Original Research Article

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Frequency of infra-orbital nerve injury after a Zygomaticomaxillary complex fracture and its functional recovery after open reduction and internal fixation

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ABSTRACT

Background: Maxillofacial injuries are on the rise and the etiology of maxillofacial injuries varies from one country to another because of social, cultural and environmental factors. Road traffic accidents (RTAs) are still the most common cause of maxillofacial injuries. Nerve injury following fracture may involve traction, pressure, ischemia, inflammation and physical damage; therefore fractures of Zygomaticomaxillary complex (ZMC) are characterized by sensory neuropathy in the area of innervation of infra-orbital nerve both as presenting symptom and as a postop complication. The objectives of the study were to investigate the frequency of infra-orbital nerve paresthesia following ZMC fractures and determine the frequency of functional nerve recovery in patients with paresthesia treated with open reduction and internal fixation.

Methods: Patients (n = 75) qualifying our inclusion criteria were selected, examined, reduced by surgery and followed up.

Results: A total of 75 patients were included in the study with male: female ratio of 5:3. Mean age was 37.43 ± 3.78 years, with majority of patients (72 %) presenting with RTAs. Infra-orbital nerve paraesthesia was found to be positive in 70.67% (n = 53) patients with 62.26% (n = 33) patients with functional nerve recovery after 3 months.

Conclusions: Prognosis of infra-orbital nerve recovery after a Zygomaticomaxillary complex fracture can be enhanced by open reduction and internal fixation.

Keywords: Infraorbital nerve, Open Reduction, Road Traffic Accident, Zygomaticomaxillary complex fractures

INTRODUCTION

The zygoma or the malar bone is an aesthetically appealing bony prominence within the facial anatomy. Our normal cheek contours also owes to this bone big time. The zygoma is the origin for the masseter, thus affecting mastication. The zygomatic bone creates the inferior and lateral walls of the orbital socket, thus potentially affecting the correct position of the globe and

mobility of the extra-ocular muscles. It also serves a bony barrier which separates the contents of the orbit from the inferiorly present maxillary sinus and posteriorly located temporal fossa.¹

A prominent bone is a ready target for both intentional and accidental traumas and dislocations. The zygomaticomaxillary complex (ZMC) is second most commonly injured area followed by nasal bone alone.

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The trauma of ZMC constitutes 45% of the midfacial and 25% of all the fractures of facial population.² Other reasons include personal alterations, a fall, fights, domestic violence, firearm and sports injury. Males are four times more prone to the fracture than females with peak age between 20 to 30 years.³ It can present in the emergency room (ER) as an isolated injury in case of violence or fight or as a part of polytrauma in case of a severe RTA.⁴

RTAs are the main cause of ZMC fractures in the developing countries. In all the traffic accidents, motorbike accidents are most frequently encountered, comprising of 24.8% of the reported cases with ZMC fractures, followed by car accidents (19.2%). As a whole, traffic-related causes represent 57.6% of the causative events observed.⁵ However in the western world the main cause is inter personal violence and fight accountings 15.2%.⁶

Patient with ZMC fracture presents with depression of affected side, pain, subconjunctival haemorrhage, circumorbital ecchymosis, limited mouth opening etc. Indications for the surgical reduction of zygomatic arch fractures are based on sign and symptoms, cosmetic and functional impairments and on the radiological examinations. There is a variety of clinical sign and symptoms including compromised vision, extra ocular muscle dysfunction, visible facial asymmetry, significant functional impairment of mandibular movements, and a steep at infraorbital rim or zygomaticofrontal suture and infraorbital nerve malfunctions.⁷

Surgical treatment modality depends on nature and extent of the fracture. Undisplaced fractures are usually treated via closed reduction by Gillies (temporal) or Keen (transoral) approach. If the zygomatic complex is likely to be unstable after reduction, open reduction is achieved with miniplate osteosynthesis which is the treatment of choice for these types of cases.⁸

Common complications resulting post operatively are sensory alterations, infection, diplopia, persistent malar depression, enophthalmos, cutaneous fistula, persistent lid retraction, strabismus, upper lid ptosis, altered visual acuity, proptosis and persistent paraesthesia.⁵

Infra-orbital nerve is often involved in ZMC fractures because fracture line includes infra-orbital fissure, canal or foramen in 95% of reported cases. The incidence of infraorbital nerve injury following ZMC fractures ranges from 18-83%. The damage can either be a direct effect of the injury or it can be due to compression of the nerve as it leaves its canal to supply the structures of mid face. Infra-orbital nerve damage can produce sensory alterations such as hypoesthesia, dysesthesia, paresthesia or anaesthesia of the mid facial structures including lower eyelid, cheek, upper lip, skin of nose, and intra-orally, includes anterior region of gingiva and teeth of affected side. As far as the functional recovery of infra-orbital

nerve is concerned, 77.3% of the patients reported complete functional recovery after open reduction and internal fixation.⁷

Rationale of this study is to determine the frequency of sensory disturbance of infra-orbital nerve after a ZMC fracture, monitor the sensory recovery postoperatively treated with open reduction and internal fixation. To explain is better than to excuse so this may help to counsel the patients for prolonged recovery of paresthesia postoperatively. There is no such study previously conducted at local level in Pakistan.

METHODS

It was a descriptive study consisting of case series conducted in the department of Oral and Maxillofacial Surgery, Mayo Hospital, Lahore. The study was completed in 12 months (February 2013 to January 2014). A total of n = 75 adult subjects of both gender were selected using non probability consecutive sampling technique. The inclusion criteria comprised of subjects with zygomatic bone fractures diagnosed clinically and radiographically (Water's view, Submento Vertex (SMV) radiographs and a true posterior-anterior (PA) view) with no previous infra-orbital nerve sensory disturbances. Patients presenting with only maxillary fractures and Lefort III fractures were excluded from the study. All patients presenting with midfacial trauma fulfilling inclusion & exclusion criteria were included in the study. An informed consent was obtained from patient's guardian after explaining study protocol, use of data for research and risk benefit ratio. Patient's demographic data like age and gender was collected on a specially designed proforma. Patients were examined after injury and initial assessment was recorded. Patients underwent surgical management within 1-5 days of injury. Displaced ZMC fractures were treated with open reduction and internal fixation by a team of surgeons. Follow up was done after 1, 2, 6 and 12 weeks of reduction and a final evaluation was made on the last follow up. Patients were monitored for the recovery of the infraorbital nerve functions using static light touch and two point discrimination tests. Data was analysed using SPSS version 15. Frequencies and percentages were computed for all categorical variables and age was presented as mean \pm standard deviation.

RESULTS

A total of n=75 cases fulfilling the inclusion/exclusion criteria were enrolled in the study from the department of Oral and Maxillofacial Surgery, Mayo Hospital, Lahore to investigate the infra-orbital nerve paresthesia and determine the frequency of functional nerve recovery in patients with paresthesia treated with open reduction and internal fixation following ZMC fracture.

In this study, out of n=75 patients, 62.67% (n=47) were male and 37.33% (n=28) were females with a 5:3 male to female ratio. Mean age of the patients in the study was

 37.43 ± 3.78 years with an age range of 18 to 74 years. Majority of the patients n=25 (33.33%) were in fifth decade of life as seen in Table 1. The mean age of male patients was 38.54 ± 4.82 with a range of 18 to 74 years. The mean age of female patients was 36.01 ± 6.25 with a range of 21 to 62 years.

Table 1: Distribution of patients in different age groups (n = 75).

Age (years)	No. of patients	Percentages
18-30	18	24
31-40	23	30.67
41-50	25	33.33
>50	9	12
Total	75	100
Mean and SD	37.43±3.78	

Table 2: Infraorbital nerve paresthesia with regards to the age group of the patients (n = 53).

Age (years)	No. of patients	Percentages
18-30	11	20.75
31-40	18	33.96
41-50	19	35.85
>50	5	9.44
Total	53	100

Patients presented mainly (72%) with an RTA, the other causes of the fractures being violence, fight, fall, firearm and sport injuries. Out of n=47 male patients, 76.59% (n=36) presented with an RTA and whereas 64.28% (n=18) of female reported a ZMC fracture after a RTA. So the male to female ratio due to RTA was 2:1.

Infraorbital nerve paresthesia following ZMC fracture was found to be positive in 70.67% (n = 53) of the cases while 29.33% (n = 22) had no findings of the morbidity. When frequency of infraorbital nerve paresthesia was stratified according to the age groups, study found that out of n = 53, majority of the patients n = 19 (35.85%) were between 41-50 years of age (Table 2).

Table 3: Functional nerve recovery with regards to the age groups (n = 53).

Age (years)	No. of patients	Percentages
18-30	7	21.21
31-40	13	39.40
41-50	11	33.33
>50	2	6.06
Total	33	100

After the clinical assessment of the infra-orbital nerve paresthesia among the patients, open reduction and internal fixation was performed in n=53 cases who developed the morbidity. The frequency of functional nerve recovery was recorded in the follow-up visits

among the patients. Out of n = 53 patients, who presented with infra-orbital nerve paresthesia after the ZMC fracture, 62.26% (n = 33) had functional nerve recovery after 12 weeks while 37.74% (n = 20) had no recovery (Table 3).

When this functional nerve recovery was graded according to the age groups, 31-40 years had maximum 39.40% (n = 13) number of the patients with recovered infra-orbital nerve functions as shown in Table 3.

DISCUSSION

Apart from nasal bone and mandible, zygomatic region is the most prominent portion of face and therefore an easy target for zygomatic complex fractures which is the second most common facial fracture in the lateral mid face area.¹¹

Maxillofacial injuries are on the rise and the causes of maxillofacial injuries vary widely from one part of the world to another because of various factors including social, cultural, geographical and environmental factors. ¹² Road traffic accidents (RTAs) are still the most common cause of maxillofacial injuries worldwide especially for developing countries as in our study 72% presented with a RTA. ^{13,14} There are various causes of RTA, but in this part of the developing world, the main cause lies in the attitude of the population which results in speedy driving, not following the rules of the traffic, crossing the intersection on a red light, overburdened vehicles, driver fatigue, lack of regular and proper checkup of the automobile and the dearth of a proper road structures. ¹⁵

Worldwide the fracture to the facial regions are more common in males, the ratio may vary widely but males are more prone to maxillofacial trauma due to RTA, assaults, sports and war. Bakardjiev and Pechalova from Bulgaria reported a male to female ratio of 4.6:1.16 In China, the male to female ratio reported after a maxillofacial injury by Zhou and coworkers in 2013 was 3.35:1.17 Arslan et al from Turkey reported 2.8:1 male to female ratio.¹⁸ However our result showed a male: female ratio of 5:3, the difference in the ratios can be due to high RTAs in females as they commonly accompany males especially on the motorbike which is itself a major cause of RTA. The age group affected was 18-39 years which was also concordant with our study (18-30 years had 20% cases and 31-40 years had 34.67% cases totalling 54.67% of the reported cases) but the main cause in their study for ZMC fractures was interpersonal assault as opposed to our results which was RTA.18 Balakrishnan from India also reported age group 20 to 40 being more prone to RTAs which was also concordant with our results.¹⁹

Nerve injury following fracture may present with various pathophysiology involving traction, pressure, ischemia, inflammation and physical damage of the infra-orbital nerve resulting in sensory neuropathy and motor functions in the area of innervation of infra-orbital nerve both as presenting symptom and as a postoperative complication.⁷ A study from Iran assessed the sensorimotor nerve damage in patients with maxillofacial trauma and found that infra-orbital nerve damage was the second most common nerve damaged after trigeminal.²⁰ As all the fractures to facial region were studied in the previously mentioned study that might be the reason that infra-orbital nerve damage was second on the chart. In our study only ZMC fractures were evaluated which showed infra-orbital nerve paresthesia in 70.67% (n = 53) of the patients. The results of the study are in agreement with other recorded incidence of infra-orbital nerve injury following ZMC fractures ranging from 18-83% in a study from Israel and 58 to 94% from India.^{9,21}

Open reduction and internal fixation is one of the most used and preferred method of fixation with desirable results. De Man and Bax from Netherlands stated that reduction and fixation were important factors in the recovery of sensory disturbances of the infraorbital nerve.²² Vriens and Moos also reported that open reduction and internal fixation had a better prognosis to infraorbital nerve recovery.23 Sakavicius and workers found that function is completely repaired in 77.3% of patients after open reduction and internal fixation, these findings are in agreement with the results of the current study. 7 Benoliel documented the neurosensory changes in the infra-orbital nerve following zygomatic fractures managed in various ways and concluded that plate fixation allows significantly better restoration of infraorbital nerve function. 9 Chronic neuropathic pain following zygomatic fractures is rare. Kumar et al, concluded that earlier the surgical intervention, more the recovery of the nerve injury is noticeable during the 1 and 6 months follow up period.²⁴

However, the results are in agreement with other studies indicating a significantly higher frequency of functional nerve recovery in patients with paresthesia treated with open reduction and internal fixation, though results are from our country and further trials should be conducted on the issue which will be helpful and strengthen the results of the current study.

CONCLUSION

The frequency of functional nerve recovery is high among patients with paresthesia treated with open reduction and internal fixation. So, it is recommended that every patient who presents with paresthesia should be treated with open reduction and internal fixation and sorted out for functional nerve recovery. However, it is also required that every setup should have their surveillance in order to know the frequency of recovery.

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