

INFRAORBITAL NERVE INJURY IN ZYGOMATICOMAXILLARY COMPLEX FRACTURES IN PATIENTS PRESENTING TO AYUB TEACHING HOSPITAL, ABBOTTABAD

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INTRODUCTION

The zygoma's prominent, exposed position makes zygomaticomaxillary complex (ZMC) fractures among the most common midfacial injuries.¹ High-impact trauma, such as falls, road traffic accidents (RTAs), or interpersonal violence, frequently causes these fractures.² The infraorbital nerve (ION) is extremely susceptible to damage during ZMC fractures due to the close anatomical relationship between the zygomatic bone and the infraorbital foramen.³ By compromising sensory function in the midfacial area, infraorbital nerve injury can cause paresthesia, anaesthesia, or hypoesthesia, which can have a substantial negative impact on a patient's quality of life.⁴ Since neurosensory abnormalities may continue long after fracture stabilisation and surgical repair, resulting in functional and psychological complications, it is imperative to identify the patterns and factors associated with ION injury.⁵ Homer et al. found that 47.6% of the 42 patients had some degree of infraorbital hypesthesia. Compared with isolated orbital

floor fractures, ZMC fractures had worse long-term sensory outcomes.⁸ According to Sakavicius et al., 64.4% of patients with ZMC fractures had infraorbital nerve sensory abnormalities. They also stated that the degree of damage and the presence of infraorbital canal damage determine the dynamics and outcome of functional infraorbital nerve recovery.⁹ In their study of 72 patients in the Pakistani population, Saleem et al. observed that 75.0% of the patients had ION injury. They also reported a significant correlation between the occurrence of injuries and gender, with males predominating (62.5%).¹⁰ There is still a dearth of data regarding the frequency of ION in patients presenting with ZMC fractures. In addition to this, there is still a need to learn more about how certain factors, such as the type of trauma, laterality of the fracture, and demographic factors, affect infraorbital nerve injury in ZMC fractures, especially in South Asian populations where trauma patterns and access to healthcare may be different from those in Western countries. Few studies have systematically compared the types of sensory disturbances or thoroughly examined the relationship

ABSTRACT

OBJECTIVES

This study aimed to analyse the frequency and trends of infraorbital nerve (ION) damage in zygomaticomaxillary complex (ZMC) fractures.

METHODOLOGY

We conducted a cross-sectional analytical study at the Department of Oral and Maxillofacial Surgery, Ayub Teaching Hospital, Abbottabad, from January 2025 to June 2025. We recruited 132 ZMC fracture patients through non-probability consecutive sampling. Information on age, gender, aetiology and mechanism of trauma, fracture side, and ION injury presence and type was obtained. We assessed infraorbital nerve injury using neurosensory testing and graded it as paraesthesia, anaesthesia, or hypoesthesia. Data were analysed using SPSS, with $p < 0.05$ considered significant.

RESULTS

Of the 132 patients, 68 (51.52%) were male, and 64 (48.48%) were female. ION injury was seen in 88 (66.67%) patients, with paraesthesia being the most prevalent type (34.09%), followed by anaesthesia (23.48%) and hypoesthesia (9.09%). There was a statistically significant relationship between gender and ION injury ($p < 0.001$), and between fracture laterality and ION injury, with 97.5% of bilateral fractures having nerve involvement ($p < 0.001$). However, the aetiology of trauma was not significantly correlated with ION injury ($p = 0.191$).

CONCLUSION

ION injury is a common sequel of ZMC fractures, paraesthesia being the most frequent presentation. Male gender and bilateral fractures were correlated with increased injury rates, underlining the necessity of early neurosensory evaluation.

KEYWORDS: Infraorbital Nerve Injury, Zmc Fracture, Paraesthesia, Bilateral Fractures, Facial Trauma

between bilateral fractures and nerve damage. Thus, the purpose of this study is to ascertain the types and frequency of infraorbital nerve injury in ZMC fractures as well as their correlation with trauma and patient characteristics. A better understanding of these relationships can support early diagnosis, improved surgical planning, and targeted rehabilitation to reduce long-term neurosensory deficits.

METHODOLOGY

This cross-sectional study was conducted in the accident and emergency department and maxillofacial OPD (App No. Ref.No.RC-EA-2024/083, Dated, 17-04-2024) at Ayub Teaching Hospital, Abbottabad. The calculated sample size was 132 using WHO software, with a 95% confidence level, an absolute precision of 6%, and an anticipated infraorbital nerve injury (paresthesia) rate of 14.4% in ZMC fractures (Amin et al.). A non-probability consecutive sampling technique was used to recruit patients. The sample-size estimation was based on the anticipated prevalence, as this was the available estimate at the planning stage, not the prevalence observed in the present study. Inclusion criteria: Patients aged 18-65 years, of either sex, presenting with ZMC fractures secondary to facial trauma caused by road traffic accidents, falls or assault-Glasgow Coma Scale (GCS) score 15/15, who gave informed consent. Exclusion criteria: Patients with old mid-face trauma of 15 days or more as confirmed on taking history, having neuropathies, previously operated patients with any facial bone fracture, non-displaced fractures of the zygoma, and panfacial fractures due to road traffic accident. The sociodemographic data included age (in years) and gender (male/female). We elicited a brief history of the mode and mechanism of injury from the patient or their attendants. The cause of trauma was classified as road traffic accident (RTA), fall, or assault. We assessed fracture laterality clinically and radiologically as unilateral (left/right) or bilateral involvement. The extent and nature of ZMC fracture were determined clinically and verified radiographically with orthopantomogram (OPG) and/or computed tomography (CT) where facilities existed. The presence of comminution, displacement, and orbital floor involvement was recorded where appropriate. An experienced examiner tested infraorbital nerve sensation using a standardised clinical sensory test. The infraorbital area, i.e., the lower eyelid, lateral nose, upper lip, and upper cheek, was tested by light touch with a cotton wisp, pinprick with a blunt dental probe and two-point discrimination if indicated. Patients compared sensations between the affected and unaffected sides. Nerve injury presence was noted as

"Yes" if sensory deficit was found in any way, and "No" if no deficit could be identified. The nature of infraorbital nerve injury was classified as: Anaesthesia: total loss of sensation; Paraesthesia: abnormal or altered sensation (e.g., tingling) with no loss; and hypoesthesia: reduced sensation. All data were recorded as soon as we inspected them on a previously designed data collection sheet. The principal investigator cross-checked every variable for accuracy and completeness. The study excluded patients with any previous maxillofacial trauma, known neuropathies, or significant associated neurological injuries to prevent confounding and assigned each patient a unique study ID to ensure confidentiality. entered, cleaned, and analysed the data using Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM Corp., USA). Continuous variables, such as age, were reported as mean $\pm$ SD after verifying normality with the Shapiro-Wilk test. Categorical variables such as gender, infraorbital nerve injury (yes/no), nerve injury type (anaesthesia, paraesthesia, hypoesthesia), cause of trauma (RTA, fall, assault, others), trauma type (blunt, penetrating, others), and fracture laterality (unilateral/bilateral) were presented in terms of frequencies and percentages. Relationships between categorical variables (e.g., gender, cause of trauma, laterality) and infraorbital nerve injury (yes/no) were tested by the Chi-square test or Fisher's exact test in cases where expected cell counts were < 5 . The relationship between gender and nerve type was tested using the Chi-square test. p -value < 0.05 was considered statistically significant.

RESULTS

This study enrolled 132 patients with zygomaticomaxillary complex (ZMC) fractures, with a mean age of 39.79 ± 14.87 years, including 68 (51.52%) men and 64 (48.48%) women. Infraorbital nerve (ION) damage was noted in 88 patients (66.67%), and 44 patients (33.33%) reported no sensory deficit. Within those who suffered nerve damage, paraesthesia was the most frequent type (34.09%), then anaesthesia (23.48%), and hypoesthesia (9.09%) (Table 1). Gender was significantly associated with ION injury ($p < 0.001$), with a higher prevalence among males. No statistically significant disparity was noticed between gender and type of ION injury ($p = 0.577$) (Table 2). In terms of cause of trauma, RTA was the most prevalent, followed by falls and assault. While ION injury was most common in RTA (70.24%), this did not reach statistical significance ($p = 0.191$). However, fracture laterality was significantly correlated with nerve injury, with 97.5% of bilateral fractures having ION injury ($p < 0.001$) (Table 3).

Table 1: Baseline Distribution of Gender and Infraorbital Nerve Injury Characteristics Among Patients With Zygomaticomaxillary Complex Fractures (N = 132)

Variables	Categories	n (%)
Gender	Male	68 (51.52%)
	Female	64 (48.48%)
Infraorbital nerve injury	Yes	88 (66.67)
	No	44 (33.33%)
Type of Infraorbital nerve injury	paraesthesia	45 (34.09%)
	anaesthesia	31 (23.48%)
	hypoesthesia	12 (9.09%)

Table 2: Association Between Gender and Infraorbital Nerve Injury (Presence and Type)

Variables	Gender		p-value
	Male (n = 68)	Female (n = 64)	
Infraorbital nerve injury			
Yes	58 (85.29%)	30 (46.88%)	<0.001
No	10 (14.71%)	34 (53.13%)	
Type of Infraorbital nerve injury			
paraesthesia	27 (60.00%)	18 (40.00%)	0.577
anaesthesia	22 (70.97%)	9 (29.03%)	
hypoesthesia	9 (75%)	3 (25%)	

Table 3: Association Between Cause of Trauma and Laterality with Infraorbital Nerve Injury

Variables	Infraorbital Nerve Injury		p-value
	Yes (n = 88)	No (n = 44)	
Cause of ZMC			
RTA	59 (70.24%)	25 (29.76%)	0.191
Trauma	18 (69.23%)	8 (30.77%)	
Assault	11 (50%)	11 (50%)	
Laterality			
Unilateral	49 (53.26%)	43 (46.74%)	<0.001
Bilateral	39 (97.5%)	1 (2.5%)	

DISCUSSION

In this study of 132 patients with zygomaticomaxillary complex (ZMC) fractures, infraorbital nerve (ION) injury was present in 66.67% of cases. Paraesthesia was the most common type of injury (34.09%), followed by anaesthesia (23.48%) and hypoesthesia (9.09%). There was a statistically significant association between gender and ION injury (higher in males), and fracture laterality (bilateral fractures had much higher rates of ION injury) was also significantly associated with nerve involvement. Several studies report a similar high frequency of ION sensory disturbance in ZMC fractures. For example, in a descriptive study at Lady Reading Hospital, Peshawar, by Shafiq et al., with 72 patients, 69.4% had infraorbital nerve injury.¹¹ This prevalence rate is close to the rate of 66.67% observed in the current study, suggesting that the study population lies in the same expected range for this condition. In contrast, larger multi-centre/retrospective analyses sometimes report lower rates depending on what exactly is measured. For example, the study by

Dubron et al., comprising 272 patients from Leuven, Belgium, reported an ION hypoaesthesia incidence of 37.3%, much lower than 66.67%, but their focus was only on hypoaesthesia rather than all sensory disturbances (anaesthesia, paraesthesia, etc.).¹² Regarding gender association, the finding of significantly higher ION injury rates in males mirrors many other studies. Shafiq et al. found males constituted ~72% of the sample and had significantly more ION injury ($p = 0.026$) than females. Dubron et al. also included 169 males and 103 females among 272 patients and similarly reported that certain fracture types and anatomical involvement (infraorbital canal, orbital floor) predict nerve injury. Bilateral fractures usually imply higher-energy trauma, more displacement, and possibly more involvement of the infraorbital canal or foramen on both sides. More anatomical disruption increases the likelihood of nerve stretching, compression, or even transection. Bilaterality may also mean a more central fracture line, more connective tissue disruption, and possibly more bilateral swelling and oedema, which can compress both infraorbital nerves. Fogaça et al. detailed neurosensory testing after zygoma fractures demonstrated abnormal sensibility in 76% of patients overall and 100% of those requiring orbital floor reconstruction, with much higher detection rates in widely displaced fractures¹³—findings that link displacement/complexity (features more common in bilateral or high-energy injuries) to nerve dysfunction. Multi-centre data and reviews also report statistically significant associations between displaced zygomatic fractures and ION sensory deficits, underscoring that displacement/communion (which bilaterality often implies) is a major risk factor for persistent neurosensory abnormality (Boffano et al.).¹⁴ Anatomically, the infraorbital nerve runs within a relatively fixed canal as it exits the orbit; when both zygomatic buttresses are disrupted (as in bilateral or highly comminuted fractures), the canal and its supporting bony roof are more likely to be deformed or compressed — a mechanism emphasised in surgical/trauma references and AO surgery guidance describing the vulnerability of the nerve to displacement and orbital floor involvement.¹⁵ Anaesthesia implies more serious interruption or damage to the nerve. Hypoesthesia (reduced but not absent sense) lies between. The consistent pattern across these studies underscores plausible explanations: paraesthesia often represents partial injury (nerve compression, stretching, focal demyelination) rather than complete severance, which is required for anaesthesia (Meyer et al.).¹⁶ In many fractures, the infraorbital nerve is not transected but is compressed or subjected to oedema, which leads to altered sensations rather than total loss.¹⁷ Additionally, early clinical

examination may detect transient paresthetic changes more readily than full anaesthesia, which may also resolve over time or evolve. Finally, variability in fracture anatomy (esp. involvement of infraorbital canal and orbital floor) appears to influence not only whether nerve injury occurs but also its type and severity, with more severe anatomical disruption more likely to produce hypoesthesia or anaesthesia.¹⁸ Time since injury and swelling may influence detection of complete vs partial deficits. In the French study of 81 patients by Devoti et al., over half (51.8%) had persistent neurological signs at 6 months; within that group, isolated hypoesthesia was the most frequent sequela (66.7%) among persistent cases, rather than complete anaesthesia or dysesthesia.¹⁹ Meanwhile, Renzi et al. showed an overall 70.9% prevalence of trigeminal sensory impairment among facial fractures, but with a marked increase in more severe fractures (88.2% for displaced fractures) and 100% in direct nerve injuries, arguing that severity and anatomical involvement govern whether injury is partial (sensory alteration) or complete loss.²⁰ Together, these data reinforce our findings: paraesthesia (or sensory alteration) is usually more common than complete anaesthesia or more severe sensory loss in ION injury following ZMC fractures, because many injuries are incomplete (compression, stretching, oedema) rather than full transection of the nerve.

LIMITATIONS

This study had a few limitations. First, because this study was conducted in a single tertiary care centre, the results may be less generalisable to other populations. Secondly, the diagnosis of ION injury following ZMC fractures was made using clinical neurosensory testing without the use of advanced imaging or adjunctive electrophysiological evaluations, which could have resulted in an overestimation or underestimation of the severity of the injury. Fourth, the cross-sectional design made it impossible to evaluate nerve regeneration or long-term patterns of sensory recovery. Lastly, the observed associations may have been affected by the lack of detailed stratification of potential confounders such as fracture displacement, surgical timing, and technique.

CONCLUSIONS

Our study revealed that zygomaticomaxillary complex fractures frequently resulted in infraorbital nerve damage. The most frequent kind of nerve damage was paresthesia, and bilateral fractures were more significantly associated with nerve involvement, while

trauma mechanism was not a significant predictor. The incidence of ION injury was significantly higher in male patients compared with female patients. The reasons for this association could not be determined in the present study. These results highlight the value of early neurosensory assessment in ZMC fracture cases, especially for male patients who are at higher risk and for bilateral fractures. Identifying patterns of nerve damage at presentation can guide prompt interventions, improve postoperative outcomes, and support patient prognosis and counselling.

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The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.



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