CASE SERIES

Challenges of Managing Orbital Floor Blow–out Fracture in a Developing Country

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Received: September 3rd, 2012
Accepted: March 10th, 2013

ABSTRACT

Background: Orbtal blow-out fracture can be associated with ocular injuries which may involve the anterior or posterior segments of the eye. This can present significant morbidity to patients which can impact on the quality of life.

Objective: To evaluate cases of orbital floor blow-out fractures seen at two centres.

Methodology: A retrospective study of patients seen with a diagnosis of orbital blow-out fracture between July 2009 and March 2010 was done. Diagnosis was based on history, clinical examination and computerised tomography (CT) scan. The patients had lower lid incision – transcutaneous or transconjunctival. Silicone and bone implants were used to reconstruct the defects.

Results: Five patients – 3 males and 2 females were reviewed, age range between 21 to 26 years. The fracture occurred as a result of road traffic injury in 3 patients (60%), and the involved eye had poor visual acuity on presentation, but no associated ocular injury was noticed in 3 (60%) of the patients. The interval between injury and presentation ranged from 9 to 120 days. Vertical limitation of ocular motility and significant enophthalmos were noticed in all the 5 patients; 2 had diplopia and hypoesthesia in the distribution of the infraorbital nerve. The average time interval between injury and surgery were 49 days and 3 of the patients (60%) had repairs after 14 days of presentation. Postoperatively, slight improvement in ocular motility was observed.

Conclusion: The challenges of managing orbital fracture include late presentation, lack of synthetic implant materials, increased morbidity with graft harvesting, and poor cosmetic outcome.

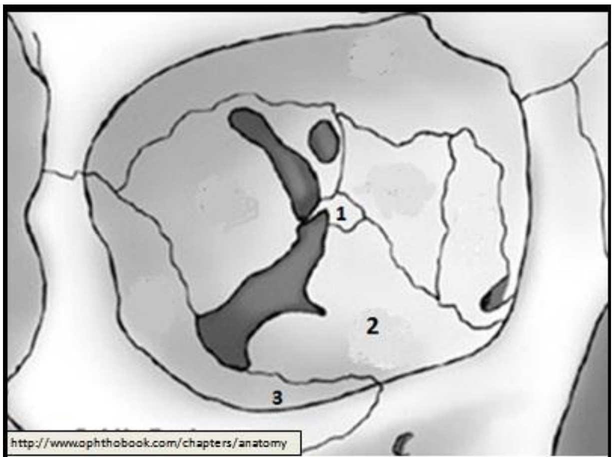
Keywords: *Challenges, enophthalmos, road traffic injury*

INTRODUCTION

The orbit represents the bony cavity for the eye among other contents. The floor of the orbit is made up of orbital surface of maxilla, the orbital surface of zygomatic bone and the minute orbital process of palatine bone (*Figure 1*). A fracture of this bony structure not involving the orbital margins is called a "pure" blow-out fracture.

A blow-out fracture arises when a blunt object larger than the eye hits the orbit.[1,2] This situation often leads to incarceration of orbital tissues, especially the inferior rectus muscle and rarely the inferior oblique muscle.[3,4,5,6] There can be associated ocular injuries which may involve the anterior or posterior segments of the eye.[7,8,9,10]

Figure 1. Bony components of the orbital floor



1. Minute orbital process of palatine bone
2. Orbital surface of maxilla
3. Orbital surface of zygomatic bone

Two theories have been propounded to explain the mechanism of blow–out fractures. There is the hydraulic mechanism which involves the compression of orbital contents with an associated increase in the intra-orbital pressure, and the buckling mechanism theory which involves stress transmission to the orbital floor from the rim.[1,11,12,13,14,15] Orbital blow–out fracture with associated clinical features can present significant morbidity to patients which can impact on their quality of life. The management of orbital fracture is largely surgical, though some surgeons have reported good outcomes without surgery in some cases.[16,17] The outcome of interventions are influenced by a number of factors. One very important factor is the duration between injury and surgery.[18,19,20]

There are a number of reports on blow-out fractures from the developed world. However, there is paucity of data on such from the developing countries, hence, the purpose of this study which is to evaluate the cases seen from two centres in our locality and the challenges encountered in managing them.

METHODOLOGY

This is a retrospective study involving two centres: Oculoplastic Unit, Department of Ophthalmology, University of Ilorin, Nigeria and Chaha Eye Hospital, Kaduna, Nigeria. The case notes of the patients seen at these two centres between July 2009 and March 2010, with a diagnosis of orbital blow-out fracture were reviewed. Information was also obtained from theatre records and admission notes. Five cases with a diagnosis of orbital floor blow-out fracture were seen within the study period and therefore included in the study.

Information retrieved included demographic data, nature and time of injury, time lapse between injury and presentation, as well as the presence or absence of diplopia. Data on clinical examination included: visual acuity (VA) in both eyes, pupillary examination, ocular motility, Hertel exophthalmometry measurements, slit – lamp biomicroscopy, applanation tonometry, funduscopy and skin sensitivity test over the distribution of the infra-orbital nerve. Findings on computerised tomography (CT) scan were also retrieved. Informed consent was obtained from patients for the use of clinical photographs. All patients had operative interventions.

The operative procedure in 3 patients involved using a 2mm thick and pliable silicone implant (*Dow Corning Ltd, USA*) following a transcutaneous, sub-ciliary incision on the lower eyelid. The dissection was carried down to the periosteum at the level of the orbital rim. A 5mm horizontal incision was made on the periosteum below the orbital rim. A vertical relaxing incision was made on either side of the periosteum and the later was reflected over a periosteal elevator, as far posterior as possible until the fracture is visualized. A gentle traction was applied on the identifiable entrapped orbital content, restoring to the orbit as much of the entrapped tissues as possible.

The extent of the fracture site was determined and a silicone implant of that size was cut and placed over the defect. The implant was not sutured to the orbit, neither was any glue applied. The periosteal cut ends were sutured with 6-0 vicryl sutures, while the skin incision was closed with 6-0 silk sutures. The other 2 patients had a transconjunctival lower lid incision with lateral cantholysis and inferior canthotomy. Bone grafts for implant were harvested from the contralateral maxillary bone and the right iliac crest, respectively.

The patients were followed up post-operatively until one month. Post-operative examinations included: visual acuity (VA) in botheyes, pupillary examination, ocular motility, Hertel exophthalmometry, slit–lamp biomicroscopy, applanation tonometry, funduscopy and skin sensitivity test over the distribution of the infra-orbital nerve.

RESULTS

There were 5 patients; 3 (60%) males and 2 (40%) females. Laterality was right eye (RE) in 2 (40%) and left eye (LE) in 3 (60%) patients. Age range was 21-26 years, with an average of 24 years. The fractures occurred during a fight in 1 (20%) patient, road traffic accident in 3 (60%) patients and occupational injury in 1 (20%). All the patients presented with poor visual acuity in the involved eye. The interval between injury and diagnosis ranged 9-120 days, average of 56days. There was limitation of up gaze and enophthalmos in all the 5 (100%) patients; diplopia was seen in 3 (60%) patients in primary position of gaze and hypoesthesia in the distribution of the infraorbital nerve in 3 (60%) patients.

Associated ocular injury included macular scar, healed lid lacerations, and optic atrophy. The average time interval between injury and surgery was 48 days, and 3 (60%) of the patients had late repairs (>14 days after injury). Postoperatively, limitation of vertical eye movements, diplopia, and hypoesthesia were still observed as occurred pre-operatively; four patients had a partially reduced enophthalmos. Complications such as infection, tissue reaction to implant and extrusion were not observed. *Table 1* shows the summary of findings in the patients, while *Figures 2* and *3* show the photographs of one of the patients pre- and post-operatively, respectively.

Table 1. Findings in five patients managed for orbital blow-out fractures

	1	2	3	4	5
Gender	Female	Male	Female	Male	Male
Occupation	Student	Artisan	Student	Farming	Soldier
Age in years	22	26	21	24	26
Involved Eye	LE	RE	LE	LE	RE
VA at Diagnosis (Involved Eye)	3/60	HM	1/60	NLP	LP
VA at follow up visit (1 month post – op)	3/60	HM	1/60	NLP	LP
Nature of Injury	RTI	Occupational hazard	Assault (Brawl)	RTI	RTI
Interval between Injury and presentation	3months	4months	9 days	6 weeks	3 weeks
Interval between presentation and surgery	1 month	3 months	3 months	2 weeks	2 weeks
Limitation of ocular motility	Up gaze	Up gaze	Up gaze	Up gaze	Up gaze
Diplopia	+	+	+	_	_
Degree of Enophthalmos at presentation	3mm	4mm	3mm	3mm	4mm
Degree of Enophthalmos at follow up (1month post-op)	2mm	3mm	2mm	2mm	2mm
Hypaesthesia @ 1month follow-up	Yes	Yes	Yes	No	No

*LE – Left Eye, RE – Right Eye, LP – Light Perception, NLP – No Light Perception, HM – Hand Motion, LL – Lower Lid, RTI – Road Traffic Injury, VA – visual acuity

Figure 2. Left eye blow-out fracture (pre-operative) showing limitation of up gaze and enophthalmos

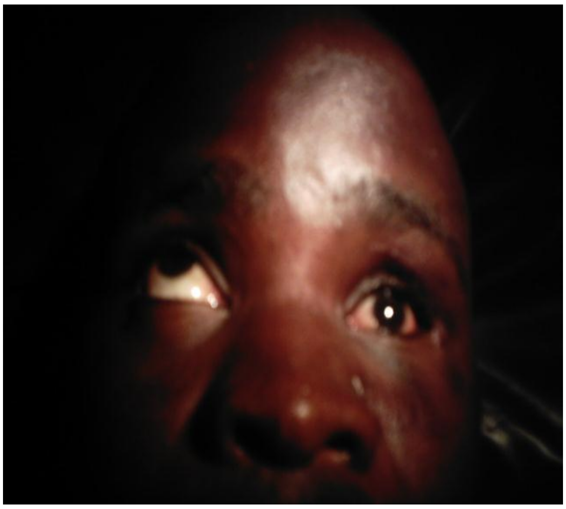
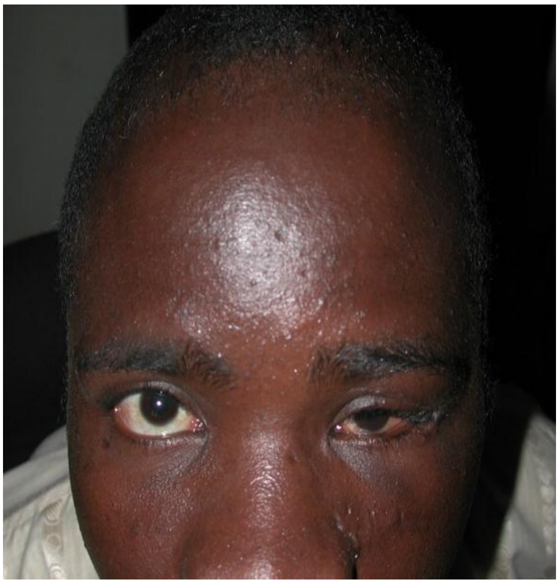


Figure 3. The same patient as in *Figure 2* with persistent limitation of up gaze and enophthalmos post-operatively



DISCUSSION

The orbit is a conical structure made up of the frontal, zygomatic, lacrimal, ethmoid, palatine, sphenoid and maxillary bones. The floor of the orbit is formed by the zygomatic, maxillary and palatine bones. Orbital wall fractures usually involve the inferior, medial, roof and lateral walls in that order,[21] the orbital floor being the commonest site for a fracture.[1, 21] There is a male preponderance in our series, similar to other studies.[22,23,24] This may be related to the fact that males are usually more active and may be involved in potentially physically challenging situations that may predispose them to injury. It is also remarkable that the ages of our patients were all below 30years (range 21–26 years), and this represents a period of active lifestyle for young adults. This is similar to findings by Chi, *et al* who found an age range of 20-29 years.[23]

Road traffic injury (RTI) was the most common cause of the orbital fracture in our patients, responsible for two third of the cases. This is a very important cause of injuries in general and of orbital floor blow-out fracture as seen in other studies.[23,24,25] Those involved in RTI may also present with associated ocular and non-ocular injuries which further contributes to the significant morbidity experienced by these patients.[4,7,9] Other causes include assault, (usually the human fist which was seen in one of our patients), sport related injuries (especially in developed countries) and falls.[23,26,27] A rare cause is nose blowing.[28]

Orbital contents at risk in inferior orbital blow-out fractures include: muscles (inferior rectus muscle especially), nerves (infraorbital nerve), vessels, orbital fat and the eyeball itself.[29] Clinical presentation includes: peri-orbital ecchymosis, inability to elevate the globe, vertical diplopia especially in up gaze, hypo- or hyper-anaesthesia in the distribution of the infraorbital nerve, and enophthalmos.[30] Incarceration of the inferior rectus muscle with consequent restriction of upgaze is a frequent presentation of inferior orbital blow-out fracture, and was seen in all the patients in this study.[3,25] This restrictive myopathy often results in vertical and or oblique diplopia.[17,31]

The patients in this series presented late to us with an average duration of symptom of 49 days, in contrast to the western world where patients with blow-out fractures present to the ophthalmologist or maxillo-facial surgeon within hours or days after injury. One of the patients presented after four months of initial injury. Appropriate referrals are usually made very late due to missed diagnosis by general practitioners. It is also possible that patient might have tried other alternative local herbal remedies further contributing to the delay. Significant time loss also occurred between the initial presentation and subsequent surgical intervention.

Delay in surgery was due to non-availability of CT machine within the practice area and also inability of patients to pay for this investigation. Majority of medical costs are still being borne by patients directly due to lack of adequate insurance, and these become a considerable burden to the patients. Due to non-availability of implant materials, 2 of the patients had harvested bone grafts in place of synthetic implants. This required the services of a maxillofacial and an orthopaedic surgeon at various times. The size of harvestable bone grafts in these instances was limited.

All the patients presented with poor vision in the involved eye and there was no improvement post-operatively. This may be due to the permanent nature of the ocular complications encountered in these patients. Similarly, even though presenting enophthalmos improved slightly, all the patients still had significant enophthalmos post-operatively. Many authors have suggested the early repair of the orbital blow-out fracture to minimize complications, especially, enophthalmos.[31,32,33] The longer the globe is held back in the enophthalmic position, the less likely it is to get the eyeball back to its normal position, possibly from fibrosis and tethering of orbital soft tissues despite successful surgical reduction.[20] The enophthalmos in our patients was cosmetically unacceptable (>2mm), hence the need for surgery in spite of the poor visual prognosis. Possible causes in our series could be marked fibrosis occasioned by the long duration between injury, presentation and surgery.

CONCLUSION

The management of orbital blow-out fractures in our environment is difficult. Prevailing challenges include late presentation of patients, lack of necessary synthetic materials, multidisciplinary nature of management for these patients, and financial constraints experienced by patients. These challenges need to be tackled, especially that of early referral of patients with blow-out fracture to ophthalmologists.

REFERENCES

1. Smith B, Regan WF. Blow-out fracture of the orbit. Mechanism and correction of internal orbital fracture. *Am J Ophthalmol* 1957; 44:733-739.
2. Courtney DJ, Thomas S, Whitfield PH. Isolated orbital blowout fractures: survey and review. *Br J Oral Maxillofac Surg* 2000 Oct; 38:496-504.
3. Okinaka Y, Hara J, Takahashi M. Orbital blowout fracture with persistent mobility deficit due to fibrosis of the inferior rectus muscle and perimuscular tissue. *Ann Otol Rhinol Laryngol* 1999 Dec; 108:1174-1176.
4. Fujino T, Makino K. Entrapment mechanism and ocular injury in orbital blowout fracture. *Plast Reconstr Surg* 1980 May; 65:571-576.
5. Kim S, Kim TK, Kim SH. Clinico-radiologic findings of entrapped inferior oblique muscle in a fracture of the orbital floor. *Korean J Ophthalmol* 2009 Sep; 23:224-227.
6. Kushner BJ. Paresis and restriction of the inferior rectus muscle after orbital floor fracture. *Am J Ophthalmol* 1982 Jul; 94:81-86.
7. Magarakis M, Mundinger GS, Kelamis JA, Dorafshar AH, Bojovic B, Rodriguez ED. Ocular injury, visual impairment, and

blindness associated with facial fractures: a systematic literature review. *Plast Reconstr Surg* 2012 Jan; 129:227-233.
8. Cullen GC, Luce CM, Shannon GM. Blindness following blowout orbital fractures. *Ophthalmic Surg* 1977 Feb; 8:60-62.
9. Brown MS, Ky W, Lisman RD. Concomitant ocular injuries with orbital fractures. *J Craniomaxillofac Trauma* 1999 Fall; 5:41-48.
10. Kreidl KO, Kim DY, Mansour SE. Prevalence of significant intraocular sequelae in blunt orbital trauma. *Am J Emerg Med* 2003 Nov; 21:525-528.
11. Ahmad F, Kirkpatrick NA, Lyne J, Urdang M, Waterhouse N. Buckling and hydraulic mechanisms in orbital blowout fractures: fact or fiction? *J Craniofac Surg* 2006 May May; 17:438-441.
12. Nagasao T, Miyamoto J, Jiang H, Tamaki T, Kaneko T. Interaction of hydraulic and buckling mechanisms in blowout fractures. *Ann Plast Surg* 2010 Apr; 64:471-476.
13. Nagasao T, Miyamoto J, Shimizu Y, Jiang H, Nakajima T. What happens between pure hydraulic and buckling mechanisms of blowout fractures? *J Craniomaxillofac Surg* 2010 Jun; 38:306-313.
14. Suzuki H, Furukawa M, Takahashi E, Matsuura K. Barotraumatic blowout fracture of the orbit. *Auris Nasus Larynx* 2001 Aug; 28:257-259.
15. Adeyemo WL, Aribaba OT, Ladehinde AL, Ogunlewe MO. Mechanisms of orbital blowout fracture: a critical review of the literature. *Niger Postgrad Med J* 2008 Dec; 15:251-254.
16. Putterman AM, Stevens T, Urist MJ. Nonsurgical management of blow-out fractures of the orbital floor. *Am J Ophthalmol* 1974; 77:232-238.
17. Emery JM, Von Noorden GK, Schlernitzauer DA. Orbital floor fractures. Long-term follow-up of cases with and without surgical repair. *Trans Am Acad Ophthalmol Otoloryngol* 1971; 75:802-806.
18. Hartstein ME, Roper-Hall G. Update on orbital floor fractures: indications and timing for repair. *Facial Plast Surg* 2000; 16:95-106.
19. Burnstine MA. Clinical recommendations for repair of orbital facial fractures. *Curr Opin Ophthalmol* 2003 Oct; 14:236-240.
20. Harris GJ. Orbital blow-out fractures: Surgical timing and technique. *Eye* 2006; 20: 1207–1212.
21. Scherer M, Sullivan WG, Smith DJ Jr, Phillips LG, Robson MC. An analysis of 1423 facial fractures in 788 patients at an urban trauma center. *J Trauma* 1989; 29:388-390.
22. Elliot D, O'Brien TP. Trauma. In Varma R (ed): Essentials of Eye Care. The Johns Hopkins Wilmer Handbook, Lippincott-Raven Publishers, Philadelphia, 1997, 468.
23. Chi MJ, Ku M, Shin KH, Baek S. An analysis of 733 surgically treated blowout fractures. *Ophthalmologica* 2010; 224:167-175.
24. Abiodun A, Atinuke A, Yvonne O. Computerized tomography assessment of cranial and mid-facial fractures in patients following road traffic accident in South-West Nigeria. *Ann Afr Med* 2012; 11:131-138.
25. Cruz AAV, Eichenberger GCD. Epidemiology and management of orbital fractures. *Current Opinion in Ophthalmology* 2004; 15:416-421.
26. Karsteter PA, Yunker C. Recognition and management of an orbital blowout fracture in an amateur boxer. *J Orthop Sports Phys Ther* 2006 Aug; 36:611-618.
27. Jones NP. Orbital blowout fractures in sport. *Br J Sports Med* 1994 Dec; 28:272-275.
28. Watanabe T, Kawano T, Kodama S, Suzuki M. Orbital blowout fracture caused by nose blowing. *Ear Nose Throat J* 2012 Jan; 91:24-25.
29. Yab K, Tajima S, Ohba S. Displacements of eyeball in orbital blowout fractures. *Plast Reconstr Surg* 1997 Nov; 100:1409-1417.
30. Brady SM, McMann MA, Mazzoli RA, Bushley DM, Ainbinder DJ, Carroll RB. The diagnosis and management of orbital blowout fractures: update 2001. *Am J Emerg Med* 2001 Mar; 19:147-154.
31. Dutton J.J. Management of blow-out fractures of the orbital floor. *Surv Ophthalmol* 1991; 35:279-280.
32. Chen JM, Zing G M, Leadrach K, Raveh J. Early surgical intervention for orbital floor fractures: a clinical evaluation of lyophilized dura and cartilage reconstruction. *J Oral Maxillofac Surg* 1992; 50:935-941.
33. Mathog RH. Management of orbital blowout fractures. *Otolaryngol Clin North Am* 1991; 24:79-91.