to the adjacent bone were seen. A magnetic resonance image was, therefore, obtained to further assess muscle extent. It showed soft tissue abnormalities within the right lateral orbit involving the preseptal soft tissues extending posteriorly along the lateral margin of the lateral rectus by 1 cm. This extended in the superior muscle complex anteriorly. Heterogeneous T2 signal and enhancement was also present within the superior extraconal space extending above the superior muscle complex nearly reaching the medial orbit. Extent of involvement of the rectus muscle was difficult to assess; however, the proximal insertion of both muscles were presumed affected. The lateral orbital wall was not separately symmetrical from the soft tissue mass lesion. Intracanal contents and globe appeared unremarkable. No bone marrow or temporal fossa abnormality was identified.
muscle defect or globe involvement or destruction of bone demonstrate tumour extension into the anterior orbital tissues but no intraconal control and neither invasion of orbital fat nor orbital periosteum was isolated with silk ties and the deep tumour extension appeared to be

The tumour was found to be adherent to bone and dissecting deeply into the lateral orbital cavity, as well as along the orbital roof toward the medial orbital cavity. Access was required before this portion of the tumour could be visualized. Before performing the cranial orbital osteotomy, a titanium mesh template was fixed to the cranio-orbital segment that was to be osteotomized. This was fixed with multiple 1.2 mm screws. The fixation was performed to provide optimal adaptation of mesh to the normal shape of the skull and lateral orbit. All screws were removed and the shaped titanium mesh implant was set aside for subsequent placement.

A periosteal elevator was used to reflect the orbital periosteum away from the bony orbital wall. An oscillating saw was then used for extracranial osteotomy. The osteotomy was created through the superolateral orbital rim 1 cm above and 3 cm below the zygomaticofrontal suture line. This bony segment of lateral orbital rim infiltrated by tumour was completely removed. The more posterior lateral orbital wall was then further debulked using rongeurs to facilitate exposure of the superior orbital cavity.

The corneal protector was then removed so that pupil reactivity could be monitored throughout the case. Any sign of a mydriatic response would indicate excessive traction on the optic nerve. The superior rectus and superior oblique extraocular muscles were then isolated; however, the aponeurosis fused with the periosteum on the deep surface of the muscle and continues distally as periorbital. This provided abundant well-vascularized flap for draping over the reconstructed orbital rim and to provide reconstruction of the tarsal plates of the upper and lower eyelids. The temporalis muscle flap was transposed 90° into the orbital cavity and wrapped around the skeletal reconstruction of the orbital rim (Figure 5). It was then split and used to repair the tarsal plates of the upper and lower eyelids.

The remaining defect was a very large cutaneous defect that involved more than one-half of the lower eyelid. This was reconstructed using a large Mustarde cervical facial rotation flap (13-15). This flap extended in a previous scar from the previously skin-grafted area in the temple toward the preauricular crease and then well down into the neck just above the clavicle where a backcut was made. This entire flap was elevated in the plane above the superficial fascia of the face and above the platysma muscle. The flap was rotated into the defect of the lower eyelid and reconstructed in layers using 5-0 prolene to reconstruct the cutaneous incisions, 3-0 Polysorb to close the flap donor site along with 4-0 prolene and 5-0 gut along the lid margin. The flap remained well perfused throughout. A single small soft Hemovac drain was inserted and brought out through a stab incision and out to suction. A right supraorbital vessel was Dopplered out and found to have persistent pulse and vascular perfusion to the right forehead, even following dissection of the supraorbital tumour. The vascular pedicle appeared to have been preserved and a right forehead flap was mapped out. This forehead flap, based on the right supraorbital artery and vein, was elevated initially in a subfascial plane and a subgaleal plane (15,16). The flap was transposed 90° into the defect of the right lower forehead, eyebrow and upper lid and fixed in place with 4-0 vicryl and 5-0 nylon sutures. This flap remained well perfused. At its most posterior and inferior portion, it was repaired to the leading edge of the cervicofacial flap. The levator palpebrae superioris muscle was then isolated; however, the aponeurosis

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RESULTS

Reconstruction

First, the lateral orbital rim was reconstructed using the prebent titanium mesh implant. This was fixed to the stable skeletal margins with multiple 1.2 mm screws (Figure 4A), restoring the patient's skeletal morphology as precisely as possible. A Titan (composite titanium mesh and porous polyethylene sheet implant, Stryker Co, USA) implant was then used to reconstruct the defect in the lateral orbital wall to prevent any prolapse of orbital soft tissues into the temporal fossa. This was performed to maintain ocular projection. The anterior half of the temporalis muscle flap was then elevated on the anterior deep temporal artery. A distal fascial extension was elevated in continuity with the muscle (Figure 4B). This distal extension is comprised of the deep temporal fascia on the superficial surface of the muscle as it fuses with the periosteum on the deep surface of the muscle and continues distally as periorbit. This provided abundant well-vascularized flap for draping over the reconstructed orbital rim and to provide reconstruction of the tarsal plates of the upper and lower eyelids. The temporalis muscle flap was transposed 90° into the orbital cavity and wrapped around the skeletal reconstruction of the orbital rim (Figure 5). It was then split and used to repair the tarsal plates of the upper and lower eyelids.

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Figure 1) Clinical photographs demonstrating a crusted lesion fixating the right upper eyelid and brow to the superolateral orbital rim and a marked temporalis muscle defect

Figure 2) Coronal (A) and axial (B) computed tomography images demonstrate tumour extension into the anterior orbital tissues but no intraconal or globe involvement or destruction of bone

Resection

The patient underwent general and local anesthesia. The clinically evident tumour margins were marked and the surgical sites were infiltrated with 1% lidocaine with 1:100,000 epinephrine. With a corneal protector in place, the tumour was resected en bloc with frozen section control of margins. This resulted in full-thickness defects of the upper and lower eyelids, the lateral canthus including upper and lower canthal tendons, the upper right midface, temple, lateral two-thirds of the eyebrow and forehead. The craniofacial skeleton was then exposed.

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The corneal protector was then removed so that pupil reactivity could be monitored throughout the case. Any sign of a mydriatic response would indicate excessive traction on the optic nerve. The globe was distracted inferotemporally with gentle traction.

The superior rectus and superior oblique extraocular muscles were isolated with silk ties and the deep tumour extension appeared to be limited to the anterior orbit. This was resected with frozen section control and neither invasion of orbital fat nor orbital periosteum was detected. The resulting defect after complete orbitofacial tumor resection is shown in Figure 3.
had been sacrificed during tumor resection. The levator muscle was approximated to the upper eyelid margin (remnant tarsus medially and cervicofacial flap laterally) with 5-0 Vicryl horizontal mattresses. The suture tension was adjusted to leave these horizontal mattresses as 'hang-back' sutures that would allow for eyelid retraction but limit the risk of postoperative lagophthalmos. Although the forehead flap reconstructed the superior orbital soft tissue deficit, a split-thickness skin graft was used to reconstruct the remaining right upper eyelid cutaneous defect. The thin skin graft was sutured directly to the eyelid margin and levator muscle with interrupted 6-0 Plain gut suture. The superior palpebral and eyelid margin conjunctival surfaces were reconstructed to protect the cornea. This was accomplished with conjunctival advancement flaps from the upper fornix. Finally, a denuded surface was exposed and the frontal bone was found over the central portion of the forehead. This required resurfacing to prevent desiccation and necrosis of bone. The scalp flaps were widely undermined and elevated and a left pericranial flap was elevated. This was based inferiorly. The flap was transposed into the defect of the forehead and repaired all cutaneous margins of the defect with 5-0 pullout prolene sutures. The split temporalis muscle flap provided the structural integrity to the right lower eyelid. Similar to the upper eyelid defect, conjunctival advancement flaps were fashioned from inferior forniceal conjunctiva to reconstruct the mucosal deficit of the palpebral and lid margin conjunctiva. The Mustarde temporal rotation flap provided the anterior lamellar component to the reconstruction.

The final result is shown in Figure 6. Two week postoperative results are show in Figure 7.

**DISCUSSION**

The eyelid margin is comprised of an anterior lamella composed of skin and orbicularis oculi muscle, and a posterior lamella composed of tarsus and conjunctiva. The orbital septum extends from the arcus marginalis of the orbital rim and inserts directly onto the tarsus. Posterior to the upper orbital septum lies preaponeurotic fat pads, the retracting muscles (levator palpebrae superioris and Muller’s muscle) and conjunctiva. Reconstruction of full-thickness eyelid defects involving the eyelid margin requires consideration of all lamellar structures. Moreover, each of these structures requires separate approaches for proper function. The principles of when to use a graft, direct closure, lid-sharing procedures or distant flap have been described in many review articles and textbooks (17-24). These principles include restoring coverage, support and lining, maintaining mobility of the upper eyelid (opening and closing) and position and stability of the lower eyelid. Options for reconstruction are summarized as such: anterior lamella: skin flap, myocutaneous flap, full thickness skin graft; support: periosteal flap, fascial flap, fascial sling, cartilage graft; lining: mucosa, buccal, local conjunctival flap; composite lining/support: palate graft, septal mucoperichondrial graft, tarsoconjunctival flap. The reconstructive options depend on the requirements for reconstruction and each case should be treated as unique often requiring creative techniques and a multidisciplinary approach.

In particular, several articles describe reconstruction options for either upper or lower eyelids, while very few focus on defects that span both upper and lower eyelids (17,25). Previous articles have described techniques for reconstruction of both the upper and lower eyelids using split- and full-thickness grafts (26,27), a pedicle deltopectoral flap (28), a paramedian forehead flap (29), a free dorsalis pedis flap (30,31), a spindle-shaped ‘lateral orbital island flap’ designed between the lateral canthus and the sideburn (19) or a free anterolateral thigh (ALT) flap (32). Each of these grafts or flaps were used to reconstruct both components. Other flap methods combined separate techniques, such as a medusa flap, which was described in a facial burn patient (33). It involves a pedicled superficial temporal fascial flap including a skin island and a buccal mucosal graft for reconstruction of the eyebrow, upper and lower eyelids, and lacrimal system in a one-stage procedure. Another method that has been described is a Y-shaped hard palate mucoperiosteal graft and a V-Y advancement flap from the temporal side of the defect on its subcutaneous pedicle for curative ablation of a basosquamous cell carcinoma, resulting in a complex full-thickness defect of upper and lower eyelids, lateral canthal area and lateral canthal tendon (34).
The functional and cosmetic outcomes following oncological surgery depend on the quality of the reconstruction. Adjuvant radiotherapy becomes an important consideration when orbital fat is involved and/or extension beyond the periosteum. With frank orbital involvement, some cases require exenteration. The temporalis muscle is versatile and has multiple applications. It has been used for reconstruction of isolated upper eyelid defects (2-4) such as for the anterior lamella in combination with a mucocchondrial autologous graft taken from the alae (2) or in combination with skin grafting (4). It provides well-vascularized tissue for coverage of surface defects and orbital reconstruction after extended maxillectomy (5,10) for total defects following orbital exenteration (6,9,10,12) without resection of the lateral orbital rim (7) or in combination with a glabellar flap (11).

To our knowledge, the present article is one of few descriptions of the use of the temporalis muscle in such a manner, spanning both upper and lower eyelids, in combination with a cervicofacial and forehead flaps for reconstruction of combined defects of the upper and lower eyelids.

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