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DIPLOPIA AND ENOPHTHALMOS FOLLOWING MID FACE FRACTURES – A PROSPECTIVE CLINICAL STUDY.

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Abstract:

BACKGROUNDAND OBJECTIVE: Mid face trauma needs careful ophthalmological evaluation to assess the presence of vision threatening injuries.Injuries like diplopia and enophthalmos mostly occur in midface fractures involving orbit. Inappropriate treatment can be a devastating experience for the patients. It can also lead to medico-legal aligations. Timely detection and correction of injuries reduces morbidity. The prevalence and co-relationship of diplopia and enophthalmos in midface fractures and frequency of surgical correction needed is assed in this study.

METHODS: This study assessed 401 patients with Lefort I, Lefort II, Lefort III, zygomatic complex and naso-ethmoid fracture. Assessment of diplopia and enophthalmos in facial fractures was done through clinical examination and specific tests. Ophthalmological evaluation was completed under the guidance of a registered ophthalmologist. Orbital injuries that lead to diplopia and enophthalmos was assessed clinically and radiographically .

RESULTS: .The incidence of enophthalmos was 54.5% and diplopia15.7% in the present study. Zygomatic complex fractures with involvement of the lateral wall of orbit and the infra orbital rim along with extension to the orbital floor showed highest association with diplopia and enophthalmos .

CONCLUSION: Based on the study it can be concluded that all mid face fracture need a comprehensive ophthalmological evaluation to rule out vision threatening injuries. Early surgical intervention was needed in the correction of enophthalmos, hypoglobus, diplopia etc. Zygomatic- complex fracture was the main midface fracture associated with highest incidence of ophthalmic and orbital injuries.

KEY WORDS: Diplopia, enophthalmos, supraorbital rim, infraorbital rim, floor fracture, extraocular movements.

INTRODUCTION

Diplopia and enopthalmos are frequently encountered complications of mid face fractures that involve the orbital walls causing enlargement of orbit leading to displacement of orbital contents. Human orbit is a small cavity having the shape of a pyramid with the apex pointing posteriorly. Within this crowded space are juxtaposed a complex array of tightly packed structures serving the ultimate function of vision. Orbital fat and connective tissue fascia act as a cushion protecting orbital contents and together they serve as a functional unit of vision ,whose complexity and precision are unmatched elsewhere in the vertebrate body. Maxillofacial injuries especially those affecting the middle third of the face disrupts the orbital anatomy and cause entrapment and displacement of orbital contents. These injuries causes an alteration in the level of globe leading to diplopia , enophthalmos, vision threatening injuries etc.

Enophthalmos can be assessed only when odema, hematoma and inflammatory reaction following fracture subsides. Enophthalmos have a wide range of causes. One of the cause suggested in early literature states is atrophy of orbitalis muscles seen in the floor of orbit due injury to the sympathetic nerves causing horner's syndrome and third nerve paralysis. Another cause of enophthalmos is the atrophy of orbital fat due to the distruption of orbital walls in mid face trauma, leading to dislocation of trochlea ,tearing of muscle attachment, cicatricial contraction of retrobular tissues. Injury to the sympathetic innervations can also lead to fat atrophy. Enophthalmos canalso be due to displacement of orbital fat to maxillary sinus through fractured orbital walls, or displaced walls itself causing an increase in orbital volume. Diplopia occurring in midface

fractures is a devastating experience for the patient. Two types are there monocular and binocular diplopia. Alteration in the visual axis with respect to the opposite eye causes diplopia in orbital floor fractures. Displaced orbital floor fracture can causes entrapment of periorbita and inferior rectus muscle leading to diplopia. Usually patients presents with downward displaced eyeball, accentuated superior palpebral groove, extrocular movement restriction. Entrapment and scarring of inferior rectus and inferior oblique muscle between fracture is the cause of limitation of movement of eyeball.

Determination of the prevalance and co-relationship of ophthalmic injuries in mid face trauma was the objective of this study. This study also assessed the pattern of orbital injuries mostly associated with diplopia and enophthalmos.

MATERIALS AND METHODS: The duration of study was from May 2014 to May 2016.Total number of paients assessed was 401.All patients received a comprehensive ophthalmological evaluation. Clinical, Radiographic/ CT evaluation was done to assess various orbital fractures and patterns of injury. All patients sustaining confirmed midface fractures was included in the study. Excluded cases were those with solitary fractures of the dentoalveolar process or pure dental injuries, only soft tissue injuries in facial region, isolated mandibular fractures. Patient evaluation included history, clinical examination, ophthalmological assessment, radiographic evaluation, and treatment given. History included personal details, date of injury, causes of trauma to mid face. Pre-existing ophthalmic injuries, alterations in visual acuity related to conditions like diabetes, and due to other ocular diseases were noted.

Clinical examination: Enophthalmos assessed by positioning the patient's chair at a 45 –degree angle or by asking the patient to lift his /her chin up, and then examine the patient from below and compare the position of cornea with respect to the malar surfaces. Accentuation of supratarsal fold and upper eyelid ptosis indicate enophthalmos, which can be more accurately measured with Hertel exophthalmometer

Figure 1: Enophthalmos

Figure 2: Enophthalmos

Restriction of extraocular movements assessed by asking patient to sit or stand with head up and looking straight ahead. A pen or finger was held about 14 inches from the patient's eyes; ask the patient to follow the finger as it is moved through the six cardinal fields of gaze. A cover/uncover test was also done. In forced duction test a cotton tip applicator soaked in topical anesthetic was held on the conjunctiva for one minute. A small non-toothed forceps was used to grasp the conjunctiva and extraocular muscle insertion about 8 mm from the cornea and the globe is rotated both towards and away from the muscle. Resistance suggested muscle entrapment.

Figure 3: Superior gaze restriction

Diplopia assessed by red –glass test. A red plane glass is placed in front of one eye and light source was moved in all nine directions of gaze. Red glass helped to dissociate the eyes and makes diplopia more recognizable by perceiving both white light and red light when diplopia is present. A horizontal line is drawn through the center of the pupil of both eyes. Depression of level of pupil below this line suggest hypoglobus

Figure 4: Diplopia test

All the four orbital rims were palpated for any tenderness or step defect.Increase in orbital volume due to fracture of orbit causes enophthalmos and hypoglobus. Extraocular muscles entrapment lead to restriction of extra ocular movements and diplopia.

Radiological evaluation waters view was the main plain X–ray view used. CT scan; axialand coronal views were used to assess the involvement of various orbital walls and rims.Mid face fractures were radiographically confirmed using waters view, PA skull, lateral skull views and axial,coronal and sagittal sections of CT Scan.

Figure 5: Coronal CT view

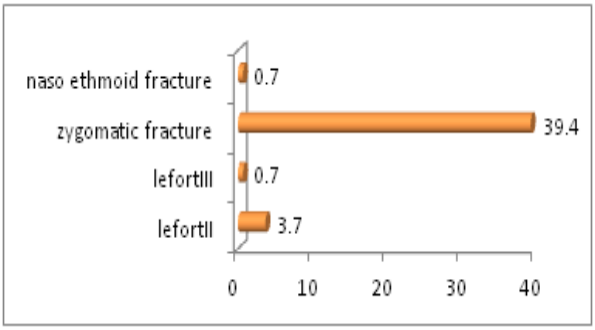
Figure 6: Intraop view

Figure 7: Floor Repair

Results: The results are summarized in the form of tables and graphs as follows. The statistical test used in the study was chi square test for ophthalmic injuries and software employed is SPSS

Table 1: Distribution of enophthalmos in mid face fractures.

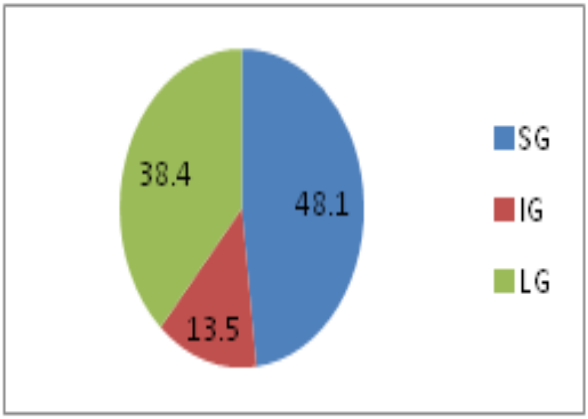
Midface fracture	Frequency	Percent
Lefort II	15	3.7
Lefort III	3	0.7
Zygomatic-complex fractures	158	39.4
Naso ethmoid fractures	3	0.7
No injury	222	55.5
Total	401	100.0



Graph 1: Distribution of enophthalmos in mid face fractures

Table 2: Distribution of restriction of extraocular movement invarious gazes.

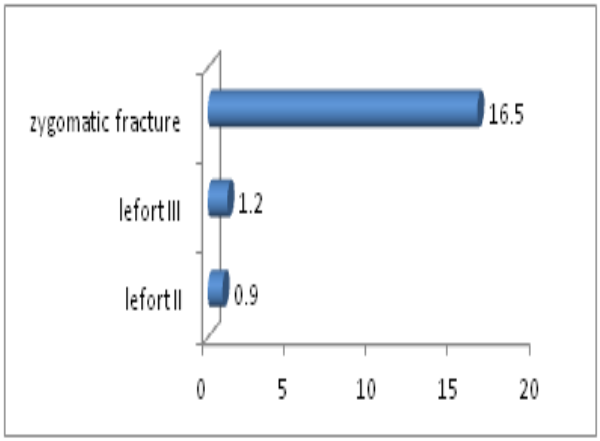
Restriction	Frequency	percentage
SG	75	48.1
IG	21	13.5
LG	60	38.4
MG	0	0
Total gaze restrictions	156	0.1



Graph 2: The restriction of extraocular movement in various gazes

Table 3: Superior gaze restriction in mid face fracture.

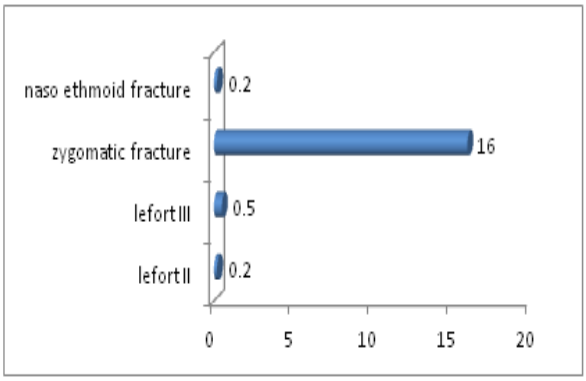
Midface fracture	Frequency	Percent
Lefort I	**0**	**0.0**
Lefort II	4	0.9
Lefort III	5	1.2
Zygomatic complex fractures	66	16.5
Naso ethmoid fractures	0	0
No injury	326	81.4
Total	401	100.0



Graph 3: Superior gaze restriction in mid face fractures.

Table 4: Distribution of diplopia in mid face fractures

Midface fracture	Frequency	Percent
Lefort II	1	0.2
Lefort III	2	0.5
Zygomatic complex fractures	64	16.0
Naso ethmoid fractures	1	0.2
No injury	333	83.1
Total	401	100.0



Graph 4: Distribution of diplopia in mid face fractures

Discussion

Ophthalmic injuries occur frequently during mid facial trauma. There are many studies associating maxillofacial fractures and ophthalmic injuries in literature. Road traffic accidents followed by assault, falls, and sports injury are the major etiological factors (Michael Perry et al in 2005).Assaults stand as the main etiology in recent studies (Nichola zachariades et al in 1996). In our study 401 patients with midface trauma were assessed. The main etiology was road traffic accident (80.5%) followed by assaults (16.7%) and accidental falls. (2.8%). 345 males (86%) and 56 females (14%) were assessed for the percentage of occurrence of ophthalmic injuries like diplopia and enophthalmos in various mid face fractures.

Enophthalmos was present in 54.5% of case, restriction of extraocular movements were seen in 38.9% of cases,156 patients had restriction of extraocular movement. Out of the patients 48.1% have superior gaze, 13.5% have inferior gaze, 38.4% have lateral gaze and none have medial gaze. The percentage of occurrence of diplopia was 16.9%.

Diplopia in primary position or downward gaze is an embarrassing experience for the patient. Frequency

of diplopia in association with mid face reported in literature is 5 to 37 %(L.Folkestad in 2006). Incidence of persisting diplopia is 5–7 % o (Hawes MJ in 1983 and Tadj.A in 2003) .Types of diplopia is monocular or binocular. Lens opacification and displacement are the usual causes of monocular diplopia. Binocular diplopia occurs secondary to trauma. Edema and hematoma due to trauma can lead to diplopia which resolves as it subsides. Persistent diploia can be due to restriction of extraocular movements caused by muscle entrapment and scarring, neurogenic injuries causing atrophy of orbital issues and fat or alteration in the level of orbit and visual axis due to orbital trauma. Orbital floor fracture with muscle entrapment commonly result in diplopia. Diplopia not resolving as edema subsides needs combined maxillofacial and ophthalmological evaluation. Diplopia is a common complaint among the patients with maxillofacial trauma. In study by Jamal *et al.*(2009) reported 16% incidence of persistent diplopia. In the present study, among 401 cases 16.9% had diplopia. 16.0% of the diplopia was associated with zygomatic complex fractures, 0.2% with Lefort II, 0.5% with Lefort III and 0.2% with naso ethmoid fracture. Incidence of diplopia in mid face fracture was around 19.8 % in previous studies (Al-Qurainy et al in 1991) and (Barry C in 2008 and Marin MI in 1998)

Al-Qurainy (1991) reported 8% incidence of enophthalmos in midfacial fractures. Amrith*et al*(2000) reported6% of patients to have enophthalmos of 4-6 mm. In the present study,54.5% of total cases have enophthalmos. 39.4% of the enophthalmos was associated with zygomatic complex fractures, 3.7% with Lefort II, 0.7% with Lefort III and 0.7% with naso ethmoid fractures. Displaced zygomatic complex fracture resulted in enophthalmos. 2–7 % incidence of enophthalmos was seen in relation to displaced zygomatic complex fractures (Whitehouse RW in 2011). CT imaging was used to confirm the orbital volume expansion causing post traumatic enophthalmos (Bite U in 1985) . Inferior and posterior displacement of zygoma produces varying degree of disorganization of the soft tissue of orbital cavity with bony expansion causing enophthalmos. Whitehouse et al. emphasized evaluation of enophthalmos after first10- 20 days to allow for resolution of edema and haemorrhage. Orbital volume expansion was directly related to the degree of enopthalmos. As orbital volume increase by 1 cm, about 0.8 mm enophthalmos occurred. (Chadwick J in 1950). Medially displaced zygomatic complex fracture reduced volume of the orbit and produce exophthalmos (Whitehouse .R.W in 1994).

Considerable deformity of bony orbit and globe can lead to esthetic and functional handicap. Evaluation of the extent of comminution of the orbital wall, timing of surgery, and a precise surgical technique is important in the correction of diplopia and enophthalmos. Correction of diplopia should not be delayed for more than 1 week as irreversible scarring of orbital soft tissues and necrosis of prolapsed fat can occur in extreme positions of gaze.Enophthalmos is the soft tissue manifestation of an underlying bony orbital defects. Enophthalmos can be of four types:simple enophthalmos due to bony defect, enophthalmos with diplopia due to bony and soft tissue insult,cicatricial enophthalmos due to soft tissue scarring, and enophthalmos secondary to fat atrophy. The result of correction surgery depends on the state of soft tissue and restoration of bony form of zygoma and orbital floor. Proper reduction and fixation of fractured bones along with release of the soft tissue entrapment and three-dimensional reconstruction of the orbital floor using auto graft, allograft or alloplastic material assures correction of diplopia and enophthalmos. Surgery must be gentle with meticulous hemostasis and steroid cover. Bone must be placed behind the equator to push the globe forward. Autogenous materials include cranial bone, iliac crest, rib maxillary anterior wall, or auricular cartilage.Resorbable and non-resorbable alloplastic materials include Teflon, Marlex, Prolene, polyethylene and metallic alloys like titanium mesh. Resorbable mesh and plate and homografts like lyodura and zenoderm are other options.

Conclusion

Zygomatic complex fracture was the most common middle third fracture that resulted in diplopia and enophthalmos. Expansion of orbital volume due to disruption of the orbital walls lead to these ophthalmic injuries. The midface fractures definitely alters the normal sequential pattern of orbital contents, thus producing effects like diplopia and enophthalmos altering the normal quality of life. Timely surgical intervention and proper restoration of orbital contour can correct these disabling and aesthetic consequences of mid face trauma.

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