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# Patterns of Infraorbital Nerve Injury in Zygomatic Maxillary Complex Fractures: A Study from A Public Hospital in Karachi

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## ABSTRACT

The zygomatic region is highly susceptible to zygomatic maxillary Complex fractures, making it the second most common facial fracture in the lateral midface. **Objective:** To determine the types and frequencies of infraorbital nerve injuries (anesthesia, paresthesia, dysesthesia, and hypoesthesia) in patients with zygomatic maxillary complex fractures. **Methods:** A cross-sectional study was conducted over six months at the Department of Oral and Maxillofacial Surgery, Jinnah Postgraduate Medical Centre, Karachi. The total sample size of 72 was determined using OPEN-EPI software, based on a 95% confidence interval, 7% margin of error, and an assumed 89.77% proportion of infraorbital nerve injury in zygomatic maxillary fractures from a previous study. Non-probability consecutive sampling was employed. Demographic data (gender, age, residence, Body Mass Index) and infraorbital nerve injuries were recorded, and categorized into hypoesthesia, paresthesia, dysesthesia, and anesthesia based on clinical examination and radiographs. Data were analyzed using SPSS version 20.0, with means and percentages used for analysis. The chi-square test was utilized to explore associations between categorical variables. **Results:** Among 72 patients, 62.5% were male, with a mean age of 37.43 ± 11.04 years. Urban residents made up 65.3%. The mean Body Mass Index was 24.77 ± 3.0 kg/m$^2$, and 19.4% were obese. Infraorbital nerve injury was present in 75% of cases, with paresthesia the most common (59.7%), followed by hypoesthesia (8.3%), dysesthesia (4.2%), and anesthesia (2.8%). **Conclusions:** It was concluded that infraorbital nerve injuries are frequent in zygomatic maxillary fractures, with paresthesia being the most common. Early detection and treatment are essential to improve patient outcomes.

## INTRODUCTION

The zygomatic bone is a vital component of the facial skeleton, contributing to facial aesthetics, supporting mastication through the masseter muscle, and forming part of the orbital walls. Zygomaticomaxillary Complex (ZMC) fractures are common due to the bone's prominence, accounting for 45% of mid-facial fractures and 25% of all facial fractures. The primary causes of these fractures include road traffic accidents (RTAs), interpersonal violence, and falls, with motorbike accidents being a leading cause in developing countries like Pakistan, while violence and altercations are more frequent in Western countries [1, 2]. ZMC fractures are frequently accompanied by infraorbital nerve injuries, leading to sensory disturbances such as paresthesia, hypoesthesia, dysesthesia, and anesthesia in the affected areas. These injuries occur in up to 95% of cases involving fractures of the infraorbital fissure or canal. The incidence of infraorbital nerve injury in ZMC fractures varies widely, with reports ranging from 18% to 89.77%, depending on the population and diagnostic methods used [3-5]. Despite their high incidence, infraorbital nerve injuries are often overlooked in the clinical management of facial trauma, particularly in resource-constrained settings where diagnostic and therapeutic capacities may be limited [6, 7]. This study aims to address this gap by exploring the types and frequencies of infraorbital nerve injuries in patients

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with ZMC fractures treated at a major public hospital in Karachi.

This study aims to improve diagnostic accuracy and management strategies for ZMC fractures, ultimately enhancing patient outcomes by understanding the local prevalence and characteristics of these injuries.

## METHODS

This cross-sectional study was conducted in the Department of Oral and Maxillofacial Surgery at Jinnah Post Graduate Medical Centre in Karachi. The study spanned six months, from September 24, 2021, to March 23, 2022. The sample size of 72 was determined using OPEN-EPI software, with a 95% confidence interval, 7% margin, and a proportion of 89.77% for infraorbital nerve injury in Zygomatic Complex (ZMC) fractures derived from a prior study [8]. Non-probability consecutive sampling was employed to recruit participants who were newly diagnosed with zygomatic bone fractures [9]. All eligible patients presenting to the Department of Oral and Maxillofacial Surgery at the hospital during the defined timeframe were included if they met the criteria, thereby ensuring a representative sample of the population experiencing these injuries. Eligible participants included those who were newly diagnosed with zygomatic bone fractures, aged between 16 to 65 years and who were Pakistani nationals, as verified by their National Identity Card (NIC). Exclusion criteria comprised individuals with only maxillary and Lefort III fractures, a history of previous infraorbital nerve sensory disturbances, diabetes, or neurological disorders. These criteria were implemented to minimize confounding variables that could affect the outcomes of the study. Approval from the Review Board Committee of JPMC was obtained (IRB No.F.2-81/2020-GENL/39562/JPMC). All eligible outpatients presenting with ZMC fractures and meeting the inclusion criteria were enrolled after providing informed consent. Detailed patient histories and relevant clinical examinations were conducted, gathering baseline information on gender, age groups, residential status, and obesity. Radiological examinations included water sub-mento-vertex and occipito-mental views, as well as computed tomography scans to assess the presence and extent of fractures. Data collection was supervised by a senior consultant, a fellow of the College of Physicians and Surgeons Pakistan (CPSP), and recorded on a pre-designed proforma. SPSS version 20.0 was used for data analysis. Frequencies and percentages were calculated for categorical variables, such as gender, residential status, obesity, and types of infraorbital nerve injury. Mean and standard deviation were provided for age, with stratification applied to account for effect modifiers such as age, gender, and residential status. The Chi-Square test was employed to evaluate associations between categorical variables, with statistical significance set at $p<0.05$.

## RESULTS

Our study included a total of 72 patients who met the inclusion criteria. Among these, 45 (62.5%) were male, and 27 (37.5%) were female. The mean age of the study participants was 37.43 ± 11.04 years, ranging from a minimum of 16 years to a maximum of 65 years. Specifically, male patients had a mean age of 40.44 ± 10.62 years, while female patients had a mean age of 32.40 ± 10.02 years. The majority of the study cases, 51 (70.8%), were aged over 30 years (p=0.295). Regarding residential distribution, 47 (65.3%) of the study cases were from urban areas, while 25 (34.7%) belonged to rural areas. The mean body mass index (BMI) of the study participants was 24.77 ± 3.0 kg/m$^2$, with obesity observed in 14 (19.4%) cases (Table 1).

**Table 1:** Graf Classification of Hip

| Variables | Frequency (%) |
|---|---|
| **Gender** | |
| Male | 45 (62.5%) |
| Female | 27 (37.5%) |
| Total | 72 (100%) |
| **Age Groups** | |
| Up to 30 Years | 21 (29.2%) |
| More Than 30 Years | 51 (70.8%) |
| Total | 72 (100%) |
| **Residential Status** | |
| Urban | 47 (65.3%) |
| Rural | 25 (34.7%) |
| Total | 72 (100%) |
| **Obesity** | |
| Yes | 14 (19.4%) |
| No | 58 (80.6%) |
| Total | 72 (100%) |
| **Infra-orbital Nerve Injury** | |
| Yes | 54 (75%) |
| No | 18 (25%) |
| Total | 72 (100%) |
| **Paresthesia** | |
| Yes | 43 (59.7%) |
| No | 29 (40.3%) |
| Total | 72 (100%) |
| **Anesthesia** | |
| Yes | 02 (02.8%) |
| No | 70 (97.2%) |
| Total | 72 (100%) |
| **Dysesthesia** | |
| Yes | 03 (04.2%) |
| No | 69 (95.8%) |
| Total | 72 (100%) |
| **Hypoesthesia** | |
| Yes | 06 (8.3%) |
| No | 66 (91.7%) |
| Total | 72 (100%) |

The stratification of infra-orbital nerve injury was analyzed

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based on gender, age, residential status, obesity, and the types of nerve injury (hypoesthesia, paresthesia, dysesthesia, and anesthesia). Our findings revealed that most patients with zygomatic fractures were over 30 years old, and this age group demonstrated a statistically significant relationship with infra-orbital nerve injury (p-value<0.05). While more male (77.8%) experienced infra-orbital nerve injury compared to female (70.4%), the difference between genders was not statistically significant (p-value=0.48). Regarding residential status, 65.3% of cases came from urban areas compared to 34.7% from rural areas, although this distribution did not show statistical significance (p-value=0.198). Among the types of nerve injuries, paresthesia was the most common, affecting 59.7% of patients, with a highly significant p-value of 0.001, indicating a strong association with infra-orbital nerve injury. Hypoesthesia occurred in 8.3% of cases, but this finding was not statistically significant (p-value=0.140). Additionally, anesthesia and dysesthesia were less frequent, and their associations with infra-orbital nerve injury were not statistically significant. These results underscore the high prevalence of paresthesia in patients with infra-orbital nerve injury and highlight its importance in early diagnosis and management, especially in those with ZMC fractures (Table 2).

**Table 2:** Stratification among the Study Cases

| Variables | Infra-orbital Nerve Injury | | p-value |
|---|---|---|---|
| | Yes (n=54) | No (n=18) | |
| **Gender** | | | |
| Male (n=45) | 35 (77.78%) | 10 (22.22%) | 0.482 |
| Female (n=27) | 19 (70.37%) | 8 (29.63%) | |
| **Age Groups** | | | |
| Up to 30 Years (n=21) | 14 (66.67%) | 7 (33.33%) | 0.295 |
| More than 30 Years (n=51) | 40 (78.43%) | 18 (35.29%) | |
| **Residential Status** | | | |
| Urban (n=47) | 33 (70.21%) | 14 (29.79%) | 0.198 |
| Rural (n=25) | 21 (84.00%) | 4 (16.00%) | |
| **Obesity** | | | |
| Yes (n=14) | 12 (85.71%) | 2 (14.29%) | 0.302 |
| No (n=58) | 42 (72.41%) | 16 (27.59%) | |
| **Paresthesia** | | | |
| Yes (n=43) | 43 (100.0%) | 0 (0.00%) | 0.000 |
| No (n=29) | 11 (37.93%) | 18 (62.07%) | |
| **Anesthesia** | | | |
| Yes (n=02) | 2 (100.0%) | 0 (0.00%) | 0.656 |
| No (n=70) | 52 (74.29%) | 18 (25.71%) | |
| **Dysesthesia** | | | |
| Yes (n=03) | 3 (100.0%) | 0 (0.00%) | 0.307 |
| No (n=69) | 51 (73.91%) | 18 (26.09%) | |
| **Hypoesthesia** | | | |
| Yes (n=06) | 06 (100.0%) | 0 (0.00%) | 0.140 |
| No (n=66) | 48 (72.73%) | 18 (27.27%) | |

*Chi-squared test was applied, p-value<0.05 is considered significant

## DISCUSSION

Analysis revealed a higher incidence of zygomatic fractures among males compared to females (62.5% vs. 37.5%), this difference did not reach statistical significance. However, it is worth noting this trend as it may have implications for preventive strategies or targeted interventions in at-risk populations. Previous literature supports the notion of a male predominance in facial fractures, likely due to lifestyle factors and increased engagement in high-risk activities [10, 11]. Concerning residential distribution, results showed that urban areas were associated with a higher proportion of zygomatic fracture cases compared to rural areas (65.3% vs. 34.7%). This finding underscores the potential influence of environmental or socioeconomic factors on the occurrence of facial fractures, possibly related to differences in infrastructure, lifestyle, or access to healthcare resources between urban and rural settings [12, 13]. In terms of sensory disturbances associated with zygomatic fractures, the study identified paresthesia as the most prevalent type, affecting nearly 60% of patients. Paresthesia refers to abnormal sensations such as tingling or numbness, often indicative of nerve injury or compression [14]. Hypoesthesia, characterized by reduced sensitivity to touch or sensation, was observed in a smaller subset of cases (8.3%). These findings highlight the considerable impact of zygomatic fractures on sensory function and underscore the importance of assessing and managing associated nerve injuries in clinical practice [15, 16]. Previous studies have also reported high incidences of paresthesia in cases of Zygomaticomaxillary Complex (ZMC) fractures. For example, a recent study observed infraorbital nerve (ION) hypoesthesia in a significant proportion of ZMC fractures, aligning with reported incidences ranging from 30% to 80% [17]. Fracture lines intersecting the infraorbital canal were associated with a higher likelihood of ION hypoesthesia, emphasizing the correlation between the specific anatomical features of the fracture line and the degree of displacement. The zygomatic bone, a critical component linking the cranium and maxilla, plays an essential role in the structure, function, and aesthetics of the facial skeleton [18]. Its convex shape and protrusion render it vulnerable to fractures, ranking as the second most common facial fracture following nasal bone fractures, with road traffic accidents being a significant cause of maxillofacial injuries [19]. The infraorbital groove and canal provide a natural pathway for the infraorbital nerve (ION) and vessels as they traverse from the fissure to the foramen. Variants of this canal, including canal-only, groove-only, and combined configurations, can influence the risk of nerve injury [20]. Injury to the nerve within this complex can lead to paresthesia, and sensory disturbances along the infraorbital nerve distribution are commonly observed in orbit zygomatic fractures [21]. The incidence of

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posttraumatic neurosensory deficiencies in the infraorbital nerve varies and is influenced by factors such as the type and energy of impact, fracture displacement, timing of surgical intervention, and treatment method. Compression injuries or neuropraxia predominantly affect the infraorbital nerve due to impaction from bony fragments or oedema in surrounding tissues. The small sample size constrains the generalizability of findings, and potential biases in the data collection process could affect the validity of the results. Further research with larger sample sizes and multicenter approaches is essential to corroborate our findings and enhance their applicability to broader populations. The clinical implications of the current study are significant. The findings could inform management practices in maxillofacial surgeries, emphasizing the need for thorough preoperative assessments of sensory function in patients with zygomatic fractures.

## CONCLUSIONS

It was concluded that overall infraorbital nerve injury was frequently present in the majority of the study cases associated with zygomatic complex fractures and the most common type of infraorbital nerve injury in the study cases was paresthesia followed by hypoesthesia, dysesthesia and anesthesia. Paresthesia was significantly associated with infraorbital nerve injury. Patients and surgeons should recognize that identifying these observations in radiological and clinical assessments can be valuable for predicting infraorbital nerve injuries and determining the type of paresthesia in patients with zygomatic complex fractures.

## Authors Contribution

Conceptualization: QS
Methodology: QS, ZA, UH
Formal analysis: QS, S
Writing review and editing: TS, FI

All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest

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