Etiology and pattern of orbital fractures in a teaching hospital

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Abstract

Purpose: To explore the etiological factors and pattern of orbital injuries in patients of trauma.

Materials and Methods: A prospective case series of 176 patients of orbital trauma was diagnosed by computerized tomography. All patients were interviewed for demographic and injury profile. After clinical examinations, injury and fracture pattern were analyzed by using multi-slice CT Scan, utilizing three- dimensional visualization of computed tomography images.

Results: Hundred eighty two eyes of 176 patients were examined. There were 81.82% male and 18.18% females. 61.36% victims were between 16-45 years of age. Majority (73.86%) of victims belonged to rural background. Based on the etiology, road traffic accident (37.50%) were most common, followed by assault (22.16%), sport related injuries (15.90%) and fall/ domestic accidents (10.23%). Most common mode of injury was collision/ impact (48.86%). Majority of patients had unilateral orbital fracture (96.60%); 59.66% had left sided injury. Most of the eyes (51.95% right eye and 27.62% left eye) had single orbital wall fracture and pan orbital wall fracture was more (5.20%) commonly observed in right eye injury. Among the right eye injury, most common orbital wall fracture was floor fracture (64.93%) while in left eye injury most common was roof fracture (56.19%). Most common type of fracture was linear/ minimally displaced break (48.86%) while multiple comminuted severely displaced fracture was observed in 40.91% cases. At the time of presentation visual impairment (visual acuity 6/18 – 6/60) was observed in 23 right eye and 40 left eye and blindness (< 6/60 – NO PL) was seen in 32 eyes (right & left both).

Conclusion: Orbital injuries are commonly caused by road traffic accidents. Orbital injuries are more likely to occur in young adult male, and be associated with craniofacial injuries. Because of complex nature of craniofacial fractures, which may be comminuted, involving multiple bone and or associated with soft tissue edema / neurologic injuries. Management of such orbital injuries is more challenging and require a multidisciplinary approach.

Keyword: Assault, Ecchymosis, Emphysema, Maxillofacial trauma, Orbital wall fracture, Road traffic accidents

Introduction

Orbital injuries are diverse group of injuries which continue to pose a therapeutic challenge to ophthalmologists as well as to orbital surgeons. Orbital trauma may be purely confined to the orbit (in isolation) or may be the part of panfacial or craniofacial trauma. Trauma to the orbit can involve the globe, eyelid, paranasal sinuses and intracranial structures.[(1)] Most common orbital injury is orbital wall fracture.[(2)] Approximately half of the patients with orbital wall fracture have associated maxillofacial fracture and 30% of these cases have associated ocular injuries.[(2)] Orbital injury can lead to complications such as diplopia, visual impairment/ blindness and anatomical defects.[(3)] Orbito-facial trauma has long term functional, cosmetic and psychological impact. It also poses substantial economic burden to the patient requiring complex treatment. The etiology of orbito-facial trauma include road traffic accidents, assault, fall, sports and high speed missile/ bullets injuries.[(4)] Several studies have shown that young adult males are commonly affected.[(2-5)] Elderly patients with trauma are more likely to have poor prognosis than young adults. Incidence of facial fractures in elderly patient accounts for 5.3-8.6%.[(5)] The orbito-facial fractures are rare in under 5 years age[(6)] but pediatric orbital fractures carry higher incidence of blinding injuries.[(7)] Rowe reported that only 1% of all facial fractures occur in children ≤ 1 year old.[(8)] The pattern of pediatric orbital trauma and its clinical presentation differs from adult injury due to preponderance of elastic, cancellous bone in children's. The presentation pattern of orbito-facial fracture depends upon geographical area, cultural, environmental and socioeconomic status, age and sex distribution of the population. This study was conducted to assess the etiological factors and pattern of orbital injuries in patients of ocular trauma attending to the teaching hospital of Banaras Hindu University, Uttar Pradesh, India.

Materials and Methods

This cross sectional study was carried out at the eye department and emergency out-patient department of Sir Sundarlal Hospital, Banaras Hindu University, Varanasi, Uttar Pradesh, India over a period of five years from September 2011 to August 2016. Total of 402 patients having ocular trauma attended the hospital, out of them 176 having orbital injuries were included in this study. Approval of Institute Ethical Committee was obtained prior to commencement of study. Informed written consent was also obtained from each participant. With the help of pre-designed and pretested proforma information regarding demographic

characteristics. Relevant history of trauma (viz. date, time, place, season of injury and characteristic of traumatic agent, circumstances of injury and mechanism & mode of injury with side of impact) were interviewed. All patients underwent routine clinical examination for periocular& facial swelling, ecchymosis, deformity of face, tenderness, abnormal mobility, step defect at fracture site, malocclusion of teeth, loss of sensation & function, any bleeding from mouth, nose or ear. Ocular examination included initial best corrected visual acuity, extraocular movement and intraocular pressure (only in closed globe injury); examination of anterior segment in torch light and with slit lamp, posterior segment evaluation with direct ophthalmoscopy, indirect ophthalmoscopy and slit lamp bio-microscopy with 20 and 78 diopter lenses. After clinical examination, patients were subjected to radiological investigations like Plain X-ray, USG, multi-slice CT Scan with 3D reconstruction and MRI as per requirement. Data including demographic information, etiology, site of injury & associated injuries, number and type of bony injuries and complications were statistically analyzed using SPSS version 17 statistical software package (SPSS Mean, Standard Deviation and x^2 were applied for inferential purpose.

Results

Hundred eighty two eyes of 176 patients with orbital trauma were examined. The study subjects comprised of 144 (81.82%) male and 32 (18.18%) females. Maximum incidence of orbital trauma occurred in age group, 16-25 years, which had 40(22.73%) patients followed by 34 (19.32%) patients in 26-35 years and 36-45 years age group. The least incidence occurred in extreme of ages. Majority of victims belonged to rural background (73.86%) and student (34.60%) by occupation (Table 1).

Based on the etiology of ocular trauma road traffic accidents (37.50%) were most common, followed by assault (22.16%), sports related accident (15.90%) and fall from height / domestic accident (10.23%). The most common place of injury was street/road 72(40.91%) followed by home 52(29.54%), work place 27 (15.34%) and playground 10 (5.68%). Although maximum patients sustained injury during day time, the peak time of trauma was between 18.00 and 23.59 hours. The most common source of injury was blunt trauma; stone/ brick (24.43%) was commonest traumatic agent followed by metal like rod, hammer (22.16%) and wooden materials like tree, lathi, hockey/ bat etc. (21.59%). The commonest mode of injury was collision/ impact 86(48.86%) followed by fall 43 (24.43%) and projectile object 36(20.45%) (Table 2). 42.05% injury victims had consumed alcohol/intoxicated at the time of injury.

17.05% patients had single injury (isolated ocular injury) while rest had polytrauma; 48.86% had two organ involvement and 32.98% had three organ involvement (Table 3 & 4). Orbital fracture associated with craniofacial fracture (51.71%) were more common than isolated orbital fractures (18.75%) (Table 5). Hundred seventy (96.60%) subjects had unilateral involvement and only 3.41% had bilateral injuries (Fig. 1). There was slight predominance of left eye involvement (59.66%) (Fig. 2). Among the right eye injury most common orbital wall fracture was floor fracture (64.93%) (Fig. 3) while in left eye injury most common was roof fracture (56.19%) (Table 6, 7 & 8). Most of the eyes (51.95% right eye & 27.62% left eye) had single orbital wall fracture (Fig. 3) while pan orbital wall fracture was more commonly observed in right eye injury (5.20%) (Fig. 4 a) (Table 9). Most common type of fracture was linear/ minimally displaced break (48.86%) (Fig. 5) while multiple comminuted severely displaced fracture was observed in 40.91% cases(Fig. 4a). Common clinico-radiological presentation and complications associated with orbital fractures were viz., ecchymosis, proptosis, diplopia, emphysema and hemorrhage (Table 10 & Fig. 4b) Globe injury was present in 41.48% cases (Fig. 6). Majority of study subjects (66.23% of right eye and 60.95% of left eye) had ≥ 3 ocular structure involvement (Table 11). 19.18% patients had intracranial/ neurological injuries (Fig. 4 c & Fig. 7) At the time of initial presentation visual impairment (visual acuity 6/18 – 6/60) was observed in 29.87% cases of right eye and 38.10% cases of left eye and blindness (< 6/60 – NO PL) was observed in 41.56% cases of right & 30.48% cases of left eye injury (Table 12). Severe visual loss was observed in eyes having > 2 orbital wall fracture.

Table 1: Demographic characteristics of study subjects

Characteristics	Number (n=176)	Percentage (%)
Age (Years)		
0-5	7	3.98
6-15	24	13.64
16-25	40	22.73
26-35	34	19.32
36-45	34	19.32
46-55	20	11.35
56-65	11	6.25
>65	06	3.41
Sex		
Male	144	81.82
Female	32	18.18
Residence		
Urban	17	9.66
Semi-urban	29	16.48
Rural	130	73.86
Occupation		
Former	32	18.18
Laborer	29	16.48
Factory Worker	03	1.70
House Wife	19	10.80
Student	61	34.66
Service	24	13.64
Others	08	4.54

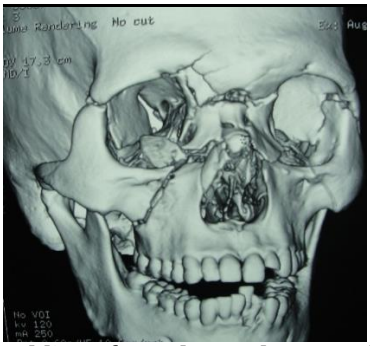


Fig. 1: A case of road traffic accident, oblique-frontal 3D volume rendered CT image projection with bone thresholding showing a complex comminuted fracture of bilateral orbital walls; involve the both maxillary, ethmoid bones and left zygomatic bones

A **B** **C**

Fig. 2: A case of fall from height with ecchymosis, periocular & facial edema. (b, c) Coronal and direct frontal 3D volume rendered CT image projection with bone thresholding and a coronal reconstruction showing a complex comminuted, displaced fracture of left maxillary, zygomatic, nasal & ethmoid bone. The floor, medial wall & lateral wall with orbital rim are involved

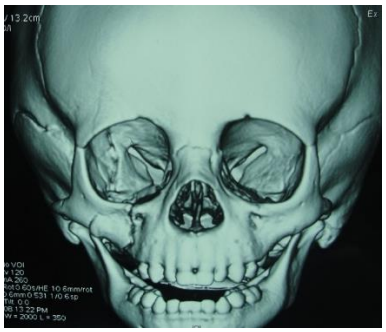
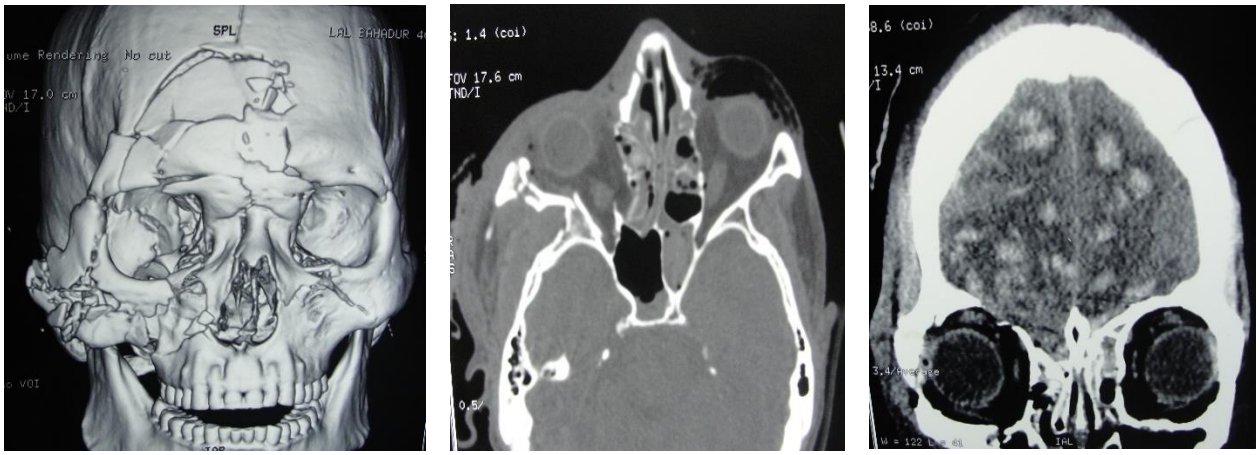


Fig. 3: A child with history of fall from height, frontal 3D volume rendered image of CT scan showing fracture involving the floor & rim of right orbit

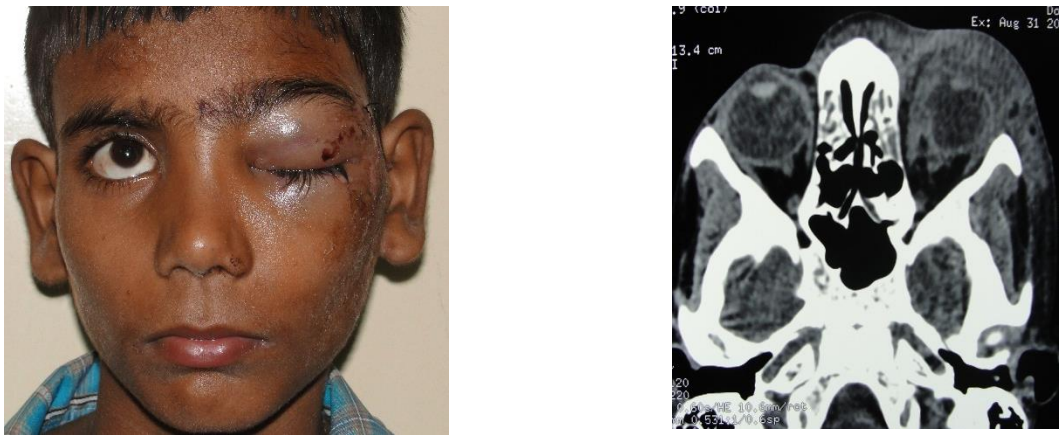


A **B** **C**

Fig. 4: A case of physical assault, direct frontal 3D volume rendered with bone thresholding, axial bone window and coronal soft tissue window image showing complex comminuted fracture of bilateral frontal bones extending to involve the maxillary, zygomatic, nasal and ethmoid bones. Extensive contusion in both cerebral hemisphere and proptosis & emphysema of left orbit

A **B** **C**

Fig. 5: A child with history of road traffic accident with right eye ecchymosis. (b, c) Direct frontal 3D volume rendered CT image projection and axial bone window section with bone thresholding showing linear undisplaced fracture of right frontal bone involving roof of right orbit



A **B**

Fig. 6 a & b: A child with history of physical assault by cricket bat with eyelid & periocular swelling, axial CT image showing left eye proptosis, disorganized eye ball

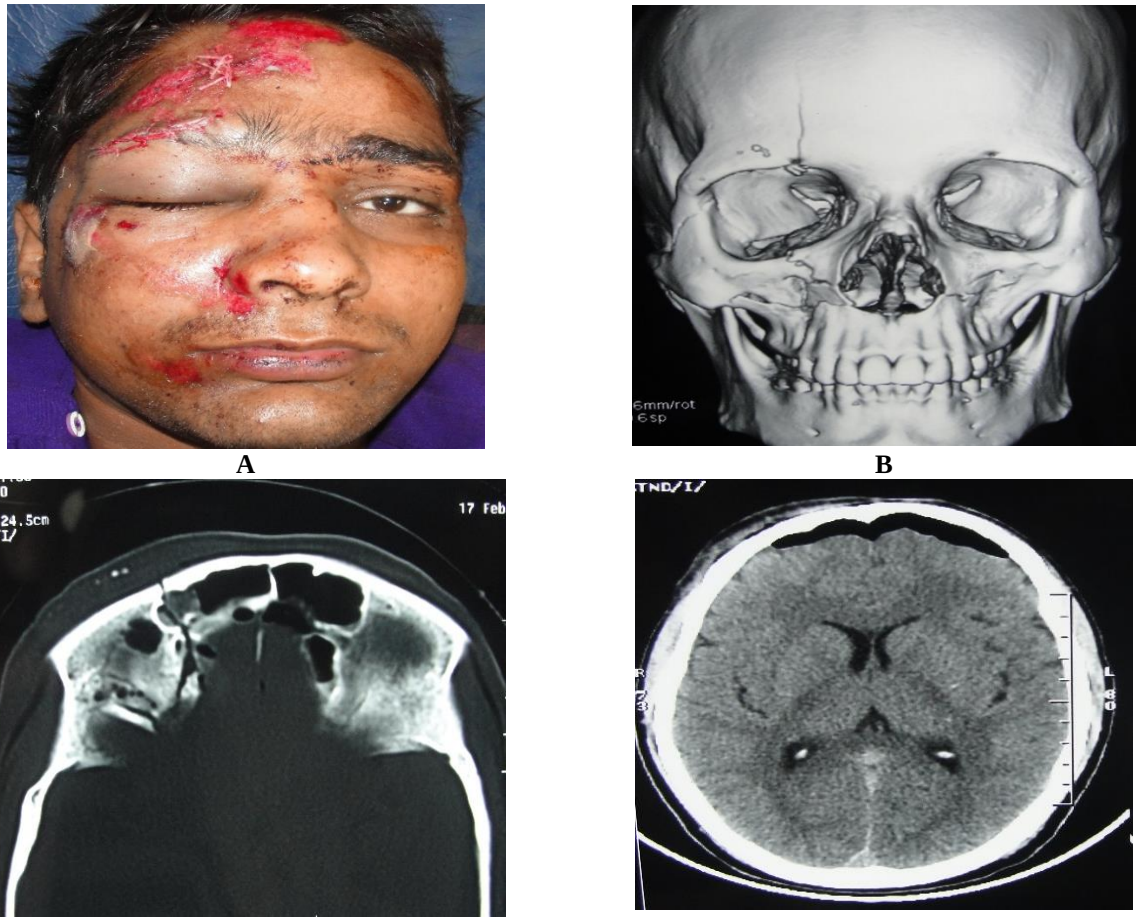


Fig. 7: A young male patient with history of road traffic accident with eyelid, facial & forehead abrasion, axial bone window CT orbit, CT cranium & frontal 3D volume rendered CT image projection with bone thresholding showing fracture right maxillary and frontal bones involving floor & roof of right orbit. The frontal pneumocephalous present

Table 2: Injury profile of the study subjects

Characteristics	Number (n= 176)	Percentage (%)
Time of Injury		
06.00-11.59 Hour	22	12.50
12.00-17.59 Hour	65	36.93
18.00- 23.59 Hour	73	41.47
00.00- 05.59 Hour	16	9.10
Place of Injury		
Home	52	29.54
Street/Road	72	40.91
School	10	5.68
Playground	15	8.52
Work Place	27	15.34
Etiology		
RTA	66	37.50
Assault	39	22.16
Sport related	28	15.91
Fall/ Domestic Accident	18	10.23
Agricultural injury	10	5.68

Engineering Work	09	5.11
Miscellaneous	06	3.41
Traumatic Agent		
Metal	39	22.16
Stone/Brick	43	24.43
Vegetable Product / Wooden	38	21.59
Ball	16	9.10
Glass	10	5.68
Miscellaneous	30	17.04
Mode of Injury		
Projectile Object	36	20.45
Fall	43	24.43
Collision/impact	86	48.86
Blast/Fire arm	01	0.57
Miscellaneous	10	5.68

Table 3: Distribution of cases according to total number of body organ involved

Number of body Organ injured	Number	Percentage
1	30	17.05
2	86	48.86
3	58	32.95
4	2	1.14
Total	176	100

Table 4: Distribution of cases according to body Organ involved

Organ involved	Number	Percentage
Eye	30	17.05
Eye and Maxillofacial	40	22.73
Eye and Head	43	24.43
Eye, Head and Maxillofacial	35	19.89
Eye, Head and Cervical	08	4.55
Eye, Head and Limb	5	2.84
Eye, Maxillofacial, limband Abdominal/ Pelvic	2	1.14
Eye, Maxillofacial and Limb	10	5.68
Eye and Limb	3	1.70
Total	176	100

Table 5: Type of Orbital Trauma

Type of Trauma	Number	Percentage
Isolated Orbital Trauma	33	18.75
Cranio-orbital Trauma	56	31.82
Maxillofacio-orbital Trauma	52	29.54
Cranio-orbitofacial Trauma	35	19.89

Table 6: Distribution of subjects according to Right Eye –Orbital Injury

RE – Orbital Injury	No.	%
Emphysema, Fracture Floor of Orbit and Medial Wall	1	1.30
Emphysema/ Hemorrhage and Medial Wall	8	10.38
Emphysema/Hemorrhage , Lateral Wall and Roof	5	6.48
Emphysema/Hemorrhage and Roof	1	1.30
Fracture Floor of Orbit	20	25.96
Fracture Floor of Orbit and Medial Wall	9	11.68
Fracture Floor of Orbit and Lateral Wall	7	9.10
Fracture Floor of Orbit, Lateral Wall and Roof	6	7.80

Fracture Floor of Orbit and Roof	7	9.10
Medial Wall, Lateral Wall and Roof	2	2.60
Roof	11	14.30
Total	77	100

Table 7: Distribution of subjects according to Left Eye –Orbital Injury

LE – Orbital Injury	No.	%
Emphysema and Fracture Floor of Orbit	10	9.52
Emphysema /Hemorrhage, Fracture Floor of Orbit and Medial Wall	2	1.90
Emphysema, Fracture Floor of Orbit and Roof	1	0.95
Emphysema/ Hemorrhage and Roof	1	0.95
Fracture Floor of Orbit	15	14.29
Fracture Floor of Orbit and Medial Wall	2	1.90
Fracture Floor of Orbit, Medial Wall and Lateral Wall	1	0.95
Fracture Floor of Orbit, Medial Wall, Lateral Wall and Roof	2	1.90
Fracture Floor of Orbit and Lateral Wall	5	4.76
Fracture Floor of Orbit, Lateral Wall and Roof	1	0.95
Fracture Floor of Orbit and Roof	2	1.90
Medial wall	3	2.86
Medial Wall and Roof	7	6.67
Lateral Wall	8	7.62
Lateral Wall and Roof	7	6.67
Roof	38	36.19
Total	105	100

Table 8: Type of Orbital wall fracture in study subjects

Orbital wall fracture	Right Eye (N=77)		Left Eye (N=105)	
	Frequency	Percentage	Frequency	Percentage
Inferior wall (Floor)	50	64.93	39	37.14
Medial wall fracture	20	25.97	17	16.19
Superior wall (Roof) fracture	32	41.55	59	56.19
Lateral wall fracture	20	25.97	24	22.86

(More than one wall fracture in some cases)

Table 9: Distribution of subjects according to number of orbital wall fracture

Number of orbital wall fracture	RE (N=77)		LE (N=105)	
	Frequency	Percentage	Frequency	Percentage
Single wall Fracture	40	51.95	29	27.62
Two wall Fracture	26	33.77	26	24.76
Three wall fracture	07	9.10	02	1.90
Pan orbital wall fracture	04	5.20	02	1.90

Table 10: Distribution of subjects according to Clinical Presentation

Clinical Presentation	Frequency	Percentage
Diplopia	28	15.91
Decreased visual acuity	64	36.36
Ecchymosis & periorbital swelling	148	84.10
Proptosis	90	51.14
Enophthalmos	20	11.36
Emphysema	33	18.75
Orbital haemorrhage	55	31.25
Lid & periocular Laceration	60	34.10
Globe injury	73	41.48

Table 11: Distribution of subjects according to number of ocular structure involved

Number of ocular Structure Involved	Right Eye		Left Eye	
	Frequency	Percentage	Frequency	Percentage
1	0	0.00	0	0.00
2	9	11.69	24	22.86
3	28	36.36	37	35.24
4	23	29.87	27	25.71
5	17	22.08	17	16.19
Total	77	100	105	100

Table 12: Distribution of initial grad of Visual Acuity in subjects

Initial Grad of Visual Acuity	Right Eye		Left Eye	
	Frequency	Percentage	Frequency	Percentage
6/12	17	22.08	30	28.57
6/18-6/60	23	29.87	40	38.10
6/60-FC	16	20.78	10	9.52
HM-PL	12	15.58	9	8.57
NOPL	4	5.19	13	12.38
Could not be assessed	5	6.49	3	2.86
Total	77	100	105	100

Discussion

The pattern of orbito-facial fracture depends upon geographical area, cultural, environmental and socioeconomic background, age and sex distribution of the population. Present study showed male predominance, which is almost universal finding in all studies.[9-12] We found male: female ratio of 4.5:1. Observations of the present study indicate that males were more exposed to outdoor work and involved in aggressive and hazardous activities. In this study maximum orbital trauma occurred in young adult while only 17.61% patients belonged to pediatric age group. In children skull fractures were more common whereas in adult facial bones are commonly injured. Pediatric facial fractures account for only 1.55 to 15% of all facial fractures in all age group.[13,14] Of all pediatric facial fractures 3%-45% patients were associated with orbital injuries.[15,16]

The etiology of orbito-facial fracture varies across the world and even within the same country. The causes of orbital fracture also tend to change with changes in industrialization, transportation, legislative measures and lifestyle in community. In present study about one third study subjects injured due to road traffic accident. In many developing countries road traffic accidents remain the most frequent cause of orbito-facial trauma[11,12] while in most of the developed countries assault and sports are replacing road traffic accidents due to wide range of road safety measures and traffic law enforcement.[17,18] In India due to poor quality of roads, untrained drivers, lack of enforcement of traffic rules and regulations and non-usages of protective measures lead to RTA related injuries. Prevalence of assault related orbital fractures are higher in urban population.[19,20] In pediatric population, sport/ recreational accidents are the leading cause of orbital fractures in both genders. It has been reported that alcohol intake is highly associated with incidence of oculo-facial injuries caused by physical assault and RTAs.[21,22] Study from Philippine reported 73.5% patients had alcohol intake immediately prior to the motorcycle –related ophthalmic injuries.[23] Australian study observed that 76.2% of all assaults were alcohol related.[24]

In the present study majority of patients had multiple injuries (82.95%), most of them had injury to skull and facial bones. 15.90% sustained injuries outside the facial skeleton. Lim et al, in his study of 839 facial trauma patients found 11 % injuries outside the facial skeleton, 8% had injuries of extremities and 1% had spinal injury.[25] In this study orbital fracture associated with craniofacial fractures (51.71%) were more common than isolated orbital fractures (18.75%). We observed that 51.95% right eye & 27.62% left eye injury had single orbital wall fracture while pan orbital wall fracture was in 5.20% of right eye injury. The most common location of orbital fracture was the floor fracture (64.93%) in right eye and roof fracture (56.19%) in left eye injury. Several studies revealed that orbital roof fractures are more common in pediatric patients and orbital floor, medial wall and lateral wall fractures were more common in adults.[13,15,16,26,27] This series demonstrates several serious ophthalmic complications like eyelid &periocular edema and laceration, globe injury, diplopia and decreased visual acuity. In present study neurological injuries were commonly associated with skull fractures, pediatric age and multiple, complex & extensive fractures, similar to other studies.[16,28-31] Degree of visual impairment is directly proportional to the number of orbital wall

fracture and total number of ocular structure affected. Traumatic optic neuropathy was the most common cause of blindness / visual impairment.

Conclusion

Orbital injuries are commonly caused by road traffic accidents and often associated with craniofacial injuries which may be comminuted, involving multiple bones and/or associated with soft tissue edema / neurologic injuries. Management of such orbital injuries are more challenging and require a multidisciplinary approach. Degree of visual impairment is directly proportional to the number of orbital wall fracture and ocular structure injured.

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