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Original Article

Management of Mandibular Angle Fractures Using One Miniplate Versus Two Miniplate Fixation System

Shahrukh Zafar, Shahid Iqbal Khan, Muhammad Junaid, Syed Junaid Hussain Bukhari, Sana Somair, Ayesha Imran

Department of Oral and Maxillofacial Surgery, Armed Forces Institute of Dentistry, Rawalpindi/National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To compare postoperative complication rates in patients with non-comminuted, favourable mandibular angle fractures treated using either single miniplate fixation (Champy's technique) or a two-miniplate approach.
Study Design: Quasi-experimental study.
Place and Duration of Study: Department of Oral and Maxillofacial Surgery, Armed Forces Institute of Dentistry Rawalpindi, Pakistan from Dec 2024 to May 2025.
Methodology: Sixty patients with favourable mandibular angle fractures were non-randomly allocated by alternate assignment into two equal groups. Group-A underwent fixation with a single miniplate at the superior border, while Group-B received two miniplates at the superior and inferior borders. Postoperative complications, including wound infection, neurosensory disturbance, malocclusion, wound dehiscence, pseudoarthrosis, hardware failure, and scarring, were evaluated on Day 1 and Weeks 1, 2, and 4. Data were analysed using SPSS version 23. Chi-square test was applied to compare complication rates between the two groups, with significance set at $p \leq 0.05$.
Results: Wound infection occurred in 6.7% of patients in Group-A and 33.3% of patients in Group-B (p=0.010). Statistically significant differences were also noted in neurosensory dysfunction (0.0% vs. 16.7%, p=0.020), wound dehiscence (6.7% vs. 26.7%, p=0.038), hardware failure (6.7% vs. 26.7%, p=0.038), and scarring (3.3% vs. 23.3%, p=0.023), respectively. Malocclusion showed no significant difference (10.0% vs. 13.3%, p=0.688), and pseudoarthrosis was absent in both groups. Overall, 26.7% of Group-A and 73.3% of Group-B experienced at least one complication (p<0.001).
Conclusion: Single miniplate fixation resulted in fewer postoperative complications and is preferable for favourable mandibular angle fractures.

Keywords: Champy's Technique, Internal Fixators, Mandibular Fractures, Maxillofacial Injuries, Open Fracture Reduction, Postoperative Complications.

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INTRODUCTION

Mandibular fractures rank second among facial injuries globally, following nasal bone fractures. The angle of the mandible is especially prone to fracture due to its anatomical transition between the horizontal body and vertical ramus and the influence of masticatory muscles like the masseter and medial pterygoid. Mandibular fractures are classified as favourable or unfavourable based on muscle forces affecting fragment displacement.[1]

Frequent causes include road traffic accidents, interpersonal violence and falls most commonly affecting young adult males. Fracture distribution data show the symphysis involved in 52.7% of cases, followed by unilateral condyle (37.1%), angle (36.2%), bilateral condyle (9.4%), body (8%), and coronoid (2.2%). Daily-life activity accounted for 57.6% of fractures, followed by violence (30.4%), traffic trauma (8.5%), and syncope (3.6%).[2,3] A retrospective Pakistani study by Alam *et al*., reported the body (32%) and condylar process (29%) as most commonly involved, followed by the chin (18.4%) and angle (17%). The alveolus (2.6%) and pterygoid body (0.1%) were least involved.[4]

Traditionally, mandibular angle fractures were treated with closed reduction and maxillomandibular fixation (MMF), which while achieving union, posed risks to airway safety, nutrition and patient comfort.[5] Open reduction and internal fixation (ORIF), enabled by rigid fixation techniques is now the standard of care due to improved outcomes and early mobilization.[6]

Champy's technique recommends a single superior-border miniplate for stability with minimal hardware and favourable biological outcomes.[7]

Correspondence: Dr Shahrukh Zafar, Department of Oral and Maxillofacial Surgery, AFID Rawalpindi, Pakistan
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Champy's method is widely used for mandibular angle fractures but still has risks like infection and malocclusion. Evidence suggested single-plate fixation led to fewer complications than dual-plate technique, whereas dual plating increased fixation stability.[8]

This quasi-experimental study aims to compare the short-term complication rates of single versus dual miniplate fixation in non-comminuted, favourable mandibular angle fractures, to generate data for managing such fractures with minimal surgical intervention.

METHODOLOGY

This quasi-experimental study was carried out in the Department of Oral and Maxillofacial Surgery at the Armed Forces Institute of Dentistry (AFID), Rawalpindi, Pakistan, over a six-month period from December 2024 to May 2025, following approval of institutional ethical committee (Ref No. 918/Trg/05/Apr/2023).

Inclusion Criteria: Patients aged between 20 and 60 years of either gender were included in the study. Those presenting with traumatic, non-comminuted, favourable fractures of the mandibular angle were considered eligible. Patients who required open reduction and internal fixation (ORIF) as treatment option were enrolled.

Exclusion Criteria: Patients were excluded if they were unfit for general anaesthesia due to underlying conditions such as ischemic heart disease, chronic kidney disease, pulmonary dysfunction, or uncontrolled diabetes mellitus. Additional exclusion criteria included a prior history of mandibular fixation, comminuted or unfavourable fractures of the mandibular angle, pathological fractures associated with malignancy or chronic osteomyelitis, and bilateral mandibular angle fractures.

Sample size was calculated using the WHO sample size calculator for two independent proportions. We powered the study on scarring, the complication with the largest and most consistent difference between one and two-plate fixation as identified in the updated systematic review and meta-analysis by Vitkos *et al*., (2022).[6] That review reported an odds ratio of 0.13 (95% CI 0.05–0.32; p<0.001), indicating markedly lower scarring with a single plate. Using the odds-ratio identity, we assumed a conservative baseline scarring rate of 35% for the two-plate group, consistent with included studies. This corresponds to an expected rate of 6.5% for the single-plate group, an absolute risk difference of 28.5%. Applying the WHO two-proportions formula with two-sided α=0.05 and 80% power, the required sample size was ≈31 patients per group. We therefore enrolled 30 per group (60 total), which yields an estimated power of ≈83% for detecting this difference. Given the quasi-experimental design, non-probability consecutive sampling was adopted. Diagnosis was confirmed via orthopantomogram (OPG) and posteroanterior (PA) mandible radiographs. After informed consent, patients were placed into Group-A (one miniplate using Champy's technique) and Group-B (two miniplates).

Sixty patients were enrolled and non-randomly assigned to Groups A and B, with thirty patients in each group. Allocation to groups was done on an alternate basis (odd-even order of presentation).

All procedures were performed under general anaesthesia by a consultant maxillofacial surgeon with more than ten years of experience, using a standardized transoral approach. A mucoperiosteal flap was elevated to expose the fracture site. Group-A received a single 2.0 mm titanium miniplate secured with monocortical screws along the superior border. In Group-B, an additional miniplate was placed along the inferior border using a trocar. Fixation was done following the AO fixation principles. Postoperative radiographs confirmed adequate fracture reduction. Post-surgical care included intravenous antibiotics for 48 hours, followed by a five-day course of oral antibiotics. Analgesics and oral hygiene instructions were provided to all patients. Clinical evaluations were conducted postoperatively on day 1, and then at weeks 1, 2, and 4, by a single assessor. Each follow-up visit included both clinical and radiographic assessment. Primary outcome measures registered were postoperative complications, which included; wound infection (that could present as increased pain and swelling around the surgical site, potentially accompanied by redness and warmth, purulent discharge, or abscess formation with or without positive cultures), malocclusion (subjective occlusal disturbance reported by the patient), neurosensory dysfunction (paraesthesia, hypoesthesia, or dysesthesia of the lower lip and chin assessed by standardized neurosensory tests), wound dehiscence (partial or total separation of the wound edges), hardware failure (loosening, fracture, or exposure of the plates or screws), scarring (intraoral fibrotic tissue causing discomfort or reduced mouth opening), pseudoarthrosis (radiographic evidence of non-union after 4 weeks)

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 23. Continuous variables, including age and operative time, were expressed as Mean±SD and compared between groups using the independent samples t-test in order to detect mean differences. Categorical variables, including gender and postoperative complications (wound infection, wound dehiscence, hardware failure, neurosensory disturbance, scarring, malocclusion, and pseudoarthrosis), were summarized as frequencies and percentages. Intergroup comparisons for categorical outcomes were performed using the Pearson Chi-square test, applied to evaluate whether the distribution of complications differed significantly between the single-plate and double-plate fixation groups. A p-value ≤0.05 was considered statistically significant.

RESULTS

A total of sixty patients completed the study, with thirty allocated to each treatment group. Demographic distribution and baseline characteristics of the two groups were comparable. The mean age in Group-A was 34.7 ± 10.2 years, and 36.3 ± 9.7 years in Group-B. Group-A comprised 21 (70%) males and 9 (30%) females, while Group-B included 22 (73.3%) males and 8 (26.7%) females. The average interval between injury and surgery was also similar: 2.8 ± 1.1 days in Group-A and 3.1 ± 1.2 days in Group-B.

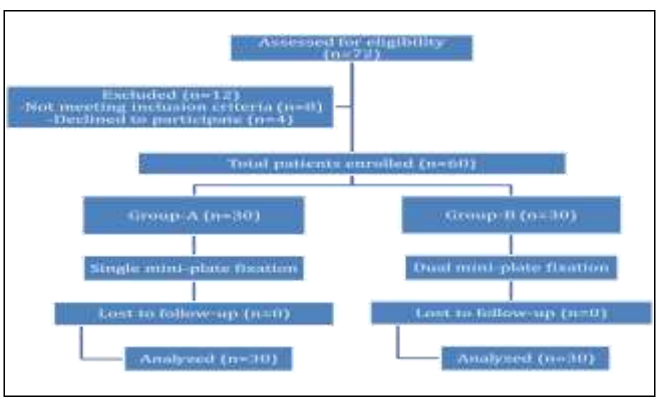

Figure-1: Patient Flow Diagram (n=60)

Postoperative outcomes were recorded at follow-up visits on Day 1, Week 1, Week 2, and Week 4, as summarized in Table-I. Wound infection occurred in 2 (6.7%) patients in Group-A and 10(33.3%) in Group-B. Neurosensory dysfunction was not observed in Group-A but was noted in 5(16.7%) patients in Group-B. Malocclusion was reported in 3(10.0%) cases in Group-A and 4(13.3%) in Group-B. No patient of pseudoarthrosis were observed in either group. Wound dehiscence occurred in 2(6.7%) patients in Group-A and 8(26.7%) in Group-B. Hardware failure was observed in 2(6.7%) patients in Group-A compared to 8(26.7%) in Group-B. Visible scarring was noted in 1(3.3%) patient in Group-A and 7(23.3%) in Group-B. A detailed patient-level distribution of complications is shown in Table-II.

Table-I: Comparison of Postoperative Complications Among Both Groups (n=60)

Complications	Group-A (n=30)	Group-B (n=30)	p-value
Wound Infection	2(6.7%)	10(33.3%)	0.010
Neurosensory Dysfunction	0(0.0%)	5(16.7%)	0.020
Malocclusion	3(10.0%)	4(13.3%)	0.688
Pseudoarthrosis	0(0.0%)	0(0.0%)	-
Wound Dehiscence	2(6.7%)	8(26.7%)	0.038
Hardware Failure	2(6.7%)	8(26.7%)	0.038
Scarring	1(3.3%)	7(23.3%)	0.023
Total number of patients with at least one complication	8(26.7%)	22(73.3%)	0.001

Table-II: Patient-Level Distribution of Postoperative Complications in Each Group (n=60)

Group	No. of Patients	Complication(s)
Group-A	2(6.7%)	Wound infection + Hardware failure
Group-A	3(10%)	Malocclusion
Group-A	2(6.7%)	Wound dehiscence
Group-A	1(3.3%)	Scarring
Group-B	8(26.7%)	Wound infection + Hardware failure
Group-B	2(6.7%)	Wound infection + Wound dehiscence
Group-B	4(13.3%)	Malocclusion + Neurosensory disturbance
Group-B	6(20%)	Scarring + Wound dehiscence
Group-B	1(3.3%)	Neurosensory disturbance
Group-B	1(3.3%)	Scarring

Overall, patients in Group-A (single miniplate) experienced fewer postoperative complications compared to those in Group-B (two miniplates), shown in Table-I, supporting the hypothesis that single-plate fixation is associated with superior treatment outcomes in non-comminuted, favourable mandibular angle fractures.

DISCUSSION

In this quasi-experimental study, sixty patients with non-comminuted, favourable mandibular angle fractures were treated over a six-month period at a single tertiary care centre.The results revealed a statistically significant increase in postoperative complications among patients treated with two miniplates compared to those receiving single-plate fixation. A total of 22 patients (73.3%) in Group-B experienced one or more complications compared to

8(26.7%) patients in Group-A ($p<0.001$). This finding challenges the traditional assumption that additional fixation hardware necessarily results in better clinical outcomes. In fact, our results indicate that for favourable fracture configurations, additional hardware may impose greater biological cost without proportional benefit.

Wound infection was the most prevalent complication, occurring in 33.3% of patients in Group-B versus only 6.7% in Group-A (p=0.010). The two patients in Group A, who acquired infection also had associated hardware failure, suggesting a potential link between infection-induced mechanical compromise. In Group-B, among 22 patients who presented with complications, 20 had more than one adverse outcome; most frequently combinations of infection, wound dehiscence, and hardware failure.

These findings suggest that increased surgical exposure, prolonged operative time, and a greater volume of implanted hardware may contribute to higher complication rates. Extensive dissection required for inferior plate placement can compromise soft-tissue integrity, disturb local vasculature, and create dead space, all of which may facilitate infection and mechanical failure.[9] Compared to the pooled infection rate of 4.2% (95% CI: 3.0–5.6%) reported by Kostares *et al*., in a meta-analysis of 5,825 ORIF cases, the infection rate in our single-plate group was comparable, while that in the two-plate group was markedly higher. Regional infections rates ranged from 4.2% in Europe to 4.3% in Asia and 7.3% in America, further highlighting the elevated risk in our dual-plate group.[10] This increased risk is likely due to greater soft tissue manipulation and periosteal stripping during transbuccal access, as reported by Muhammed, which can promote contamination and delay healing .[11] Additionally, as noted by Olsen *et al*., patient-specific factors such as poor oral hygiene, limited compliance, and socioeconomic constraints significantly affect the outcomes.[12] This is particularly relevant to our health-care settings, where most patients belong to a lower socio-economic background, which contributes to poor oral hygiene, limited compliance, and delayed access to postoperative care.

Neurosensory dysfunction was observed exclusively in the two-plate group (16.7%, p=0.020), with no case in Group-A. This aligns with findings of Tariq *et al*., who reported inferior alveolar nerve dysfunction in 58.3% of cases, with persistent symptoms in 40.6% following ORIF.[13] Rai *et al*., also emphasized vulnerability to nerve injury in mandibular angle fractures, especially when extensive periosteal stripping and hardware placement near the mandibular canal are involved.[14] In our study, among patients treated with two plate fixation, increased soft tissue dissection, lower border manipulation and transbuccal access contributed to high rate of neurosensory disturbance. These findings highlight the importance of conservative dissection, precise plate placement, and structured sensory follow-up in high-risk anatomical zones.

Among our patient sample, wound dehiscence occurred in 6.7% of patients in Group-A and 26.7% in Group-B (p=0.038). Our finding in Group-A aligns with the 7.3% cases reported by Oksa *et al*., for one plate fixation.[15] The significantly higher occurrence in our Group-B patients probably reflects the additional surgical exposure and soft tissue manipulation required for lateral plate placement via transbuccal access. Kong *et al*., found that combined intraoral and extraoral approaches increased the odds of postoperative complications by 5.63 times (OR=5.63, p=0.017); a statistically significant elevation.[16] Since all patients in Group-B underwent transbuccal fixation, the approach itself possibly contributed to the increased risk. This risk was likely compounded by poor oral hygiene and limited postoperative compliance in our patients. These findings highlight the need to balance mechanical stability with soft tissue preservation, even in patients without any known comorbid.

Hardware failure recorded in 6.7% patients of Group-A vs 26.7% of Group-B (p=0.038), possibly reflects greater surgical exposure, extensive periosteal stripping, and higher biomechanical stress in dual plate fixation. Capucha *et al*., in a multicenter study of 571 patients, reported an overall plate removal rate of 18.7%, with dual-plate constructs contributing to 23.4% of removals, particularly in angle fractures.[17] Albert *et al*., found infection to be the leading cause of hardware removal, responsible for 82.4% of cases; which is consistent with our observation that most hardware failures in Group-B were preceded or accompanied by infection.[18] Pal *et al*., also highlighted the biomechanical instability of the mandibular angle, which makes it prone to fixation-related complications.[19] Thus, while dual plating offers added rigidity, it may increase the risk of mechanical and biological failures.

Scarring, particularly intraoral, can significantly impair postoperative function, especially mouth opening. In our study, intraoral scarring occurred in 7(23.3%) patients in Group-B compared to only 1(3.3%) patient in Group-A (*p*=0.023). Nazar *et al*., reported that 17.1% of patients treated for maxillofacial fractures experienced reduced mouth opening due to fibrotic scarring.[20] Mahmood *et al*., similarly observed higher soft tissue complications with transbuccal plating, attributing them to trocar-induced trauma and mucosal manipulation.[21] Pavithra *et al*., further confirmed that mucosal scarring from intraoral incisions can restrict mandibular mobility during early recovery.[22] These findings emphasize the need to minimize intraoral trauma to preserve postoperative functions.

No cases of pseudoarthrosis were observed in either of our groups, aligning with the findings by Sakong *et al*., who reported no fracture instability in patients treated with either Champy's technique or rigid fixation.[23] Vitkos *et al*., in a meta-analysis of 1,667 patients, also did not find any significant difference in pseudoarthrosis between single- and dual-plate fixation (OR=0.90; 95% CI: 0.58–1.39; p=0.63).[6] Lander *et al*., analysing 19,152 cases, reported a malunion/non-union rate of 1.3%, which rose significantly when treatment was delayed beyond 6–7 days (OR = 1.84; 95% CI: 1.11–3.06).[24] The complete absence of pseudoarthrosis in our study likely reflects timely surgical intervention, appropriate case selection, and effective fixation.

Postoperative malocclusion occurred in 10% of Group-A and 13.3% of Group-B patients (*p*=0.688), with no significant statistical difference between the two. Chatterjee *et al*. reported occlusal disturbances in 2% of patients treated with a single non-compression miniplate and 4% in those with dual plating, supporting the trend of comparable occlusal outcomes (25). Vitkos *et al*., also found no significant difference in malocclusion between the groups (OR =0.97; 95% CI: 0.53–1.18; *p*=0.25).[6] Although both techniques offer stable fixation, the few cases of malocclusion observed in our study may be linked to suboptimal patient compliance and poor adherence to postoperative instructions.

In addition to reduced morbidity, single miniplate fixation offers practical advantages including shorter operative time, reduced cost, and limited dissection. Nonetheless, two-plate fixation may still be justified in specific clinical scenarios such as unfavourable fracture configurations, high functional demands, or multiple fracture lines. Therefore, the choice of fixation method should be tailored according to the patient's fracture pattern, functional requirement, and overall surgical risk profile.

LIMITATIONS OF STUDY

The limitation of our study primarily lies in its relatively small sample size, which may affect the generalization and statistical strength of the results. Additionally, no cost–benefit analysis was conducted, limiting the ability to assess the economic implications of the two fixation methods. The follow-up period was restricted to four weeks, which may not have been sufficient to capture delayed complications or long-term outcomes associated with either treatment modality.

CONCLUSION

Single miniplate fixation, as per Champy's technique, is associated with significantly fewer postoperative complications compared to dual-plate fixation in the management of non-comminuted, favourable mandibular angle fractures. While dual plating may offer increased mechanical stability in complex cases, it does not confer clinical benefit in straightforward fractures and is linked to a higher chance of wound infection, neurosensory disturbance, and hardware-related complications. Therefore, single-plate fixation should be considered the preferred approach in such cases, particularly when the fracture morphology allows for a less invasive technique without sacrificing biomechanical integrity.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SZ & SIK: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

MJ & SJHB: Data acquisition, data analysis, approval of the final version to be published.

SS & AI: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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