When repairing an orbital fracture, the inferior orbital floor needs to be exposed. For that exposure, either a transcutaneous or a transconjunctival approach can be taken. The transconjunctival approach was first described by Bourquet in 1924 for the removal of lower eyelid fat. Tessier later advocated this approach, in 1973, for exposure of the orbital floor and the maxilla for the treatment of facial traumas and maxillofacial anomalies. The transconjunctival approach provides the surgeon with an ample enough surgical site in which to work on the orbit’s inferior surface, leaving no visible scar and reducing the risk of complications often associated with transcutaneous techniques.

Objective: To ask experts in the field to evaluate a surgeon’s experience with a retroseptal transconjunctival approach for the repair of the orbital floor damaged by blowout fracture that the surgeon encountered in 12 East-Asian patients.

Methods: Patients were identified from a database, and a retrospective case note review was conducted. A total of 12 conjunctival procedures were conducted for the repair of blowout fracture with no other complicating fractures. All operative procedures were done by transconjunctival approach alone without lateral canthotomy or any other additional approach.

Results: The repair of the orbital floor was successful in all the cases. Three patients had bone grafting to the orbital floor after reduction. The mean of overall surgical time was 48.8 minutes (range, 22–85 minutes) for orbit exposure by transconjunctival approach plus reduction and bone grafting when applicable. There were 6 urgent surgeries associated with missing or entrapment of the inferior rectus muscle, and its repair took an average of 32.0 minutes (range, 22–41 minutes). Postoperative diplopia recovered at an average of 12.4 weeks (range, 0–60 weeks); in urgent cases, it took an average of 5.3 weeks (range, 0–14 weeks) before recovery.

Conclusions: A retroseptal transconjunctival approach in repairing the orbital floor is a simple, easily manageable, and effective procedure, leaving no conspicuous facial scars. It has proved to be an optimal choice in blowout fracture cases, especially when there was urgency to decompress the ischemic inferior rectus muscle in as short a surgery time as possible.
The transconjunctival approach is not only useful for aesthetic purposes but also facilitates exposure of the orbital floor in East-Asian patients. East Asians are anatomically different from Caucasians in that their lower eyelids are characterized by puffiness. This East-Asian trait in anatomy serves as a merit when it comes to exposing the orbital floor using a retroseptal approach. Our technique is based on what the first author of this article (Uemura) had acquired and refined while he trained under Dr. David J. David of the Australian Craniofacial Unit in Adelaide, S.A., between November 1993 and March 1994.

**PATIENTS AND METHODS**

We conducted a retrospective data file review of all patients inflicted by acute unilateral blowout fracture and treated with a retroseptal transconjunctival approach. All the patients were treated at the Saga University Hospital (Saga City, Japan) during the December 2003 to September 2013 period. Patients were identified from a clinical database. Data collected included patient name, age, patient number at the hospital, sex, diagnosis, laterality, symptoms (nausea, vomiting, diplopia, etc), day of surgery, waiting time to surgery, duration of follow-up, and also surgical details including time of operation, intraoperative injury to the globe, lacrimal sac and/or eyelid, time to disappearance of postoperative diplopia, time to dissipation of nausea and/or vomiting when applicable, and postoperative complications and sequelae, if any. Blowout fractures associated with a medial wall fracture were not included in this series.

All operations were performed by a single plastic surgeon (Uemura), who also reviewed all patients himself after surgery.

**The Surgical Procedure for Acute Blowout Fracture**

The lower eyelid is everted using 2 traction stitches of 6-0 nylon through the tarsal plate. Next, 1–2 mL epinephrine solution at 1:100,000 with 1% lidocaine is injected into the subconjunctival space, toward the inferior orbital rim of the affected orbit. A minimum of 10 minutes is allowed for epinephrine-induced homeostasis to take effect before surgery. The conjunctiva is incised widely, at 2–3 mm below the tarsus, starting medially at the precise point of the lacrimal punctum to proceed to the canthal space at the lateral end. A single traction stitch of 6-0 nylon is placed on the cranial side of the conjunctival incision. In the treatment of East-Asian patients, the retroseptal approach facilitates exposure of orbital fat on blunt dissection (Fig. 1). The orbital rim is palpated with a periosteal elevator before the periosteum is incised and elevated widely. The fractured area of the orbital floor can then be exposed widely. The exposed orbital fat and connective tissue including the inferior rectus muscle are gently put inside the orbital space. If bone grafting is needed to the floor, the split inner table bone from iliac or rib bone is taken and set to the defect of the orbital floor.

Postoperatively, the conjunctiva is closed with a running 6-0 fast resorbable suture, and the buccal mucosa is closed using 4-0 resorbable sutures. Finally, tarsorrhaphy is done using 2 traction stitches with 6-0 nylon through the tarsal plate, and it is kept 1 or 2 days shorter after surgery in most blowout fracture cases than in a transconjunctival approach for zygomatic fracture. That is because we advise the patients to start moving the eyeball as soon as possible after the removal of tarsorrhaphy.

**RESULTS**

Mean age of the 12 patients at the time of surgery was 20.8 years (range, 6–50 years). There was little difference in laterality with 7 right to 5 left cases, and the same applied to the sex ratio with 7 male to 5 female patients. A total of 12 conjunctival incisions were made for unilateral blowout fracture. Mean time from
injury to presentation was 7.5 days (range, 0–27 days). All operative procedures were performed with a transconjunctival approach for the repair of blowout fractures with diplopia. Nine cases required reduction only without the need for bone grafting. Three cases required bone grafting with bone harvested from iliac bone (1 case) and rib bone (2 cases). Mean of overall surgical time was 48.8 minutes (range, 22–85 minutes) for orbit exposure by transconjunctival approach plus reduction and bone grafting when applicable, and it was reduced to 37.8 minutes (range, 22–64 minutes) for likewise exposure plus reduction with no bone grafting. There were 6 urgent surgeries associated with missing orbital rectus muscle or severe entrapment thereof, which required an average of 32.0 minutes (range, 22–41 minutes) to repair. None of the patients had complications with eczepion or entropion. Postoperative diplopia recovered at an average of 12.4 weeks (range, 0–60 weeks); in urgent cases, it took an average of 5.3 weeks (range, 0–14 weeks) before recovery. Follow-up periods ranged from 1 to 17 months, with a median of 6 months (Table 1).

Case Report

Case

A 22-year-old woman needing urgent surgery with missing rectus muscle with nausea and vomiting was presented to our clinic. She sustained facial injuries and presented with diplopia with severe nausea and vomiting. She was referred to our emergency clinic and was charged to our department for a suspected blowout fracture. Computed tomography imaging did not reveal an apparent fracture, but it disclosed the absence of the inferior rectus muscle on the orbital floor (true missing rectus; Fig. 2). The patient’s left eye movements—up gaze and down gaze—were severely restricted (Fig. 3). The diagnosis was a blowout fracture with a linear fracture of the orbital floor. Immediate surgery was performed to release the strangulated muscle at 6 hours after injury. A presurgical forced duction test under general anesthesia was performed, but her left eye was locked in the middle to caudal side (Fig. 4). By retroseptal transconjunctival approach, the orbital fat and muscle was retracted to the anterior side from the floor. As expected, a linear fracture with entrapment of the orbital content was confirmed. The herniated tissue was carefully restored without other osteotomy, and no defects of the orbital floor were seen. Tarsorrhaphy was done to remain for 1 day to prevent the swelling of conjunctiva, and the exercise of eye movements started soon. Nausea and vomiting began to disappear immediately after surgery, and diplopia was rectified completely in 2 weeks after surgery (Fig. 5).

Table 1. Patients’ Demographics

|                              | Quantity |
|------------------------------|----------|
| Sex                          |          |
| Male                         | 7        |
| Female                       | 5        |
| Age (y)                      | 20.8     |
| Range                        | 6–50     |
| Side                         |          |
| Right                        | 7        |
| Left                         | 5        |
| Waiting time to surgery      |          |
| Overall (days)               | 7.5      |
| Range                        | 0–27     |
| Urgent (h)                   | 66       |
| Mean                         | 6–210    |
| Surgery time (min)           |          |
| Overall Mean                 | 48.8     |
| Range                        | 22–85    |
| TCA + R Mean                 | 38       |
| Range                        | 22–64    |
| Urgent (TCA) Mean            | 32       |
| Range                        | 22–41    |
| Follow-up period (months)    |          |
| Overall Mean                 | 6        |
| Range                        | 1–17     |
| Diplopia recovery time (weeks)|         |
| Overall Mean                 | 12.4     |
| Range                        | 0–60     |
| Nausea dissipation timing    |          |
| Total cases                  | 7        |
| Before reduction             | 2        |
| Immediately after surgery    | 5        |

Complications

Intraoperative

Postoperative

None

None

Nausea dissipation timing: when dissipation of nausea and/or vomiting occurred; Diplopia recovery time: time to disappearance of postoperative diplopia.

R, reduction; TCA, transconjunctival approach.

Fig. 2. Coronal view of computed tomography image of rectus muscle before surgery (entrapment of inferior rectus muscle).
DISCUSSION

Pure-type orbital floor fracture, or blowout fracture, was first described by Lang. There are 2 competing theories about the mechanism by which blowout fracture is caused. In one theory, known as the buckling theory, a blowout fracture occurs through force transmission from the more rigid infraorbital rim to the weaker orbital floor. The other, perhaps now more widely accepted hydraulic theory, says that hydraulic pressure from the globe is transmitted to the bony orbit and causes a fracture in the thin orbital floor. The hydraulic mechanism tends to produce larger, more posterior fractures in both the floor and the medial wall, with frequent herniation and a higher likelihood of enophthalmos.

Whichever theory above a surgeon subscribes to, there is little difference as to what the surgeon must do to a patient who is inflicted with blowout fracture, especially if the case needs urgent surgery. Sustained high pressure in the eyeball and in the orbital cavity will be detrimental to the healing of scarred musculature in the adjoining sites, so surgical invasion is inevitable to reduce the pressure. In the case of blowout fractures, it may be inflammation or swelling that delays the healing process. The longer the operation lasts, the slower the healing process in any event. Hence, the surgeon must finish the operation in as short a time as possible. To that end, the retroseptal transconjunctival approach that we have used seems the optimal choice. When one evaluates the outcome of the treatment of blowout fracture, including complications, one will probably support this conviction of ours as far as retroseptal transconjunctival approach goes, especially when the presence or absence, or severity, of complications is taken into consideration.

A recent review of incision techniques for the repair of blowout fracture found insufficient high-level evidence to suggest one pattern over another but did show a low incidence of complications with transconjunctival approaches and the highest rate of complications and revisions in subciliary approaches.

The transconjunctival approach was first reported by Bourquet in 1924 as an approach for the removal of lower eyelid fat. As the size of the incision in his original method was too small, a favorable visual field could not be obtained.

Tessier conducted a follow-up study and expressed initial hesitation regarding the use of the Bourquet approach. In 1973, however, Tessier did use the technique to approach the orbital floor and maxilla in the treatment of maxillofacial anomalies and traumas in 20 patients. He described in detail the methods for approaching the orbital floor, medial wall, lateral wall, maxilla, and zygoma and documented
the usefulness of the approach. Converse et al \cite{11} and David \cite{12} conducted follow-up studies and reported the advantages, disadvantages, and complications associated with the transconjunctival approach.

Converse et al divided the transconjunctival approach into retroseptal and preseptal routes based on incision layer. The retroseptal approach is easy, and the orbital floor can be reached under direct visualization, but because orbital fat is exposed, its exclusion is necessary. With the preseptal approach, a favorable field of view can be obtained in the orbital rim and floor without exposing orbital fat. The biggest advantage of the transconjunctival approach is that no visible scar remains postoperatively in the lower eyelid. This approach is thus particularly useful in younger persons and children. Compared with the subciliary approach, the transconjunctival approach is generally associated with a lower incidence of postoperative complications such as scleral exposure and ectropion.\cite{3,4}

A recent Asian-Pacific survey reported the tendency of change in the surgical approach for blowout fracture, stating that a transconjunctival approach is most popular among oculofacial surgeons.\cite{13}

We have used the transconjunctival approach for the repair of orbital floor and rim on more than 100 cases during over 20 years in Japan. In our estimation, the transconjunctival approach is the best choice to apply for blowout fractures in younger patients, especially in urgent and severe entrapment cases including the missing rectus syndrome.

In our previous study of the transconjunctival approach for zygomatic fractures, we noted that it is vitally important that the surgeon understand the anatomic differences between East-Asian and non-East-Asian lower eyelid makeups when he/she exposes the orbital rim using the preseptal approach (submitted to PRS Global Open). In East-Asian lower eyelids, orbital fat projects further anteriorly with respect to the orbital rim. In the repair of blowout fracture, the surgeon is free from the possibility of orbital fat exposure because its fat is already exposed out of the orbital cavity. This East-Asian anatomical characteristic serves as an advantage when it comes to expose the orbital floor using a retroseptal approach (Fig. 1). In replacing the orbital tissue including orbital fat and muscle inside the orbital cavity, it is easier to use the retroseptal procedure, because it is easier to take out intraorbital fat and muscle into the fat layer than into the periosteal layer for a decrease in pressure in the orbital tissue (Figs. 6–8). It is also important to obtain a decrease in the pressure of soft tissue around the muscle as stipulated by the theory of treatment for the compartment syndrome. From the above reasons, a retroseptal transconjunctival approach is our favorite approach.

It goes without saying that it is vitally important that the diagnosis of a blowout fracture should be made as soon as possible, especially if an urgent surgery seems in order. In cases of missing rectus muscle or severe entrapment, surgery must be done before ischemia occurs in the rectus muscle. In our experience with urgent cases involving blowout fractures, the transconjunctival approach has proved to be of...
more merit than other approaches such as transcuta-
neous, subciliary, transtarsal, and suborbital, in that
surgery time can be minimized. Recent meta-analyt-
ic evidence about the transconjunctival approach
for orbital fracture, including zygomatic fracture
and blowout fracture, points to the advantage that
the transconjunctival approach offers, precisely be-
because it is less complication-prone, especially in the
treatment of blowout fracture.3

When the senior author opts for the transcon-
junctival approach for blowout fracture, he always
keeps in mind that he should try to finish the sur-
gery as quickly as possible, within the maximum of
60 minutes overall, or in about 30 minutes in espe-
cially urgent cases.

Because it takes a long time for a lower eyelid
inflammation to heal, unnecessary complications
and muscle dysfunction often result, which would
otherwise have been spared. The recovery time and
sequelae of muscle function were correlated to both
degree of damage and initial time before surgery.14
If no bone graft is required to the orbital floor such
as in linear fracture, surgery time gets that much
shorter.

The lack of a visible scar represents the biggest
advantage of the transconjunctival approach. To
reduce the risk of complications, surgery needs to
be completed without lateral canthotomy from an
aesthetic perspective. If a lateral canthotomy is re-
quired, lateral paracanthal incision could aestheti-
cally be a better choice.15

A transconjunctival approach in repairing the
orbital floor is simple, easy, and effective, leaving
no conspicuous facial scars. This approach is our fa-
vorite choice for blowout fracture, especially when
younger patients are involved in urgent cases that
call for less surgery time.

Many incisional techniques have been described
for access to the craniofacial skeleton for traum-
ic blowout fracture repair, including subcili-
ary, subtarsal, and transconjunctival approaches.3
Although determination of the true incidence for
each of those approaches may be extremely dif-
ficult, meta-analysis does provide us with the best
approximation. Larger trauma registry studies will
be necessary to capture these complications and re-
sults accurately.

Tetsuji Uemura, MD
Department of Plastic and Reconstructive Surgery
Saga University Hospital
5-1-1 Nabeshima, Saga City
Saga 849-8501, Japan
E-mail: uemurat@cc.saga-u.ac.jp

ACKNOWLEDGMENTS
The authors thank their secretary Kyoko Ohkubo at the
Saga University Hospital for getting the database ready for
the study. Finally, but not least, they appreciate the expert
advice offered by David J. David, Uemura’s mentor, before
submission of this manuscript.

REFERENCES
1. Bourquet J. Les hernies graisseuses de l’orbite; Notre
traitement chirurgical. Bull Acad Med Paris 1924; 92:
1270–1272.
2. Tessier P. The conjunctival approach to the orbital floor
and maxilla in congenital malformation and trauma.
J Maxillofac Surg 1973;1:3–8.
3. Ridgway EB, Chen C, Colakoglu S, et al. The incidence of
lower eyelid malposition after facial fracture repair: a re-
rospective study and meta-analysis comparing subtarsal,
subciliary, and transconjunctival incisions. Plast Reconstr
Surg 2009;124:1578–1586.
4. Salgarelli AC, Bellini P, Landini B, et al. A comparative
study of different approaches in the treatment of orbital
trauma: an experience based on 274 cases. Oral Maxillofac
Surg 2010;14:23–27.
5. Lang W. Traumatic enophthalmos with retention of per-
fect acuity of vision. Trans Ophthalmol Soc UK. 1889;9:41–45.
6. Pfeiffer RL. Traumatic enophthalmos. Trans Am
Ophthalmol Soc. 1943;41:293–306.
7. Tajima S, Fujino T, Oshiro T. Mechanism of orbital blow-
out fracture. I. Stress coat test. Keio J Med. 1974;23:71–75.
8. Ahmad F, Kirkpatrick NA, Lyne J, et al. Buckling and hy-
draulic mechanisms in orbital blowout fractures: fact or
fiction? J Craniofac Surg. 2006;17:438–441.
9. Waterhouse N, Lyne J, Urdang M, et al. An investigation
into the mechanism of orbital blowout fractures. Br J Plast
Surg. 1999;52:607–612.
10. Kothari NA, Avashia VJ, Lemelman BT, et al. Incisions
for orbital floor exploration. J Craniofac Surg. 2012;23
(7 Suppl 1):1985–1989.
11. Converse JM, Firmin F, Wood-Smith D, et al. The conjunctival approach in orbital fractures. *Plast Reconstr Surg.* 1973;52:656–657.

12. David DJ. Exploration of the orbital floor through a conjunctival approach. *Aust N Z J Surg.* 1974;44:25–27.

13. Koh V, Chiam N, Sundar G. Survey of common practices among oculofacial surgeons in the Asia-Pacific region: management of orbital floor blowout fractures. *Craniomaxillofac Trauma Reconstr.* 2014;7:197–202.

14. Yano H, Suzuki Y, Yoshimoto H, et al. Linear-type orbital floor fracture with or without muscle involvement. *J Craniofac Surg.* 2010;21:1072–1078.

15. Song J, Lee GK, Kwon ST, et al. Modified transconjunctival lower lid approach for orbital fractures in East Asian patients: the lateral paracanthal incision revisited. *Plast Reconstr Surg.* 2014;134:1023–1030.