DIPLOPIA IN ZYGOMATIC – COMPLEX FRACTURE

[1]MAJED HANI KHREISAT, JPO, MSc Manchester (Oral & Maxillofacial Surgery)

ABSTRACT

The purpose of this study was to investigate the incidence, etiology, treatment modalities, morbidity and types of diplopia in zygomatic complex fracture.

Fifty patients with zygomatic-complex fractures who had attended the out-patient review clinic at Manchester Royal Infirmary in Manchester United Kingdom formed the study group. Information for the study was gathered from patient records from 10 Jan 2004 to 20 July 2004. Ethical approval was gained from the local research ethics committee. Fifty study group patients were examined clinically and radiographically. They also underwent orthoptic investigation.

Out of these nine patients presented with diplopia as a result of their injury and following surgical exploration of the infraorbital floor. Eight patients had diplopia in the upward gaze and one patient experienced diplopia in the downward gaze. One patient had persistent diplopia at 12 weeks. In patients who presented with diplopia, assault was the most common aetiolog (66%). Statistically analysis revealed a significant difference between assault as the aetiology and the types of diplopia ($p<0.02$). Fifty-six percent of patients had surgical intervention for diplopia between 8 and 13 days post injury. In this patient group, the subcilliary incision was a common surgical approach for the orbital floor (40%). Diplopia was the presenting symptom in 6 patients with zygomatic-complex fractures involving the orbital floor and also in 4 patients with body complex fractures. Diplopia resolved within one week after surgery in two patients (22.2%) and within 3 weeks after surgical intervention for 6 patients (66.7%). However, one patient recovered after 12 weeks.

This study highlights the importance of evaluating the symptoms of diplopia and its appropriate management. Indications for early operation are: symptomatic diplopia with positive forced duction and CT evidence of entrapment of orbital fat or septae with no improvement over 1 to 2 weeks.

Key words: *Diplopia, Zygomatic Fracture, Assault*

INTRODUCTION

Fractures involving the zygomatic-complex are the second most common fractures of the facial bones, after nasal bone.[1,2,3,4] The prominent convex shape of the zygoma makes it vulnerable to traumatic injury. Even minimally displaced zygomatic-complex fractures can result in functional and aesthetic deformities. All traumas to the face, particularly above the level of the mouth, require a careful ocular examination including an estimation of visual acuity of each eye, and zygomatic-complex fractures are frequently complicated by injury to the orbit and eye adnexae, which are the most serious negative outcomes of zygomatic complex fractures.[5] Diplopia is potentially one of the serious complication following zygomatic-complex fractures. The term diplopia is derived from two Greek words: *diplous,* meaning double and *ops,* meaning eye. Diplopia occurs when one object appears double, and is a common subjective complaint. Normal coordination of eye movements is designed to stimulate corresponding points on two retinas, with maximum acuity being present at the macula. Diplopia arises if non corresponding points are stimulated in two eyes by the same object. A minor degree of alteration in the visual axis may be compensated for by alteration of neuromuscular activity of both eyes. Physiological diplopia is a normal phenomenon because the visual axis cannot possibly intersect

[1]Amman, Jordan, Tla ali, PO Box 760, majed96@hotmail.com

at all distances at the same time.[6] This is present only when the patient is tired and then only fleetingly. On the other hand, diplopia associated with orbital trauma has multiple causes. Early diplopia indicates involvement of extraocular muscle either through entrapment (usually through inferior rectus or oblique), oedema, haemorrhage or damage to motor nerves. Generally speaking, traumatic diplopia can be variable in type and extent. It may be transient diplopia following fracture of the malar is due in most cases to simple distortion of the eye level by haemorrhage and is usually present on looking upwards as the haematoma is in the lower part of the orbit. In almost all cases the haemorrhage will be only moderate and will absorb in few days, with return of single vision. Persistent diplopia is mainly due to direct damage to the extraocular muscles. This can occur due to laceration of the muscles by bone fragments, disruption of the muscle attachment or intra orbital damage to one of the motor nerves, mainly the third, fourth or sixth cranial nerves. Inadequate diagnosis and treatment in proper time, or tethering and fibrosis of muscle tissue may lead to and result in persistent diplopia. In the majority of cases of diplopia arising in connection with fractures of the orbit, the failure of movement is not due to paresis of the prime mover but is caused by the inability of the direct antagonist to "pay out rope" or relax because of fibrosis between its sheath and adjacent periosteum following a fracture of the relevant orbital wall. For example, when there is adhesion between inferior rectus and floor of the orbit, the superior rectus is mechanically ineffective.[7]

METHODOLOGY

Patient records of fifty patients with zygomatic-complex fractures who attended the out-patients review clinic at Manchester Royal Infirmary in Manchester, United Kingdom from Jan 10, 2004 to July 20, 2004 formed the study group. Ethical approval was gained from the local research ethics committee. All these patients were examined clinically, radiographically and they also underwent orthoptic investigations related data from injury to presentation time and from presentation to treatment time of surgical intervention were recorded. Time of presentation of diplopia in injury: Less than 24 hours, more than 24 hours and less than three days, more than three days and less than seven day, more than seven days and less than thirteen days, more than thirteen days were noted. Orthoptic assessment was Hess or lees screen test, Diplopia chart, 3-steps tests. Ocular level: Some up, and down. Type of Diplopia: Upward, Outward, Downward and Inward, Surgical intervention from time of presentation at an Accident and Emergency clinic was recorded as following: Less than 24 hours, more than 24 hours and less than three days, more than three days and less than seven days, more than seven days and less than thirteen days, and more than thirteen days. Time of diplopia to resolution was recorded as following. One week, three weeks, six weeks, and nine weeks function. Esthetics and neurological assessments were done in immediate post operative phase and during periodic review. Ocular functions such as eye movements, presence/absence of diplopia were assessed postoperatively.[22]

Diagnosis involved clinical examination, CT scan and orthoptic investigations. The clinical examination may suggest that diplopia may be the result of entrapment of orbital fat or septae include pain and retraction of the globe on attempted upward gaze (globe retraction test) (Fig 1). Varying degrees of periorbital haematoma, oesema and subconjuctival ecchymosis may be present. Concerns about late development of

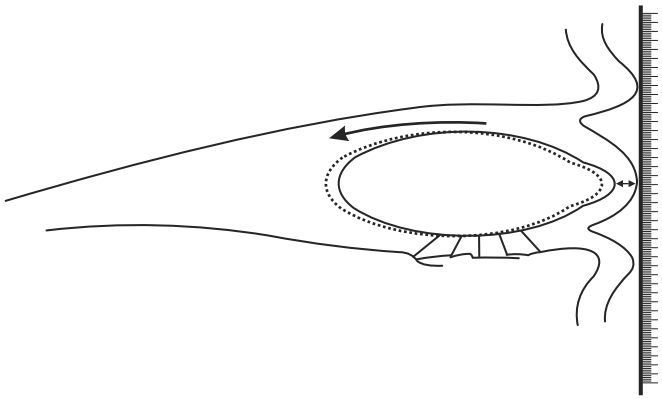

Fig 1: The globe retraction test: assessment of globe retraction with attempted upward gaze. The arrow indicates the pull of the superior rectus muscle. Inferior tethering transforms movement of the globe from upward rotation to posterior retraction. A straight edge (piece of card or ruler) placed between the upper and lower orbital rims provides a reference plane for clinical observation of globe retraction o attempted elevation, seen as an increase in the distance between the front of the eye and the reference plane (Dutton, 1991).[7]

diplopia are difficult to justify even if there is no obvious improvement of vertical eye movement within the first 14 days of the accident (Figure 2). De Mau et al (1991) pointed out that if the vertical limitation exists with a large herniation of orbital contents into maxillary sinus, a wait and see policy to allow resolution of the initial harmorrhage and oedema has been recommended.[7] If the eye movements improve, operation should be delayed. Dutton (1991) mentioned that a positive forced duction test may be misleading as it does not always correlate with entrapment.[8] Indication for early operation is symptomatic diplopia with positive forced duction test and CT evidence of entrapment of orbital fat or septae with no improvement over one to two weeks.

Orthoptic test of diplopia

The purpose of this test is to find the position of gaze where the diplopia is maximum and thereby determine the muscle paresis responsible for the disorder. This is particularly important if the paresis is slight and can not easily be seen. In this test the direction in which the diplopia is maximum will give the direction of action of the paretic muscle; the most peripherally seen image belongs to the paretic eye; and the object appears displaced in the direction the paretic muscle should move the eye.

Horizontal diplopia is caused by abnormalities of the medial or lateral recti, and vertical diplopia by abnormalities of either the obliques, superior or inferior muscles. In most cases, if horizontal and vertical diplopia is present, attention should be focused on the vertical element, as frequently the horizontal element is secondary to the vertical muscle paresis.

Torsional diplopia is characteristically produced by lesion affecting either the obliques or occasionally the recti. The tilting is in the direction the paretic muscle would have moved the eye.

In other words, the image is tilted in a direction opposite to the abnormal deviation of the affected eye. For instance, in a superior oblique palsy the eye is torted so that the upper pole of the cornea is turned out and the inner end of a horizontal image is turned down.

Diplopia Chart

This can be a useful tool for differential diagnosis of incomitancy, especially in the absence of a Hess Chart.

Fig 2: Vertical diplopia on the left eye (restriction of eye movement upward gaze. (Mwanza et al 2001).[9]

Hess Chart

When used correctly, the Hess chart (or Lees screen) provides a major weapon in the armory for differential diagnosis of incomitant deviations). The ocular movements of each eye in turn are recorded on a Hess chart. Figure 3

Methods of analysis: Data for 50 patients with a variety of zygomatic-complex fractures were recorded into a (SPSS) statistical package for analysis by chi-square test.

RESULTS

Nine patients out of 50 cases of zygomatic fracture presented with diplopia. The age ranged from 17 years to 75 years. The majority of the patients were males 38 (76%). Male to female ratio was 3:1. The mean and median age of study group in males were (32.2; 30.5) respectively; while 12 cases (24%) were female. The mean and median age of the study group in females were (33.4; 30.5) respectively. The highest incidence of

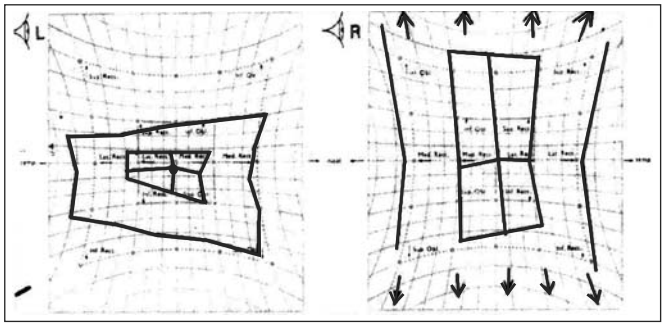

Fig 3: Hess chart showing (the left orbital floor fracture causing restriction of inferior rectuse muscle movement).

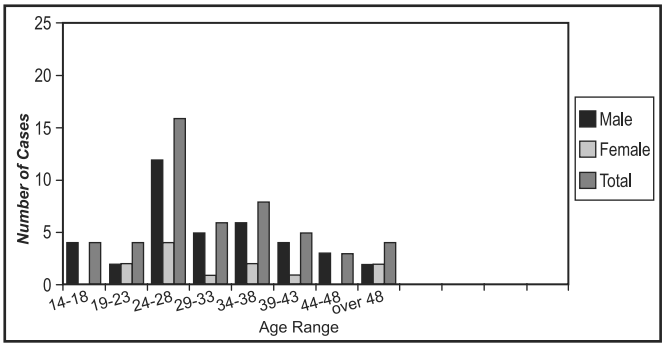

Fig 4: Age and sex distribution of study group.

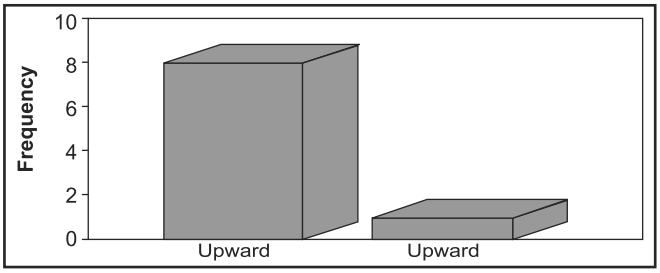

Fig 5: Types of Diplopia.

zygomatic-complex fractures occurred in the age range of 24-28 years (12 males; 4 females). Figure 4)

Assault was the major cause of upward diplopia in 6 cases (66%), and the second most common cause was sports injuries (44%) (one upward and one downward). (Figure 6)

Diplopia was apparent within the first 24 hours of injury (6 cases, 67%). Three patients attended at 1-3 days (33%) (Figure 7)

The majority of surgical intervention for diplopia was undertaken at 8-13 days (5 cases, 56%). Three of patients were treated between 4-7 days of injury (33%). One patient was treated after 14 days of injury (11%). (Figure 8)

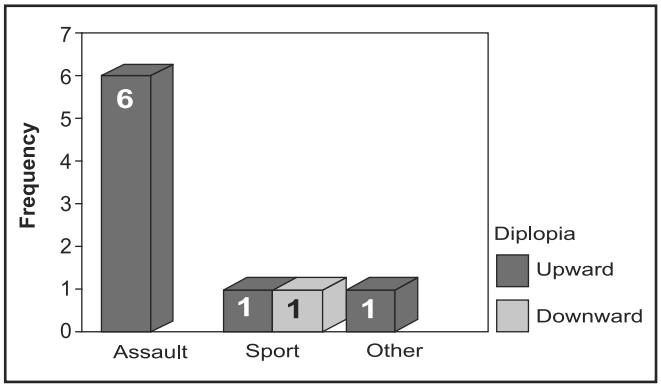

Fig 6: Causes of Diplopia

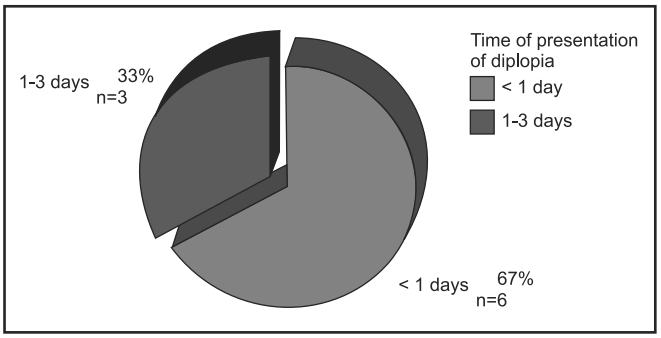

Fig 7: Time of presentation of diplopia.

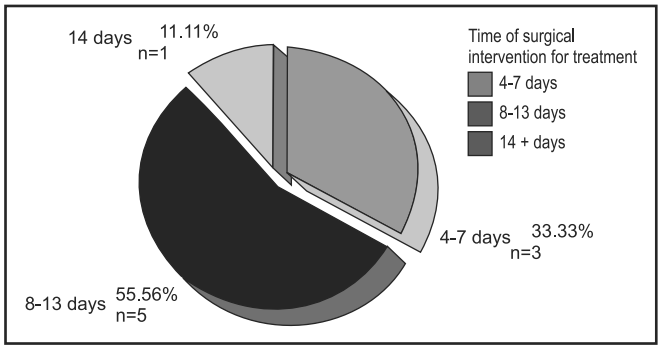

Fig 8: Timing of surgical intervention.

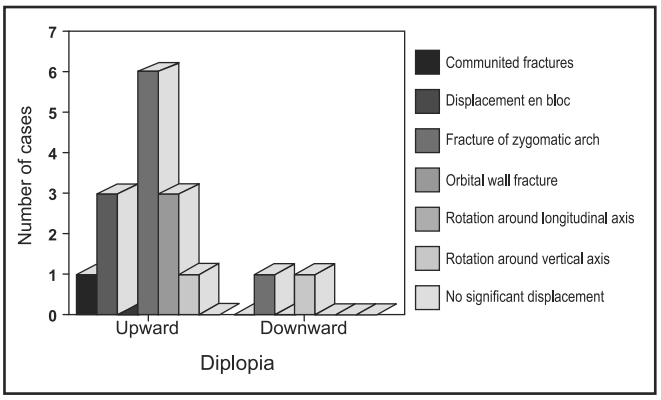

Fig 9: Diplopia according to the types of zygomatic-complex fractures.

Diplopia occurred more often in the fractures involving the orbital floor (6 cases), followed by body complex fractures which accounted for 4 cases (3 cases upward, one case downward) (Figure 9). Three patients who had fractures involving rotation around the longitudinal axis, and one case for each of a comminuted fracture and rotation around vertical axis presented with diplopia.

The most common surgical approach in the treatment of diplopia was the subciliary incision (6 cases [5 cases upward and one case downward]), followed by 3 cases who had lateral brow incision. (Figure 10)

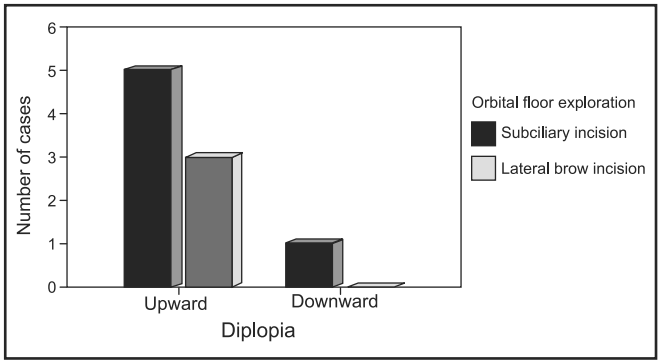

Fig 10: Surgical approach for orbital floor fractures where diplopia was present.

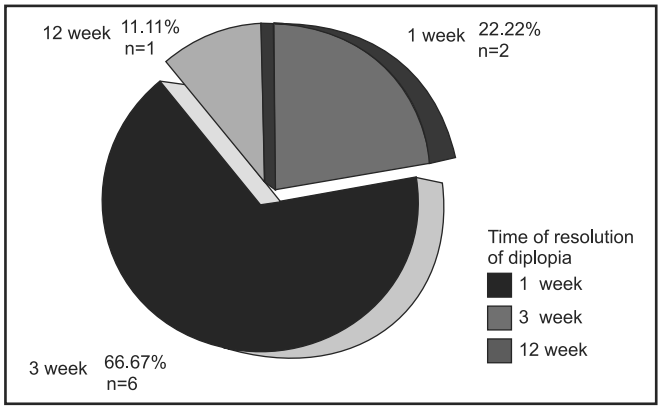

Fig 11: Time of resolution of diplopia.

Diplopia resolved within 3 weeks after surgical intervention for 6 cases (66.7%). Two cases (22.2%) took one week to resolve and in one patient recovery occurred after 12 weeks (Figure 11)

DISCUSSION

The zygomatic complex gives the cheek prominence, and it is the second most common mid-facial bone fractured after the nasal bone and overall represents 13% of craniofacial fractures.[10] Zygomatic complex fractures are almost always associated with fractures of the floor of the orbit. Typically, a fracture line extends from the inferior orbital fissure anteromedially along the orbital process of the maxilla, toward the infraorbital rim. Facial bones, especially of the middle third of the face, are composed of a network of fragile bones held together across sutures which give way in case of force to a lesser extent than other parts of the body. The key to management of facial trauma is to operate the cases as soon as clinical conditions permits with a special emphasis on function and esthetics.[23]

Nine cases out of fifty (18%) presented with diplopia. Studies in the literature report similar figures.[11,12,13,14] Some studies reported a lower incidence.[15,16,17]

In the study conducted by Man et al[7] out of nine patients with diplopia, 5 patients had exploration and treatment for the orbital floor within 8-13 days of presentation and three patients were treated after 14 days while one patient received treatment within 4-7 days following injury. They recommended that if vertical limitation exists with large herniation of orbital contents into the maxillary sinus, a "wait and see" policy should be employed to allow resolution of the initial haemorrhage and residual oedema. If, following examination, eye movements improve operation should be delayed. This policy was adopted by the maxillofacial surgeons at Manchester Royal Infirmary.

Another study by Mansfield showed diplopia was the presenting symptom in 6 patients with zygomatic-complex fractures involving the orbital floor and also in 4 patients with body complex fractures. Of these four, three fractures were rotated around the longitudinal axis, and one case had rotation around vertical axis. A further case presented with a comminuted fracture of the zygomatic complex. As expected, fractures involving the orbital floor had the greatest incidence of diplopia. In our patients group although 13 patients presented with fractures involving the orbital floor, 4 did not present with diplopia. Not all orbital defects in all mid-facial fractures present with diplopia. All the patients who presented with diplopia at Manchester Royal Infirmary had a full ophthalmological assessment including Hess chart. Three patients were unable or unwilling to have forced duction test pre and postoperatively because they feared further manipulation of the injured eye.

Diplopia resolved within one week after surgery in two patients (22.2%) and within 3 weeks after surgical intervention for 6 patients (66.7%). However, one patient recovered after 12 weeks.[20] There was negative association between return of ocular motility and resolving of diplopia if there is delay in surgery. Early surgery resulted in not only more rapid improvement of preoperative motility deficit and diplopia, but also improvement in visual acuity. The one patient with late recovery of diplopia had surgery after 14 days and this may have been contributing factor.[20]

CONCLUSION

This study highlights the importance of evaluating the symptoms of diplopia and its appropriate management. Indications for early operation are: symptomatic diplopia with positive forced duction and CT evidence of entrapment of orbital fat or septae with no improvement over 1 to 2 weeks. Due to the limited time period of this study, which was further compounded by a selective sample size, this study was observational in nature. With a large sample size more objective conclusions could have been drawn with respect to outcomes following treatment of zygomatic complex fractures. The operative procedure should ideally be performed by the same surgeon for all patients, but due to the nature of staffing levels and theatre availability, this was not possible in this study. The importance of any such observational study is to highlight to the public what the consequences of zygomatic complex related injuries can be.

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