Efficacy of Transcaruncular approach to reconstruct isolated medial orbital fracture

Kai Lee · Leslie Snape

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Abstract

Background Traditional approaches used to repair medial orbital wall fracture include transcutaneous incision such as advocated by Killian and Lynch, or coronal approach. Transcaruncular approach provides an anatomically safe and efficient alternative, allowing generous exposure without the cutaneous scar.

Methods Patients presenting with medial orbital wall fractures were identified through the trauma database over a 5 year period. Data of twelve consecutive patients who presented with isolated medial wall fracture and treated via a transcaruncular approach were analysed. The extent of the injury, operative and follow up details were documented.

Results There were ten male patients and two female patients. On computed tomography, vertical defect ranged from 8 to 16 mm (mean 12 mm) and longitudinal defect ranged from 14 to 31 mm (mean 22 mm). All but three patients were followed up for 9 months postoperatively. Two patients were assessed as having a slightly enlarged caruncle on the operated side, but neither patient was aware of this. Of the 2 patients who complained of diplopia, only one had objective restriction beyond 30° of abduction from primary gaze.

Conclusion Transcaruncular approach allows satisfactory exposure for repair of isolated medial orbital wall fracture. It is an anatomically safe and efficient technique, with superior cosmetic result. Postoperative morbidity is minimal and follow up data demonstrates no permanent complications.

Keywords Medial orbital fracture · Transcaruncular approach

Introduction

The thin lamina papyracea of the ethmoid bone predisposes the medial orbital wall to fracture (Fig. 1). Cadaver studies and clinical evidence have shown that medial wall fractures often occur concurrently with inferior wall fractures [1] even though this is not always reflected in the frequency of diagnosis and treatment of medial wall fractures [2]. One recent radiographic study demonstrated isolated medial wall fracture to be the most common type of orbital fracture (55%) [3], more frequent than combined medial and inferior wall fracture (27%) [4].

Diagnosing medial orbital wall fracture with plain radiograph is difficult as studies have shown that although prolapse of orbital fat is present in more than 50% of plain radiographs as an opaque ethmoid sinus, interpretation is usually difficult as the view is obscured by overlapping adjacent structures [5]. Detection of isolated medial wall fractures is now greatly improved with the advent of computed tomography (CT) which has led to increased frequency in surgical reconstruction of the fractures and helped to eliminate the onset of late enophthalmos and other complications when these fractures are not treated [2].

Traditional surgical approaches to medial orbital exploration and reconstruction are Lynch and Killian incisions or through an existing laceration in the area [6]. Coronal approach may also be used, particularly if there are multiple craniofacial fractures or indication for calvarial bone grafting. Transcaruncular approach has gained wider use particularly in ophthalmology [7–14].

K. Lee (✉)
Geelong Hospital, Geelong, VIC 3220, Australia
e-mail: klee1@gmp.usyd.edu.au

L. Snape
Christchurch Hospital, Christchurch, New Zealand

Fig. 1 Skull showing the thin lamina papyracea of the ethmoid bone which is missing

Fig. 2 Axial view of a CT scan of a patient with left medial orbital wall fractures

Fig. 3 Coronal view of a CT scan of a patient with left medial orbital wall fractures

Materials and methods

Transcaruncular approach—Surgical technique (Figs. 2 and 3) demonstrate a patient with a left medial orbital wall fracture. At operation, the caruncle is identified (Fig. 4) and blunt dissection on the posterior aspect of the medial

Fig. 4 Caruncle is identified

canthal ligament allowed satisfactory identification of the posterior lacrimal bony crest by palpation with a periosteal elevator. Where difficulty was encountered due to extension of the fracture anteriorly, dissection was directed more superiorly where stable frontal bone allowed subperiosteal dissection to proceed more easily to identify the margins of the fracture defect.

After retrieval of periorbital fat and identification of fracture margins, fine titanium mesh sheet was cut to size to cover the defect, and secured with a single titanium microscrew placed anteriorly above the lacrimal fossa in stable frontal bone (Fig. 5). Extension superiorly or inferiorly from the transconjunctival incision is made to allow better exposure for larger defects and ease of insertion of mesh. Minimal post-surgical swelling is observed (Fig. 6).

Fig. 5 Titanium mesh seated to bridge the orbital defect

Fig. 6 Week one postoperatively showing minimal swelling

Patient Selection

Between May 2001 and December 2006, a total of 1468 patients presented with facial fractures to the Oral and Maxillofacial Surgery unit at Christchurch Hospital. Analysis of the trauma database revealed 39(3%) isolated medial orbital wall fractures, all confirmed by CT, twelve of which underwent operative repair via a transcaruncular approach. Indications for surgical exploration and reconstruction were based on radiological assessment and severity of clinical signs. Variables collected included demography, radiographic and clinical findings, operative details and follow-up findings. Surgery in all twelve cases was performed by the same surgeon at the Christchurch Hospital, using the technique as described by Baumann and Ewers [8].

Results

There were ten males and two females (range 19–52 years). Operations were performed at 6–22 days post injury (mean 15 days). All patients received CT scan preoperatively to assess the extent of the injury, with vertical defect ranging from 8 to 16 mm (mean 12 mm), and longitudinal defect ranging from 14 to 31 mm (mean 22 mm).

Postoperative follow-up period has been 9 months in nine of the twelve cases, 4 months in one case and 2 months only in two patients. Those 10 patients reviewed more than 4 months after operation were examined for appearance in the medial canthal region and any globe limitation (Table 1).

Two patients were assessed as having a slightly enlarged caruncle on the operated side, but neither patient was aware of this. Of the 2 patients who complained of diplopia, only one had objective restriction beyond 30 degrees of abduction from primary gaze.

Table 1 Postoperative findings after 4 months in 12 cases

Clinical signs	No of patients
Sensory loss (ext. nasal nerve)	3 (all transient)
Normal palpebral angle	10
Enlarged caruncle	2 (no complaint)
Enophthalmos	–
Diplopia (subjective)	2
Limitation (>30° abduction on Hess chart)	1

Discussion

The need to reconstruct medial orbital defects has become more recognized due to improved imaging. Medial orbital fractures have only become more widely diagnosed with the advent of CT scanning. In one study, plain radiograph was diagnostic for only 16% of patients with medial wall fractures; this is improved by further 27% with additional plain views, however with 57% still negative. In this study only 17% of patients with isolated medial fractures underwent surgery [5]. Fueger et al. noted less than 30% of correct diagnosis of surgically confirmed orbital fractures with plain radiographs [15].

Early recognition, careful assessment and adequate reconstruction of medial orbital wall fractures is crucial in preventing persistent diplopia, restriction in lateral gaze and enophthalmos. It has been suggested that ocular disability occurs more commonly in large medial orbital fractures than orbital floor fractures [16]. One of the reasons may be that medial fractures commonly have an orbital floor component which may be overlooked. Early surgical treatment, if possible, is usually recommended within 2 weeks of injury to avoid complex delayed repair, where reversal of diplopia is not always predictable due to fibrosis and irreparable impairment of extraocular muscle function. Prolonged tissue injury causes fibrosis, which can join the globe even after complete surgical release [17].

The surgical technique of transcaruncular approach has been widely described in the literature [7, 8, 10]. It is an anatomically elegant technique, involving division between the medial aspect of the medial orbital septum and Horner's muscle to approach the posterior lacrimal crest. Incision is then made sharply through periosteum just behind the posterior lacrimal crest to gain access to the medial wall. As noted in this series, subperiosteal dissection is made easier by incising periosteum more superiorly on the thicker frontal bone, rather than the very thin bone of the lamina papyracea. This approach allows direct access to the medial orbital wall and orbital apex without cutaneous incision or disruption of the medial canthus and insertion of

reconstructive materials is possible under direct vision. Recent studies have also shown highly successful and safe results by using this approach for medial orbital fracture repair [7–11, 13]. A variation of this technique is demonstrated in a recent cadaver study which uses an approach medial to the caruncle, providing a more direct and avascular path to mid orbit [18].

Surgical access to isolated medial wall fractures and those with orbital floor component was classically through a fronto-ethmoid incision, also called the Lynch incision [6]. This has the disadvantage of leaving a cutaneous scar, possible disinsertion of medial canthal ligament and damage to the lacrimal sac due to scarring of medial canthal ligament. Diplopia can be worse postoperatively due to injury to the trochlear nerve supply to superior oblique muscle and scarring of adjacent tissues [7, 9]. Subciliary incision is a commonly used incision to access the orbital floor, but does not give enough exposure to access the medial wall and is limited by the lacrimal sac. Coronal approach provides excellent access to fractures of the upper midface and orbit, also allowing calvarial bone harvest; however it may be associated with significantly more morbidity, such as bleeding or postoperative complications such as nerve injury and alopecia. Some centers use endoscopic-controlled endonasal procedure following partial ethmoidectomy, to reposition orbital fatty tissue and cover the defect with lyodura [19]. However, it is a time consuming process and almost always involves breaching the septa within the ethmoid sinus, with reduced support for the fractured wall.

None of the patients in this series required additional approach to gain wider access. We find that transcaruncular incision alone allows medial wall access from the orbital floor area just inferior to the maxilloethmoid suture up to the orbital roof area superior to the frontoethmoid suture. Extension superiorly or inferiorly is possible for even wider exposure. However, insertion of titanium mesh may be technically difficult in some cases, due to sharp cut edges of the material, especially with larger defects, where herniation of periorbita makes retraction difficult. Fixation of the titanium mesh is simple with a single titanium micro-screw, securing it to the stable frontal bone anteriorly. Cosmetic result was excellent. Two of our patients had an enlarged caruncle, but there was no complaint and all patients had normal palpebral angle postoperatively.

The wide exposure of this approach lends itself to other applications, including orbital decompression, biopsy of medial orbital mass, drainage of orbital abscess or marsupialization of mucocele [10, 12, 14]. As the surgical path is essentially through avascular tissue away from some important structures, it has the anatomical advantage of minimal disruption to the medial canthal ligament and lacrimal sac.

Conclusion

Transcaruncular approach has several advantages. It allows satisfactory exposure to identify the fracture site as well as insert reconstruction materials, with extension through transconjunctival approach possible for even wider exposure. Postoperative morbidity is minimal and follow-up data demonstrates no permanent complications.

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