Lateral Retrocanthral Orbitotomy

A Minimally Invasive, Canthus-Sparing Approach

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Objective: To develop and evaluate a minimally invasive technique of lateral orbitotomy that provides improved orbital access with fewer complications.

Methods: A cadaver study was undertaken to develop a technique of transconjunctival lateral orbitotomy that preserves the structural integrity of the eyelid support system and provides extended access to the orbit from floor to roof. We then evaluated the procedure in an outcome study of 30 consecutive patients.

Results: The cadaver investigations demonstrated that a transconjunctival lateral retrocanthal approach is technically possible and provides improved direct access to the lateral orbit. In the study of 30 consecutive procedures, there were no complications resulting from the surgical access. The wound healing was rapid, without tissue distortion or scars. The exposure was ample for all surgical interventions.

Conclusions: Lateral retrocanthral orbitotomy is a new approach that provides extended access to the entire lateral orbit. The technique is rapid and can be extended in a single continuous incision to the medial orbit. The structural integrity of the lateral retinaculum is preserved, which appears to improve the postoperative cosmetic and functional result.

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Numerous indications exist for surgical access to the lateral orbital wall. These include the repair of zygomaticomaxillary complex or isolated orbit fractures, orbital decompression for thyroid orbitopathy, resection of tumors involving the orbit (Figure 1) or periorbital region, orbital reconstruction after resection of tumors, and removal of foreign bodies. The most common approaches to the lateral orbit in use today are the lateral brow, lateral blepharoplasty, and lateral canthotomy incisions. A disadvantage common to these techniques is that they create visible scars (Figure 2A). Furthermore, access provided by the lateral brow and blepharoplasty approaches to the orbit is limited. While lateral brow and blepharoplasty incisions allow adequate access to the frontozygomatic suture for fracture repair, they provide poor visualization of the medial aspect of the lateral orbit wall, especially in the region of the greater wing of the sphenoid. This area is important to visualize when restoring the zygoma to its pre-morbid position.3,4 Furthermore, because both of these approaches are superior to the lateral canthal tendon, the possibility of extending the approach inferiorly to visualize the lateral orbital floor and provide access for placement of miniplates or bone grafts is limited. In addition, these transcutaneous incisions cannot be joined in a continuous incision to the medial orbit, and thus will not provide additional exposure for placement of the rigid or semirigid materials used in fracture repair of this region.

While the access provided by lateral canthotomy and inferior cantholysis can be excellent, there are drawbacks to this incision as well. Potential complications include delayed wound healing, prolonged pain in the area, and separation of the wound (Figure 2B). Postoperative rounding of the lateral canthal angle (Figure 3), canthal dystopia with inferior or lateral (Figure 4) dislocation, and overriding of the upper eyelid relative to the lower eyelid (Figure 5) are also observed. Lateral ectropion may also occur (Figure 6).

The best option to prevent these complications seems to be to avoid incisions...
in the lateral canthus and enter the orbit from behind, rather than through, the tendon. We, therefore, developed a canthus-sparing “lateral retrocanthal” (LRC) approach to the orbit in which the lateral canthus is retracted laterally. The approach is transconjunctival and thus leaves no visible scar (Figure 7A and B and Figure 8A and B). Because it is posterior to the lateral canthal tendon, the approach can be extended from the orbital floor all the way to the orbital roof. This allows full visualization of the medial aspect of the lateral orbital wall as far posterior as the orbital apex, including the critical area of the zygomaticosphenoid suture that is typically involved in orbital wall fractures. The incision allows ample exposure for repairing fractures at the frontozygomatic suture (Figure 8C). It also provides an excellent portal for orbital endoscopy of the lateral wall and floor for multiple indications ranging from biopsy to fracture repair (Figure 7C and D). Furthermore, this approach can be joined inferiorly with a transconjunctival approach to the orbital floor, providing an extended preseptal approach for visualization and repair of the orbital floor and lateral wall. By using this combined approach, implants can be placed to repair the floor and wall without the need for lateral canthotomy.

**METHODS**

**CADAVER STUDY**

Five cadaver heads (10 orbits) were studied to define the possible exposure that could be attained, locate the appropriate dissection planes, and determine the anatomic landmarks of the approach (Figure 9 and Figure 10). On the basis of the dissections, the following surgical technique was adopted.

The lateral aspect of the upper and lower eyelids is retracted laterally (Figure 11A and Figure 12), and the lateral canthal tendon is palpated at its attachment to the medial aspect of the lateral orbital wall (Whitnall tubercle). An incision through the conjunctiva is made immediately posterior to this point and continued laterally through the periorbita to the orbital wall (Figure 13). The incision is continued superiorly and anteriorly, paralleling the orbital rim. The lacrimal gland, similar in appearance to parotid tissue, is displaced medially with a ribbon retractor. Inferiorly, the incision is extended to enter the same plane that is used in the preseptal transconjunctival approach to the orbital floor (Figure 11B). After completion of the surgical goal, attention is turned to closure of the incision. If the lateral canthal tendon was intentionally transected, it is sutured to the residual stump with 5-0 permanent sutures. If the LRC approach was extended to or beyond a transconjunctival approach, several inverted 5-0 fast-absorbing gut sutures are placed to loosely approximate the conjunctival edges, and the lower eyelid is extended superiorly to ensure that it is not tethered. If the LRC approach was used as the exclusive orbitotomy, we do not generally close the incision.

**CLINICAL OUTCOME STUDY**

The initial 30 consecutive procedures in which we used the LRC approach were studied retrospectively. The operations were performed during a 24-month period between 2004 and 2006. No patients were excluded from analysis. The indications for surgery were extensive fractures involving the lateral orbital wall (either as isolated orbital fractures or as a component of zygomaticomaxillary complex fractures), tumors requiring lateral orbitotomy for diagnosis or resection, and orbital wall defects requiring reconstruction after tumor excision. All patients had a minimum of 1 postoperative visit, and compliant patients were observed for up to 8 months. Patients underwent routine pre-

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**Figure 1.** Computed tomographic scan showing dermoid tumor of right orbital roof with intracranial extension.

**Figure 2.** Suboptimal outcome 3 months after surgery in a patient treated by a conventional approach for an orbitozygomatic fracture. A, Lateral brow and lateral canthal scarring. The patient presented because of pain and irritation in the area. B, Manual separation of the eyelids and lateral distraction shows that the canthotomy incision failed to heal fully, leaving a persistent gap between the eyelids.
operative and postoperative examination with special attention to position of the eyelids and lateral canthus. Any complaints related to the surgery were noted.

RESULTS

The cadaver dissection study demonstrated the anatomic feasibility of the LRC approach, as well as the wide exposure that it provides to the medial aspect of the lateral orbital wall. We found that it is possible to approach the lateral orbit from behind the lateral retinaculum without damaging either the lateral canthus or the lateral horn of the levator aponeurosis. By maintaining the dissection in the plane between the orbital wall and periosteum, the lacrimal gland can be displaced medially away from the wall without damaging the gland or compromising its blood supply. This dissection plane could be continued over the entire inner aspect of the orbital wall from the roof to the floor without herniation of orbital fat.

On the basis of the favorable outcomes in the 10 cadaver dissections, the procedure was then studied in 30 consecutive patients who underwent LRC. Six (20%) of the patients had LRC as the exclusive orbitotomy; 7 (23%) underwent extension of the LRC into a preseptal, transconjunctival approach to the orbital floor; and 17 (57%) underwent LRC with extension to transconjunctival and precaruncular3 orbitotomies for surgical access.

The indications for surgery were tumor resection (n=3), orbital fracture repair (n=24), diagnostic orbital exploration with biopsies (n=1), reconstruction of an ablative defect (n=1), and reconstruction of an orbital defect after previous tumor resection (n=1).

Each of the 3 patients who underwent tumor resection through this approach received concomitant reconstruction of the bone defect. This was achieved by fitting the orbital reconstruction prosthesis to the orbital contours before undertaking the orbital osteotomies (a technique we refer to as preconstruction), allowing us to recreate the orbital volume and shape much more effectively than if we attempted this after tumor resection. The implant is then removed for the tumor resection and replaced at the end of the procedure.

Transorbital endoscopy was performed through the LRC approach for patients undergoing transorbital tumor resection to ascertain the extent and degree of tumor invasion before performing osteotomies. Similarly, in selected cases, we performed transorbital endoscopy through an isolated LRC approach after repositioning a zygomaticomaxillary fracture to determine whether open repair of the orbital floor was necessary.

In the 25 orbital trauma cases, we readily obtained excellent visualization of the entire fracture. We were able to expose the fracture site efficiently, with minimal tissue retraction. The exposure was ample for orbital en-
doscopy and open manipulation of bone fragments. When indicated for major fractures involving both the orbital floor and lateral wall, the reconstructive material was placed without difficulty by extending the incision along the anterior rim to incorporate a preseptal, transconjunctival approach. For massive fractures involving the medial and lateral walls and the orbital floor, the approach was extended into a precaruncular orbitotomy for access to the medial orbital wall and skull base.

Through LRC it was also possible to access the anterior aspect of the lateral orbital rim without canthotomy or cantholysis for the placement of reconstruction plates. In most cases, the fracture in this region travels through the frontozygomatic suture, which is located superior to the lateral canthal tendon. In this situation, the lateral canthal tendon is easily preserved. In the uncommon event that additional access is needed over the central anterior aspect of the lateral rim (inferior to the frontozygomatic suture and superficial to the lateral canthus), the lateral canthal tendon can be transected near its insertion on the orbital wall, leaving a portion for reanchoring at the conclusion of the procedure.

There were no complications in this series that we considered to be due to the type of orbitotomy used. There were no instances of prolonged wound healing or chemosis. No patients complained of symptoms such as a dry eye that would have indicated damage to the lacrimal gland. There were no cases of upper eyelid malposition or dysfunction of either eyelid. One patient who underwent repair of bilateral LeFort I, II, III, and mandible fractures was noted to have slight superior displacement of the lateral canthus relative to the contralateral side. The position of the eyelids was unaffected, however, and the patient was asymptomatic and satisfied with the surgical result.

Seven patients had postoperative complications (Table). Two patients (patients 2 and 5) had diplopia after repair of their fractures. Both of these underwent removal of their reconstruction implants; one was subsequently lost to follow-up, and the other had resolution of his diplopia. One patient (patient 4) had a postoperative pulmonary embolism that required anticoagulation; 6 months after surgery he developed what appeared to be an infection of the resorbable polylactide orbital floor implant. The implant was removed, and multiple small pieces of dissolving material were noted in the orbital floor. He recovered uneventfully.

There were 4 cases of asymmetric lower eyelid position after surgery (patients 1, 3, 6, and 7). One of these

Figure 7. Results 3 months after lateral retrocanthal (LRC) approach for orbital endoscopy and repair of right orbitozygomatic fracture. A and B, Appearance showing absence of incisions or scars. An abrasion from the original trauma is visible over the lateral malar region. C, Endoscopic view of the right lateral orbit fracture. Superior arrow indicates fracture line approaching the frontozygomatic suture; inferior arrow shows bone fragment at the sphenozygomatic suture. An elevator is retracting the orbital contents medially. D, Endoscopic view from lateral to medial of the right orbital floor through the LRC approach. Orbital apex is on the left of the image; orbital rim is on the right. An elevator is lifting the orbital contents superiorly. Inferior arrow indicates the infraorbital nerve; superior arrow demonstrates the medial margin of the fracture. With minimal displacement of the fracture and no muscle entrapment, the floor does not need to be repaired.
(patient 3) had slight elevation of the lateral canthus that was noted by the surgeon after repair of LeFort II and III fractures; the patient was asymptomatic and did not want adjustment of the eyelid. One patient (patient 1) with severe bilateral LeFort fractures underwent a prolonged reconstruction, and a Frost stitch was placed at the conclusion of the repair to prevent lower eyelid retraction. The patient removed the suture on postoperative day 3 and subsequently developed lower eyelid retraction. He was lost to follow-up. Patient 7 underwent extended orbitotomies for repair of his fractures and was noted to have lower eyelid edema causing mild entropion 2 weeks after surgery. It was believed that this would resolve spon-
taneously, but the patient was lost to follow-up. Another patient (patient 6) underwent repair of significant orbitozygomatic fractures requiring an extended preauricular, transconjunctival, and LRC approach. He was noted to have mild lower eyelid retraction postoperatively, but this resolved spontaneously.

**COMMENT**

The transconjunctival approach was first described in 1924 by Bourquet for cosmetic blepharoplasty. During the next 30 to 40 years, the approach was used for repair of orbital floor fractures and for maxillofacial congenital malformations.6,7 It was not until 1985 that the first report appeared in the literature of using a combined transconjunctival and lateral canthotomy approach for the repair of orbitozygomatic fractures.8 This combined approach gained popularity with some groups through the early 1990s; however, the late complications of lateral canthotomy (poor wound healing and ectropion) caused many surgeons to avoid it. Zingg et al,9 reporting on a large series of patients (N=813) with trimalar fractures, advocated a transconjunctival approach and a lateral brow incision when needed for frontozygomatic suture line reduction and avoided the lateral canthotomy at all costs. In 1999, Turk et al10 reported their similar experience in using an upper blepharoplasty or brow incision in conjunction with the transconjunctival approach to access the zygomaticofrontal buttress.

There have been few recent reports in the literature regarding minimally invasive access to the lateral orbit. There have been studies concerning variations in the transconjunctival and lateral canthal incisions,11 but none without transcutaneous incisions. In fact, most authors re-

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**Figure 11.** The lateral retrocanthal surgical approach. A, Cadaver view of the lateral canthal complex being retracted laterally before a conjunctival incision is made. The globe is slightly deflated. B, Completed approach to the medial aspect of the lateral orbital wall. Arrow indicates insertion of the lateral canthal tendon at the Whitnall tubercle.

**Figure 12.** The retrocanthal extension of the transconjunctival incision preserves the lateral canthal tendon.

**Figure 13.** Access to the lateral orbital wall is achieved by retrocanthal dissection.
port that the transconjunctival approach is useful only for access to the orbital floor and perhaps the medial orbital wall, but provides insufficient exposure of the lateral orbital wall. We have found that the LRC approach, which is exclusively transconjunctival, offers excellent exposure of the lateral orbital wall.

We also found the procedure to be safe. Seven patients in this series had postoperative complications. The most serious was the pulmonary embolism in patient 4. It is highly unlikely that this was related to the surgical approach. Furthermore, the infection this patient had 6 months after surgery was probably not due to the approach we used; it is more likely to have been influenced by degradation of the implant material.12

There were only 2 instances of persistent postoperative diplopia in this series. It is doubtful that these were due to the type of orbitotomy we used; the orbitotomy does not affect the extraocular muscles or orbital volume. Furthermore, neither of these patients had eyelid retraction, and the diplopia in 1 patient resolved with removal of the orbital hardware through an LRC approach (the final outcome of the other is unknown). Diplopia after complex orbital fractures is common and more likely to be caused by the trauma itself, the implant material used, or impingement on the extraocular musculature by bone fragments.13

There was 1 case of persistent eyelid malposition in 30 patients; this occurred in a noncompliant patient for whom postoperative eyelid malposition was an anticipated risk. Unfortunately, the patient removed his protective Frost stitch. There was 1 case of transient malposition and another case that was expected to be transient but could not be followed up. Thus, there were 3 instances of lower eyelid asymmetry in this series, each occurring in patients who underwent extended or far-extented orbitotomy.

It is difficult to determine which of the complications in this series, if any, were due to the LRC approach. The types of complication one would theoretically be concerned about when performing an orbitotomy adjacent to the lateral canthus are weakening of the lower eyelid with inadequate postoperative support, alteration of the lateral canthal architecture with conjunctival scarring, and lateral or inferior tethering of the canthus. None of these complications occurred. This is logical, given that the LRC approach spares the structures of the lateral canthus.

Table. Postoperative Complications in 7 Patients

<table>
<thead>
<tr>
<th>Patient No./Sex/Age, y</th>
<th>Diagnosis</th>
<th>Procedure</th>
<th>Orbitotomy</th>
<th>Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M/44</td>
<td>Bilateral LeFort I, II, III fractures</td>
<td>ORIF LeFort fractures, orbital floors, left lateral orbital wall</td>
<td>LRC, transconjunctival</td>
<td>Patient removed Frost stitch on POD 3, developed lower eyelid retraction, lost to follow-up</td>
</tr>
<tr>
<td>2/M/34</td>
<td>Orbitozygomatic fracture</td>
<td>ORIF zygoma, orbital floor and lateral wall</td>
<td>LRC, transconjunctival, precaruncular</td>
<td>Postoperative diplopia; resolved after miniplate removal</td>
</tr>
<tr>
<td>3/M/35</td>
<td>Bilateral LeFort II, III fractures, mandible fracture</td>
<td>ORIF LeFort fractures, ORIF mandible</td>
<td>Bilateral LRC, transconjunctival</td>
<td>Slight elevation of lateral canthus</td>
</tr>
<tr>
<td>4/M/69</td>
<td>Squamous cell carcinoma of maxilla</td>
<td>Transorbital maxillectomy, defect reconstruction, lower eyelid splint</td>
<td>LRC, transconjunctival, precaruncular</td>
<td>Postoperative pulmonary embolism; implant infection 6 mo postoperatively, resolved with removal</td>
</tr>
<tr>
<td>5/M/42</td>
<td>Orbitozygomatic, nasal fractures</td>
<td>ORIF zygoma, orbital wall, endoscopic orbital floor exploration, repair nasal fractures</td>
<td>LRC</td>
<td>Postoperative diplopia, implant removed, lost to follow-up</td>
</tr>
<tr>
<td>6/M/17</td>
<td>Orbitozygomatic fracture</td>
<td>ORIF zygoma, orbital floor and lateral wall</td>
<td>LRC, transconjunctival, precaruncular</td>
<td>Mild postoperative lower eyelid retraction, resolved without treatment</td>
</tr>
<tr>
<td>7/M/21</td>
<td>LeFort I, II fractures</td>
<td>ORIF LeFort fractures</td>
<td>LRC, transconjunctival, precaruncular</td>
<td>Lower eyelid edema causing mild entropion 2 wk postoperatively, lost to follow-up</td>
</tr>
</tbody>
</table>

Abbreviations: LRC, lateral retrocanthal; ORIF, open reduction internal fixation; POD, postoperative day.

CONCLUSIONS

To avoid the complications of the standard methods of lateral orbitotomy, we developed a canthus-sparing concept that shifts the approach from the lateral aspect of the lateral canthus (transcanthal) to the medial aspect of the lateral orbit. We believe that, by avoiding trauma to the canthus and approaching the orbit directly, the LRC approach adds safety and efficacy. While it is difficult to separate the outcomes of the surgical manipulation from those of the mode of access, there were no significant complications in this series that we could attribute to the LRC approach. All wounds healed rapidly in the study group, and there were no instances of postoperative eyelid malfunction.

We believe that the LRC orbitotomy provides improved exposure to the entire lateral orbit from the floor to the roof, through a minimally invasive approach. It avoids the cutaneous incisions and visible scars that oc-
cur with other techniques. When combined with the transconjunctival approach to the orbital floor, the entire orbital floor and lateral wall can be accessed for fracture repair or tumor resection, and reconstructive materials can be placed and secured expeditiously without the need for lateral canthotomy or cantholysis. This can be extended even farther, adding a precaruncular approach for 300° orbital exposure, if needed. As a small portal of entry for orbital endoscopy, it provides full access to the lateral wall and floor. Thus, cutaneous incisions, with their favorable yet (despite optimal management) notable scars, are eliminated.14

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