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Original Research Article

Optimal Management of Orbital Blowout Fracture with Limited Available Resources: A 5 Years' Experience from Nepal

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Abstract: ***Background:*** Reconstruction of orbital wall fracture is not only difficult but challenging for restoring orbital cavity volume and shape. This study aimed to evaluate the outcome of orbital wall fracture reconstructed with limited available resources. Method -A single-center, retrospective analysis of orbital wall fracture reconstructed with silastic sheets from January 2015 to December 2019 was conducted after ethical approval from the institutional review committee. Electronic medical records (EMR) of post-operative cases were thoroughly reviewed and data based on demographic profile, nature of trauma, site of the fracture, surgical complication, and outcome were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences version 20(SPSS). Result-A total of 33 blow-out fractures, 15(45.5%) right eye and 18(54.5%) left eye, reconstructed with silastic sheets were included. Of the total, 23(69.7%) were male. The mean age of patients was 27.79 ± 11.56years (range, 6- 50). The common mode of injury was physical assault 11(33.3%) followed by fall injury 10(30.3%) and road traffic accidents (RTAs) 5(15.2%). An isolated floor fracture was found in 21 (63.6%) cases. The mean duration from injury to surgery was 113.97± 385 days. The mean reduction of enophthalmos and hypoglobus was 1.7±0.6 mm and 1.4±1.2mm respectively. The diplopia, enophthalmos, hypoglobus, and hypoesthesia completely resolved in 88.9%, 92.3%, 100%, and 88.9% cases respectively. Two patients reported implant extrusion. Conclusion-Physical assault, falling injury, and road traffic accidents were common causes of fracture. Overall surgical outcome was good with the silastic implants. However, public awareness against violence, RTAs, and a safe working environment is indispensable for preventing fracture.

Keywords: Diplopia; Enophthalmos; Hypoglobus; Limited resources; Orbital wall fracture; Reconstruction; Silastic sheets.

INTRODUCTION

Orbital wall fracture is a break or cracks in one or more bones forming an orbital cavity which can be isolated to the individual wall or combined involving more than one wall. The most common site of orbital wall fracture is an inferior wall followed by the medial wall. However, combined orbital floor and medial wall fractures are being diagnosed more frequently nowadays [1]. The blow-out fracture occurs due to a sudden increase in intra-orbital pressure following direct blunt trauma (Hydraulic theory) and/or force transmission through the bony walls (Buckling theory) [2-4]. These fractures are categorized into two main groups, those that involve the orbital rim called 'impure" blow out and those in which only walls are involved known as "pure" blow out a fracture. The consequences after blowout fracture like enophthalmos, restricted ocular movement leading to diplopia, globe displacement, and dermatological sensory loss over the distribution of infraorbital nerve are reported in the literature [5-9].

The common mode of injury causing orbital wall fracture is RTAs, physical aggression, fall injury, and sports-related injury mentioned in previous studies [10, 11]. However, there may be variation in occurrence depending upon the geographical and socioeconomic condition of the study population. Reconstruction of fracture primarily aims to restore the volume and shape of the cavity by using autogenous grafting to alloplastic implants. The commonly used materials are bone, cartilage, porous polyethylene implants, titanium, poly L-lactide (PLLA), and polydioxanone (PDS) as reported in the literature. [12-14]. The silicon or silastic sheets are more commonly used because of their easy availability, cost-effectiveness, and fewer complications [15].

In our setup, we are using the silastic sheets only because no other implants are available and they are extremely cheaper and possess relatively fewer complications. However, no study regarding long-term outcomes of silastic implants in orbital fracture reconstruction has been conducted in our institute as well as the country. So, we retrospectively reviewed functional and aesthetic outcomes of orbital wall fracture reconstructed with silastic sheets to assess the functional outcome.

MATERIALS AND METHODS

A hospital-based retrospective analysis of all consecutive cases of orbital wall fracture that had undergone reconstruction with a Silastic implant at a tertiary eye hospital in Kathmandu, Nepal from January 2015 to December 2019. The study has been approved by the Institutional Review Committee of the institute and was carried out with tenets of the Declaration of Helsinki. Medical records were retrospectively reviewed. All the consecutive cases that had undergone orbital wall fracture reconstruction with a Silastic implant were included in this study. Patients with incomplete information regarding fracture site, type of surgery, an implant used, and lacking clinical long-term follow-up examination were excluded from this study.

Data collection was done based on patient demographics, nature, and duration of trauma, pre-operative computerized tomography (CT) scan showing fracture location, time of injury to surgical repair, surgical indication, and a thorough ophthalmological evaluation visual acuity, pupillary examination, infraorbital hypoesthesia, extraocular movement examination and posterior segment evaluation using Indirect Ophthalmoscopy. The enophthalmos measurement was done using Hertel Exophthalmometry whereas vertical globe position measurement using an mm ruler. The diplopia charting and colour vision test were also reviewed. Surgical indications for orbital wall fractures were significant enophthalmos ≥ 2mm and extraocular muscle restriction causing diplopia in primary and downgaze. All the surgeries were performed by two senior Consultant oculoplastic surgeons under general anaesthesia. Forced duction test (FDT) was done for every patient before incision as well as the closure of wound to rule out any mechanical restriction and iatrogenic entrapment. All the patients were put on oral broad-spectrum antibiotics and steroids to decrease inflammation and swelling, analgesics, proteolytic enzymes, and topical antibiotic and steroid eye drops. Post-operative records of BCVA, EOM and diplopia charting, enophthalmos and hypoglobus measurement, pupillary examination, complications encountered subsequent follow-up visits on 1 week, 1 month, 3 months 6 months, and 1 year after surgery were recorded. However, a postoperative CT scan was not done for all patients, only a few patients with suspected implant extrusion were advised.

Data were entered into a customized Microsoft Excel 2016 spreadsheet and statistically, analyzed using Statistical Package for Social Sciences version 20 (SPSS, Inc. Chicago, IL, USA). Descriptive statistics, percentage, mean, standard deviation was calculated along with the graphical and tabular presentation. One-way analysis of variance was used to compare continuous variables and Chi-square test for comparing categorical variables. The test of significance was considered significant when the p-value was <0.05.

RESULTS

Thirty-three patients who had undergone surgery in right eyes 15(45.5%) and left eyes 18 (54.5%) were reviewed. Of the total, 10(30.3%) were female and 23(69.7%) male with a ratio of 1:2.3. The mean age of patients was 27.79 ± 11.56 years (range, 6- 50 years). The mean duration of injury was 96.67 ± 378 days (range, 1-2160 days). The duration from the time of injury to surgery ranged from 7-2220 days (Mean 113. 97± 385 days). The detailed demographic characteristics are as shown in Table 1.

Table-1: Demographic characteristics of study population

Parameters	Values
Age (years) mean ± SD* (range)	27.79 ± 11.56 (6-50)
Gender	
Male	23(69.7%)
Female	10 (30.3%)
Laterality	
Right Eye	15(45.5%)
Left Eye	18 (54.5%)
Duration of injury (days) mean ± SD (range)	96.67 ± 378 (1-2160)
Duration from injury to surgery (days) mean ± SD (range)	113. 97± 385 (7-2220)

*SD; Standard Deviation

The most common mechanism of injury in our study was physical assault 11(33.3%) followed by fall injury 10(30.3%), RTAs 5(15.2%), falling object 4(12.1%), and sports- related 3 (9.1%). The distribution of mechanism of injury by gender is as shown in Table 2.

Table-2: Mechanism of injury distributed by Gender

Mechanism of injury	Gender		Total	P-value [a]
	Male No. (%)	Female No. (%)	No (%)	
Physical assault	10 (30.3)	1 (3.1)	11(33.3)	0.138
Fall injury	6 (18.2)	4 (12.1)	10 (30.3)	
RTA- 2 wheeler	1 (3)	2 (6.1)	3 (9.1)	
RTA- 4 wheeler	1 (3)	1 (3)	2(6.1)	
Falling object	2(6.1)	2(6)	4(12.1)	
Sports related	3(9.1)	0	3(9.1)	
Total	23 (69.7)	10 (30.3)	33 (100)	

a. ANOVA analysis

Most of patients presented with a chief complaint of double vision 21(63.6%) in some gaze, shrunken eye 8 (24.2), and both 4 (12.1%) cases. Pre-operatively, 27(81.8%), 26(78.8%), 15 (45.5%) and 9(27.3%) patients had diplopia in some gaze, enophthalmos on Hertel Exophthalmometry, hypoglobus, and hypoesthesia over the distribution of the infraorbital nerve respectively. A year after surgery, 3 patients had persistent diplopia, 2 had persistent enophthalmos, 1 had persistent hypoesthesia. However, 6 patients had reported persistent EOM restriction in some gaze. The pre and post-operative outcomes are shown in Figure 1.

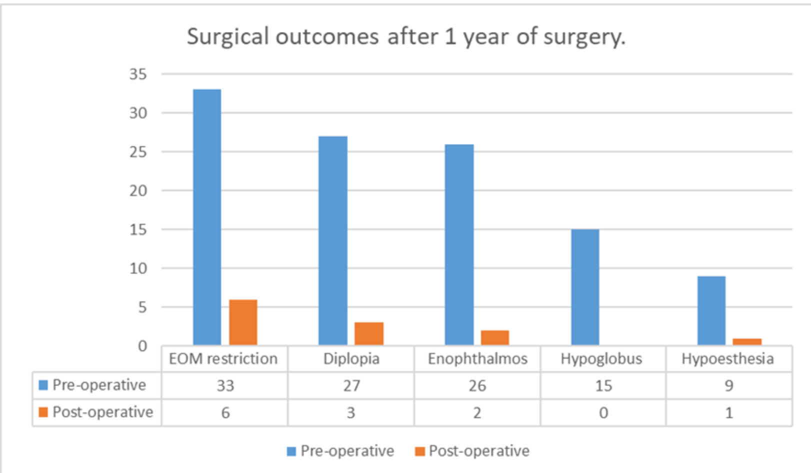

Fig-1: Surgical outcomes in patients with orbital wall fracture reconstruction

In this study, orbital wall fracture was associated with closed globe injury in 18(54.5%), open globe injury in 1(3%), and eyelid injury in 17(51.5%) cases. Most of the patients presented with best-corrected visual acuity of ≥ 6/18 in 29(87.9%), up to 6/60 in 3(9.1%), and PL in 1(3%). However, there was no change in visual acuity at 12 months of surgery except for 1 case whose vision was NPL owing to phthisis bulbi. No systemic associations were accompanying orbital fracture except fracture of the maxilla in 3(9.1%) cases. However, the relative afferent pupillary defect was presented in 2(6.1%) cases which resolved itself after 1 month.

The pre-operative CT scan report revealed that isolated floor fracture was the most common as shown in Figure 2. Soft tissue entrapment was found in almost all cases, out of which 12 (36.36%) had extraocular muscle incarceration (8 Inferior Rectus and 4 Medial Rectus). However, 21 isolated floor fractures, 8 both wall (floor + medial wall) fractures, and 3 isolated medial wall fractures were reconstructed with Silastic sheet via transforniceal approach whereas only 1case of both wall fractures was reconstructed with Silastic sheet via both (transcutaneous and transforniceal) approach. All the operations were uneventful except 1 encountered retrobulbar haemorrhage (RBH) immediately after surgery and lateral canthotomy and cantholysis were done immediately.

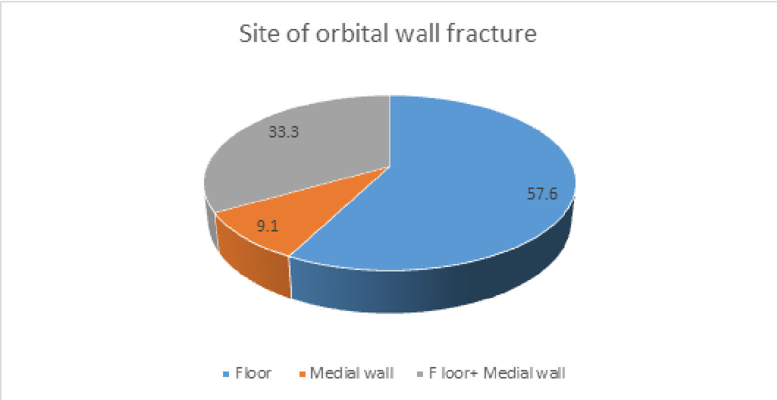

Fig-2: Location of orbital fracture

The mean pre and post-operative enophthalmos were 1.8 ± 1mm (range, 0-3.5mm) and 0.1±0.4 mm (range,0-2) respectively, corresponding to the mean reduction of enophthalmos in 1.7±0.6 mm. Similarly, the mean pre and post-operative hypoglobus were 1.5 ± 1.7mm(range,0-5mm) and 0.1 ± 0.5mm(range,0-3mm) respectively corresponding to the mean reduction of hypoglobus in 1.4±1.2mm. The changes in pre and post-operative enophthalmos and hypoglobus in our study were statistically significant for p-value being for p-value 0.00 at 95% Confidence Interval of difference as shown in Table 3.

Table-3: Pre and post-operative changes in enophthalmos and hypoglobus

Parameters	**Mean ± SD †**	**95% CI ‡ (lower- upper)**	**p-value**
Enophthalmos	1.7 ± 0.9	1.4-2	0.000
Hypoglobus	1.4 ± 1.7	0.8-2	0.000

a. Paired sample t-test
† SD; Standard Deviation
‡ CI; Confidence Interval

The early postoperative complications were transitory periorbital edema 5(15.2%), ecchymosis 2 (6.1%), and subconjunctival haemorrhage 3(9.1%) which were completely resolved within 1 month. In the late period, EOM restriction occurred in 6 (18.2%), diplopia 3(9.1%), and other complications as shown in Table 4.

Table-4: Late complications after reconstruction

Complications	**Number (%)**
EOM restriction	6 (18.2)
Diplopia	3(9.1)
Enophthalmos	2(6.1)
Hypoesthesia	1(3)
Implant extrusion	2(6.1)
Phthisis bulbi	1(3)
Secondary glaucoma	1(3)

DISCUSSION

Orbital fractures are usually caused by blunt ocular and mid-facial trauma. Generally, patients are polytraumatized and may need multi-specialty opinions regarding the functional and aesthetic outcome of fracture reconstruction. Different medical specialties like Ophthalmology, Otolaryngology, Maxillofacial Surgery, Plastic, and Reconstructive Surgery can perform reconstruction with variable outcomes, modality, and complications depending upon socioeconomic, geographical conditions of patients. In our institute, orbital wall fracture without involving other facial bones is reconstructed and other complex fractures are referred to maxillofacial surgeon. So, this is a retrospective review of electronic medical records of patients diagnosed with orbital floor or medial wall or both undergoing reconstruction with silastic sheets over the study period.

The present study reported isolated orbital wall fractures occurred in 24 (72.7 %) cases including floor 21(63.6%) and medial wall 3(9.1%) whereas 9(27.3%) cases had the combined floor and medial wall fracture. The isolated fractures rate is reported 57.6% by Çağatay et al. study [1] and 47.1% in retrospective analysis of 132 patients by Hwang K. et al. [16] which is lower than our study. The lower rate of isolated medial wall fracture in our study is because of the reason that we reviewed only those cases with CT diagnosis of orbital fractures undergoing reconstruction. Though most of the medial wall fractures remain underdiagnosed due to lack of symptoms, suspected cases must undergo orbital CT imaging for diagnosis.

The common mechanism of injury attributed to orbital wall fracture in our study was physical aggression 11(33.3%) followed by fall injury 10(30.3%), RTAs 5(15.2%), falling object 4(12.1%), and sports-related 3 (9.1%). Physical assault was reported as a common mechanism of injury in many previously published studies [11, 17, 18] Similarly, Road traffic accident as a common cause of fracture has been reported in many epidemiological studies [11, 19, 20]. Among 5 RTAs in our study, 3 were 2- wheeler accidents and 2 were 4 wheeler accidents. The variations in the mechanism of trauma for an orbital fracture depend upon the socioeconomic and geographical conditions of the study population.

Out of the total, 23(69.7%) males and 10 (30.3%) females with a male: female ratio of 2.3:1 was operated on. Surprisingly, the mechanism of injuries like physical assault (30.3%), falling injury (18.1%) and sports-related (9.1%) were more common in male whereas 2-wheeler accident (6.1%) was more common in female. However, ocular injury by a falling object (6%) and 4- wheeler accidents (3%) were equally distributed in both sexes. The difference in the distribution of the mechanism of injury within and between groups was not statistically significant (p-value 0.138, ANOVA analysis). We think males have physical aggression and outdoor activities more than females in our socio-economic background, attributing to orbital wall fracture. The male predominance over female for fracture is reported in previously published studies [1, 14, 21-23].

The mean age of presentation in our study was 27.8 ± 11.6 years (range,6-50years) which is similar to previously published literature [1, 15, 24]. However, the higher mean age of presentation was reported in other studies [22, 25]. The youngest patient in our study (6years) had a history of falling injury from height whereas the oldest patient (50 years) had a 4-wheeler accident. The mean duration of injury in our study was 96.67 ± 378 days (range, 1-2160 days), which is inconsistent with 10.7±7.8 days (range: 0–30 days) reported in the study. [24] The longer duration of injury in our study is due to delayed presentation for seeking treatment. The duration from the time of injury to surgery ranged from 7-2220 days (Mean 113. 97± 385days) in our study which is longer compared to other studies [22, 26].

Concerning laterality, right eye involvement was seen in 15(45.5%) cases and left eye 18 (54.5%). The majority of patients presented with a chief complaint of double vision 21(63.6%) in some gaze, shrunken eye 8 (24.2), and both 4 (12.1%) cases. Postoperative evaluation after 1 year of surgery, revealed that 24/27 (88.9%) diplopia, 24/26 (92.3%) enophthalmos, 9/9(100) hypoglobus, and 8/9(88.9%) hypoesthesia was resolved completely. Diplopia was persistent only in extreme lateral gaze without difficulty in primary and downgaze. However, EOM limitation was persistent in 6(18.2%) cases. Other complications like implant extrusion or displacement were reported in 2 (6%) cases whereas phthisis bulbi, secondary glaucoma was reported in 1 case each. The surgical outcomes with regards to enophthalmos, diplopia hypoglobus, and hypoesthesia reported in a previously published study are comparable to our findings [27].

The present study revealed that the mean enophthalmos pre and post-operatively were 1.8 ± 1 mm (range, 0-3.5mm) and 0.1±0.4mm (range, 0-2mm) respectively, with a mean reduction of 1.7±0.6 mm. Similarly, the mean pre and post-operative hypoglobus were 1.5 ± 1.7mm (range,0-5mm) and 0.1 ± 0.5 mm(range,0-3mm) respectively, with a mean reduction of 1.4±1.2mm. The changes in pre and post-operative enophthalmos and hypoglobus were statistically significant (p-value 0.00, paired sample t-test). In a retrospective analysis of 20 patients by Shawn RL et al. the mean reduction of enophthalmos was 2.1 mm ± 1.2 mm (range, 1.0–5 mm) which is similar to our finding [10]. Of the 2 persistent enophthalmos, one patient with a history of wild bear attack developed phthisis bulbi.

In this study, 2 patients had significant proptosis in the late postoperative period and both of them were advised for orbital CT scan examination. The CT report in one of them showed normal position and orientation of implant and feature suggestive of thyroid eye disease (TED). The other patient who had persistent limitation of EOM and diplopia in primary and downgaze with CT report revealing entrapment of soft tissue with a displacement of the implant was advised for revisional surgery. Unfortunately, he again encountered a complication on 1st day of surgery with features suggestive of optic nerve compression. The orbital CT examination revealed a hematoma of 3x2.5 mm, he was admitted and intravenous methylprednisolone was given for 3 days. However, the rate of revisional surgery reported in the published study showed 4.5% which is consistent with our finding [15].

CONCLUSION

In summary, physical assault, fall injury, and road traffic accidents were common cause's orbital wall fracture. The surgical outcome with regards to enophthalmos, diplopia, hypoglobus, and hypoesthesia was good. We recommend an effective public awareness program against violence, road traffic accidents, and safety precautions at the workplace to reduce orbital wall fracture.

LIMITATION

This is a retrospective study with relatively small sample size. Therefore, well designed prospective study with larger sample size is recommended to evaluate surgical outcome of fracture reconstruction.

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