Evaluation of Post-Traumatic Neurosensory Recovery Following Mandibular Fracture Fixation

[1]Avinash Sonune, [2]Komalpreet Kaur Mann, [3]Varun Ramachandra, [4]Pranay Amin, [5]Sachin Franklin, [6]Annu Saini,

[1]Assistant Professor, Department Of Dentistry, Sant Sewalal Maharaj Government Medical College & Hospital, Maharashtra University Of Health Sceinces, Nashik, Washim, Maharashtra, India avinashsonune01@gmail.com

[2]Dental Surgeon, Dr. Ahluwalia's Dental Care Centre Ambala, Haryana, India komal2892@gmail.com

[3]Reader, Department of Oral & Maxillofacial Surgery, Manubhai Patel Dental College & Hospital, Vadodara, Gujarat, India drvarun_r@yahoo.com

[4]Senior Lecturer, Department of Oral & Maxillofacial Surgery, Manubhai Patel Dental College & Hospital, Vadodara, Gujarat, India aminpranay22@yahoo.com

[5]Consultant Dentist, Centers Counties Health Centers, Springfield, Illinois, United States of America franklinsachin@gmail.com

[6]Reader, Department of Oral Medicine & Radiology, ITS Dental College, Hospital & Research Centre, Greater Noida, Uttar Pradesh, India annusaini555@gmail.com

Corresponding author: Avinash Sonune, avinashsonune01@gmail.com

HOW TO CITE:

Avinash Sonune, Komalpreet Kaur Mann, Varun Ramachandra, Pranay Amin, Sachin Franklin, Annu Saini, (2026). Evaluation of Post-Traumatic Neurosensory Recovery Following Mandibular Fracture Fixation. International Journal of Special Education, 41(16s), 872-889

COPYRIGHT STATEMENT:

Copyright: © 2026 Authors. Open access publication underthe terms and conditions of the Creative CommonsAttribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).

ABSTRACT:

Background:

Mandibular fractures are among the most common maxillofacial injuries and are frequently associated with inferior alveolar nerve dysfunction, resulting in varying degrees of neurosensory impairment. Timely surgical management aims not only to restore mandibular continuity but also to facilitate recovery of sensory function.

Aim:

To evaluate the pattern of neurosensory recovery following surgical fixation of mandibular fractures over a six-month follow-up period.

Materials and Methods:

A prospective observational study was conducted on 30 patients with mandibular fractures requiring open reduction and internal fixation (ORIF). Demographic characteristics, fracture etiology, anatomical site, side involved, fixation method, interval from trauma to surgery, associated injuries, and baseline neurosensory status were recorded. Neurosensory assessment included two-point discrimination, light touch sensation, pin-prick sensation, brush direction discrimination, and thermal sensation. Evaluations were performed preoperatively and at 1, 3, and 6 months postoperatively. Data were analyzed using Statistical Package for the Social Sciences (SPSS), Version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the findings, while Chi-square tests were applied to compare neurosensory outcomes across different follow-up intervals. A p-value <0.05 was considered statistically significant.

Results: The majority of patients was males (80.0%) and belonged to the 31–40-year age group (36.7%). Road traffic accidents were the leading cause of mandibular fractures (60.0%), with the parasymphysis (33.3%) and angle (26.7%) being the most frequently affected sites. Mild baseline neurosensory deficit

was observed in 40.0% of patients. Progressive improvement was demonstrated in all neurosensory parameters during follow-up. Normal two-point discrimination increased from 26.7% at baseline to 90.0% at 6 months, while normal light touch and pin-prick sensation each improved to 93.3%. Brush direction discrimination and thermal sensation reached normal values in 96.7% of patients by the final follow-up. Overall complete neurosensory recovery increased from 20.0% at 1 month to 83.3% at 6 months, with corresponding reductions in partial and absent recovery. These improvements were highly statistically significant ($p < 0.001$).

Conclusion: Surgical fixation of mandibular fractures resulted in substantial and progressive restoration of neurosensory function over six months. Most patients achieved complete sensory recovery by the end of the follow-up period, highlighting the effectiveness of appropriate fracture management and emphasizing the importance of regular postoperative neurosensory evaluation for monitoring functional recovery.

Keywords: Inferior alveolar nerve, Mandibular fracture, Maxillofacial trauma, Neurosensory recovery, Open reduction and internal fixation, Sensory assessment

Introduction

Mandibular fractures are among the most frequently encountered injuries of the maxillofacial skeleton because of the prominence and anatomical position of the mandible. These fractures commonly result from high-impact trauma such as road traffic accidents, falls, interpersonal violence, and sports-related injuries. The pattern of mandibular fracture varies depending on the mechanism and magnitude of trauma, with the parasymphysis, angle, body, and condyle being the most commonly affected anatomical sites. Appropriate diagnosis and timely surgical intervention are essential for restoring mandibular form, function, and occlusion while minimizing postoperative complications [1].

One of the most significant complications associated with mandibular fractures is injury to the inferior alveolar nerve, particularly in fractures involving the body, angle, and parasymphysis of the mandible. Neurosensory disturbances may occur as a direct consequence of trauma or as a result of surgical manipulation during fracture reduction and fixation. Patients with inferior alveolar nerve injury commonly experience numbness, tingling, altered sensation, hypoesthesia, paresthesia, or dysesthesia involving the mandibular lip, chin, and gingival tissues supplied by the mental nerve. These sensory deficits may adversely affect speech, mastication, oral hygiene, and overall quality of life [2].

Open reduction and internal fixation (ORIF) has become the standard treatment for displaced mandibular fractures because it provides stable fixation, restores anatomical alignment, and facilitates early functional rehabilitation. Advances in fixation systems, including titanium miniplates, three-dimensional (3D) plates, and reconstruction plates, have significantly improved fracture stability and healing outcomes. Despite these advancements, postoperative neurosensory impairment remains a concern, emphasizing the need for careful surgical technique and systematic postoperative evaluation [3].

Recovery of neurosensory function following mandibular fracture depends on several factors, including the severity of the initial nerve injury, fracture location, degree of displacement, interval between injury and surgical

management, patient age, and the method of fixation employed. Mild nerve injuries may recover spontaneously over several weeks or months, whereas severe injuries may result in prolonged or permanent sensory deficits. Consequently, longitudinal assessment of neurosensory function is an important component of postoperative follow-up and helps clinicians monitor nerve regeneration and counsel patients regarding prognosis [4].

Clinical evaluation of inferior alveolar nerve function is primarily based on standardized neurosensory tests. Methods such as two-point discrimination, light touch assessment, pin-prick testing, brush direction discrimination, and thermal sensation testing provide practical and reliable information regarding sensory recovery. These tests evaluate different sensory modalities mediated by peripheral nerve fibers and are widely used in both clinical practice and research to assess functional nerve regeneration following maxillofacial trauma and surgery [5].

Previous studies have reported variable rates of neurosensory recovery after mandibular fracture fixation, with many patients demonstrating gradual improvement during the first six months after surgery. Although complete recovery is achieved in a substantial proportion of patients, persistent sensory impairment may occur in cases involving severe nerve compression, transection, delayed treatment, or complex fracture patterns. The reported variability in recovery emphasizes the importance of periodic neurosensory evaluation using standardized assessment protocols [6].

Several investigators have identified fracture-related and treatment-related variables that may influence postoperative sensory recovery. Factors such as fracture site, bilateral involvement, associated facial injuries, duration between trauma and surgery, and fixation technique have all been associated with differences in neurosensory outcomes. Understanding these variables may assist surgeons in predicting prognosis and optimizing treatment planning for patients with mandibular fractures [7].

Despite numerous reports on the management of mandibular fractures, relatively few prospective studies have comprehensively evaluated multiple neurosensory parameters over sequential postoperative follow-up visits using standardized clinical testing. Furthermore, there remains limited evidence regarding the pattern and timeline of recovery following surgical fixation in different patient populations, highlighting the need for additional clinical investigations [8, 9].

Therefore, the present prospective observational study was undertaken to evaluate neurosensory recovery following ORIF of mandibular fractures. The study assessed recovery using two-point discrimination, light touch sensation, pin-prick sensation, brush direction discrimination, and thermal sensation at baseline and during postoperative follow-up at one, three, and six months. The findings are expected to contribute to a better understanding of postoperative nerve recovery and assist clinicians in monitoring treatment outcomes and improving patient care.

Materials and Methods

Study Design and Setting

This prospective observational study was conducted in the at a tertiary care teaching hospital to evaluate neurosensory recovery following surgical management of mandibular fractures. The study was carried out after written informed consent was obtained from all participants prior to enrollment.

Study Population

A total of 30 consecutive patients diagnosed with mandibular fractures and requiring surgical treatment by ORIF were included in the study.

Inclusion Criteria

- Patients aged 18 years and above with radiographically confirmed mandibular fractures
- Patients undergoing ORIF using miniplates, 3D plates, or reconstruction plates

- Patients with preoperative or postoperative neurosensory disturbances involving the distribution of the inferior alveolar or mental nerve
- Patients willing to participate and comply with scheduled follow-up visits

Exclusion Criteria

- Patients managed by conservative treatment or closed reduction
- Pathological fractures or fractures secondary to neoplastic lesions
- Previous mandibular fractures or pre-existing neurological disorders affecting facial sensation
- Patients with associated craniofacial injuries preventing reliable neurosensory examination
- Patients lost to follow-up or with incomplete clinical records

Data Collection

Demographic and clinical information was recorded using a standardized case record form. The following variables were documented:

- Age and gender
- Etiology of mandibular fracture
- Anatomical site of fracture
- Side involved (right, left, or bilateral)
- Type of fixation used
- Time interval between trauma and surgery
- Presence of associated injuries
- Baseline neurosensory status

The interval between trauma and surgical intervention was also recorded in hours for descriptive statistical analysis.

Surgical Procedure

All patients underwent ORIF under appropriate anesthesia following standard surgical principles. Fracture reduction was achieved through intraoral or extraoral approaches depending on the fracture location. Internal fixation was performed using 2.0-mm titanium miniplates, 3D plates, or reconstruction plates, selected according to fracture configuration, displacement, and surgeon preference. Wound closure and postoperative care were standardized for all patients, including antibiotic therapy, analgesics, oral hygiene instructions, and follow-up evaluation.

Neurosensory Assessment

Neurosensory function was evaluated by the same examiner at the following time points:

- Preoperatively (baseline)
- One month postoperatively
- Three months postoperatively
- Six months postoperatively

The following standardized clinical neurosensory tests were performed:

- **Two-point discrimination:** Assessment of the minimum distance at which two separate points were perceived
- **Light touch sensation:** Evaluated using a cotton wisp applied gently over the affected area
- **Pin-prick sensation:** Assessed using a sterile blunt pin to evaluate nociceptive perception
- **Brush direction discrimination:** Performed using a soft brush moved in different directions while the patient identified the direction of movement
- **Thermal sensation:** Evaluated using warm and cold stimuli applied alternately to the affected region

Each sensory modality was categorized as normal or reduced based on the patient's response compared with the contralateral unaffected side.

Assessment of Overall Neurosensory Recovery

Overall neurosensory recovery was assessed at 1, 3, and 6 months and classified into three categories:

Complete recovery: Normal findings in all neurosensory tests

Partial recovery: Improvement in sensory function with residual deficit in one or more parameters

No recovery: Persistence of neurosensory deficit without clinically appreciable improvement

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the demographic and clinical characteristics of the study participants. Categorical variables such as age group, gender, etiology of fracture, fracture site, side involved, type of fixation, time from trauma to surgery, associated injuries, baseline neurosensory status, and overall neurosensory recovery were presented as frequencies and percentages. Continuous variables, including time to surgery, were expressed as mean ± standard deviation (SD), standard error (SE), and 95% confidence interval (CI).

The changes in neurosensory function over the follow-up period (baseline, 1 month, 3 months, and 6 months) for two-point discrimination, light touch sensation, pin-prick sensation, brush direction discrimination, and thermal sensation were analyzed using the Chi-square (χ^2) test for trend/repeated categorical comparisons to determine differences in the distribution of normal and reduced sensation across the different time intervals. Similarly, changes in overall neurosensory recovery (complete, partial, and no recovery) across the postoperative follow-up visits were evaluated using the Chi-square test. A p-value <0.05 was considered statistically significant, while $p < 0.001$ was considered highly statistically significant. All statistical tests were two-tailed.

Results

Table 1 & Figure 1 illustrate the age distribution of the participants enrolled in the study. Of the 30 patients, the highest number belonged to the 31–40 years age group, comprising 11 patients (36.7%). The 18–30 years age group included 9 patients (30.0%), followed by the 41–50 years age group with 6 patients (20.0%). Participants aged more than 50 years represented the smallest group, with 4 patients (13.3%). Overall, the study population was largely composed of young and middle-aged adults, with 20 patients (66.7%) falling within the 18–40 years age range. This distribution indicates that mandibular fractures were more frequently observed among younger individuals in the present study.

Results

Table 1: Age Distribution

Age Group (Years)	n	%
18–30	9	30.0
31–40	11	36.7
41–50	6	20.0
>50	4	13.3
Total	30	100.0

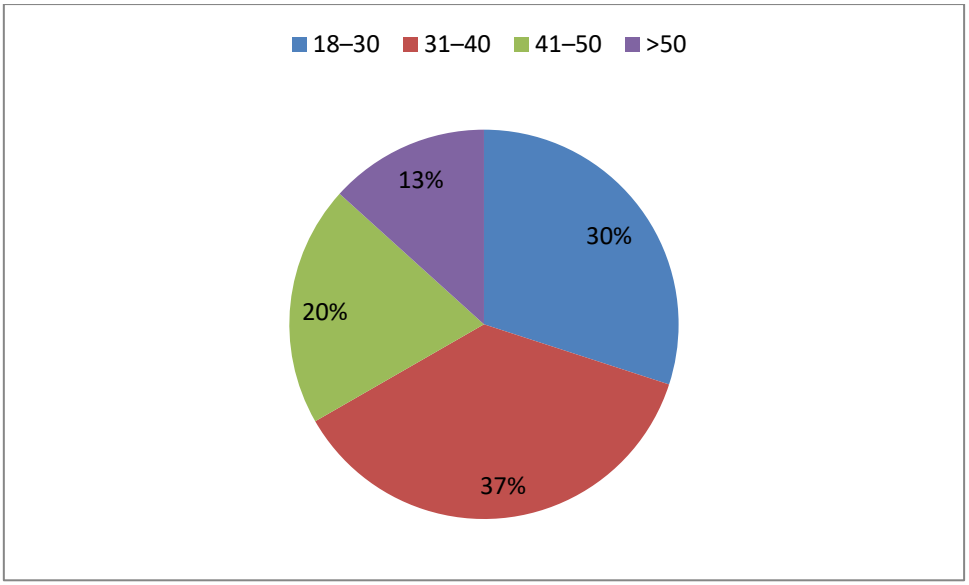

Figure 1: Age-wise Distribution of Study Participants

Table 2 & Figure 2 depict the gender distribution of the study participants. Among the 30 patients included in the study, 24 (80.0%) were males and 6 (20.0%) were females. A clear male predominance was observed, with males constituting the majority of the study population. These findings indicate that mandibular fractures occurred more frequently in male patients than in female patients in the present study.

Table 2: Gender Distribution

Gender	n	%
Male	24	80.0
Female	6	20.0
Total	30	100.0

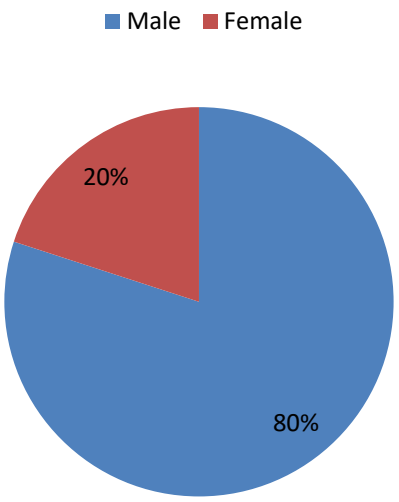

Figure 2: Gender Distribution of Study Participants

Table 3 & Figure 3 show the distribution of mandibular fractures according to their etiology. Among the 30 patients included in the study, road traffic accidents were the leading cause, accounting for 18 cases (60.0%). Falls were the second most common cause, observed in 6 patients (20.0%), followed by assault in 4 patients (13.3%). Sports-related injuries were the least frequent cause, affecting 2 patients (6.7%). Overall, road traffic accidents accounted for the majority of mandibular fractures, representing more than half of all cases in the study population.

Table 3: Etiology of Mandibular Fracture

Etiology	n	%
Road traffic accident	18	60.0
Fall	6	20.0
Assault	4	13.3
Sports injury	2	6.7
Total	30	100.0

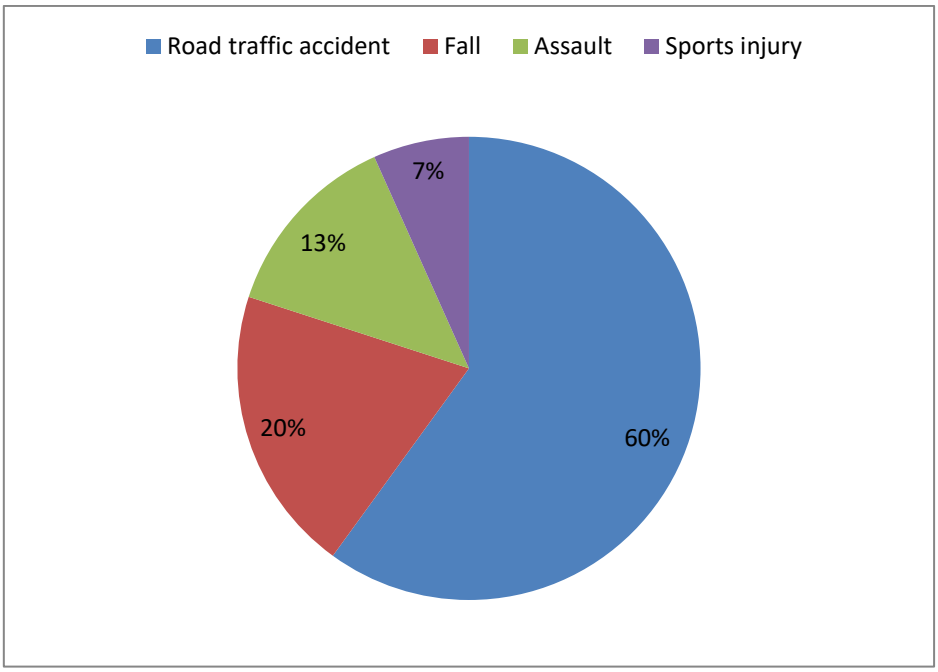

Figure 3: Etiological Distribution of Mandibular Fractures

Table 4 & Figure 4 illustrate the distribution of mandibular fractures based on the anatomical site involved. Among the 30 patients, the parasymphysis was the most frequently affected region, accounting for 10 cases (33.3%). This was followed by angle fractures, which were observed in 8 patients (26.7%). Body fractures occurred in 5 patients (16.7%), while condylar fractures were identified in 4 patients (13.3%). The symphysis was the least commonly involved site, with 3 cases (10.0%). Collectively, fractures involving the parasymphysis and angle represented 60.0% of all mandibular fractures, indicating that these regions were the most commonly affected sites in the study population.

Table 4: Site of Mandibular Fracture

Site	n	%
Parasymphysis	10	33.3
Angle	8	26.7
Body	5	16.7
Condyle	4	13.3
Symphysis	3	10.0
Total	30	100.0

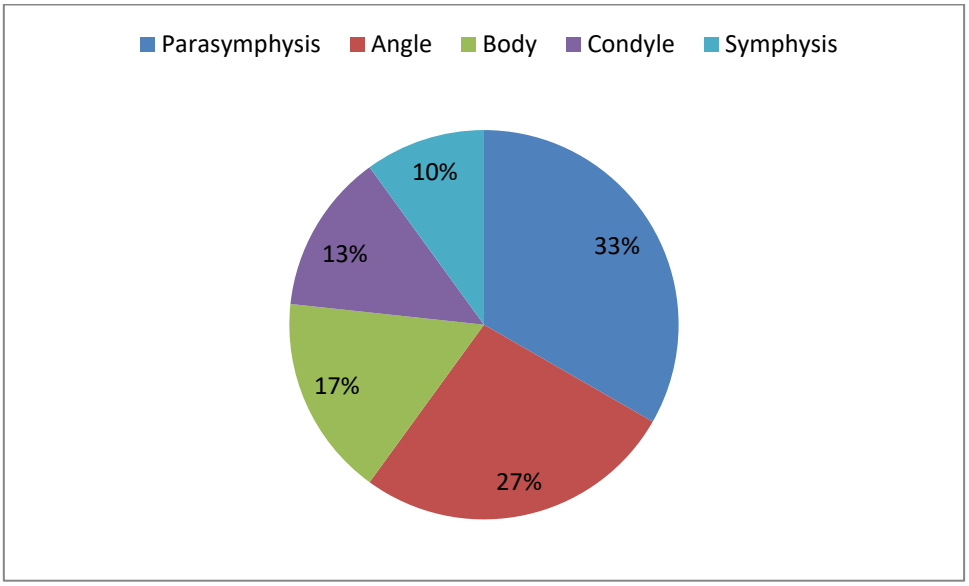

Figure 4: Distribution of Mandibular Fractures According to Anatomical Site

Table 5 & Figure 5 present the distribution of mandibular fractures based on the side involved. Among the 30 patients, the right side was affected most frequently, accounting for 13 cases (43.3%). Left-sided fractures were observed in 11 patients (36.7%), while bilateral fractures were identified in 6 patients (20.0%). Overall, unilateral fractures were more common than bilateral involvement, with the right side showing a slightly higher frequency than the left in the present study.

Table 5: Side Involved

Side	n	%
Right	13	43.3
Left	11	36.7
Bilateral	6	20.0
Total	30	100.0

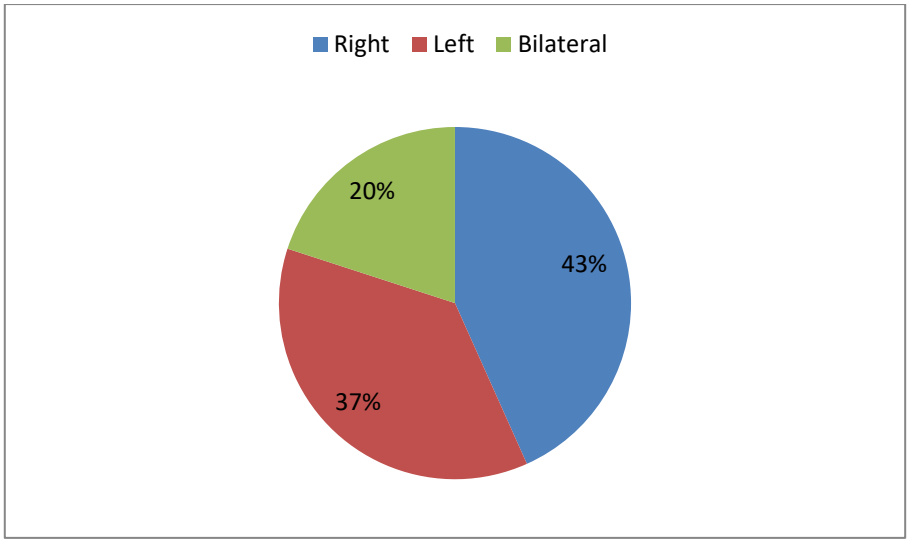

Figure 5: Distribution of Mandibular Fractures According to the Side Involved

Table 6 & Figure 6 illustrate the distribution of patients based on the type of fixation used for the management of mandibular fractures. Among the 30 patients, 2.0 mm miniplates were the most frequently used fixation system, applied in 21 cases (70.0%). 3D plates were utilized in 6 patients (20.0%), whereas reconstruction plates were used in 3 patients (10.0%). These findings indicate that 2.0 mm miniplates were the preferred fixation method for most mandibular fractures, while reconstruction plates were employed in a smaller number of patients, likely for more complex fracture patterns.

Table 6: Type of Fixation

Fixation	n	%
2.0 mm Miniplates	21	70.0
3D Plate	6	20.0
Reconstruction Plate	3	10.0
Total	30	100.0

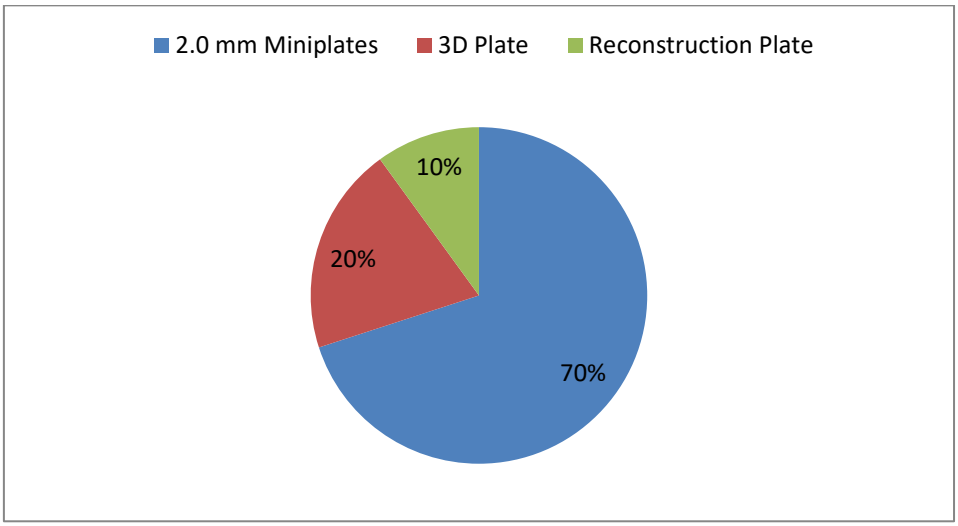

Figure 6: Distribution of Patients According to the Type of Fixation Used

Table 7 & Figure 7 show the distribution of patients based on the interval between trauma and surgical intervention. Among the 30 patients, 15 (50.0%) underwent surgery within 24–72 hours of injury, making this the most common treatment interval. Eight patients (26.7%) received surgical management within the first 24 hours, whereas 7 patients (23.3%) underwent surgery more than 72 hours after sustaining the injury. Overall, the findings indicate that most patients were treated surgically within 24–72 hours following trauma, reflecting the preferred timing for operative management in the present study.

Table 7: Time from Trauma to Surgery

Duration	N	%
<24 h	8	26.7
24–72 h	15	50.0
>72 h	7	23.3
Total	30	100.0

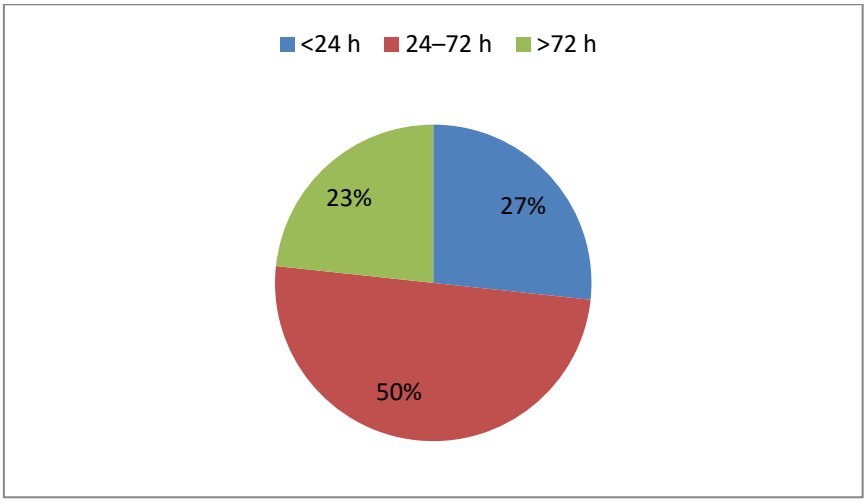

Figure 7: Distribution of Patients According to Time from Trauma to Surgery

Table 8 & Figure 8 illustrate the distribution of patients based on the presence of associated injuries. Of the 30 patients included in the study, soft tissue injuries were the most frequently observed associated injury, affecting 14 patients (46.7%). Eight patients (26.7%) presented with isolated mandibular fractures without any associated injuries. Zygomatic fractures were identified in 5 patients (16.7%), while maxillary fractures were the least common, occurring in 3 patients (10.0%). These findings indicate that soft tissue injuries commonly accompanied mandibular fractures, whereas approximately one-quarter of the patients sustained isolated mandibular fractures without additional facial injuries.

Table 8: Associated Injuries

Associated Injury	N	%
Soft tissue injury	14	46.7
Zygomatic fracture	5	16.7
Maxillary fracture	3	10.0
None	8	26.7
Total	30	100.0

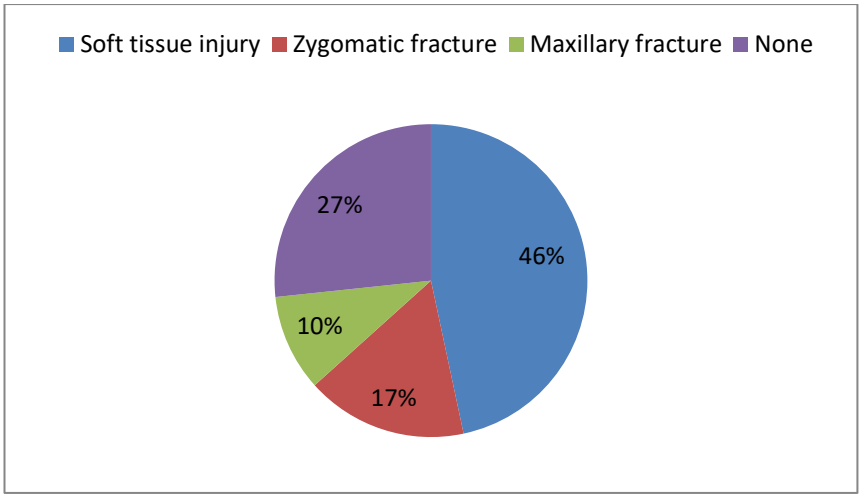

Figure 8: Distribution of Patients According to Associated Injuries

Table 9 & Figure 9 depict the baseline neurosensory status of the study participants prior to surgical intervention. Among the 30 patients included in the study, mild neurosensory deficit was the most common finding, affecting 12 patients (40.0%). Normal neurosensory function was observed in 9 patients (30.0%), while moderate neurosensory deficit was identified in 7 patients (23.3%). Severe neurosensory deficit was the least frequent presentation, occurring in 2 patients (6.7%). Overall, 21 patients (70.0%) exhibited some degree of neurosensory impairment before treatment, with mild deficits representing the predominant clinical presentation.

Table 9: Baseline Neurosensory Status

Status	N	%
Normal	9	30.0
Mild deficit	12	40.0
Moderate deficit	7	23.3
Severe deficit	2	6.7
Total	30	100.0

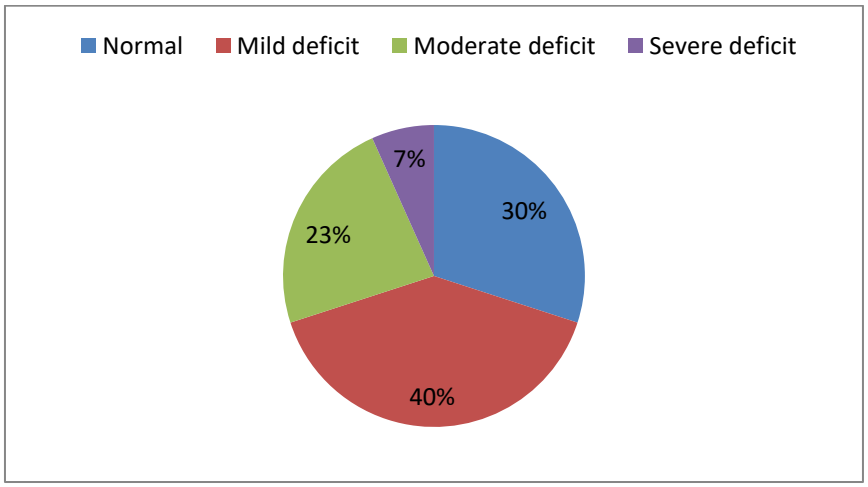

Figure 9: Baseline Distribution of Neurosensory Status Before Surgical Intervention

Table 10 & Figure 10 present the descriptive statistics for the interval between trauma and surgical intervention among the study participants. The mean time to surgery was 42.6 ± 18.4 hours, with a standard error of 3.36 hours. The 95% CI for the mean ranged from 35.72 to 49.48 hours, indicating that, on average, patients underwent surgical treatment approximately two days after injury. The relatively large standard deviation reflects moderate variation in the time from trauma to surgery across the study population.

Table 10: Descriptive Statistics of Time to Surgery

Variable	Mean	SD	SE	95% CI Lower	95% CI Upper
Time to surgery (hours)	42.6	18.4	3.36	35.72	49.48

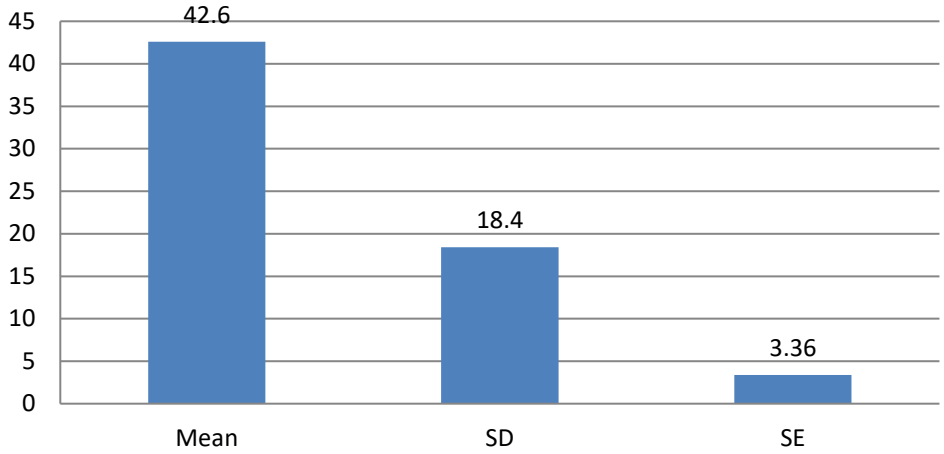

Figure 10: Descriptive Statistics for the Time Interval Between Trauma and Surgical Intervention

Table 11 & Figure 11 compare neurosensory function at baseline and during postoperative follow-up at 1 month, 3 months, and 6 months. A consistent improvement was observed across all evaluated sensory modalities throughout the follow-up period. For two-point discrimination, the proportion of patients with normal sensation increased from 8 (26.7%) at baseline to 14 (46.7%) at 1 month, 21 (70.0%) at 3 months, and 27 (90.0%) at 6 months. Correspondingly, the proportion of patients with reduced sensation declined from 73.3% at baseline to 10.0% at the final follow-up.

A similar trend was observed for light touch sensation, with the percentage of patients demonstrating normal sensation increasing from 10 (33.3%) at baseline to 16 (53.3%), 23 (76.7%), and 28 (93.3%) at 1, 3, and 6 months, respectively. The prevalence of sensory deficits decreased from 66.7% to 6.7% over the same period. Improvement was also noted in pin-prick sensation, where the proportion of patients with normal sensation increased from 9 (30.0%) at baseline to 15 (50.0%) at 1 month, 22 (73.3%) at 3 months, and 28 (93.3%) at 6 months. The percentage of patients with reduced pin-prick sensation decreased from 70.0% at baseline to 6.7% at 6 months.

Statistical analysis demonstrated that the improvements in two-point discrimination (χ^2 = 23.18), light touch sensation (χ^2 = 21.64), and pin-prick sensation (χ^2 = 22.37) were highly statistically significant ($p < 0.001$). These findings indicate a substantial and progressive recovery of neurosensory function following mandibular fracture fixation over the 6-month postoperative period.

Table 11: Comparison of Neurosensory Parameters at Baseline, 1 Month, 3 Months, and 6 Months

Parameter	Category	Baseline n (%)	1 Month n (%)	3 Months n (%)	6 Months n (%)	χ^2	P value
Two-point discrimination	Normal	8 (26.7)	14 (46.7)	21 (70.0)	27 (90.0)	23.18	<0.001*
	Reduced	22 (73.3)	16 (53.3)	9 (30.0)	3 (10.0)		
Light touch sensation	Normal	10 (33.3)	16 (53.3)	23 (76.7)	28 (93.3)	21.64	<0.001*
	Reduced	20 (66.7)	14 (46.7)	7 (23.3)	2 (6.7)		
Pin-prick sensation	Normal	9 (30.0)	15 (50.0)	22 (73.3)	28 (93.3)	22.37	<0.001*
	Reduced	21 (70.0)	15 (50.0)	8 (26.7)	2 (6.7)		

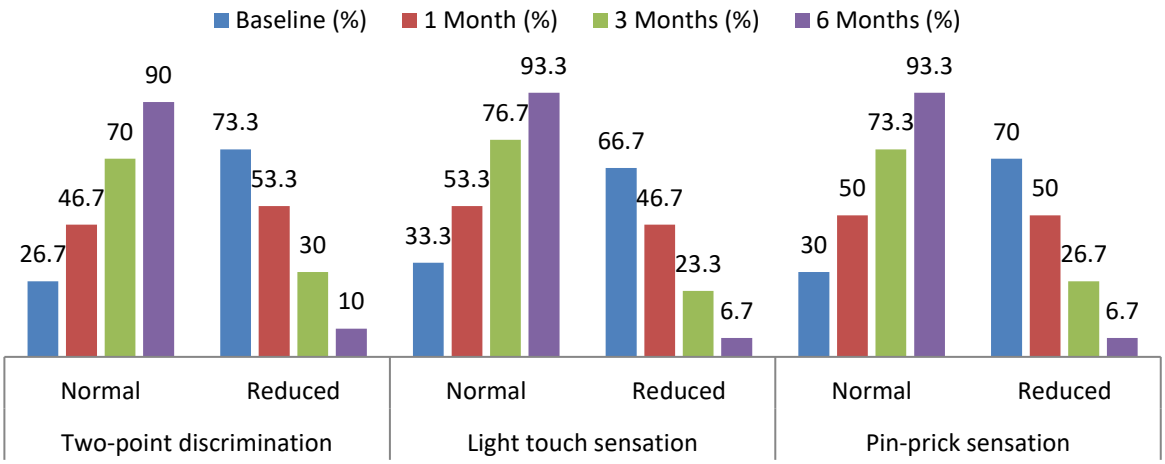

Figure 11: Comparison of Neurosensory Function at Baseline and During the 1-, 3-, and 6-Month Postoperative Follow-up

Table 12 & Figure 12 compare brush direction discrimination and thermal sensation at baseline and during the postoperative follow-up at 1 month, 3 months, and 6 months. Both sensory modalities demonstrated a gradual and consistent improvement throughout the follow-up period. For brush direction discrimination, the proportion of patients with normal sensation increased from 11 (36.7%) at baseline to 17 (56.7%) at 1 month, 24 (80.0%) at 3 months, and 29 (96.7%) at 6 months. In contrast, the percentage of patients with reduced sensation declined from 63.3% at baseline to 3.3% by the end of the study.

A similar pattern was observed for thermal sensation. The proportion of patients with normal thermal perception increased from 12 (40.0%) at baseline to 18 (60.0%) at 1 month, 25 (83.3%) at 3 months, and 29 (96.7%) at 6 months. Correspondingly, the proportion of patients with impaired thermal sensation decreased from 60.0% at baseline to 3.3% at the 6-month follow-up.

Statistical analysis revealed that the improvements in both brush direction discrimination (χ^2 = 22.81) and thermal sensation (χ^2 = 21.94) were highly statistically significant ($p < 0.001$). These findings indicate a continuous and significant recovery of neurosensory function following mandibular fracture fixation over the 6-month postoperative period.

Table 12: Comparison of Brush Direction Discrimination and Thermal Sensation at Baseline, 1 Month, 3 Months, and 6 Months

Parameter	Category	Baseline n (%)	1 Month n (%)	3 Months n (%)	6 Months n (%)	χ^2	P value
Brush direction discrimination	Normal	11 (36.7)	17 (56.7)	24 (80.0)	29 (96.7)	22.81	<0.001*
	Reduced	19 (63.3)	13 (43.3)	6 (20.0)	1 (3.3)		
Thermal sensation	Normal	12 (40.0)	18 (60.0)	25 (83.3)	29 (96.7)	21.94	<0.001*
	Reduced	18 (60.0)	12 (40.0)	5 (16.7)	1 (3.3)		

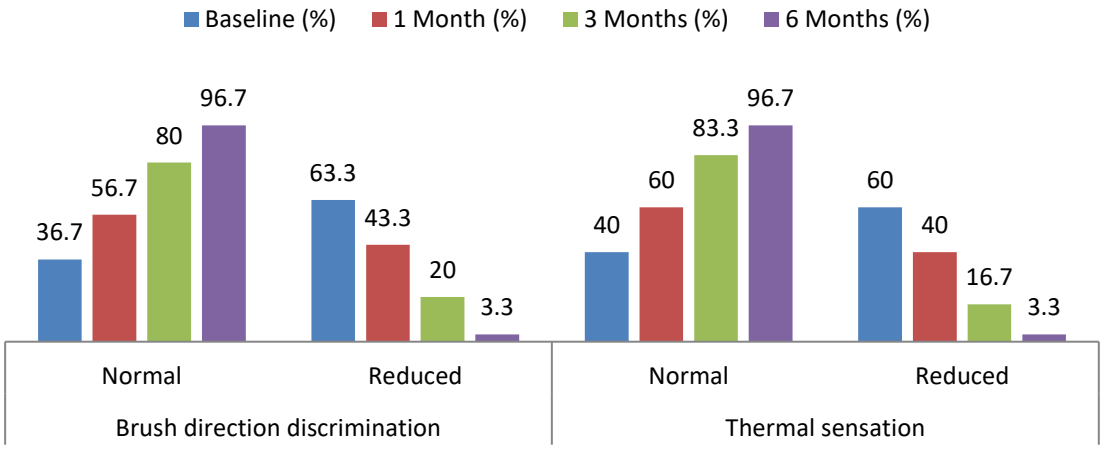

Figure 12: Comparison of Brush Direction Discrimination and Thermal Sensation at Baseline and During the 1-, 3-, and 6-Month Postoperative Follow-up

Table 13 & Figure 13 compare the overall neurosensory recovery of patients at 1 month, 3 months, and 6 months following mandibular fracture fixation. A progressive improvement in neurosensory recovery was observed throughout the follow-up period.

At the 1-month follow-up, 6 patients (20.0%) achieved **c**omplete recovery**,** 18 patients (60.0%) demonstrated partial recovery**,** and 6 patients (20.0%) showed no recovery**.** By 3 months**,** the number of patients with complete recovery had increased to 17 (56.7%)**,** while the proportions with partial recovery and no recovery declined to 10 (33.3%) and 3 (10.0%)**,** respectively.

At the 6-month follow-up, 25 patients (83.3%) had achieved complete neurosensory recovery**.** Only 4 patients (13.3%) continued to exhibit partial recovery, and 1 patient (3.3%) showed no evidence of recovery.

The overall improvement in neurosensory recovery across the follow-up period was highly statistically significant (χ^2 = 24.76, $p < 0.001$)**,** demonstrating a sustained and clinically meaningful restoration of neurosensory function following mandibular fracture fixation.

Table 13: Comparison of Overall Neurosensory Recovery at 1 Month, 3 Months, and 6 Months

Recovery Status	1 Month n (%)	3 Months n (%)	6 Months n (%)	χ^2	P value
Complete Recovery	6 (20.0)	17 (56.7)	25 (83.3)	24.76	<0.001*
Partial Recovery	18 (60.0)	10 (33.3)	4 (13.3)		
No Recovery	6 (20.0)	3 (10.0)	1 (3.3)		

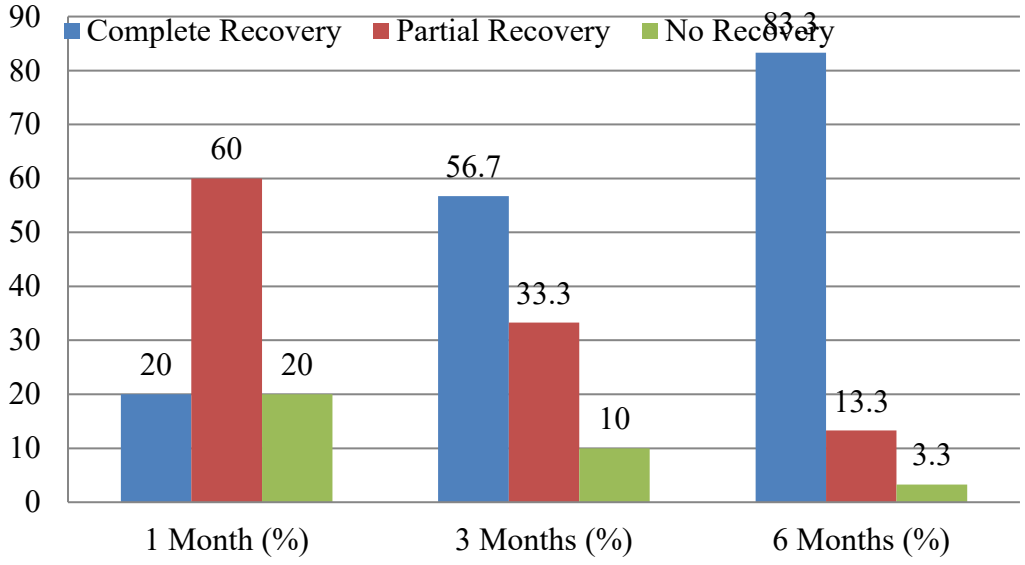

Figure 13: Comparison of Overall Neurosensory Recovery at 1, 3, and 6 Months Following Mandibular Fracture Fixation

Discussion

The present prospective study assessed the pattern of neurosensory recovery following ORIF of mandibular fractures over a six-month follow-up period. A progressive improvement was observed in all evaluated neurosensory parameters, including two-point discrimination, light touch, pin-prick sensation, brush direction discrimination, and thermal sensation. At the final follow-up, 83.3% of patients demonstrated complete neurosensory recovery, while persistent sensory impairment was observed in only one patient (3.3%). These findings indicate that satisfactory restoration of sensory function can be achieved in the majority of patients following timely surgical management and appropriate stabilization of mandibular fractures.

The epidemiological profile of the present study showed that mandibular fractures occurred predominantly in young and middle-aged adults, with males accounting for 80% of the study population. Road traffic accidents were identified as the leading cause of injury (60%), followed by falls, assault, and sports-related trauma. These observations are consistent with the findings of Lee (2009) [10], who reported that mandibular fractures occur more frequently in young males because of greater exposure to road traffic accidents, occupational activities, and interpersonal violence.

Similarly, the multicenter European Maxillofacial Trauma (EURMAT) Project by Boffano et al. (2015) [11] demonstrated that young adult males constitute the largest proportion of patients with maxillofacial trauma and that road traffic accidents remain one of the principal etiological factors in mandibular fractures across different populations.

The anatomical distribution of fractures in the present study revealed that the parasymphysis (33.3%) was the most frequently involved site,

followed by the angle (26.7%). These fracture locations are closely associated with the course of the inferior alveolar nerve, making neurosensory disturbances a common complication. In the present investigation, 70% of patients exhibited varying degrees of neurosensory deficit before surgical intervention, with mild sensory impairment representing the most frequent presentation. Comparable findings were reported by N CS et al. (2021) [12], who observed that inferior alveolar nerve dysfunction commonly accompanies mandibular fractures involving the body and angle of the mandible. Their prospective cohort study also demonstrated that the severity of sensory impairment was associated with fracture displacement and gradually improved following fracture fixation.

Recovery of peripheral nerve function depends on the extent of neural injury, fracture stabilization, and the biological process of nerve regeneration. In the present study, all evaluated sensory modalities showed continuous improvement throughout the follow-up period. Normal two-point discrimination increased from 26.7% at baseline to 90.0% after six months, whereas normal light touch and pin-prick sensation increased to 93.3%. Brush direction discrimination and thermal sensation demonstrated the greatest improvement, with normal responses recorded in 96.7% of patients at the final evaluation. These findings indicate that peripheral nerve recovery is a gradual process extending over several months after surgical treatment.

Comprehensive evaluation of neurosensory function is essential for accurately monitoring postoperative recovery. Meyer and Bagheri (2011) [13] emphasized that no single clinical test adequately evaluates trigeminal nerve function and recommended the combined assessment of two-point discrimination, light touch, nociceptive sensation, and thermal perception to provide a complete evaluation of sensory integrity. The present study followed a similar multidimensional neurosensory assessment protocol, enabling objective documentation of sensory recovery throughout the postoperative period.

Although most patients in the present study experienced favorable recovery, one patient continued to demonstrate persistent neurosensory deficit after six months. Persistent sensory dysfunction following mandibular trauma may indicate more severe neural damage, including nerve compression, stretching, or partial transection. Similar conclusions were drawn by Bagheri et al. (2010) [14], who reviewed 222 patients undergoing microsurgical repair of lingual nerve injuries and reported that the severity of nerve injury, duration before treatment, and timing of intervention significantly influenced long-term sensory outcomes. Although microsurgical nerve repair was not required in the present study, the persistence of neurosensory deficit in a small proportion of patients supports the concept that severe nerve injuries may not completely recover despite successful fracture stabilization.

The method and timing of fracture management are important determinants of postoperative functional recovery. ORIF remains the preferred treatment modality for displaced mandibular fractures because it provides accurate anatomical reduction, stable fixation, and early restoration of mandibular function. In the present study, the majority of fractures were managed using 2.0-mm titanium miniplates (70%), while 3D plates and reconstruction plates were used in selected cases depending on fracture characteristics. Furthermore, most patients underwent surgery within 24–72 hours after trauma, with a mean time to surgery of 42.6 hours. Early surgical intervention likely contributed to favorable neurosensory recovery by relieving mechanical compression of the inferior alveolar nerve and promoting optimal fracture healing.

The role of rigid internal fixation in improving postoperative functional outcomes has been highlighted by several investigators. Chrcanovic (2012) [15] emphasized that treatment selection should be individualized according to fracture type and displacement, while rigid fixation

provides superior anatomical reduction and earlier functional rehabilitation in appropriately selected patients. Although the present study did not compare different fixation techniques, the high rate of complete neurosensory recovery observed supports the effectiveness of stable internal fixation in facilitating peripheral nerve recovery after mandibular fractures.

Overall, the findings of the present investigation demonstrate that neurosensory recovery following mandibular fracture fixation is progressive and clinically significant during the first six postoperative months. The observed improvement across all sensory modalities is consistent with previously published studies evaluating inferior alveolar nerve injury and trigeminal nerve recovery. Routine postoperative neurosensory assessment using standardized clinical tests should therefore be considered an integral component of mandibular fracture management to monitor nerve regeneration, identify patients with delayed recovery, and guide appropriate long-term follow-up. Future multicenter studies with larger patient populations, longer observation periods, and objective neurophysiological investigations are warranted to further clarify prognostic factors influencing neurosensory recovery following mandibular fracture treatment.

Limitations

The present study has several limitations that should be considered while interpreting the findings. First, the study included a relatively small sample size of only 30 patients, which may limit the generalizability of the results to larger and more diverse populations. Second, the investigation was conducted at a single institution, and therefore the findings may not fully represent patients treated in different clinical settings or geographic regions. Third, the follow-up period was limited to six months; although substantial neurosensory improvement was observed, longer follow-up would provide better insight into delayed or complete nerve recovery beyond this period. Fourth, the study lacked a comparison or control group employing alternative treatment approaches or conservative management, limiting the ability to compare different therapeutic strategies. Finally, neurosensory evaluation relied primarily on standardized clinical sensory tests without adjunctive objective electrophysiological investigations, which may have provided additional information regarding the extent and quality of nerve regeneration.

Conclusion

The present study demonstrated that neurosensory impairment is a common finding following mandibular fractures, with most patients exhibiting mild-to-moderate sensory deficits before surgical intervention. Road traffic accidents represented the predominant cause of injury, and fractures most frequently involved the parasymphysis and angle of the mandible. Following ORIF, all evaluated neurosensory parameters—including two-point discrimination, light touch, pin-prick sensation, brush direction discrimination, and thermal sensation—showed consistent and statistically significant improvement throughout the six-month follow-up period. More than four-fifths of the patients achieved complete neurosensory recovery by the end of the study, while persistent sensory deficits were observed in only a small proportion of cases. These findings indicate that appropriate surgical stabilization of mandibular fractures is associated with favorable functional nerve recovery. Routine postoperative neurosensory assessment is recommended to monitor recovery, identify patients requiring prolonged follow-up, and optimize clinical outcomes. Future multicenter studies with larger sample sizes, longer follow-up periods, and objective neurophysiological assessments are warranted to further validate these findings and refine strategies for the management of post-traumatic neurosensory deficits.

References

Ellis E 3rd. Outcomes of patients with teeth in the line of mandibular angle fractures treated with stable internal fixation. J Oral Maxillofac Surg. 2002 Aug;60(8):863-5; discussion 866. doi: 10.1053/joms.2002.33852. PMID: 12149727.

Bormann KH, Wild S, Gellrich NC, Kokemüller H, Stühmer C, Schmelzeisen R, Schön R. Five-year retrospective study of mandibular fractures in Freiburg, Germany: incidence, etiology, treatment, and complications. J Oral Maxillofac Surg. 2009 Jun;67(6):1251-5. doi: 10.1016/j.joms.2008.09.022. PMID: 19446212.

Iizuka T, Lindqvist C. Rigid internal fixation of mandibular fractures. An analysis of 270 fractures treated using the AO/ASIF method. Int J Oral Maxillofac Surg. 1992 Apr;21(2):65-9. doi: 10.1016/s0901-5027(05)80533-8. PMID: 1602161.

Ellis E 3rd, Walker LR. Treatment of mandibular angle fractures using one noncompression miniplate. J Oral Maxillofac Surg. 1996 Jul;54(7):864-71; discussion 871-2. doi: 10.1016/s0278-2391(96)90538-8. PMID: 8676232.

Haug RH, Prather J, Indresano AT. An epidemiologic survey of facial fractures and concomitant injuries. J Oral Maxillofac Surg. 1990 Sep;48(9):926-32. doi: 10.1016/0278-2391(90)90004-l. PMID: 2395044.

Tay AB, Zuniga JR. Clinical characteristics of trigeminal nerve injury referrals to a university centre. Int J Oral Maxillofac Surg. 2007 Oct;36(10):922-7. doi: 10.1016/j.ijom.2007.03.012. Epub 2007 Sep 17. PMID: 17875382.

Renton T, Yilmaz Z. Profiling of patients presenting with posttraumatic neuropathy of the trigeminal nerve. J Orofac Pain. 2011 Fall;25(4):333-44. PMID: 22247929.

Robinson PP, Loescher AR, Smith KG. A prospective, quantitative study on the clinical outcome of lingual nerve repair. Br J Oral Maxillofac Surg. 2000 Aug;38(4):255-63. doi: 10.1054/bjom.2000.0463. PMID: 10922146.

Pogrel MA. The results of microneurosurgery of the inferior alveolar and lingual nerve. J Oral Maxillofac Surg. 2002 May;60(5):485-9. doi: 10.1053/joms.2002.31841. PMID: 11988920.

Lee KH. Interpersonal violence and facial fractures. *J Oral Maxillofac Surg.* 2009 Sep;67(9):1878-83. doi: 10.1016/j.joms.2009.04.117. Epub 2009 Jul 29. PMID: 19686924.

Boffano P, Roccia F, Zavattero E, Dediol E, Uglešić V, Kovačič Ž, Vesnaver A, Konstantinović VS, Petrović M, Stephens J, Kanzaria A, Bhatti N, Holmes S, Pechalova PF, Bakardjiev AG, Malanchuk VA, Kopchak AV, Galteland P, Mjøen E, Skjelbred P, Koudougou C, Mouallem G, Corre P, Løes S, Lekven N, Laverick S, Gordon P, Tamme T, Akermann S, Karagozoglu KH, Kommers SC, Forouzanfar T. European Maxillofacial Trauma (EURMAT) project: a multicentre and prospective study. *J Craniomaxillofac Surg.* 2015 Jan;43(1):62-70. doi: 10.1016/j.jcms.2014.10.011. Epub 2014 Oct 22. PMID: 25457465.

N CS, Shetty SK, Shetty SK, Shah AK. Inferior alveolar nerve dysfunction in mandibular fractures: a prospective cohort study. *J Korean Assoc Oral Maxillofac Surg.* 2021 Jun 30;47(3):183-189. doi: 10.5125/jkaoms.2021.47.3.183. PMID: 34187958; PMCID: PMC8249188.

Meyer RA, Bagheri SC. Clinical evaluation of peripheral trigeminal nerve injuries. *Atlas Oral Maxillofac Surg Clin North Am.* 2011 Mar;19(1):15-33. doi: 10.1016/j.cxom.2010.11.002. PMID: 21277498.

Bagheri SC, Meyer RA, Khan HA, Kuhmichel A, Steed MB. Retrospective review of microsurgical repair of 222 lingual nerve injuries. *J Oral Maxillofac Surg.* 2010 Apr;68(4):715-23. doi: 10.1016/j.joms.2009.09.111. Epub 2009 Dec 29. PMID: 20036042.

Chrcanovic BR. Open versus closed reduction: diacapitular fractures of the mandibular condyle. *Oral Maxillofac Surg.* 2012 Sep;16(3):257-65. doi: 10.1007/s10006-012-0337-6. Epub 2012 Jul 28. PMID: 22842852.