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Infraorbital nerve sensory disturbances in relation to zygomatic complex fracture: A retrospective study

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Abstract: Aim: The aim of the study is to determine the prevalence and recovery of infraorbital nerve sensory disturbances following the occurrence of zygomatic complex fractures.

Method: 61 patients from 2017 to 2019 who sustained zygomatic complex fractures and received treatment at a tertiary care centre in Malaysia were recruited for this study. The patterns of the fractures were reviewed and classified using the classification proposed by Zingg et al. Infraorbital nerve disturbances were recorded before and after treatment.

Result: 21 patients (34.4%) developed infraorbital nerve disturbances following trauma. 16 patients (26.2%) were treated via open reduction and internal fixation (ORIF) and 5 patients (8.2%) via conservative management. Patients who sustained Type C fractures that reported infraorbital nerve disturbances numbered 11 cases (37.9%) while Type B fractures numbered 10 cases (41.7%). After 3 months, 11 patients treated via ORIF and 1 patient treated conservatively reported recovery of the infraorbital nerve sensation.

Conclusion: The more serious the fracture displacement is, the worse the prognosis with regard to infraorbital nerve recovery. ORIF of severe fracture displacement may improve outcome of infraorbital nerve recovery following zygomatic complex trauma.

Key words: Zygomatic complex fracture, Infraorbital nerve, Sensory Disturbances, Open Reduction.

Introduction

The zygomatic bone or the malar bone is the central portion of the zygomatic complex that gives prominence to the cheek. It contributes to the formation of inferior and lateral walls of the orbital socket and acts as a barrier that separates the contents of the orbit and maxillary sinus[1-3]. A zygomatic complex fracture is defined as a fracture that involves the zygoma and its surrounding bones; namely frontal, maxillary, temporal and sphenoid[4]. In terms of midfacial fractures, the zygomatic complex and maxillary fractures were the most frequent, due to its prominent position[5,6]. The zygomatic bone itself is rarely broken but rather becomes separated from its surrounding bones[7]. The most common mode of injury causing midface fractures was reported to be motor-vehicular accidents (MVA), followed by fall from height, and assault[8,9]. In developing nations, the poor maintenance of roads, poor driving skills, and lack of enforcement of traffic rules and regulations such as the use of seat belts and helmets are probable reasons responsible for extensive midface fractures[8].

The weakest point of the zygomatic complex is the infraorbital foramen[1]. Therefore, sensory disturbances of the infraorbital region are frequently present once zygomatic complex fracture occurs[1]. There are three distinct types of nerve injuries; neurotmesis, axonotmesis and neuropraxia[10]. Neurotmesis (a ‘cutting” which implies a separation of related parts) describes the state of a nerve that has been completely divided. The injury produces a lesion which is in every sense complete[10]. In axonotmesis, the essential lesion is damage to the nerve fibres of such severity that complete peripheral degeneration has followed; and yet the sheath and the more intimate supporting structures of the nerve have not been completely divided, which means that the nerve as a mass of tissue is still in continuity.[10] Neuropraxia (non-action) is used to describe those cases in which there is a short-lived paralysis-so short that recovery could not possibly be explained in terms of true regeneration[10]. Zygomatic complex fracture is associated with infraorbital nerve injury as the nerve passes through the infraorbital foramen and in 95 percent of recorded cases, the fracture line involves the infraorbital fissure, canal or foramen[3]. Concomitant orbital floor blowout fractures medial to the infraorbital nerve canal may also contribute to infraorbital nerve compression and canal deformation[11]. The damage can be either 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 the mid face[3].

Advanced clinical knowledge of zygomatic complex fractures could aid in earlier treatment and possible mitigation of related sequelae. Failure to correctly diagnose and manage zygomatic complex fractures can be a major factor in the development of posttraumatic sensory disturbances[12]. Inaccurate diagnosis and under-management of fractures of the zygomatic complex can therefore not only affect the appearance of the patient, but also may adversely affect sensory function around the midface. The aim of this study is to determine the occurrence of infraorbital nerve disturbances related to the zygomatic complex and its subsequent recovery in relation to fracture types and the management of these fractures.

Methods

This is a retrospective study consisting of patients who sustained zygomatic complex fractures. Records of patients treated at Hospital Tengku Ampuan Afzan between 2017-2019 were retrieved for analysis. The inclusion criteria of this study included patients who were 18 years old and above who sustained zygomatic complex fractures and received treatment at our setting with complete medical records and computed tomography (CT) scans available for assessment. All patients were required to have at least 3 months of post treatment follow up. Patients who were below 18 years old, sustained other fractures not involving the zygomatic complex and inadequate follow-up were excluded from this study.

The patterns of the fractures were reviewed and classified using the classification proposed by Zingg et al. The patterns of fractures were divided into Type A (incomplete fracture; A1 arch fracture, A2 frontozygomatic suture fracture, A3 infraorbital rim fracture), Type B (complete mono fragment or tetrapod fracture) and Type C (comminuted or multi fragment fracture)[12]. The parameters assessed were gender, aetiology of the injury, type of fractures, treatment received and recovery of the nerve function post-treatment.

All the data were analysed using IBM SPSS Software Version 20.0. In addition, Chi Square tests were used to compare the relation between fracture classification, treatment modalities and infraorbital nerve disturbances. A P-value of less than 0.05 was considered statistically significant.

Results

A total of 120 patients were identified to have sustained zygomatic complex fracture in the study period. Sixty-one patients met the inclusion criteria and were included in this study. There were 56 males (91.8%) and 5 females (8.2%). The most common etiology was MVA with 59 cases (96. 7%) followed by 2 assault cases (3.3%). 47.5% of patients sustained Type C fractures, 39.3% sustained Type B fracture and the remaining 13.1% sustained Type A fracture. A summary of results is presented in Table 1.

Table 1. *Demographic data of patients sustaining zygomatic complex fractures included in the study*

	n = 61	%
Age		
16 – 19 years old	3	4.9
20 – 39 years old	39	63.9
40 – 59 years old	14	23.0
60 years and above	5	8.2
Gender		
Male	56	91.8
Female	5	8.2
Aetiology		
MVA (Motor-Vehicular-Accident)	59	96.7
Assault	2	3.3
Type of fracture according to Zingg et al Classification		
Type A : Incomplete zygomatic fracture		
Isolated zygomatic arch fracture (A1)	0	0
Lateral orbital wall fracture (A2)	3	4.9
Infraorbital rim fracture (A3)	5	8.2
Type B : Complete monofragment zygomatic fracture (tetrapod fracture)	24	39.3
Type C : Multifragment zygomatic fracture	29	47.5

37 patients (60.7%) underwent open reduction and internal fixation surgery (ORIF); 3 (4.9%) underwent closed reduction, and the remaining 21 (34.4%) patients were treated conservatively. Conservative management was done by observing and monitoring the patient's progress from the time of injury until the end of the follow-up period. The results are summarised in Table 2.

With regards to infraorbital nerve disturbances, 21 patients (34.4%) had preoperative infraorbital nerve paraesthesia as the result of trauma, with 10 patients having type B fractures (41.7%) and 11 patients having type C fractures (37.9%). Infraorbital nerve sensation recovered in 7 out of 10 patients with type B fractures, whereas 5 out of 11 patients with type C fractures regained their infraorbital nerve function after three months. The results are summarised in both Table 2 and 3.

When comparing classification against infraorbital nerve disturbances and treatment modalities against infraorbital nerve disturbances, there was no statistically significant relationship ($p > 0.05$).

For patients undergoing ORIF, we evaluated the mean treatment time from injury to surgery; which was 17 days. Out of 37 patients who underwent ORIF, a total of 16 (26.2%) had preoperative paresthesia. At 1 month, 10 (16.4%) patients still reported postoperative paresthesia while at 3 months, 5 (8.2%) reported postoperative paresthesia. We evaluated the effect of injury-to-repair time spans on the recovery of infraorbital nerve paresthesia; with the 16 patients grouped into patients operated between 0 to 14 days, 14 to 30 days and more than 30 days respectively. Out of 7 patients treated within 14 days from time of trauma, 1 had paraesthesia at 3 months postoperative. Three of the eight patients treated between 14 and 30 days after the trauma had postoperative paraesthesia, and one patient treated beyond 30 days had paraesthesia that persisted after treatment. The summary of results is in Figure 1.

Discussion

Zygomatic complex fracture is related to infraorbital nerve injury because the nerve runs through the infraorbital foramen. The infraorbital nerve is often involved in zygomatic complex fractures because the fracture line includes the infraorbital fissure, canal or foramen in 95% of reported cases[3,13]. Therefore, sensory disturbances of the infraorbital region often develop as a presenting symptom and as a postoperative complication[1,3,12,14]. The severity of the fracture is related to the progress of the nerve recovery. A higher occurrence of sensory dysfunction and slower rehabilitation can be expected where a fracture line is displaced[12,15]. In our study, 11 out of 16 patients (68.75%) recovered from infraorbital nerve disturbances following open reduction and internal fixation. For patients who opted for conservative management, only 1 out 5 patients (20%) recovered. This

Table 2. *Management of zygomatic complex fracture*

Classification	Management			IOND
	ORIF	Closed Reduction	Conservative	
A2	1 (1.6%)	0 (0%)	2 (3.3%)	0/3 (0%)
A3	3 (4.9%)	1 (1.6%)	1 (1.6%)	0/5 (0%)
B	15 (24.6%)	0 (0%)	9 (14.8%)	10/24 (41.7%)
C	18 (29.5%)	2 (3.3%)	9 (14.8%)	11/29 (37.9%)
Total	37 (60.7%)	3 (4.9%)	21 (34.3%)	21/61 (34.4%)

ORIF = Open Reduction and Internal FixationI; IOND = Infraorbital nerve disturbances.

Table 3. *Preoperative and postoperative infraorbital nerve sensory disturbances progress and recovery*

Management	Preoperative	1 month Postoperative	3 months Postoperative
Total ORIF with IOND	16/61 (26.2%)	10/61 (16.4%)	5/61 (8.2%)
Type A ORIF	0/16	0/10	0/5
Type B ORIF	6/16	2/10	0/5
Type C ORIF	10/16	8/10	5/5
Total CR with IOND	0/0 (0%)	0/0 (0%)	0/0 (0%)
Type A CR	–	–	–
Type B CR	–	–	–
Type C CR	–	–	–
Total Conservative	5/61 (8.2%)	4/61 (6.6%)	4/61 (6.6%)
Type A Cons	0/5	0/4	0/4
Type B Cons	4/5	3/4	3/4
Type C Cons	1/5	1/4	1/4
Total	21/61 (34.4%)	14/61 (23.0%)	9/61 (14.8%)
P-value	0.142	0.491	0.647

ORIF = Open Reduction and Internal Fixation; IOND = Infraorbital nerve disturbances; CR = Close reduction; Cons = conservative.

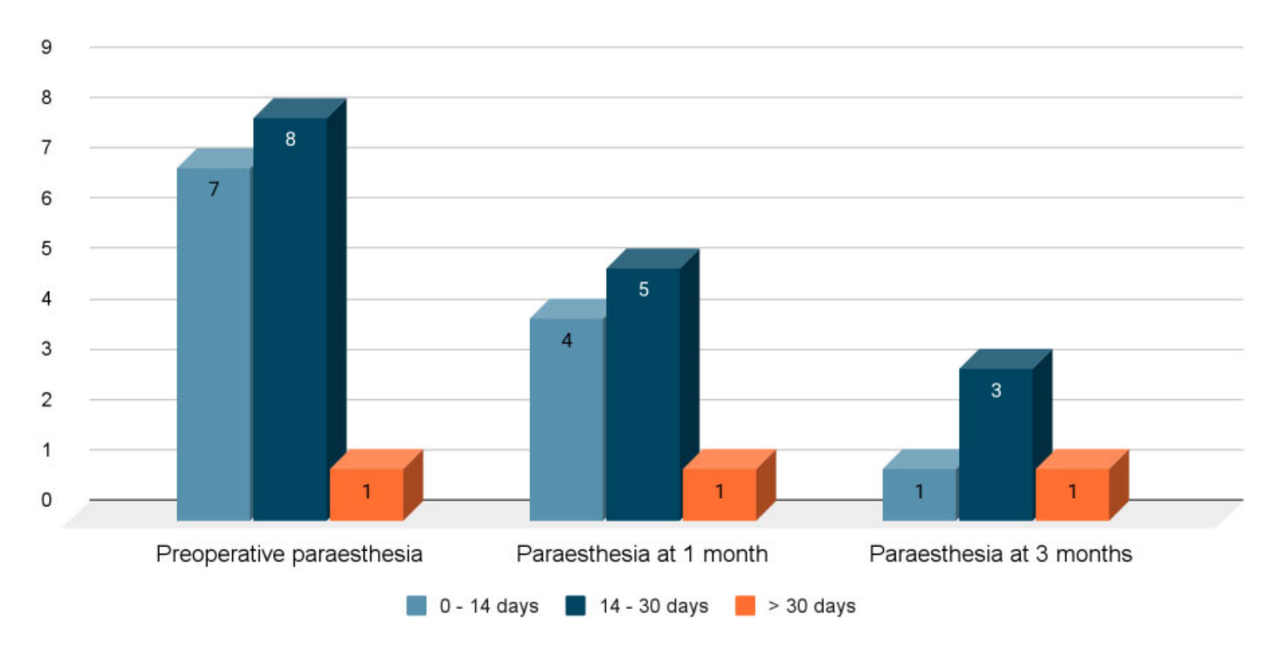

Figure 1. *Injury-to-repair time spans on recovery of infraorbital nerve paraesthesia following orif of ZMC fractures.*

suggests that open reduction and internal fixation leads to better infraorbital nerve recovery for patients sustaining zygomatic complex fracture compared to conservative management as manipulation of fragments might relief compression of a trapped infraorbital nerve[3,16]. It is also reported that early surgical management of zygomatic complex fracture resulted in a higher incidence of recovery[16,17]. In our study, patients operated within 14 days showed a higher rate of recovery compared to patients operated after 14 days.

A zygomatic complex fracture is defined as a fracture that involves the zygoma and its surrounding bones, namely frontal, maxillary, temporal and sphenoid[4,18]. Different classification systems for better understanding of zygomatic complex fractures were designed by different authors. In this study, the classification of Zingg et al was used. The use of Zingg's zygomatic complex fracture classification in this study is because it sufficiently covers the scope of fracture patterns and provides a more orderly approach to the fracture management[12]. Our findings based on this definition were that most fractures were type C (47.5%) followed by type B (39.3%).

There were three treatment modalities provided to the patients in this study; which are ORIF, close reduction and lastly, nonsurgical approach or conservative management. Conservative management was done by observing and monitoring the patient's progress from the time of injury until the end of the follow-up period. According to Kovacs et al, the best treatment time is generally considered to be as early as possible for fractures of the midface[13,17]. The decision regarding treatment was made based on the severity of injury as well as following consultation and agreement with the patient.

The zygoma plays an important part in the midface and orbit shape, work and aesthetics[17,18,19]. For this reason, the integrity of the zygomatic complex is important for preserving normal face width and prominence of the cheek[20]. Sergio et al emphasized a good aesthetic appearance is as important as the functional recovery[17]. Failure to recognise and treat zygomatic complex fracture may cause permanent deformity with depression of the malar eminence, facial widening, malocclusion, limited mouth opening and neurosensory disturbances of the infraorbital nerve[20]. In our study, the main reason for seeking treatment was noted to be the presence of the malar depression, presence of infraorbital nerve sensory disturbances or asymmetry of the face.

Our study coincides with other studies on surgical intervention as the effective treatment modality of zygomatic complex fractures and by far was the most widely used technique[8,19.20,21]. Some of the studies agreed that surgical intervention is necessary to retrieve functional and cosmetic results of malar depression especially in the presence of infraorbital nerve disturbances. 60.7% of patients in our study were treated with open reduction and internal fixation with most patients sustaining type C fractures (29.5%). Menon et al mentioned that surgical intervention was found to give stability in terms of restoration of shape without the danger of displacement[22].

Among the patients that underwent conservative treatment, 5 patients had paresthesia consisting of 4 patients sustaining type B and 1 patient sustaining type C injuries. All of these 5 patients presented with malar depression at the respective site of fracture. Two of the patients were elderly, and one claimed that paraesthesia resolved 3 months after the trauma. Only 1 out of 5 patients had resolved infraorbital nerve disturbances. The reason for conservative method was mainly because they were not concerned with the step deformity, facial asymmetry or infraorbital nerve paraesthesia. They further claimed that infraorbital nerve disturbances were bearable and did not affect their quality of life negatively.

As this study is retrospective, it must be noted that we could not include all patients as some patients treated in this facility did not receive a CT scan, thus not meeting the inclusion criteria. We also acknowledge the imbalanced and small sample size between treatment modalities. Future studies could be done to address these issues.

Conclusion

In conclusion, sensory disturbances of the infraorbital nerve following zygomatic complex fracture can occur once the infraorbital fissure, canal or foramen is involved. The more severe the displacement of the fracture, the more likely that ION injury would be seen. Correct and timely management can improve recovery outcomes in relation to sensory disturbance of the infraorbital nerve following trauma.

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Conflict of interest
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Ethical approval
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