Nylon Foil “Wraparound” Repair of Combined Orbital Floor and Medial Wall Fractures

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Purpose: To evaluate a technique of implanting a single 0.4-mm–thick nylon foil (Supramid) continuously across combined medial wall and floor fractures within weeks of orbital trauma.

Methods: This retrospective, interventional case series includes patients with combined medial wall and floor fractures with or without external orbital and facial fractures, without prior surgery, and who were in the early posttrauma phase. One hundred two orbits in 98 consecutive patients were treated with a “wraparound” technique. The surgical technique is provided in detail. Comatose patients, those with cranial nerve palsies, severe globe injury, anophthalmia, or previous repair of the same fractures were excluded. Patients underwent surgery from 5 to 21 days after trauma. Postoperatively (average, 6.2 months), patients were evaluated for enophthalmos, extraocular motility, and diplopia.

Results: In 101 of 102 orbits, normal globe position, and full extraocular motility without diplopia was accomplished. One orbit had persistent enophthalmos, requiring a second procedure. This same patient had ipsilateral restriction in extreme upgaze, but no diplopia symptoms. This orbit had complete loss of inferomedial strut support. Overall, strut loss was not a risk factor for subsequent enophthalmos. No other patient had globe malposition, restrictive myopathy, or diplopia. Implant migration, hemorrhage, fistula, or infection was not observed. The transconjunctival and canthal wounds were hidden and tolerated by all patients with no eyelid cicatrization, webbing, or malposition.

Conclusions: The “wraparound” technique for 0.4-mm nylon foil implantation continuously across orbital floor and medial wall fractures was associated with almost no enophthalmos and diplopia in this series.

Fractures of the orbital floor and medial wall frequently occur concomitantly. This combination of fractures may be associated with other facial fractures, including naso-orbital-ethmoidal fractures, zygomatico-maxillary-complex fractures, and Le Fort II and III fractures. The inferonasal support buttress to the orbit may be disrupted, creating a challenging reconstructive problem for the orbit surgeon. Critical anatomy, namely the medial canthal tendon, lacrimal sac, and inferior oblique muscle origin, block external access to these fractures from a single approach.

The timing of surgical repair and choice of implant material have not been standardized. The outcomes of enophthalmos and persistent diplopia following repair of these large and complex fractures are common.¹⁻⁵ We report a method of treating large, combined orbital floor and medial wall fractures using a single 0.4-mm–thick nylon foil implant (Supramid) wrapped around the floor and medial wall of the orbit as a continuous plate.

METHODS

One hundred two consecutive orbits in 98 patients with combined orbital medial wall/floor fractures, with or without concomitant extraorbital facial or inferomedial orbital strut disruption, were treated with 0.4-mm–thick nylon foil (Supramid) in a “wraparound” technique. The senior author (W.R.N.), alone or with one of the other authors, treated each patient. Comatose patients, those presenting more than 21 days after trauma, those with cranial nerve palsies, severe globe injury, anophthalmia, or previous orbital repair of the same fractures by another surgeon were excluded from the study.

The timing of surgery was between 5 and 21 days after injury, with the majority of patients (81.6%) being repaired between days 5 and 10. No rigid or porous implants were used within the orbit, and the implants were not secured with tabbing, sutures, rigid rim fixation devices, or adhesives. The implant was simply placed over all edges of the fractures under direct observation. Care was taken to see that the implant was well seated behind the orbital rims, lacrimal structures, inferior oblique muscle origin, and all edges (superior, posterior, ante-
rior, and lateral) of the fractures. Follow-up ranged from 6 weeks to 4 years (average, 6.2 months).

**Surgical Technique.** With the patient under general anesthesia, the face was prepped and draped, bilateral corneal protectors were placed, and approximately 3 ml 1% lidocaine with 1:100,000 epinephrine combined with 0.5% bupivacaine was injected in the lateral canthus, medial canthus, and inferior fornix. A lateral canthotomy was performed with a #15 blade and straight iris scissors. The inferior ramus of the lateral canthal tendon was severed. The lower palpebral conjunctiva and lower eyelid retractors were incised at the inferior one-quarter, upper three-quarter line between the fornix and inferior aspect of the tarsus. With the eyelid distracted inferiorly, dissection was continued down to the inferior orbital rim in the preseptal plane, avoiding both the orbicularis muscle anteriorly and orbital fat posteriorly.

The inferior rim periosteum was incised with a #15 blade and separated from bone using a periosteal elevator. The orbital floor fracture was exposed, orbital soft tissues were elevated from the defect, and dissection was continued until the entire floor fracture perimeter was visualized both laterally and posteriorly.

The medial wall was exposed through a 1-cm vertical incision fashioned just anterior to the medial canthal tendon. (The transcutaneous route was favored over transcaruncular for the greater ease of developing a continuous subperiosteal plane and wider exposure to the medial wall in the authors’ hands.) Sharp dissection was carried to the periosteum, which was incised and elevated, thereby elevating the medial canthal tendon and the lacrimal sac. Care was taken to preserve the nasolacrimal outflow system.

Dissection was continued posteriorly to expose the perimeter of the medial wall fracture. Orbital soft tissues were extracted from the fracture site. The subperiosteal plane dissection was directed inferotemporally until continuous with the previous orbital floor approach.

After gently elevating all herniated orbital tissue from the fracture sites, and replacing it in the normal anatomic position within the orbit, a 0.4-mm–thick nylon foil (Supramid) implant was cut in an ovoid pattern that adequately spanned all fractures as a single unit. The average size of the implant was 4 cm × 2 cm. The implant was introduced to the orbit from the inferior transconjunctival approach and advanced superomedially in the subperiosteal plane using a temporary suture as a “lariat” and pulling through with a curved hemostat (Figs. 1–3). The implant was positioned to be seated covering: 1) the upper aspect of the medial wall fracture to prevent displacement in the ethmoid sinus; 2) the posterior ledge of both fractures; and 3) the lateral aspect of the floor defect (Figs. 2–3).
The orbital soft tissue was verified free from impingement by the implant edges.

The medial canthus was closed with 5-0 polyglactin suture that engaged medial periorbita and the medial canthal tendon, and skin, to prevent webbing of skin. The skin was closed with 6-0 mild chromic sutures. The inferior palpebral conjunctiva and retractor muscle layer were closed using interrupted 6-0 mild chromic sutures and the lateral canthus was reapproximated by attaching the free lateral tarsus to the lateral orbital tubercle with a 4-0 polyglactin suture. No sealants, fixation devices to the implant, or drains were used. Multilayered closure in the fornix was avoided.

In addition to routine postoperative instructions and wound care, patients were instructed to refrain from nose blowing for a minimum of 6 weeks after surgery. Eye muscle “range-of-motion” exercises (consisting of moving eyes in all fields of extreme gaze 5–10 times per day) were routinely recommended in attempt to maintain maximal extraocular muscle function.

RESULTS

Preoperatively, 79 orbits (77.5%) were noted on review of examination records to have limited extraocular ductions, with 64 patients (65.3%) reporting diplopia as a presenting symptom. Fourteen orbits also had complete inferomedial orbital strut disruption. Forty-three orbits had concomitant, same-sided external orbital and facial fractures in the following distribution: 9 naso-orbito-ethmoid; 21 zygomatico-maxillary complex; 3 frontal sinus/superior orbital rim; 7 Leforte II; and 3 Leforte III. Edema and tenderness precluded Hertel testing preoperatively in many patients.

Postoperatively, in 101 of 102 orbits, repair was successful with return to normal Hertel metrics, full extraocular motility, and without diplopia. Postoperatively, 1 orbit had persistent enophthalmos of 3 mm.

The lone enophthalmic patient also had a concomitant naso-orbital-ethmoidal fracture and complete maxillo-ethmoidal

FIG. 4. Schematic on left represents a suboptimal repair of a 2-wall orbit fracture using a single inferior implant with resultant poor orbit contour and implant herniation in the ethmoid sinus. On the right, the same orbit with a “wraparound” implant. Note complete coverage of all fractures and precise re-establishment of normal orbital walls and curvature (image courtesy of J. Tao, MD, and the Office of Visual Media, Indiana University School of Medicine).

FIG. 5. Preoperative coronal CT of a combined orbital floor/medial wall fracture with maxilloethmoidal strut displacement (arrow).
The outcome of restoring the traumatized orbit to a condition of normal globe position and full ocular motility without diplopia, in our series, was consistent and reliable, when early surgery was performed and no prior surgery had been performed by another surgeon. Rigid fixation devices were not used and no complications were seen during the follow-up period.

Avoidance of persistent diplopia and enophthalmos following repair of combined medial orbital wall and orbital floor combination fractures has previously proved to be problematic. Biesman et al.\textsuperscript{1} reported an incidence of postoperative diplopia in 13 of 17 patients (76\%) with these combination medial wall/floor fractures. They postulated that diplopia was related to the greater orbital soft tissue trauma that occurs with these medial wall/floor fractures when compared with floor fracture alone.

Hosal and Beatty\textsuperscript{2} reported that 4 of 21 patients (19\%) had postoperative diplopia, and 3 of 21 patients (14\%) had enophthalmos following repair of medial wall/floor combination fractures. Both the Biesman and Hosal series comprised cases that were repaired early (less than 2 weeks), and those that were repaired late (after 2 weeks). Also, a variety of implant materials were used (porous polyethylene, Supramid, gelfilm gelatin). Other authors have reported postoperative diplopia rates as high as 20\% to 50\% after repair of less extensive floor fractures.\textsuperscript{6–8} Hawes and Dortzbach\textsuperscript{9} believed that the postoperative incidence of diplopia following floor fracture repair was influenced by the timing of the repair. They reported 38\% diplopia when repaired late, and 7\% diplopia when repaired within the first 2 weeks.

Su and Harris\textsuperscript{10} reported on 19 patients who underwent combined medial orbital wall and floor fracture repair. These authors used a technique somewhat similar to the technique we describe and operated an average of 9 days following trauma. All but one of their patients was treated with nylon foil (Supramid).

Their technique differed from ours in that they used a transcaruncular approach to the medial wall, and placed separate implants on the medial wall and floor. Seven of their 19 cases required the placement of a third implant overlapping the medial wall and floor implants, to prevent a “box-shaped” orbit that would otherwise occur in large medial wall/floor combination fractures. Other differences include their use of tissue glue to fixate their implants, the placement of postoperative drains, and the use of prepunched holes in the nylon (Supramid) implants to encourage cicatrization (fibrovascular ingrowth) through the implant to prohibit migration. None of their 19 patients had postoperative enophthalmos, and no patient developed new or worsened diplopia. We are not told, however, how many of their patients had diplopia preoperatively and how many had residual diplopia.
postoperatively. Their excellent results in repairing and avoiding enophthalmos coincide with our own.

We attribute our success in repairing and avoiding postoperative enophthalmos and diplopia, in combined medial wall and floor fractures, to several factors. First, we excluded patients who have been previously operated on by others, and those who are in the late postinjury period. Both of these categories of patients are known to have a higher likelihood of cicatrization and irreparable diplopia. Second, we used only nonporous implants, and we did not fixate or encourage fibrovascular ingrowth through the implants, because this may also cause cicatrization in extraocular muscles adjacent to the implant. Third, we did not use implants (Supramid) greater than 0.4-mm–thick because this thickness is both flexible enough to lie against the orbital walls and conform to them, and rigid enough to provide support to prevent enophthalmos. We do not believe that this thickness will be prone to late complications of bleeding in the capsule, such as Custer et al.\textsuperscript{11} reported in 5 cases following the use of rigid 0.8-mm nylon implants (Supramid). The rigidity and bulk of 0.8-mm foil may be more abrasive to surrounding tissue, especially at the implant edges where the thickness may produce a greater “step-off” than the flatter and more pliable 0.4-mm foil.

Although the data from Su and Harris\textsuperscript{10} corroborate our data on avoidance of enophthalmos postoperatively, we prefer the external medial canthal incision approach (as opposed to the transcaruncular approach) to medial wall repair, because we believe the external incision gives superior exposure to the entire medial orbital wall. Because we do not use a Lynch incision (larger “hockey-stick” incision in the upper eyelid and lateral nasal wall), we do not see objectionable scarring or webbing in the canthus. We also prefer not to use any form of fixative to the implants because we have not observed implant migration or extrusion in this series, and because we believe that fibrovascular ingrowth (scar tissue) should be avoided in orbit fracture repair, as it may lead to cicatrization of the extraocular muscles in some cases.

The “wraparound” technique of repair of combined medial wall and orbital floor fracture repair proved efficacious in preventing or repairing enophthalmos and diplopia. Our data apply to all our patients who were operated primarily, within days to weeks of injury, and when a 0.4-mm nonporous nylon implant (Supramid) was used. The data were equally good for combined medial wall/floor fracture repairs, even when other rim and/or facial fractures were present. We recommend the use of the “wraparound” technique for 0.4-mm nylon foil implantation continuously across orbital floor and medial wall fractures, and within the first 2-week postinjury window, to prevent or repair enophthalmos and diplopia.

REFERENCES