OUTCOME OF OPEN REDUCTION AND INTERNAL FIXATION BY USING ONE TITANIUM PLATE AND ARCHBAR FOR THE MANAGEMENT OF MANDIBULAR FRACTURES IN SYMPHYSEAL AND PARASYMPHYSEAL REGION

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ABSTRACT

OBJECTIVES

To determine nerve injury, malocclusion, and non-union of ORIF using a single miniplate and arch bar in the treatment of mandibular fractures in the parasymphyseal and symphyseal regions.

METHODOLOGY

This descriptive cross-sectional study included 233 patients aged 13-65 years who presented within 48 hours of sustaining non-comminuted symphyseal or parasymphyseal mandibular fractures. Patients with bone pathologies, systemic diseases affecting healing, infected fractures, contraindications to general anesthesia, or who were unwilling to attend follow-up were excluded. ORIF was performed using a single titanium miniplate and Erich arch bar under general anesthesia. Outcomes were assessed at 4-week follow-up and included inferior alveolar nerve (IAN) injury, malocclusion, and non-union. Chi-square tests were used to evaluate associations between complications and clinical variables.

RESULTS

The mean age of the participants was 32.42 ± 5.75 years, with 66.95% of participants being male. Road traffic accidents were the leading cause (56.65%). IAN injury was the most frequent complication (30.04%). Malocclusion and non-union occurred in 2.58% and 1.72% of patients, respectively. No statistically significant associations were found between complications and age, gender, fracture type, or etiology.

CONCLUSION

Inferior alveolar nerve injury is the most common complication in mandibular symphyseal and parasymphyseal fractures managed with ORIF, warranting vigilant surgical technique and monitoring.

KEYWORDS: *Mandible, Symphysis, Parasymphysis, Post-Operative Complications*

INTRODUCTION

The mandible is the only mobile bone of the facial skeleton that is involved in mastication, articulation, and deglutition. It is also highly susceptible to maxillofacial trauma due to its exposed anatomical position.[1] The site of a mandibular fracture is influenced mainly by the mechanism of injury, magnitude, and vector of impact, and anatomical factors such as osseous morphology and muscle attachment sites.[2] Common etiologies of mandibular fractures include motor vehicle collisions, interpersonal violence, accidental falls, ballistic trauma, sports-related trauma, and occupational injuries.[3] Motor vehicle collisions occur more frequently in regions with inadequate traffic regulation, while other regions may show a higher incidence of injuries related to interpersonal aggression or athletic activities.[4] Maxillofacial surgeons find it a challenging procedure to treat a mandibular fracture; it requires specialized expertise and well-equipped hospital facilities.[5] The choice of treatment is influenced by various factors like chronological age of the patient, the anatomical site and classification of fracture, available clinical resources, and the surgical proficiency of the operator.[6] The overall goals of management include the re-establishment of pre-traumatic occlusion, restoration of craniofacial aesthetics and physiological function, and aiming to attain them with minimal post-operative complications and in an economically efficient manner.[7] Modern therapeutic strategies for mandibular fractures include conservative management through closed reduction with maxillomandibular fixation (MMF) and operative intervention via open reduction

and internal fixation (ORIF), with or without MMF.[8] The advancement of surgical techniques has led to the replacement of traditional methods, such as wire osteosynthesis and prolonged MMF with ORIF, which has demonstrated superior outcomes. Achieving rigid stabilization of the fractured mandibular segments is essential to permit regular functional activity and support uneventful physiological healing.[9] Significant torsional forces are generated in the symphyseal and parasymphyseal regions during mastication, necessitating firm osteosynthesis of the fractured segments.[10] It is recommended that the application of dual miniplate fixation: one along the inferior mandibular border and another just apical to the dental roots, functioning as a tension band to resist torsional forces and enhance osseous healing at the fracture site. Early functional mobilization is particularly critical in pediatric populations to prevent temporomandibular joint ankylosis.[11] It also plays a vital role in averting potentially fatal complications in patients with neurological pathologies, combat-related injuries, or polytrauma. Additionally, prompt mobilization helps reduce the incidence of post-operative sequelae in polytraumatized and immobilized individuals.[12] The purpose of this study is to determine nerve injury, malocclusion, and non-union of ORIF using a single miniplate and an arch bar as a tension band in the management of mandibular fractures in the parasymphyseal and body regions. This approach aims to reduce the amount of implanted material without compromising the stability at the fracture site. The rationale behind this study is that using ORIF with one titanium plate and an arch bar as a tension band for managing mandibular fractures in the symphyseal/parasymphyseal region can lessen the implant burden at the fracture site, ultimately decreasing morbidity and cost, minimizing post-operative complications, and promoting earlier post-operative functional recovery for patients.

METHODOLOGY

This descriptive cross-sectional study was conducted at the Department of Oral and Maxillofacial Surgery, Bacha Khan Medical College, Mardan, from January 1, 2024, to June 30, 2025, using non-probability consecutive sampling. The sample size was 233, calculated using the WHO software for sample size determination with the following parameters: frequency of inferior alveolar nerve injury following ORIF = 2%, absolute precision required = 1.5%[13], and confidence interval = 95%. Patients aged 13-65 with symphyseal or parasymphyseal mandibular fractures, occurring within 48 hours of injury, were included in this study, which was approved by the institutional ethics committee approved. Exclusion criteria included bone diseases, contraindications to general anesthesia, infected fractures, chronic systemic illnesses, and refusal to participate in follow-up. A total of 233 patients were selected from the outpatient department after obtaining informed consent. Demographic data were collected, and occupations were categorized into four groups. Under general anesthesia, a surgical team performed the treatment using arch bars secured with 0.75-gauge stainless steel wire for stabilization. After a vestibular incision and subperiosteal dissection, the fracture was exposed, with careful attention to the mental nerve if near the fracture site. Two horizontally placed 2.0 mm titanium miniplates with 7 mm screws were used for fixation, followed by wound closure with 3/0 Vicryl sutures. A mandibular fracture was defined as a break in the lower jawbone, with symphyseal and parasymphyseal fractures specified. Outcomes were measured clinically; the vertical overlap of incisors defined malocclusion, while inferior alveolar nerve (IAN) injury was assessed by lip numbness and two-point discrimination testing. Non-union was indicated by persistent bone displacement on radiographs. All patients received antibiotics and analgesics, with maxillomandibular fixation maintained for 10 days. A researcher assessed patients 4 weeks post-surgery, and the data were analyzed using SPSS version 20.0. Numerical variables were described as mean ± SD, and categorical variables were presented as frequencies and percentages. A chi-square test was applied for stratified outcomes ($p \leq 0.05$ significance).

RESULTS

The study involved 233 participants (mean age, 32.4 years; SD, 5.8), predominantly male (66.95%), with over half (51.15%) aged 30 years or younger. The leading cause of mandibular fractures was road traffic accidents (56.65%), followed by assault (27.47%) and falls (15.88%). Parasymphysis fractures (54.51%) were more common than symphysis fractures (45.49%). Inferior alveolar nerve injury occurred in 30.04% of patients, while malocclusion and non-union were rare, affecting 2.58% and 1.72%, respectively. No significant differences in complication rates were noted based on gender or age. Inferior alveolar nerve injury was highest among those injured in road traffic accidents (34.1%), with no significant differences in malocclusion or non-union rates across different causes. Malocclusion rates were low in both fracture types (2.8% for symphyseal and 2.4% for parasymphyseal), with non-union slightly more common in symphyseal fractures (2.8%) but not significantly.

Table 1: Demographic and Clinical Characteristics of the Study Population

Variable		n=233
Age (years), Mean(SD)		32.42 (5.75)
Gender	Male	156 (66.95%)
	Female	77 (33.05%)
Age group	– Up to 30 years	120 (51.15%)
	– More than 30 years	113 (48.49%)
Etiology of Fracture	– Road traffic accident	132 (56.65%)
	– Assault	64 (27.47%)
	– Fall	37 (15.88%)
Type of Mandibular Fracture	-Symphysis	106(45.49%)
	-Parasymphysis	127(54.51%)

Table 2: Frequency of Inferior Alveolar Nerve Injury, Malocclusion, and Non-Union among Patients with Mandibular Fractures in the Symphyseal and Parasymphyseal Region

Variable	Yes	No
Inferior Alveolar Nerve Injury	70 (30.04%)	163 (69.96%)
Malocclusion	06 (2.58%)	227 (97.42%)
Non-Union	04 (1.72%)	229 (98.28%)

Table 3: Frequency of inferior alveolar nerve injury, malocclusion, and non-union among patients with mandibular fractures by gender (n = 233)

Outcome	Gender	Yes (n/%)	No (n/%)	p-value
Inferior Alveolar Nerve Injury	Male	46 (29.5%)	110 (70.5%)	0.79
	Female	24 (31.2%)	53 (68.8%)	
Malocclusion	Male	04 (2.6%)	152 (97.4%)	0.99
	Female	02 (2.6%)	75 (97.4%)	
Non-Union	Male	03 (1.9%)	153 (98.1%)	0.73
	Female	01 (1.3%)	76 (98.7%)	

Table 4: Malocclusion and Non-Union among Patients with Mandibular Fractures in the Symphyseal and Parasymphyseal Region by Age Group

Variable	Age Group	Yes	No	p value
Inferior Alveolar Nerve Injury	Up to 30 years	39 (32.5%)	81 (67.5%)	0.39
	Above 30 years	31 (27.4%)	82 (72.6%)	
Malocclusion	Up to 30 years	03 (2.5%)	117(97.5%)	0.93
	Above 30 years	03 (2.7%)	110(97.3%)	
Non-Union	Up to 30 years	03 (2.5%)	117(97.5%)	0.34
	Above 30 years	01 (0.9%)	112(99.1%)	

Fisher's exact test

Table 5: Frequency of Inferior Alveolar Nerve Injury, Malocclusion, and Non-Union among Patients with Mandibular Fractures by Etiology (N = 233)

Outcome	Etiology	Yes	No	p-value
Inferior Alveolar Nerve Injury	Road Traffic Accident	45 (34.1)	87 (65.9)	0.19
	Assault	18 (28.1)	46 (71.9)	
	Fall	07 (18.9)	30 (81.1)	
Malocclusion	Road Traffic Accident	04 (3.0)	128 (97.0)	0.83
	Assault	01 (1.6)	63 (98.4)	
	Fall	01 (2.7)	36 (97.3)	
Non-Union	Road Traffic Accident	02 (1.5)	130 (98.5)	0.88
	Assault	01 (1.6)	63 (98.4)	
	Fall	01 (2.7)	36 (97.3)	

*Fisher's exact test

Table 6: Frequency of Inferior Alveolar Nerve Injury, Malocclusion, and Non-Union among Patients with Mandibular Fractures by Type of Fractures (N = 233)

Outcome	Type of Fracture	Yes (n/%)	No (n/%)	p-value
Inferior Alveolar Nerve Injury	Symphyseal	32 (30.2)	74 (69.8)	0.95
	Parasymphyseal	38 (29.9)	89 (70.1)	
Malocclusion	Symphyseal	03 (2.8)	103 (97.2)	0.81
	Parasymphyseal	03 (2.4)	124 (97.6)	
Non-Union	Symphyseal	03 (2.8)	103 (97.2)	0.23
	Parasymphyseal	01 (0.8)	126 (99.2)	

*Fisher's exact test

DISCUSSION

In this study, the complication rate was 34.34%, with inferior alveolar injury at 30.04% being the most common. A review of 734 patients with 1,312 mandibular fractures found that assaults were the leading cause, particularly affecting the parasymphyseal, subcondylar, and angle regions. ORIF was performed in 85% of cases, with fewer intraoperative arch bars used for MMF and more manual reductions. Among 228 patients with one or two nonsubcondylar fractures, the complication rates were similar: 12.9% for arch bars and 12.5% for manual reduction, showing no significant difference in surgical methods.[14] A study from Larkana found that 80% of symphyseal and parasymphyseal fractures of

the mandible were caused by road traffic accidents, with 10% each due to physical assault and falls. This aligns with our findings, though their most common complication was infection (1%), while ours was nerve injury.[15] Another study on the effectiveness of ORIF for mandibular fractures highlighted that motorcycle accidents accounted for 88.4% of cases, involving 69 patients with a male-to-female ratio of 16.5:1 (94.2% male). Patients ranged in age from 13 to 60 years, with a mean age of 25.96 years, predominantly in the 21–30 age group. Left-sided fractures were more common, and all patients had satisfactory healing with minimal morbidity and no need for further surgery. No significant morbidity or mortality was reported.[16] The investigation found a 30.04% rate of inferior alveolar nerve (IAN) injury after mandibular fractures, with no significant correlation to gender, age, or cause. In contrast, Tariq et al. (2023) reported a 58.3% perioperative IAN injury rate among 96 patients, primarily male, with an average age of 35.8 years, noting that 40.6% developed permanent neurosensory deficits post-surgery. These differences underscore the importance of fracture patterns and surgical techniques in nerve preservation and monitoring.[17] A case series reported postoperative inferior alveolar nerve (IAN) injuries in approximately 60% of cases, with persistent neurosensory dysfunction in roughly 40% of patients. This cohort had a mean age of 35.8 years and a male predominance (78%).[18] The 30% IAN injury rate in our study aligns with previous reports, varying due to factors like IAN anatomy and surgical technique. Similar research on non-comminuted symphysis/parasymphysis fractures treated with a single miniplate noted a male predominance aged 20-45 years, with road traffic accidents as a primary cause.[19] This study reported minimal complications (3% malocclusion, 4% wound infection), indicating favorable outcomes. While both studies noted a male predominance and motorcycle accidents as common causes, complication types varied.

LIMITATIONS

A 4-week follow-up is insufficient to assess nerve recovery after mandibular fractures. We cannot effectively evaluate the risks of nerve injury because we did not include a comparison group, like patients treated with two-plate fixation. Additionally, we based our assessment of nerve injury on what patients reported and a two-point discrimination test, rather than using more objective measures or a more extended follow-up period.

CONCLUSIONS

In mandibular symphyseal and parasymphyseal fractures, treatment with a single miniplate combined with an arch bar tension band provides stable fixation with minimal implant burden. The most common complication was inferior alveolar nerve (IAN) injury, occurring in 30% of cases, while malocclusion and non-union were rare (<3%). The low incidence of infection and other complications supports the safety and effectiveness of the one-plate plus arch bar approach. Clinicians should remain vigilant for IAN injury and counsel patients accordingly, as early recognition and management are important for optimal outcomes.

CONFLICT OF INTEREST: None

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AUTHORS CONTRIBUTION

Abdul Wali Khan - *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Supervision; Final Approval*

Khadija Syed - *Concept & Design; Data Analysis/Interpretation; Drafting Manuscript; Final Approval*

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Ajmal Khan - *Concept & Design; Data Analysis/Interpretation; Drafting Manuscript; Supervision; Final Approval*

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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.