Temporoparietal Fascial Flap in Orbital Reconstruction

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Objective: To evaluate the success of the temporoparietal fascial flap (TPFF) in the primary or secondary reconstruction of difficult orbital defects and to review the surgical techniques.

Design: Retrospective analysis.

Setting: Tertiary medical center.

Patients: Nine patients with diverse orbital cavity or periorbital soft tissue and bony defects due to trauma, benign or malignant neoplasms, and radiation treatment.

Interventions: Temporoparietal fascial flap anatomy and techniques of harvest and inset are reviewed in detail. Four cases are presented to illustrate possible variables in orbital reconstruction. Variables examined include the location of defects, the success of flap survival in orbital cavities after primary or secondary reconstruction, the effects of prior irradiation on flap survival, and the possibility of concurrent osteointegrated implant placement with TPFF reconstruction.

Main Outcome Measures: Functional and aesthetic outcomes were determined by physical examination and preoperative and postoperative photographs.

Results: All patients had successful transfer of TPFF grafts without flap compromise. Temporoparietal fascial flap was a viable option for subtle orbital and malar contour defects. In chronically inflamed wounds such as with osteoradionecrosis and orbitoantral fistula, TPFF successfully restored vascularity, obliterated the defects, and enabled the placement of osteointegrated implants. The TPFF also supported the concurrent placement of a free calvarial bone graft. Finally, split-thickness skin grafted onto a pedicled TPFF showed 100% survival.

Conclusions: The TPFF is one of the most reliable and versatile regional flaps in the head and neck for orbital reconstruction. This study presents the use of TPFF in a variety of orbital defects, from lateral bony rim defects to total exenteration. Timing of repair in this study spans from immediate reconstruction to reconstruction delayed more than 50 years after the initial injury. In all cases, reconstruction with TPFF resulted in improved bony and soft tissue contours, and incurred minimal morbidity.

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 Orbital defects represent some of the most difficult challenges in head and neck reconstruction. The difficulty lies in the 3-dimensional complexity of the socket, in which one must try to restore form and function. When the globe is intact, the goal of reconstruction is to retain baseline visual acuity and fields while restoring orbital and facial symmetry. When the globe is exenterated, the degree of reconstructive difficulty depends on the vitality of tissues remaining. Guyuron1 classified contracted eye socket defects into 3 categories based on the degree of bone and soft tissue loss. The recommended methods of reconstruction span from mucosal and skin grafts to free microvascular myofascial or fasciocutaneous flaps. However, most frequently, reconstruction of orbital defects calls for measures somewhere in between. Even when confronted with an apparently uncomplicated defect, one might face compounding factors such as chronic infection or prior irradiation.

Many reconstructive options for orbital defects have been reported. Most consist of regional rotational flaps from the scalp, forehead, galea, and pericranium. The regional pedicled cutaneous flaps, while having reliable vascularity, are often too thick for an orbital cavity lining and leave an undesirable donor site defect. The thinner galeal and pericranial flaps are suitable for healthy bony cavities, but do not contain a reliable blood
supply. Finally, the use of the radial forearm and rectus abdominis free microvascular flaps is ideal in the setting of large orbital and maxillofacial defects that require obliteration with soft tissue (Table).

The temporoparietal fascia flap (TPFF) provides thin, pliable coverage for a variety of head and neck defects. Its merits include a dependable blood supply, anatomical consistency, tolerance for a large degree of rotation, minimal donor site morbidity, and a large area available for harvest. Brent et al reported using the TPFF as a free microvascular flap and aptly describe it as the “microvascular transfer of a recipient bed.” Because of its reliable blood supply, TPFF can be used to support simultaneous transfer of free or attached calvarial bone. It is also ideal for reconstruction after debridement of chronically infected sites or irradiated orbital cavities. Cowen and Antonyshyn introduced the use of the flap in reconstruction of the deep superior orbital sulcus. We describe the anatomy and technique of TPFF harvest, and present 4 case reports with differing reconstructive needs to demonstrate particular merits in using TPFF for orbital reconstruction.

### SURGICAL ANATOMY

Anatomy of the temporoparietal scalp has been well described. The temporoparietal fascia (TPF) is a 2-mm to 4-mm-thick layer of connective tissue that represents a continuum between the galea superiorly and the superficial musculoaponeurotic system (SMAS) inferiorly. In terms of skin layers from superficial to deep, TPFF is the second of 5 layers in the parietal scalp (Figure 1). These layers consist of skin, TPF, loose areolar tissue, temporoparietal fascia, and temporalis muscle. The TPF is densely adherent to the subcutaneous tissue of the scalp, particularly in the area of the superior temporal line where the transition to the galea occurs. Dissection in this region must be particularly meticulous to avoid dissecting into the substance of the TPF. The loose areolar tissue deep to the TPF allows the scalp its mobility. It is an avascular plane, and is therefore ideal for dissection. The temporalis muscular fascia is contiguous with the calvarial periosteum superior to the temporal line, an area that corresponds to the transition from TPFF to the galea. Inferiorly, the TPFF passes superficial to the zygomatic arch, while the temporalis muscular fascia passes deep to the arch to insert on the coronoid process of the mandible.

The TPFF is supplied by the superficial temporal artery (STA), a branch of the external carotid artery. The

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### Clinical Cases

<table>
<thead>
<tr>
<th>Patient No./Age, y</th>
<th>Orbital Defect Reconstruction</th>
<th>Complication</th>
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<tr>
<td>1/61</td>
<td>Basal cell carcinoma of the cheek and orbit requiring orbital exenteration</td>
<td>Reconstruction of the orbit with TPFF, skin graft, and local advancement flaps</td>
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<tr>
<td>2/35</td>
<td>Orbital floor intraosseous cavernous hemangioma</td>
<td>Reconstruction of the lateral and orbital floor with TPFF, calvarial bone</td>
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<tr>
<td>3/37</td>
<td>Malar and orbital contour defect and ectropion due to childhood automobile injury</td>
<td>Reconstruction with TPFF, removal of Silastic implant, and repair of ectropion</td>
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<tr>
<td>4/70</td>
<td>Basal cell carcinoma requiring orbital exenteration; recovery complicated by orbitoantral fistula</td>
<td>Obliteration of orbito-antral fistula with TPFF, Mustarde cheek advancement flaps, and osteointegrated implants</td>
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<tr>
<td>5/60</td>
<td>Contracted orbital cavity due to childhood retinoblastoma</td>
<td>Reconstruction of the eyelid with TPFF, Alloderm, oral mucosal graft, and skin graft</td>
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<tr>
<td>6/72</td>
<td>Basal cell carcinoma of the lateral canthus</td>
<td>Reconstruction with TPFF, skin graft</td>
</tr>
<tr>
<td>7/55</td>
<td>Osteoradionecrosis of the frontal bone and orbit</td>
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<tr>
<td>8/85</td>
<td>Basal cell carcinoma of the orbit and temporal region</td>
<td>Reconstruction with TPFF, skin graft</td>
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<tr>
<td>9/28</td>
<td>Complex frontal sinus and orbital fracture with delayed bony defect</td>
<td>Reconstruction of the orbital rim and frontal sinus with TPFF and calvarial bone</td>
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</table>

*TPFF denotes temporoparietal fascial flap.*

![Figure 1. Anatomy of the temporoparietal scalp. The temporoparietal fascial flap represents the middle of 5 layers; it is contiguous with the galea superiorly and the superficial musculoaponeurotic system inferiorly. Its main vascular supply comes from the superficial temporal artery and vein.](image-url)
STA emerges from the parotid tissue in the region of the tragus. It then traverses a tortuous course in the preauricular area on or within the layer of the TPF, lateral to the zygomatic arch. In the pretragal region, the STA diameter is approximately 2 mm, and is usually easily detected by palpation or by Doppler signal. The vein may be duplicate and usually runs superficial to the artery. The vessels branch throughout the TPF in an axial pattern and freely anastomose with the occipital, supraorbital, and supratrochlear systems. Terminal branches enter the subdermal plexus of the scalp superiorly to the temporal line. The total length of the vascular pedicle from the tragus to the superior temporal line is in the range of 4 to 6 cm. Brent et al reported extending the TPFF by incorporating a posterior arterial branch of the temporal vessel system, thus extending the available area for harvest to 17 × 14 cm. Branches of the auriculotemporal nerve provide sensation to the fascial flap. The relationship of the nerve and STA are consistent and studied in detail. The TPFF has the potential of being a sensate pedicled flap.

A further advantage of the TPF is the availability of the temporalis muscle for a second pedicled flap. The temporalis muscle is supplied by the middle temporal artery as it arises from the STA at the level of the zygomatic arch. This branching pattern enables the harvest of a 2-layered muscular and fascial flap on a single vascular pedicle.

The use of TPF to reconstruct the orbit necessitates undermining of the intervening forehead skin and tunneling of the TPFF to the orbital defect. The frontal branch of the facial nerve exits from the parotid-masseteric fascia at the level of the zygomatic arch, approximately 2 cm laterally to the lateral canthus. It then becomes superficial to innervate the frontalis muscle. Awareness of facial nerve anatomy is crucial in forehead elevation as the nerve can be easily injured.

SURGICAL TECHNIQUE

Identification of the superficial temporal vessels in the pretragal region is facilitated with Doppler ultrasound. The course of vessels is mapped and marked prior to incision. The face and scalp are prepared with povidone-iodine solution (Betadine). We do not routinely shave the head for TPFF harvest. Dissection is begun in the hair-bearing scalp in the preauricular region for better camouflage of the incision. A previous parotidectomy does not preclude use of the TPFF unless the superficial temporal vessels have been injured. A Y-shaped incision is made in the temporal region extending to the superior temporal line, at the junction of the TPFF and the galea. The TPF is sharply dissected from the adherent subcutaneous layer with scissors. The appropriate plane of dissection is in the layer of the subdermal vascular plexus deep to the hair follicles. Often the STA and superficial temporal vessels can be seen to be coursing in the thin TPF. Bipolar electrocautery is used to coagulate the abundant vessels in the subdermal plexus. Dissection is limited anteriorly by the temporal hairline to avoid injuring the frontal branch of the facial nerve. Superior to the temporal line, the TPF is sharply released from the insertion on the galea. The TPF is carefully separated from the underlying temporalis muscular fascia with sharp dissection. The TPF can be easily separated from the underlying temporalis muscular fascia with minimal, even blunt dissection, because of the interposing layer of loose areolar tissue. The TPFF is ready for rotation about its axial pedicle. At this point, the forehead skin is elevated in a subperiosteal plane, and the TPFF can be tunneled in this plane to reach the orbit. The flap provides an excellent recipient bed for skin graft. A drain is placed and the wound is closed in a single layer with nylon suture.

We had 9 clinical cases for review (Table) and herein report on 4 of them.

CASE 1: SOFT TISSUE DEFECT AFTER ORBITAL EXENTERATION

A 61-year-old woman presented in October 1993 with a large basal cell carcinoma of the right malar region with extension into the right orbit. In December 1993 she underwent Mohs surgery of the right cheek and orbital exenteration. The right frontozygomatic branch of the facial nerve was infiltrated with tumor and required removal. Immediately after the extirpative procedure, the patient underwent reconstruction with a right temporoparietal fascial flap, split-thickness skin graft, and local cheek advancement flaps. The temporoparietal fascial flap was tunneled under a skin flap extending from the hair-bearing temporal scalp to the area of defect. A bolster dressing was placed over the skin graft and was removed after 12 days. At her 7-month follow-up, the patient had no tumor recurrence, with complete take of the skin graft. Thereafter the patient was lost to follow-up.

CASE 2: SIMULTANEOUS USE OF TPFF AND CALVARIAL BONE

A 35-year-old man presented in June 1995 with a slowly enlarging intraosseous cavernous hemangioma of the right orbital floor, zygoma, and frontozygomatic suture line. The patient had noted a mass in the lateral orbit for several years prior to his presentation. It was a slowly enlarging lesion without pain or tenderness. The lesion was large enough to displace the globe medially and inferiorly and cause an obvious cosmetic deformity. In July 1995, the patient underwent percutaneous intra-vascular embolization of the hemangioma. He then underwent composite resection of the frontozygomatico-maxillary complex to remove the hemangioma. Reconstruction was performed with calvarial bone free graft and temporoparietal fascial flap. Follow-up computed tomographic scan 7 months later revealed symmetry of the lateral orbit and zygoma and intact calvarial bone graft. The donor site had healed with no hair loss.

CASE 4: PLACEMENT OF OSSEOINTEGRATED IMPLANT THROUGH TPFF

A 70-year-old woman presented in 1987 with a morpheaform basal cell carcinoma of the left lateral canthus. She
underwent Mohs surgery for surgical removal of the lesion. In 1989, she underwent reexcision and radiation treatment (45 Gy total) for a local recurrence. In February 1994, a recurrence was detected in the left cheek, adjacent to the scar of the previous excisions. Intraoperative frozen section histology revealed extension of the carcinoma into the soft tissues of the left orbit. She was treated with wide excision, including excision of the frontal branch of the facial nerve, and enucleation. The procedure resulted in a persistent antral-orbital fistula that did not heal with dressing changes. Findings from a biopsy of the fistula did not reveal persistent carcinoma. In October 1994, she underwent further reconstruction with Mustarde cheek advancement flaps. The TPFF was harvested and tunneled under a skin flap laterally. One year later, she underwent placement of an osteointegrated implant and orbital prosthesis (Figure 4). Follow-up at 2 years revealed a healed orbital cavity, no recurrence of tumor, and firm placement of the osteointegrated implants.

CASE 5: EYELID RECONSTRUCTION IN A CONTRACTED SOCKET

A 60-year-old woman presented in May 1998 with a history of right orbital enucleation due to retinoblastoma at age 3 years. She did not receive any radiation treatment to the right orbit. Her initial glass implant extruded after 1 year. A Stone-Jarrod implant was replaced, and this new implant slowly extruded over the next 30 years. From 1990 to 1998, she underwent 17 separate reconstructive procedures of the right orbit, with the goal of enabling her to wear an orbital prosthesis. These procedures included various local rotational flaps, free dermal fat grafts, and free buccal and vaginal mucosal flaps. The reconstructive procedures invariably ended in scar formation and eyelid retraction. In April 1999 she underwent revision eyelid reconstruction with a free buccal mucosal graft (Alloderm; Life Cell Corp, Branchburg, NJ), TPFF, and split-thickness skin graft, to build an eyelid from inside out. These layers were closed se-
rially over an orbital conformer to prevent contracture. We planned to leave the orbital prosthesis for 3 months. Our use of Alloderm gives the reconstructed eyelid some structural integrity similar to the function of the native tarsus. At her 2-month follow-up, the donor site was healed without complications. The reconstructed eyelid showed complete acceptance of the skin graft. The orbital prosthesis remained in place without extrusion. Over the next year, the neo-eyelid was divided and a permanent prosthesis was placed.

**COMMENT**

The TPFF fills a void in the repertoire of regional flaps for reconstruction of the orbit. Its thin and pliable quality, reliable vascular supply, and minimal donor site morbidity are unparalleled when compared with other regional flaps such as forehead or scalp flaps. Patients undergoing orbital reconstruction after removal of malignancies often receive adjuvant irradiation or chemotherapy. Such treatments further compromise the viability of the native tissues and increase the failure rate of skin grafts and local flaps. Brent et al. described “transfer [of] the temporoparietal fascia in instances where a skin graft is preferable to a bulky flap but a suitable recipient bed is lacking,” thus coining the phrase “microvascular transfer of a recipient bed” for free TPFF transfers. The TPFF is an excellent flap for coverage of exposed bone, cartilage, or tendon. Others have described the flap in intraoral reconstruction, as a turn-down flap for coverage of the carotid artery system, and in secondary midface and orbital reconstruction after maxillectomy.13-15

The ideal use of TPFF lies in the reconstruction of small head and neck defects requiring minimal bulk. When the full extent of TPFF is harvested, the length of the flap easily extends to the medial canthus and can be secured to the lacrimal crest. Because of its thinness, the TPFF can be used to replace portions of the eyelid (case 5). It can be fashioned easily to conform to any contour and to provide autogenous tissue for the reconstruction of traumatic contour defects (case 3). The predictable vascular supply of the TPFF allows for placement of osteointegrated implants through the flap (case 4) and provides enough vascularity to surrounding tissues to support concomitant transfer of free calvarial bone grafts (case 2). The abundant vascularity of the TPFF has been reported to enhance the recovery of nerve fiber diameter and myelin sheath thickness in facial nerve cable graft repairs.17

The most commonly reported donor site complication is transient or permanent alopecia. Recently reported endoscopic-assisted techniques of harvesting may lower the risks of blood loss and alopecia further.18 Care-
ful anatomical dissection and judicious use of bipolar electrocautery helps minimize this complication. We routinely employ suction drainage of the donor site to prevent hematoma formation. In the 9 cases reported (Table), no donor site morbidity was encountered.

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REFERENCES