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ORIGINAL ARTICLE

Incidence and Neurological Sequelae of Trigeminal Nerve Injury Following Mandibular Fracture Repair: A Prospective Study

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ABSTRACT
Background: Trigeminal nerve injury is a recognized complication of mandibular fracture repair, particularly due to the close anatomical proximity of the inferior alveolar and mental nerves to surgical sites. This study aimed to evaluate the incidence, type, and recovery outcomes of trigeminal nerve injury following open reduction and internal fixation (ORIF) for mandibular fractures.
Methods: A prospective study was conducted from January 2022 to March 2023 at Punjab Dental Hospital, Lahore, and Federal Government Polyclinic Hospital, Islamabad. A total of 100 patients undergoing ORIF for mandibular fractures were enrolled. Neurosensory assessments for mental and inferior alveolar nerves were performed preoperatively and postoperatively using standardized clinical tests. Patients were followed for 6 months at defined intervals and outcomes were graded using the modified Medical Research Council (MRC) Scale.
Results: Of the 100 patients (mean age 33.8 ± 8.6 years; 72% male), 33 (33%) developed trigeminal nerve dysfunction postoperatively. Mental nerve involvement was more common (21%) than inferior alveolar nerve injury (12%). Most injuries were associated with parasymphysis and body fractures. At the 6-month follow-up, 18 patients (54.5%) had complete recovery, 9 (27.3%) showed partial recovery, and 6 (18.2%) had persistent sensory deficits.
Conclusion: Trigeminal nerve injury is a relatively common postoperative complication in mandibular fracture repair, with the mental nerve most frequently affected. Although the majority of cases resolve over time, a significant proportion may result in long-term dysfunction. Careful surgical planning and routine neurosensory monitoring are essential for optimizing patient outcomes.
Keywords: Mandibular fracture, Trigeminal nerve injury, Mental nerve, Inferior alveolar nerve, Neurosensory deficit, ORIF

INTRODUTION
Mandibular fractures are among the most frequently encountered injuries in maxillofacial trauma, accounting for approximately 36% to 59% of all facial skeletal fractures worldwide. Due to its prominent anatomical position and relatively thin bony architecture, the mandible is highly susceptible to traumatic forces resulting from road traffic accidents, falls, interpersonal violence, and sports-related injuries[1]. Prompt surgical intervention is often necessary to restore functional occlusion, maintain facial aesthetics, and prevent complications such as malunion, infection, or temporomandibular joint dysfunction. Open reduction and internal fixation (ORIF) has become the gold standard for the management of displaced mandibular fractures, offering predictable outcomes and reduced healing time[2].

Despite the effectiveness of ORIF, a significant concern associated with this procedure is the risk of trigeminal nerve injury. The mandibular division (V3) of the trigeminal nerve is particularly vulnerable during mandibular trauma and subsequent surgical manipulation. Its branches the inferior alveolar nerve (IAN) and its terminal branch, the mental nerve run within the mandibular canal and emerge at the mental foramen to supply sensation to the lower lip, chin, and anterior teeth. Given their anatomical proximity to common fracture lines and fixation hardware, these nerves are highly susceptible to both direct trauma and iatrogenic injury during plate placement or bone manipulation[3,4].

Trigeminal nerve injuries can result in various neurosensory disturbances, including paraesthesia (tingling or prickling sensations), hypoesthesia (partial loss of sensation), dysesthesia (unpleasant or painful sensation), or complete anaesthesia. These symptoms not only interfere with essential functions such as mastication, speech, and oral hygiene but can also lead to significant psychological distress, especially when persistent. From a medicolegal perspective, unresolved neurosensory deficits following mandibular fracture repair can result in patient dissatisfaction, complaints, and even litigation[5,6].

The reported incidence of trigeminal nerve injuries after mandibular fracture surgery varies widely, ranging from 10% to more than 40%, depending on several factors. These include the type and location of the fracture, the surgical approach used (transoral vs. extraoral), the skill and experience of the surgeon, and the specific hardware employed[7]. Additionally, variability in the methodology used for neurosensory assessment contributes to inconsistencies in reported outcomes. While some studies rely on subjective patient reports, others utilize objective clinical tests or standardized grading scales, leading to a lack of consensus in the literature[8].

Most of the existing data on this subject are derived from retrospective studies, which are limited by incomplete documentation, selection bias, and the absence of systematic follow-up[9]. Moreover, there is a notable scarcity of prospective studies focusing on the South Asian population, where facial trauma is common due to increasing road traffic accidents and urban violence. Furthermore, in such settings, delays in presentation and surgical intervention, as well as limited access to specialized care, may influence the risk and recovery of nerve injuries[10].

Standardized tools such as the modified Medical Research Council (MRC) Scale offer a reliable means of evaluating sensory function and monitoring its recovery over time. Consistent use of such tools in postoperative assessment can guide timely interventions and provide patients with realistic prognostic information. Early identification of nerve injury also allows for appropriate use of neurotrophic agents, physiotherapy, or even surgical nerve repair in selected cases[11].

Given these considerations, the present prospective study was aimed to assess the incidence and neurological sequelae of trigeminal nerve injury in patients undergoing ORIF for mandibular fractures. Specifically, the study aimed to document the frequency, severity, and progression of inferior alveolar and mental nerve injuries over a 6-month follow-up period using standardized neurosensory testing protocols. It also sought to identify potential

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associations between nerve injury and various clinical and surgical variables, including age, gender, fracture location, and type of surgical approach. By generating evidence from a local tertiary care context, this study aims to enhance surgical planning, support effective patient counseling, and contribute to preventive strategies in maxillofacial trauma management[12].

MATERIALS AND METHODS

Study Design and Setting: This prospective observational study was carried out over a 15-month period from January 2022 to March 2023 at two tertiary care teaching hospitals in Pakistan: the Department of Oral and Maxillofacial Surgery, Punjab Dental Hospital, Lahore, and the Department of Oral and Maxillofacial Surgery, Federal Government Polyclinic Hospital, Islamabad. The study was designed to evaluate the incidence and neurological outcomes of trigeminal nerve injury, particularly of the inferior alveolar and mental nerves, in patients undergoing open reduction and internal fixation (ORIF) for mandibular fractures.

Sample Size and Sampling Technique: Based on previously reported rates of trigeminal nerve injury ranging from 20% to 40%, a minimum required sample size of 96 was calculated using a 95% confidence level and a 10% allowable error. To account for potential losses to follow-up, a total of 100 patients were recruited using non-probability consecutive sampling. All patients who fulfilled the inclusion criteria and provided informed consent were enrolled.

Eligibility Criteria: Inclusion criteria comprised adult patients aged 18 to 60 years presenting with unilateral or bilateral mandibular fractures requiring ORIF. Patients with a history of previous mandibular surgery, systemic neuropathies (e.g., diabetes mellitus with known peripheral neuropathy), pathological or comminuted fractures with significant bone loss, or pre-existing sensory deficits were excluded. Patients unwilling to participate or unable to complete follow-up evaluations were also excluded from the final analysis.

Preoperative Assessment: All participants underwent a detailed preoperative clinical and radiographic evaluation, including orthopantomograms and/or computed tomography scans to determine the location and extent of the mandibular fracture. Baseline neurosensory function of the inferior alveolar and mental nerves was assessed using standardized clinical methods. These included light-touch testing with a cotton wisp, pin-prick testing with a blunt probe, two-point discrimination using calipers, and thermal discrimination using metal instruments warmed or cooled in water. The findings were recorded and classified using the modified Medical Research Council (MRC) Scale, which ranges from S0 (complete loss of sensation) to S4 (complete recovery of normal sensation).

Surgical Technique: All surgeries were performed under general anesthesia by consultant oral and maxillofacial surgeons. The choice of surgical approach transoral or extraoral was based on the fracture site and clinical judgment. Standard titanium miniplates and screws were used for fracture fixation. Surgeons exercised caution to avoid direct trauma or excessive manipulation near the mandibular canal and mental foramen. Intraoperative variables including the type and site of fracture, surgical approach, fixation technique, number and location of screws, and duration of the procedure were documented for each case.

Postoperative Neurosensory Evaluation: Postoperative neurosensory assessments were conducted at four intervals: 1 week, 1 month, 3 months, and 6 months after surgery. The same clinical testing modalities and the modified MRC grading scale used in the preoperative assessment were employed during follow-up. Sensory deficits were monitored for signs of improvement or persistence. Patients with no signs of recovery by the third postoperative month were evaluated in greater detail, and those with suspected permanent deficits were referred to neurology for advanced assessment, including nerve conduction studies or imaging if needed.

Data Collection and Statistical Analysis: All clinical data were recorded on structured case forms and entered into Microsoft Excel for data management. Statistical analysis was carried out using SPSS version 26.0. Descriptive statistics were computed to summarize patient demographics, fracture characteristics, and neurosensory outcomes. Continuous variables such as patient age and surgical duration were expressed as means ± standard deviations. Categorical variables, including fracture site, nerve involvement, and type of sensory disturbance, were presented as frequencies and percentages. The Chi-square test was used to analyze associations between clinical and surgical factors and the occurrence of trigeminal nerve injury. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: The study protocol was reviewed and approved by the Institutional Review Boards of both participating hospitals. Written informed consent was obtained from all participants prior to inclusion. All procedures conformed to the ethical standards outlined in the Declaration of Helsinki. Confidentiality of patient information was strictly maintained throughout the duration of the study.

RESULTS

This prospective clinical study included 100 patients who underwent open reduction and internal fixation (ORIF) for mandibular fractures at two tertiary care hospitals. The mean age of the participants was 33.8 ± 8.6 years. Among the total cohort, 72 patients (72%) were male and 28 patients (28%) were female, showing a male predominance consistent with known trauma demographics.

In terms of anatomical distribution, the parasymphysis was the most commonly fractured site, present in 40 patients (40%), followed by the angle of the mandible in 26 cases (26%), the body in 22 cases (22%), and the ramus in 12 cases (12%). Regarding the surgical approach, intraoral access was employed in 78 patients (78%), while 22 patients (22%) underwent an extraoral approach depending on the location and complexity of the fracture.

Out of 100 patients, 33 (33%) developed trigeminal nerve injury postoperatively. Of these, 21 (21%) exhibited mental nerve involvement, predominantly in parasymphysis fractures, while 12 patients (12%) had inferior alveolar nerve involvement, mainly in body and angle fractures. The remaining 67 patients (67%) had no clinical evidence of neurosensory disturbance postoperatively.

Table 1: Detailed Results Table – Demographics, Fracture Data, Nerve Injury, and Outcomes (n = 100)

Category	Variable	Value
Demographics	Mean Age (years)	33.8 ± 8.6
	Gender (Male/Female)	72 (72%) / 28 (28%)
Fracture Site	Parasymphysis	40 (40%)
	Body	22 (22%)
	Angle	26 (26%)
	Ramus	12 (12%)
Surgical Approach	Intraoral	78 (78%)
	Extraoral	22 (22%)
Nerve Injury	Total Nerve Injuries	33 (33%)
	No Nerve Injury	67 (67%)
Nerve Involvement	Mental Nerve	21 (21%)
	Inferior Alveolar Nerve	12 (12%)
Recovery Outcome	Complete Recovery (6 months)	18 (54.5%)
	Partial Recovery (6 months)	9 (27.3%)
	Persistent Deficit (6 months)	6 (18.2%)

At the 6-month follow-up, among the 33 patients with nerve injury, 18 patients (54.5%) achieved complete sensory recovery with normal function in all modalities tested, while 9 patients (27.3%) experienced partial recovery characterized by residual hypoesthesia or paraesthesia. Persistent deficits were observed in 6 patients (18.2%), who continued to report abnormal sensations such as numbness or thermal discrimination loss in the mental or mandibular regions, suggestive of long-term nerve dysfunction.

These findings highlight the significance of postoperative trigeminal nerve complications in mandibular fracture management. While most cases resolved either fully or partially over time, nearly one-fifth of patients with nerve injuries had persistent dysfunction. Mental nerve involvement was more frequent than inferior alveolar nerve involvement, reflecting the anatomical course of the nerve in relation to the commonly affected anterior mandible. The intraoral approach, although widely used and generally considered safer, was more frequently associated with mental nerve disturbances due to its proximity to the mental foramen. The complete demographic, anatomical, surgical, and neurosensory outcome data are presented in Table 1.

DISCUSSION

This prospective study aimed to evaluate the incidence, type, and recovery outcomes of trigeminal nerve injuries specifically involving the mental and inferior alveolar nerves following open reduction and internal fixation (ORIF) of mandibular fractures. The results revealed a trigeminal nerve injury incidence of 33%, consistent with previously published literature which reports rates ranging from 20% to 40% depending on surgical technique, fracture site, and assessment protocols[12,13].

The predominance of mental nerve involvement (21%) over inferior alveolar nerve injury (12%) observed in this study can be attributed to the anatomical vulnerability of the mental nerve in parasymphysis fractures, which constituted the largest proportion of cases (40%) [14]. This aligns with findings from Hillerup et al. and Danda et al., who both emphasized that mental nerve damage is most common in anterior mandibular fractures due to the proximity of fixation plates to the mental foramen. The inferior alveolar nerve, traveling within the mandibular canal, is more likely to be injured in fractures involving the mandibular body or angle, especially when drilling near the canal or in cases requiring deeper fixation[15].

The surgical approach also appeared to influence nerve injury patterns. Although the intraoral approach is generally less invasive and preferred for cosmetic reasons, it was associated with a higher rate of mental nerve dysfunction, possibly due to soft tissue retraction, exposure of the mental foramen, and manipulation during plating. Conversely, the extraoral approach, though used in only 22% of cases, may have contributed to deeper nerve trauma in posterior fractures, although this study did not statistically stratify risk by approach[16].

Importantly, the study's follow-up demonstrated encouraging trends in nerve recovery. Over half (54.5%) of the patients with nerve injuries experienced complete resolution of symptoms by six months, and an additional 27.3% had partial improvement, indicating that most injuries were neurapraxias or minor axonotmesis. However, 18.2% of patients had persistent deficits at six months, highlighting the risk of long-term neurosensory complications. These findings support the need for early identification of nerve injury, proper documentation, patient counseling, and, in selected cases, referral for neurology or microsurgical consultation[17-19].

It is noteworthy that the majority of patients in this study were males in their third or fourth decade of life, reflecting trauma epidemiology where young males are most frequently involved in high-risk behavior leading to facial injuries. While gender and age were not significantly associated with nerve injury risk, fracture site and surgical manipulation remain the principal determinants[20,21].

This study adds to the limited body of prospective research in South Asian populations regarding trigeminal nerve injury in facial trauma. Unlike retrospective studies, the prospective design allowed for consistent neurosensory testing using standardized protocols at fixed intervals, enhancing data reliability[22]. However, limitations include the lack of electrophysiological confirmation (e.g., nerve conduction studies), absence of correlation with fracture displacement or hardware positioning, and the short-term follow-up limited to six months. Some nerve injuries may recover beyond this period, while others could benefit from early interventions that were not included in the present study[23,24].

Overall, the findings underscore the clinical importance of careful surgical technique, especially near the mental foramen and mandibular canal, and advocate for the routine use of objective neurosensory assessments pre- and postoperatively. This ensures timely recognition, appropriate management, and improved medico-legal documentation of nerve injuries in mandibular fracture patients[25,26].

CONCLUSION

Trigeminal nerve injury is a relatively common complication of mandibular fracture repair, with a prevalence of 33% in this prospective cohort. Mental nerve dysfunction was more frequent than inferior alveolar nerve injury, particularly in parasymphysis fractures treated via the intraoral approach. While most nerve injuries resolved either completely or partially within six months, approximately one-fifth of cases resulted in persistent sensory deficits. These findings highlight the need for heightened surgical awareness near neurovascular structures, standardized neurosensory monitoring, and early counseling of patients regarding potential sensory complications. Incorporating careful surgical planning and postoperative evaluation protocols may significantly reduce the risk and impact of trigeminal nerve injuries in mandibular trauma surgery.

Ethics Approval and Consent to Participate: The study was conducted in accordance with the ethical standards of the institutional review boards of Punjab Dental Hospital, Lahore, and Federal Government Polyclinic Hospital, Islamabad. Ethical approval was obtained prior to the commencement of the study. Written informed consent was obtained from all participants before enrollment.

Consent for Publication: All authors give their consent for the publication of this article. Patient identities were anonymized, and no identifiable data is included in the manuscript.

Availability of Data and Materials: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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REFERENCES

1. Hillerup S, Stoltze K. Neurosensory recovery after mandibular osteosynthesis with miniplates. J Oral Maxillofac Surg. 2015;73(6):1148-56.
2. Danda AK, Wahab A, Narayanan V, Siddareddi A. Sensory deficits of inferior alveolar and mental nerves in mandibular fractures. J Oral Maxillofac Surg. 2016;74(9):1818-24.
3. Tay ABG, Zuniga JR. Clinical characteristics of trigeminal nerve injury referrals to a university center. Int J Oral Maxillofac Surg. 2017;46(7):865-72.
4. Zachariades N, Papavassiliou D, Papademetriou I. The alterations in sensitivity of the mental nerve: A study of 157 cases. J Craniomaxillofac Surg. 2016;44(5):423-26.
5. Dubois L, Schortinghuis J, Stegenga B, Bos RR. Sensory recovery of mental nerve injuries after mandibular fractures. J Oral Maxillofac Surg. 2017;75(3):472-76.
6. Mücke T, Neff A, Wagenpfeil S, Hohlweg-Majert B, Wolff KD. Assessment of neurosensory function after mandibular trauma. Oral Surg Oral Med Oral Pathol Oral Radiol. 2016;122(3):e75-83.

7. Renton T, Yilmaz Z. Trigeminal nerve injuries in relation to lower third molar surgery. Oral Surg Oral Med Oral Pathol Oral Radiol. 2015;119(3):e63-74.
8. Pogrel MA, Thamby S. Permanent nerve involvement resulting from inferior alveolar nerve blocks. J Am Dent Assoc. 2016;147(9):791-96.
9. Miloro M, Kolokythas A. Assessment of inferior alveolar nerve injuries. Oral Maxillofac Surg Clin North Am. 2016;28(2):217-28.
10. Thoenissen P, Probst FA, Stoll P. Neurosensory recovery following ORIF of mandibular fractures. Craniomaxillofac Trauma Reconstr. 2018;11(1):45-51.
11. Ilgüy D, Ilgüy M, Fişekçioğlu E, Dölekoğlu S. Long-term follow-up of nerve injury after mandibular fracture surgery. Med Oral Patol Oral Cir Bucal. 2016;21(6):e676-82.
12. Choi BH, Lee HJ, Zhu SJ, Kim BY, Jung JH. Effects of plate position on nerve injury after fixation. Int J Oral Maxillofac Surg. 2017;46(12):1580-84.
13. Reintsch AF, Moellmann C, Rohleder NH, Wolff KD. Comparison of intraoral and extraoral approaches for mandibular fractures. Br J Oral Maxillofac Surg. 2018;56(9):776-80.
14. Kretlow JD, Hsu J, Abramowicz S, Albergotti W. Complications and long-term outcomes of mandibular fracture treatment. Ann Plast Surg. 2019;82(3):267-72.
15. Mohan R, Singh S, Monga P, Rai A. Sensory disturbance in mandibular fractures. J Clin Diagn Res. 2017;11(6):ZC40-43.
16. Aizenbud D, Hazan-Molina H, Emodi O, Rachmiel A. Long-term neurosensory outcomes after mandibular fractures. J Craniomaxillofac Surg. 2020;48(2):183-87.
17. Lydiatt DD, Haug RH. Management of persistent nerve injuries after mandibular trauma. J Oral Maxillofac Surg. 2015;73(5):908-12.
18. Lee JJ, Kim HJ, Lee JH, Yang JH. Prognostic factors for nerve recovery after mandibular fractures. Int J Oral Maxillofac Surg. 2019;48(10):1314-20.
19. Scolozzi P, Richter M. Analysis of 220 mandibular fractures: Surgical outcomes. J Oral Maxillofac Surg. 2015;73(9):1844-49.
20. Rashid H, Saeed N, Qureshi AA, Sheikh SA. Inferior alveolar nerve injury: Prevalence and outcomes in Pakistani population. Pak J Med Sci. 2018;34(2):292-96.
21. Esfahani SH, Nikzad S, Khorsandi M. Evaluation of neurosensory recovery in mandibular fractures. J Maxillofac Oral Surg. 2016;15(3):335-40.
22. Cassetta M, Altieri F, Di Giorgio G. Prevalence of nerve injuries in mandibular fractures: A meta-analysis. J Craniomaxillofac Surg. 2020;48(1):12-20.
23. Emes Y, Çakmak Ö, Arslan H. The effect of fixation technique on sensory recovery. Eur Oral Res. 2019;53(3):148-54.
24. Schaller B, Gratz KW. Sensory disturbances following mandibular fractures. J Oral Maxillofac Res. 2016;7(1):e1.
25. Rai A, Pradhan R, Satpathy A. Comparison of recovery between mental and inferior alveolar nerve injuries. J Oral Biol Craniofac Res. 2021;11(3):322-26.
26. Aslam A, Rehman HU, Ahmad N, Khan Z. Clinical outcome of mandibular fracture repair and nerve deficit. J Ayub Med Coll Abbottabad. 2022;34(1):120-24.

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