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CORRELATION BETWEEN INCIDENCE AND SPECTRUM OF OPHTHALMIC INJURIES AND PATTERNS OF CRANIOFACIAL FRACTURES INVOLVING ORBITAL WALLS - A PROSPECTIVE STUDY

Anaesthesiology

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ABSTRACT

Introduction & Purpose : The orbit is a four sided pyramid housing precious contents, the globe and its surrounding soft tissue adnexea. Even a modest change in the position of one of the bony walls can have a significant impact on the orbital volume and, thus, globe position.

Aim : A study was designed to analyse the incidence and spectrum of ophthalmologic injuries in patients with craniofacial fractures involving orbital walls and draw a correlation for their severity scales.

Materials and Method: 60 Subjects with craniofacial fractures with suspected orbital wall involvement underwent thorough clinical examination & plain radiographic assessment using Para Nasal Sinus x - ray, CT scan using axial and coronal section of the orbit. Specific code ($F_x M_x R_x L_x$) was assigned for pattern of fractures in each case. Ophthalmic findings were recorded and correlation drawn between patterns of fracture, their etiology and ophthalmic injuries and their severity scale. Statical analysis test done using Chi square Method.

Result : A male subjets were Most commonly involved with age group between 20 to 30 years. Orbital floor fractures 81.08% (n=60) were most common followed by medial wall 68.91% (n=51), lateral wall 66.21% (n=49), and roof 32.43% (n=24). Minor ophthalmic injuries (60.14%) were mostly associated with two wall orbital fractures. While moderate (24.63%) and Major (15.21%) ophthalmic injuries were most involved when three orbital walls were fractured. RTA (73.3%) was the most common etiology followed by assault (15%) and falls (10%). There was a significant association observed between etiology and severity of ophthalmic injuries with a $p< 0.000$.

Conclusion : A prompt and systematic ophthalmic examination is indispensible when there are two or more orbital wall fractures as 15.21% of these cases have major ophthalmic injuries which may or may not be grossly evident, but have the potential to cause a serious threat to the visual status.

KEYWORDS

Ophthalmic injuries, Orbital wall fractures, Traumatic optic neuropathy

Abbreviation :
TRON –Traumatic optic neuropathy
RTA- Road Traffic Injuries
NOE- Naso-orbitoethmoid
PNS – Para Nasal Sinus

Introduction

The orbit is a four sided pyramid housing precious contents, the globe and its surrounding soft tissue adnexea. Anatomically it is located at the cross roads between the facial skeleton and cranial base and hence is often involved in complex Craniofacial fractures, Zygomatic complex fractures, NOE (Naso-orbitoethmoid) fractures, Midface fractures and as standalone orbital blow out fractures.

The average adult orbit has a volume of 30cc in which the globe occupies 7cc. Even a modest change in the position of one of the bony walls can have a significant impact on the orbital volume and, thus, globe position. Bones of the orbit serves to room and protect the globe. the orbit forms by seven bones: Maxillary, Zygomatic, Frontal, Ethmoidal, Lacrimal, Palatine, and Sphenoid.

It has been reported that ocular injuries increased by factor 6.7 when Major trauma associated with facial fractures[1].

The reported incidence of ocular injuries with midface fractures has ranged from 2.7% to 90.6%[2].

Ocular injury may result in preventable severe dysfunction of the visual apparatus, if not detected shortly after injury[2]. In this era of navigational orbital surgery it is imperative for every trauma team member to have a critical view of the ophthalmic apparatus in order not to lose sight of some innocuous signs which may lead to irreversible consequences. Hence, visual disturbances after craniofacial trauma are weighed as a severe complication and must be diagnosed early and treated in order to prevent permanent implications. This study was designed to analyse the incidence and spectrum of ophthalmologic injuries in patients with craniofacial fractures involving orbital walls and draw a correlation if any between their severity scales.

Material and Methods:

This prospective study included 60 Subjects who presented with craniofacial fractures involving the orbital walls of varying severity with or without ophthalmic injuries irrespective of gender, caste or creed. The study was conducted in MGM Institute of Health sciences from December 2014 to august 2016. Inclusion criteria were subjects with orbital wall fracture patterns ranging from linear to comminuted with or without bone loss or orbital blow out. Only those who reported within 5 days post trauma, with age group of 20-60 years were considered. Exclusion criteria were subjects within fractures not involving orbital walls and with pre existing ocular injuries like cataract, Graves disease, glaucoma and concomitant brain injuries with Glasgow coma scale below 13 and malunited fracture of orbital walls. The study was approved by the institutional review board and All subjects gave written informed consent.

Subjects with craniofacial fractures with orbital wall involvement underwent thorough clinical examination & plain radiographic assessment using PNS (Para Nasal Sinus) view to confirm the presence of orbital wall fractures. The pattern & severity of the orbital wall fracture was established by a systematic review of axial and coronal sections & 3D reconstructed images of the Para nasal sinus & Orbital scans. Based on the radiographic findings, the patient was assigned a specific code which was based on number of walls involved and the severity of the pattern of orbital wall involvement. This code was based on the following scheme and recorded as ($F_x M_x R_x L_x$) where x ranged from 0-4 depending on the pattern of fracture and the letter code was based on the scheme F- Floor, M – Medial wall, L – Lateral wall and R – Roof. The combined score assignment was as follows:

No Fracture Involvement of the Specific Orbital Wall
Floor (F0)
Medial Wall (M0)
Roof (R0)
Lateral Wall (L0)

Simple Non comminuted Fractures Involving the Specific Orbital Wall
Floor (F1)
Medial Wall (M1)
Roof (R1)
Lateral Wall (L1)

Communited Fractures Involving the Specific Orbital Wall
Floor (F2)
Medial Wall (M2)
Roof (R2)
Lateral Wall (L2)

Communited Fractures with Bone Loss Involving the Specific Orbital Wall
Floor (F3)
Medial Wall (M3)
Roof (R3)
Lateral Wall (L3)

Pure Blow-Out & Blow In Fractures Involving the Specific Orbital Wall
Floor (F4)
Medial Wall (M4)
Roof (R4
Lateral Wall (L4)

On confirmation of presence of orbital wall fractures and grading their pattern, a thorough ophthalmological examination was done which included visual acuity by Snellen's Chart, Visual Field by Perimetry, Intraocular Pressure by Tonometer, Diplopia by Hess's Chart[1], Pupilary reactivity by Direct and Consensual Light reflex and other Ophthalmic Findings by Using Slit Lamp and Fundus Examination and the findings were recorded and graded in terms of severity and described as major, moderate and minor based on the potential to cause permanent visual loss. (Table No / 1) Minor injuries included those that in all likelihood would not result in permanent visual sequelae. Moderate injuries were those which could cause visual disabilities but not complete visual loss. Major injuries were those with a potential for permanent visual loss.

The other variables which were reviewed were age, gender, mode of injury, date of injury, date of presentation to hospital, and other sites of fracture involved.

Correlation was drawn between the severity of preoperative ophthalmic injuries & pattern of orbital wall fractures and their etiology using Chi-square Test.

The data was entering into a MS-Excel Sheet. Further analysis was done using Statistical Package SPSS 22.0 software. The data was presented using descriptive statistics and Tables/graphs. Further analysis was performed using Chi-square test for correlation. The level of significance was set at 5%. All p-values less than 0.05 were treated as significant.

Results –
It was observed that the males (88.33% n=53) were most commonly affected in all age groups and the overall mean age of involvement was 31 years.(Table No / 2)

The most common etiology was RTA (Road traffic accident) (Figure No / 1) 73.3% (n=44), followed by assault 15% (n=9), fall 10% (n=6) and other causes 1.7% (n=1). RTA was the most common cause in both males and females with a $p < 0.0001$.

Bilateral orbital involvement was seen in 14 subjects (23.33%) accounting to 28 orbits and 46 subjects (76.66%) showed unilateral involvement Unilateral was significantly more common than bilateral with $p < 0.0001$. Amongst unilateral fractures, Right side involvement was more common (n= 26) than left side (n=20). In the study total 74 orbits were evaulated. Assessment of the incidence of different facial fracture patterns showed that Zygomatic complex fractures was the most common pattern observed 35.13% (n=26) followed by combined fractures involving multiple sites 27.02 % (n=20), Lefort II & III fractures 24.32% (n=18), NOE complex fractures 6.75% (n=5), orbital blow out fractures 6.75% (n=5), and lastly frontal bone injuries 2.70% (n=2).

Periorbital edema and ecchymosis were present in all orbits (100% , n=74). Step deformity was most commonly elicited in the Inferior Orbital Rim 75.67% (n=56) , followed by lateral Orbital Rim 63.51% (n=47), medial Orbital Rim 44.59% (n=33) and superior Orbital Rim 35.1% (n=26). Tenderness on palpation involved the Inferior Orbital Rim in 74.32% (n=55) followed by lateral Orbital Rim 63.51% (n=47), medial Orbital Rim 37.83 % (n=46) and superior Orbital Rim 36.48% (n=27). Nerve injuries in form of paraesthesia were observed most commonly in the supra orbital region, 19.23% (n=5) in roof fractures followed by Infraorbital region 18.18% (n=10) in floor fractures and malar region in 11.11% (n=3) among lateral wall fractures. Ptosis was present in 1.35% (n=1) (Figure / 2). Anti mongoloid appearance was observed in 21.27% (n=10).

Out of 60 only 39 subjects underwent plain PNS radiographs assessment (Figure No / 3**)** it was not feasible because of associated injuries like lower limb injuries, chest trauma and difficulty in positioning due to associated with facial fractures. Total subjects with bilateral involvement were 9 (18 orbits) and Unilateral were 30 (30 orbits). Therefore total 48 orbits were evaluated by Plain radiographic PNS assessment.(Table No / 3)

On CT scan evaluation(Figure No / 4), Orbital floor fracture was most commonly involved followed by medial wall lateral wall and roof. Linear fracture was most commonly observed in the floor 70% (n=42).Communited fractures were seen in medial wall 62.74% (n=32) and Bone loss was evident in medial wall in (33.33%) (n=17). (Table No / 4)

One wall involvement was seen in 24.32% (n=18), two walls in 36.48% (n=27), three walls in 27.02% (n=20) and four walls in 12.16%(n=9). Most common pattern in one wall was lateral wall followed by floor and medial wall, in two walls, were floor and medial and floor and lateral wall combination and in three walls, were floor, medial and lateral wall.

Incidence of Ophthalmic Injuries in Craniofacial Fractures involving Orbital walls were showed in (Table no / 5). Subconjunctival haemorrhage was most the common (94.59%) (n=70) finding. Enophthalmos was seen in 8.1% (n=6), Proptosis in 2.70% (n=2), altered pupillary reactivity in 10.81% (n=8), traumatic mydriasis in 6.75% (n=5), retrobulbar haemorrhage 1.35% (n=1) , traumatic optic neuropathy in 10.81% (n=8), retinal haemorrhage in 2.70% (n=2) and blindness was present in 7.24% (n=5). Surprisingly none of the subjects had injuries such as angle recession, hyphema, choroidal rupture, vitreous haemorrhage, retinal detachment and retinal tear.

Visual acuity was decreased 17.56% (n=13). Out of 13 subjects, visual acuity were less than 6/6 was seen in 3 subjects, only finger movements were seen by 2 subjects and hand movements were visible to 1 subject. Perception of light was present in 2 subjects and no perception of light was seen in 5 subjects.

The total number of minor injuries was 83 (60.14%), moderate injuries were 34 (24.63%) and major injuries were 21 (15.21%). Overall incidence of ophthalmic injuries was 9.32%. For minor injuries, most common pattern of fracture was two walled fracture. Moderate and major injuries were most evident when there was a triple wall involvement (floor, medial and lateral. There was however no significant association between number of walls involved and incidence of ophthalmic injuries with p value of 0.405. **(**Graph / 1**)**

RTA (73.3%) was the most common etiology in all ophthalmic injuries. Second most common etiology was assault (15 %) and third most common etiology was fall(10%). There was significant association between etiology and severity of ophthalmic injuries with $p < 0.0001$. (Graph / 2)

Discussion
Facial fractures are frequently complicated by injury to the eye and its adnexea which are made devoid of protection. Early recognition and definition and close monitoring of progress of these structural and functional defects may go a long way in improving long term prognosis.. Hence it becomes imperative for the maxillofacial surgeons to determine which patients warrant ophthalmic referral and with what urgency.

Peak incidence in the male population between the second and third decades could be attributed to the fact that they constitute the most mobile and active working age group, undergoing travel and hence more prone to be involved in road traffic accidents.. Similar observations were also made in other studies by Ellis et al who reported the peak incidence in males between 20 to 30 years and in females between 30 to 40 years[4], Al-Qurainy et a recorded an age profile of 20-30years for both sexes[5] and Amrith S reported a mean age of 32 with a range of 20-40years for both sexes[6].

However a study done by Zhou et al suggested that patients were seen

in the age group of 30 to 39 years most commonly followed by 19 to 29 years with mean age of 32.40 years[7]. Higher incidence in males is a universal finding in all previous studies[8]. The peak incidence in the second to third decades with a mean age of 31 years is identical to the observations in other studies.

Zygomatic complex fractures was the most common pattern involved in our study. A study done by Septa D on the patterns of midface fractures and associated ocular injuries showed that the ZMC fractures (62.5%) was most commonly seen followed by Lefort II (23%), multiple fractures (10%), Lefort I (6%), Lefort III (4.5%) and nasoethmoidal fractures (4%)[8]. Charis Ioannides et al noted over a 9 year period that in a series of 491 patients who had sustained orbital fractures with ocular injuries, 411 were malar bone fractures followed by 41 blowout fractures, 59 Lefort II, 35 Lefort III and 49 fractures of the upper third of the face (frontal, supraorbital, nasoethmoidal)[9]. The frequency of involvement of various sites indicated involvement of ZMC, followed by multiple facial fractures and Lefort II and III level fractures in this study. This could have been the outcome of a high velocity frontal impact from a point superior to the horizontal plane through the level of the inferior orbital rims as evidenced in unrestrained frontal impact in motor vehicle accidents which was the main cause.

The right sided preponderance in this study could be attributed to the fact that they had succumbed to Road traffic accidents with right handed driving norms. Out of 2067 patients analysed by Ellis et al, Bilateral fractures were found only in 93 patients and were mostly due to motor cycle accidents[4]. Amongst the 1974 patients with unilateral involvement 53.8% occurred on the left side as they were mostly caused by assault by right handed persons. Victims of road traffic accidents however saw a right sided involvement[4].

Bilateral involvements may pose a greater diagnostic challenge due to complexity of injury, lack of base line for reference and need for more guarded approach in management.

Periorbital edema and ecchymosis was present in 100% of the subjects. Similar frequency of findings was seen in a study by H.S.Karabekir et al who reported 89.65% of cases with periorbital hematoma[10]. Kim Y-J et al recorded Periorbital swelling in 82.1% and ecchymosis in 38.7%[11]. According to G Mittal, he found 72% cases of eyelid swelling and bruising in his study population and stated that it may be caused by subcutaneous Palpebral hemorrhages which gradually absorb[1].

Infraorbital foramen is the weakest point in the zygomatic area which usually lead to injuries to the Infraorbital nerve always gives sign of sensory disturbances in the initially stage[12]. Kai Lund reported sensory disturbances in the infraorbital region in 41 patients of the 62 patients with fractures of the zygoma[13]. Liebston et al. reported 55 patients with infraorbital paresthesia of 365 orbital floor fractures[14]. Peter Jugell and Lindqvist recorded a 81% incidence of paresthesia of the infraorbital nerve in 68 patients with the fractures of zygomatic complex[15].The present study showed a low incidence of infraorbital nerve disorders (18.18%) in comparison to the previous mentioned studies. This low incidence could be explained by the predominenetly linear configuration of fractures involving the orbital floor with no gross disruption..

In the PNS x rays, 27.08 % orbits showed an increase in the size of the orbit. Amongst these subjects, fractures involving ZMC and midface concomitantly showed increase in volume with displacement of orbital floor and lateral orbital wall.

Axial and coronal CT images are probably the only tool available on hand for critical evaluation of the orbital walls.

Analysis of the axial and coronal sections and 3D reformations (Figure No / 5) of the 74 orbits involved showed that the orbital floor fracture was the most frequently involved (81.08%). The medial wall followed next (68.91%), Lateral wall was affected in (66.21%) and the least frequently involved was the roof of the orbits(32.43%). The orbital roof and Medial wall are the thinnest wall compare to lateral and roof of the orbit and more prone for fractures, the orbital floor fractures also occur due to a buttressing effect of the ethmoid sinus laminas . while the lateral wall composed of the robust zygoma and greater wing of the sphenoid is more resistant . Roof is the most secure and least affected.

According to Kramp et al, the orbital floor is involved in 69%, the medial orbital wall in 19% and combined orbital floor and medial wall fractures in 10%. Less common are orbital roof fractures at 1.2% and combined medial orbital wall/orbital floor/orbital roof fractures with a frequency of 0.6%[16], Study done by H.S Karabekir et al, revealed that the lateral wall (n=63) was most commonly involved, second most being floor (n=32) followed by medial wall (n=14) and least frequently affected was roof (n=11)[10]. Kim Y-J et al, noted most commonly wall affected was medial wall (62.5%), followed by inferior wall (51.5%), lateral wall (13.9%) and superior wall (12.4%)[11].

Sub conjuctival Haemmorhage was present in 94.59% of the subjects and therefore proved to be the most reliable clinical pointer of orbital wall fracture. This compared favourably with the findings of Septa D (83.5%)[8] and AAL-Querainy et al (63.4%)[5].

Incidence enophthalmos in 8.1% of the subjects involved are closely in accordance with those of D. Septa et al (8.5%) and Al-Qurainy et al. The patterns of fracture that resulted in enophthalmos were midface and zygomaticomaxillary complex fractures with comminution and bone loss of the floor and multiple orbital wall fractures[8].

Traumatic mydriasis(Figure No / 6) was present in 6.75% subjects (n= 5), of which n=4 had 3 to 4 walls of the orbit disrupted. The reason for the dilatation of the pupil could be blunt eye injury with concussion of the dilator muscles of the iris considering the severity of the impact as evident from the orbital wall involvement.

Incidence of TRON (Traumatic Optic Neuropathy) in association with midfacial and craniofacial fractures has been reported as 2.5 to 10% . The most common site for indirect injuries is the optic canal. The real challenge has been in the diagnosis of TRON as it solely based on clinical grounds. Some of the sign posts which may point towards TRON are injury to the supero lateral orbital region, fracture of optic canal, evidence of orbital haemorrhage, evidence of blood in posterior ethmoidal sinus, cerebral lesion and history of loss of consciousness.

Superolateral orbital injuries were seen which ranged from blunt contusion to frontal bone fracture. All 8 patients had lateral wall fractures and 3 had frontal bone associated .it is postulated that blows to the malar and frontal areas are transmitted mostly to the optic foramen. Out of 8 patients, 4 had all four orbital walls and 3 had three orbital walls with consistent involvement of lateral and superior wall. It is imperative therefore to not only view such fracture patterns involving lateral and superolateral walls with suspicion but also exercise extensive caution during their mobilization and repair.

Subjects visual acuity status and pupillary reflex status are “vital signs” of the eye[8]. Al- Qurainy et al have reported impaired acuity in 11.6% (42/363) and D. Septa et al in 11.5%[8]. Shanta Amrith (2000) reported 23% patients with decrease in visual acuity, with 12.5% having permanent visual impairment[4]. This study observed 17.56% (n = 13) subjects with impaired visual acuity at the time of reporting, out of which n=5 were negative to light perception.

The subjects with negative light perception (n=5) had involvement of all 4 orbital walls (n= 2) or involvement of minimum 3 orbital walls (n=3). The common finding among the three was the presence of lateral wall involvement.

The above findings emphasize the fact that it is mandatory to perform visual acuity testing when there are multiple orbital walls involved in fractures specifically with involvement of lateral wall.

Diplopia is a common complaint among patients with maxillofacial trauma. El Attar et al (1985) gave an incidence of 74.5% in pure blow out fractures. In a study by Gaurav Mittal, 5 out of 131 patients had symptomatic diplopia, three with orbital blow out fractures and two with ZMC fractures[1]. In present study had low incidence of diplopia (1.35%). reason for the low incidence is that the drain effect into the sinuses when there is a comminuted fracture of the floor or the medial wall which were the sites most commonly involved in this study.

One wall was involved in 24.32% (n=18), Two wall in 36.48% (n=27), Three walls in 27.02% (n=20) and four wall in 12.16 %(n=9). Most common single wall was the lateral wall followed by floor and medial wall. Two walls combinations were typically floor and medial or floor and lateral wall and three walls were customarily floor, medial and lateral wall. Similar frequency findings were presented by Nagase et al in which incidence pattern was two wall (n=46), followed by three walls (n=37), one wall (n=20) and four walls (n= 16), However they

also included no orbital wall involvement (n=147))in facial fractures. Selim Karabekar conducted a retrospective multicentric study of 588 patients who had sustained blunt head trauma. They identified orbital fractures in 112 cases which when carefully analysed involved one wall in 48%, two walls in 30%, three walls in 19% and four walls in 3%. The lateral wall was the most frequently involved (n=63), the floor was next (n=32), Medial wall disruptions (n=16) and the least frequent was the roof. These results were distinctly different from those in the present study, where 2 wall involvement predominated (36.48%), followed by 3 wall injury (27.02%), single wall fractures (24.32%) and lastly 4 wall disruptions (12.16%). This higher degree of disruption of the orbital walls in terms of number could be because of the mechanism of Orbital trauma. High velocity road traffic accidents lead to more widespread dissipation of the impact force which is mostly likely from the frontal direction. Differences in relative strengths and structure of the 4 walls lead to its disruption at multiple points.

Minor ophthalmic injuries were recorded in 60.14%, moderate injuries in 24.63% and major injuries in 15.21% of the subjects. Comparable statistics of injuries were reported by Mittal G with 61.2% minor injuries, 29.03% moderate injuries and 9.6% major injuries[1]**,** Jamal et al found 66.6 % minor injuries and 10% major injuries but excluded moderate injuries[2]. Al Qurainy et al observed 63.4% subjects with minor injuries , moderate injuries in 15.7% and severe injuries in 11.6%[4]. Holt et al reported 79% temporary injuries, 18% moderate injuries and 3% blinding injuries[19]. Shantha amrith et al showed 9% incidence of severe injuries in a retrospective evaluation. This present study showed higher incidence of major injuries compared to previous literature and comparable incidence of minor and moderate injuries to the above mentioned studies.

The overall incidence in this study was found to be 9.32% which parallels that in other studies. Jabaley et al found an 11% incidence of eye injuries in 70 orbital fractures evaluated retrospectively. Holt and Holt (1983) has reported one of the highest incidences (67%)[19]**.**

In Minor injuries most common fracture configration was two wall involvement. Moderate and Major injuries peaked in three wall fractures. There was however no significant association between wall and ophthalmic injuries. (p = .405)

In the present study it was considered more prudent to correlate the severity of fracture in terms of number of orbital walls involved to the ophthalmic injury incidence, as most high velocity road traffic accidents often result in multiple facial bone fractures running through several orbital wall and hence drawing a one to one correlation may be difficult and meaningless.

RTA was the most common etiology in all wall fractures with ophthalmic injuries. Second most common etiology was assault and the third most common etiology was fall. There was a significant association between etiology and severity of ophthalmic injuries. (p< 0.0001)

Similar findings were presented by zhou et al who concluded that MVAs more frequently resulted in ocular injuries (p< 0.001), conversely ocular injuries occur less frequently as a result of the etiology of fall at ground level or fall from height[20], Road traffic accidents remain the most frequent cause in the many developing countries including india[8].

Limitation and future recommendation of the study :

Limitation of this study was that it is single center study with small sample Size. So multicentric trials would help devise a standard protocol for rapid ophthalmic evaluation in craniofacial fractures in the trauma and emergency clinic which would help prompt and recognition of obvious and subtle ophthalmological injuries

Conclusion:

Suscipion and prompt recognition of possible ophthalmic injuries is of utmost importance in fractures in mid and upper face for several reasons. First and foremost the management of ocular injuries may have to take precedence over the treatment of midfacial and orbital fractures to salvage vision. Secondly the fracture repair in the setting of an occult ocular injury (ruptured globe, retinal detachment) may result in exacerbation of the injury, resulting in devastating visual loss. Thirdly recognition of the extent and possible irreversibility of the ophthalmic injuries is crucial preoperatively before fracture repair is undertaken from a medico-legal standpoint.

Table No / 1: Grading Of Ophthalmic Injuries in terms Of severity as Minor, Moderate and Major.

Minor Ophthalmic Injuries	Moderate Ophthalmic Injuries	Major Ophthalmic Injuries
Sub Conjuctival Haemorrhage	Proptosis	Retinal detachment
Intraocular Pressure	Limitation of gaze	Retinal tear
Hyphema	Diplopia	Retinal haemorrhage
Angle recession	Orbital dystopia	Retrobulbar haemorrhage
Visual acuity	Visual field limitation	Choroidal rupture
	Altered pupillary reactivity	Traumatic optic neuropathy
	Enophthamous	Blindness
		Traumatic Mydriasis

Table No / 2: Age distribution of the subjects.

Age	20 to 30 yr		30 to 40 yr		40 to 50 yr		50 to 60 yr	
Groups	N	%	n	%	n	%	N	%
Male (n=53)	28	93.3%	12	80.0%	10	90.9%	3	75.0%
Female (n=7)	2	6.7%	3	20.0%	1	9.09%	1	25.0%

Table No / 3: Plain PNS Radiographic Xray Findings.

Sr.N	Parameter	Present (Total-48)
1	**Increase in Size of the Orbit :**	27.08% (n=13)
2	**Step Deformity:**	
	Supraorbital Rim	31.25%(n=15)
	Infraorbital Rim	56.25%(n=27)
	Medial Orbital Rim	20.83% (n=10)
	Lateral Orbital Rim	66.66%(n=32)
	Frontozygomatic suture	43.75%(n=21)
	Fronto Nasal Suture	4.16%(n=2)
	Zygomatico Buttress	33.33%(n=16)
3	**Opacification:**	
	Maxillary Sinus	81.39% (n=35)
	Frontal Sinus	53.33%(n=8)

Table No / 4 CT Evaluation Findings for Contour of Bony walls:

Sr. NO	Orbital Walls	Each wall (n=74)	Linear Fracture	Communited Fracture	Bone Loss	Blow out Fracture
1	Orbital Floor	81.08% (n=60)	**70% (n=42)**	10% (n=6)	11.66% (n=7)	8.33% (n=5)
2	Medial Orbital wall	68.91% (n=51)	3.92% (n=2)	**62.74% (n=32)**	**33.33% (n=17)**	0% (n=0)
3	Lateral orbital wall	66.21% (n=49)	55.10% (n=27)	40.81% (n=20)	4.08% (n=2)	0% (n=0)
4	Orbital Roof	32.43% (n=24)	70.83% (n=17)	25% (n=6)	4.1% (n=1)	0% (n=0)

Table No / 5 : Incidence of Ophthalmic Injuries in Craniofacial Fractures involving Orbital walls.

Minor Ophthalmic Injuries	Moderate Ophthalmic Injuries	Major Ophthalmic Injuries
Sub Conjuctival Haemorrhage 94.59% (n=70)	Proptosis 2.70% (n=2)	Retinal detachment 0% (n=0)
Intraocular Pressure 1.35% (n =1)	Limitation of gaze 0% (n=0)	Retinal tear 0% (n=0)
Hyphema 0% (n=0)	Diplopia 1.35% (n=1)	Retinal haemorrhage 2.70% (n=2)
Angle recession 0% (n=0)	Orbital dystopia	Retrobulbar haemorrhage 1.35% (n=1)
Visual acuity 17.56% (n=13)	Visual field Impairment 8.10%. (n=6)	Choroidal rupture 0% (n=0)
	Altered pupillary reactivity 10.81% (n=8)	Traumatic optic neuropathy 10.81% (n=8)
	Enophthamous 8.1% (n=6),	Blindness 7.24% (n=5)
		Traumatic Mydriasis 6.75% (n=5)

Figure / 1 A 26year old male subject presented with Pan facial trauma due to road traffic accident ith lacerated wound over right frontal region.

Figure / 2 Traumatic Ptosis, telecanthus, orbital dystopia present on right side due to communited fractures of right lateral, inferior and medial wall

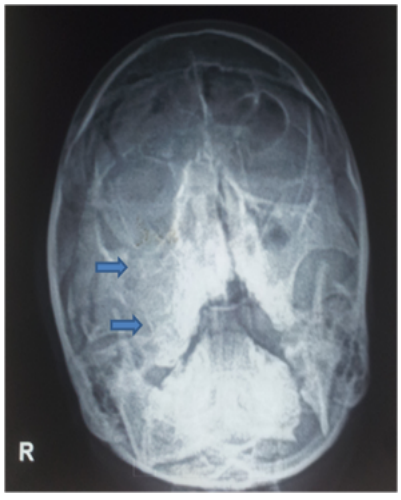


Figure / 3 PNS x ray showing enlargement of circumference of right orbit with step off involving all orbital walls, zygomatic buttress and filling of right maxillary sinus.

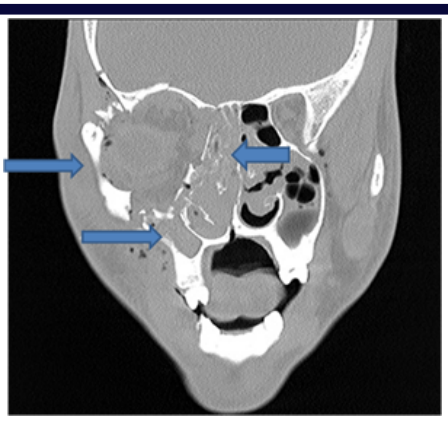


Figure / 4 Coronal CT scan showing communited fractures of Infraorbital, Medial wall and Lateral wall of right orbit and linear fracture of supraorbital wall. Hemosinus present in Bilateral Maxillary and Ethmoidal sinus and right Nasal cavity.

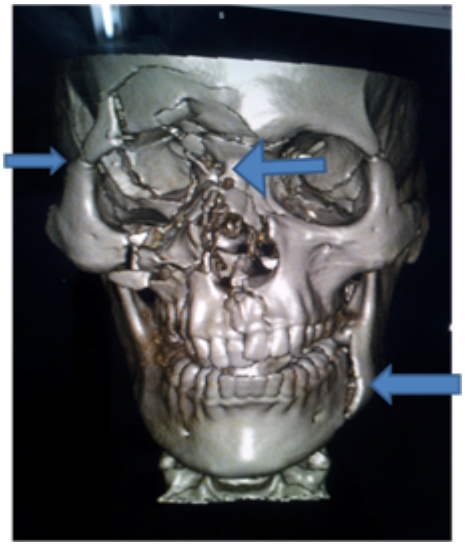
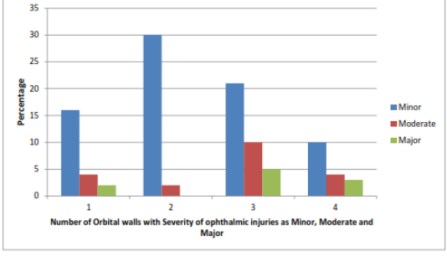
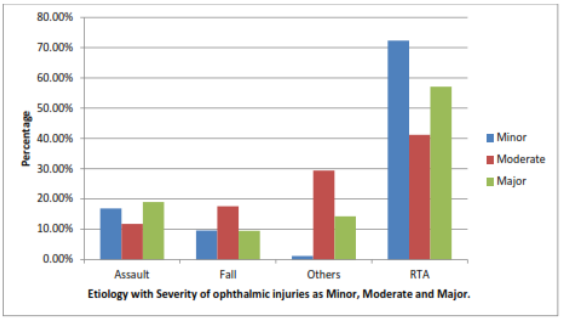


Figure / 5 3D scan showing Communited fractures of right side frontal bone and all four orbital walls, Nasal bone, Maxilla And left Mandibular angle, a consequence of high velocity road traffic accident.

Figure / 6 Traumatic Mydriasis present due to blunt trauma to pupillary muscles in a subject with four orbital wall fracture involvement pattern.



Graph No / 1 Correlation the severity of ophthalmic injuries with the patterns of Orbital wall fractures.



Graph No / 2 Correlation of Etiology with Ophthalmic Injuries.

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