Journal of Pioneering Medical Sciences
Received: July 04, 2026 | Accepted: September 28, 2026 | Published: November 05, 2026
Volume 15, Issue 10, Pages 95-103

DOI https://doi.org/10.47310/jpms2026151009



Comparative Assessment of Clinical and Functional Outcomes Following Single Versus Double Miniplate Fixation in Simple, Non-Comminuted Mandibular Parasymphysis Fractures: A Prospective Comparative Study

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Abstract **Background:** Mandibular parasymphysis fractures are among the most common facial injuries encountered in oral and maxillofacial trauma practice. Traditionally, the region is managed with two miniplates following Champy's lines of osteosynthesis to resist torsional and compressive forces. However, the placement of a superior plate near the canine-premolar region carries a risk of iatrogenic injury to the mental nerve and dental roots. **Objective:** To compare the clinical and functional outcomes of single-plate and double-plate fixation in patients with simple, non-comminuted mandibular parasymphysis fractures. **Methods:** This prospective comparative study included 16 patients with simple, non-comminuted mandibular parasymphysis fractures. Eligible patients were aged 15-55 years, while the enrolled participants were aged 18-50 years. Patients were allocated into two groups of eight each. Group I underwent fixation using a single 2.5 mm miniplate along the inferior mandibular border, whereas Group II received two 2 mm miniplates placed along the superior and inferior borders. Clinical and functional outcomes were assessed through fracture union, occlusal stability, wound complications, iatrogenic dental injury, mental nerve paresthesia, operative duration, mouth opening and return to mastication. **Results:** Both groups achieved satisfactory fracture healing and occlusal stability during the six-month follow-up period. The mean operative duration was shorter in Group I (72.1±4.6 minutes) than in Group II (84.2±5.1 minutes; $p<0.001$). Iatrogenic dental injury was observed in four patients (50%) in Group II and none in Group I. The between-group difference in dental injury was not statistically significant using a two-sided Fisher's exact test ($p = 0.077$). Wound complications and plate exposure were observed more frequently in Group II. However, the small sample size limited the precision of complication comparisons. **Conclusion:** In this small prospective comparative study involving 16 patients, both single-plate and double-plate fixation achieved satisfactory clinical outcomes in selected simple, non-comminuted mandibular parasymphysis fractures. Single-plate fixation was associated with shorter operative duration and fewer observed iatrogenic dental injuries. However, the limited sample size restricts the precision and generalizability of these findings. Larger, adequately powered multicenter studies are required to confirm the comparative effectiveness and safety of these techniques.

Key Words Mandibular Fractures, Parasymphysis, Miniplate Fixation, Osteosynthesis, Single Plate, Double Plate, Mental Nerve Injury, Iatrogenic Dental Injury, Functional Outcomes, Arch Bar Tension Band

INTRODUCTION

Mandibular fractures constitute a significant proportion of maxillofacial injuries, accounting for nearly 36-70% of all facial fractures globally, with the parasymphysis region being among the most frequently involved sites due to its anatomical and biomechanical vulnerabilities [1,2]. The parasymphysis region, extending from the canine to the mental foramen, is a structurally complex zone subjected to

significant torsional and compressive stresses during mastication. Management of fractures in this region aims to restore both the function and aesthetics of the mandible through stable osteosynthesis, promoting early mobilization and functional rehabilitation [3].

The introduction of miniplate osteosynthesis based on Champy's principles has significantly improved the management of mandibular fractures [4]. These principles emphasize the placement of fixation devices along biomechanically favorable regions of the mandible to resist functional loading. In the parasymphysis region, fixation may involve plates positioned near the superior alveolar region and the inferior mandibular border to counteract tensile, compressive and torsional forces during mandibular function [5]. The choice of fixation technique must also consider fracture morphology, anatomical limitations and the proximity of dental roots and neurovascular structures.

Placement of a superior miniplate in the mandibular parasymphysis region requires careful consideration of the anatomical relationship between the dental roots, mental foramen and surrounding neurovascular structures. Drilling and screw insertion near the canine and premolar roots may result in iatrogenic dental injury, particularly when the available bone height is limited. Similarly, surgical exposure and soft-tissue retraction around the mental foramen may increase the risk of mental nerve irritation or injury. These anatomical considerations are important when selecting the position and number of fixation plates [6,7].

Selection of an osteosynthesis technique requires consideration of fracture location, displacement, occlusal stability and the biomechanical requirements of the mandibular region. Established principles of mandibular fracture management emphasize anatomical reduction, adequate stabilization, preservation of adjacent anatomical structures and restoration of functional occlusion.

Such complications have prompted the exploration of modified techniques utilizing a single plate along the inferior border, often supplemented by a tension band mechanism like an arch bar, to achieve stable fixation while minimizing iatrogenic trauma [8].

Biomechanical analyses have shown that mandibular strains during occlusal loading are predominantly tensile at the superior border and compressive at the inferior border [9]. Hence, achieving an appropriate balance between mechanical stability and surgical safety remains the cornerstone of optimal fixation strategy selection. Although two-plate fixation theoretically offers superior torsional rigidity, clinical outcomes have shown that single-plate fixation, when supported by an arch bar or other tension-band substitute, can yield comparable stability with fewer complications [10].

Recent developments in mandibular fracture management have introduced alternative fixation systems, including three-dimensional (3D) miniplates, locking plate systems and patient-specific fixation devices. Three-dimensional plates use interconnected horizontal and vertical elements to provide stabilization across the fracture site and may offer improved resistance to rotational displacement in selected fracture configurations. Locking plate systems achieve mechanical engagement between the screw head and plate, reducing dependence on intimate plate-to-bone contact. Patient-specific fixation systems, developed using virtual surgical planning and computer-aided design and manufacturing, allow adaptation of the fixation construct to individual mandibular anatomy. Although these approaches may offer advantages in selected clinical situations, their indications, technical requirements, costs and comparative clinical outcomes require careful consideration. Conventional single-plate and double-plate fixation therefore remain relevant treatment options, particularly where surgical simplicity and availability of standard fixation systems are important. The selection of single-plate or double-plate fixation for mandibular parasymphysis fractures remains an important clinical consideration. Double-plate fixation provides stabilization at two levels of the mandible but requires additional hardware placement and surgical manipulation. In contrast, single-plate fixation, when supplemented by an arch bar functioning as a tension band, may reduce the amount of implanted hardware and the extent of surgical exposure. However, concerns remain regarding its ability to resist rotational and functional forces in certain fracture configurations. Previous comparative studies have reported varying findings regarding fracture stability, postoperative complications and functional recovery [11,12]. Therefore, evaluating the clinical outcomes of these techniques in carefully selected fracture cases remains relevant.

In India, where road traffic accidents remain a major cause of maxillofacial trauma, the need for simplified, cost-effective and less morbid fixation techniques is critical [13-15].

Fracture morphology and the condition of teeth within the fracture line are important considerations when planning internal fixation of mandibular parasymphysis fractures. Teeth located within the fracture line require careful clinical and radiographic evaluation for mobility, root fracture, periodontal involvement, infection and interference with fracture reduction. Their presence does not necessarily require extraction and the decision to retain or remove a tooth should be based on its clinical condition and its effect on fracture management. The degree and direction of fracture displacement may also influence the stability of reduction and the mechanical requirements of fixation. Minimally displaced, simple fractures may be suitable for less extensive fixation when satisfactory anatomical reduction and occlusal stability can be achieved. In contrast, markedly displaced or comminuted fractures may require more rigid fixation because of increased instability and disruption of bony continuity. These considerations support the importance of careful case selection when comparing single-plate and double-plate osteosynthesis. The present study was restricted to simple, non-comminuted parasymphysis fractures to maintain a more clinically comparable study population.

Although single-plate and double-plate fixation techniques have been investigated in mandibular

parasymphysis fractures, uncertainty remains regarding their relative clinical advantages in selected simple, non-comminuted fractures. The available evidence has not established whether the additional hardware used in double-plate fixation consistently improves clinical outcomes sufficiently to justify the associated surgical exposure and potential risk of complications. Furthermore, differences in fracture morphology, fixation methods and postoperative stabilization may influence the findings of previous studies. Small prospective comparative studies can provide preliminary clinical observations and identify outcome patterns that may be examined in larger investigations. Accordingly, the present study compared single-plate fixation supported by an arch bar with conventional double-plate fixation, focusing on fracture healing, occlusal stability, postoperative complications, operative duration and functional recovery. The findings were intended to provide preliminary comparative evidence rather than establish the superiority or equivalence of either technique.

METHODS

This prospective comparative clinical study was conducted on patients presenting with isolated parasymphysis fractures of the mandible at the Department of Oral and Maxillofacial Surgery, following approval from the Institutional Ethical Committee. The study adhered to the principles of the Declaration of Helsinki for human research ethics.

Study Design

A prospective comparative clinical study was conducted among patients presenting with isolated mandibular parasymphysis fractures. Eligible participants were evaluated according to predefined inclusion and exclusion criteria and underwent either single-plate or double-plate fixation. Clinical and functional outcomes were assessed during scheduled postoperative follow-up visits. The study was conducted following Institutional Ethics Committee approval and in accordance with the ethical principles of the Declaration of Helsinki.

Study Sample

A total of 16 patients with simple, non-comminuted mandibular parasymphysis fractures were included in this prospective comparative study. Eight patients underwent single-plate fixation (Group I) and eight underwent double-plate fixation (Group II). The limited sample size was considered when interpreting the comparative findings, particularly the frequency of postoperative complications.

Eligibility Criteria

Inclusion Criteria: Patients aged 15-55 years presenting with simple, non-comminuted mandibular parasymphysis fractures were eligible for inclusion. Participants were required to be dentate, medically fit for surgical management and free from preoperative mental nerve sensory deficits.

Exclusion Criteria

Patients with comminuted or infected mandibular fractures, associated midfacial fractures affecting occlusion, bilateral condylar fractures requiring closed reduction or systemic medical conditions precluding surgical intervention were excluded from the study.

The study was restricted to simple, non-comminuted mandibular parasymphysis fractures to maintain a relatively homogeneous clinical population for comparison of the two fixation techniques. Comminuted fractures were excluded because fragmentation and loss of bony continuity may require different fixation strategies. Infected fractures were also excluded because pre-existing infection may influence postoperative healing and complication rates. These selection criteria allowed the clinical outcomes of single-plate and double-plate fixation to be evaluated within a defined fracture category.

Study Outcomes

The study evaluated clinical, functional and perioperative outcomes following single-plate and double-plate fixation. Clinical outcomes included fracture union, occlusal stability, wound infection or dehiscence, plate exposure, iatrogenic dental injury and mental nerve paresthesia. Functional outcomes included postoperative mouth opening and time to return to mastication. Operative duration and hospital stay were also assessed.

The available study documentation did not establish a prospectively designated primary outcome. Therefore, the reported outcomes were considered exploratory and the findings were interpreted without claiming confirmatory evidence of superiority or non-inferiority between the fixation techniques.

Group Allocation

A total of 16 patients fulfilling the eligibility criteria were included in the study. Eight patients underwent single-plate fixation (Group I), while eight underwent double-plate fixation (Group II). The original study documentation should be consulted to establish the method used for treatment allocation, including whether a random sequence was generated and whether allocation concealment was implemented.

Surgical Procedure

Under general anesthesia with nasoendotracheal intubation, intraoral vestibular incisions were made to expose the fracture site. Following anatomical reduction and temporary maxillomandibular fixation, osteosynthesis was achieved using:

- **Group I:** A single 2.5 mm, 4-hole miniplate with 10 mm screws along the inferior mandibular border
- **Group II:** Two 2 mm, 4-hole miniplates with 8 mm screws one at the alveolar ridge and one at the lower border

In both groups, upper and lower arch bars were placed for occlusal stabilization. Wound closure was done in layers using 3-0 Vicryl and silk sutures. All patients received postoperative antibiotic prophylaxis with beta-lactam and metronidazole coverage for seven days.

Outcome Assessment

Postoperative clinical and radiographic assessments were performed at the scheduled follow-up visits. Outcome assessors were not blinded to the fixation technique used. Clinical outcomes included fracture healing, occlusal stability, postoperative complications and neurosensory changes. The absence of blinded assessment was considered a potential source of observer bias.

Surgical Standardization

The surgical procedures followed the fixation protocols described for the respective treatment groups. In Group I, fixation was performed using a single 2.5 mm four-hole miniplate with 10 mm screws along the inferior mandibular border. In Group II, two 2 mm four-hole miniplates with 8 mm screws were placed along the superior and inferior borders. Upper and lower arch bars were used for occlusal stabilization in both groups. Wound closure was performed using the suture materials described in the surgical protocol and postoperative antibiotic coverage was administered for seven days.

Details regarding the number of operating surgeons, their surgical experience and any additional measures used to standardize the procedures require confirmation from the investigators. Functional outcomes were assessed using maximum inter-incisal mouth opening and time required to return to mastication. These parameters were used to evaluate postoperative mandibular mobility and recovery of masticatory function following fracture fixation.

Postoperative Care and Follow-up

Patients were maintained on a liquid diet for one week followed by a soft diet for four weeks. The lower arch bar was retained for five weeks in Group I. Clinical and radiographic evaluations were performed on postoperative day 2, at five weeks and at six months. The clinical outcomes evaluated included fracture union, occlusal stability, postoperative wound infection or dehiscence, plate exposure, iatrogenic dental injury and mental nerve paresthesia. Functional outcomes included postoperative mouth opening, measured as maximum inter-incisal distance and time required to return to mastication. Operative duration and length of hospital stay were also compared between the two fixation groups. These parameters were used to assess fracture healing, postoperative morbidity and functional recovery following single-plate and double-plate fixation.

Clinical and Functional Outcome Measures

Clinical outcomes included fracture union, occlusal stability, postoperative wound infection or dehiscence, plate exposure, iatrogenic dental injury and mental nerve paresthesia. Functional outcomes included maximum inter-incisal mouth opening and time required to return to mastication. Perioperative outcomes included operative duration and length of hospital stay. Fracture healing and postoperative complications were evaluated through clinical and radiographic follow-up, as applicable. These parameters were compared between the single-plate and double-plate fixation groups to assess postoperative healing, morbidity and functional recovery.

Statistical comparisons were performed between the single-plate and double-plate fixation groups. The results were presented using descriptive statistics and p-values, with the statistical test used for each comparison specified according to the nature and distribution of the data. Continuous variables were summarized as mean and standard deviation. Normally distributed continuous variables were compared using the independent-samples Student's t-test, while categorical outcomes with small expected cell frequencies were compared using Fisher's exact test. Statistical significance was evaluated at a two-sided p-value of less than 0.05.

RESULTS

Demographic and Clinical Profile

A total of 16 patients, comprising 14 males and two females, were included in the study. Although the eligibility criteria permitted patients aged 15-55 years, the observed age range of the enrolled participants was 18-50 years. Each treatment group included eight patients. The mean age was 29.38±6.2 years in Group I and 24.38±5.8 years in Group II, as presented in Table 1.

Fracture Union and Functional Stability

Radiographic and clinical evaluation at 5 weeks showed adequate fracture union in 7 patients (87.5%) in Group I and 8 patients (100%) in Group II. **One patient in Group I showed delayed union due to poor postoperative compliance. **The difference between groups was not statistically significant (p = 0.302).

Functional occlusion was achieved in all cases at the 6 month follow-up, with no significant malocclusion or non-union detected. Mean radiographic bone density at the fracture line improved progressively in both groups, confirming stable healing (Table 2).

Post-Operative Complications

The frequencies of postoperative complications were interpreted in relation to the small number of patients in each group. As each group contained only eight participants, a single event represented 12.5% of the group. Although wound complications, plate exposure and iatrogenic dental injuries were observed more frequently in the double-plate group, the small denominators resulted in imprecise estimates of complication frequency. Therefore, these findings should be interpreted cautiously and should not be considered reliable estimates of the comparative risk of uncommon complications.

Iatrogenic dental root injury was observed in four patients (50%) in Group II, whereas no dental root injuries were recorded in Group I. The difference in the observed frequency of dental injury was 50 percentage points. However, the two-sided Fisher's exact test did not demonstrate statistical significance (p = 0.077).

Table 1: Demographic and Etiological Distribution of Patients

Variable	Group I (Single Plate (n = 8))	Group II (Double Plates (n = 8))	p- value
Mean Age (years±SD)	29.38±6.2	24.38±5.8	0.129
Sex (M/F)	7/1	7/1	-
Etiology-RTA (n (%))	6 (75%)	6 (75%)	1.000
Etiology-Assault (n (%))	1 (12.5%)	2 (25%)	0.522
Etiology-Fall (n (%))	1 (12.5%)	0 (0%)	0.302

RTA: Road Traffic Accident, Values are expressed as Mean±standard deviation or number (percentage), as appropriate. Group I: Single-plate fixation, Group II: Double-plate fixation, Statistical tests are identified for individual comparisons, CI: Confidence interval

Table 2: Comparison of Fracture Healing and Functional Outcomes

Outcome Parameter	Group I (Single Plate)	Group II (Double Plates)	p-value
Union (n (%))	7 (87.5%)	8 (100%)	0.302
Non-union (n (%))	1 (12.5%)	0 (0%)	
Radiographic Healing Time (Weeks±SD)	5.8±0.7	5.6±0.5	0.411
Functional Occlusion Achieved (n (%))	8 (100%)	8 (100%)	

Table 3: Comparison of Post-Operative Complications Between Groups

Complication	Group I (Single Plate) (n (%))	Group II (Double Plates) (n (%))	p-value
Wound infection/dehiscence	0 (0%)	2 (25%)	0.131
Plate exposure/removal	0 (0%)	1 (12.5%)	0.302
Iatrogenic dental injury	0 (0%)	4 (50%)	0.021*
Mental nerve paresthesia	2 (25%)	3 (37.5%)	0.590

Statistically significant

Table 4: Intraoperative and Functional Outcomes

Parameter	Group I (Single Plate) (Mean±SD)	Group II (Double Plates) (Mean±SD)	p-value
Operative Time (min)	72.1±4.6	84.2±5.1	<0.001*
Hospital Stay (days)	3.8±0.7	4.3±0.9	0.209
Return to Mastication (weeks)	4.5±0.6	5.2±0.8	0.047*
Mouth Opening at 6 weeks (mm)	38.5±2.4	36.8±2.2	0.184

Significant at $p<0.05$

The overall incidence of complications was higher in the double-plate group. Wound infection and dehiscence occurred in 2 patients (25%) in Group II, whereas none were reported in Group I ($p = 0.131$). Plate exposure was seen in one patient (12.5%) in Group II, which required secondary removal after five months.

Iatrogenic dental root injury, detected radiographically, was observed in 4 patients (50%) in Group II and none in Group I, a statistically significant difference ($p = 0.021$). Transient mental nerve paresthesia occurred in 2 (25%) in Group I and 3 (37.5%) in Group II, resolving within 6-8 weeks without sequelae ($p = 0.590$) (Table 3).

Intraoperative Time and Functional Recovery

The mean operative duration was significantly lower for the single-plate technique (72.1±4.6 minutes) than for the double-plate method (84.2±5.1 minutes, $p<0.001$). Patients in Group I demonstrated faster return to normal masticatory function (Mean = 4.5 weeks) compared to Group II (Mean = 5.2 weeks).

Mouth opening (inter-incisal distance) at 6 weeks averaged 38.5±2.4 mm in Group I and 36.8±2.2 mm in Group II, showing no statistically significant difference ($p = 0.184$). (Table 4 summarizes operative and functional parameters.)

Narrative Interpretation

Overall, both fixation techniques achieved satisfactory bone union and occlusal stability at 6 months. However, Group I (single-plate fixation) demonstrated:

- Shorter surgical time, reflecting reduced intraoperative complexity
- Fewer postoperative complications, particularly dental root injury and wound dehiscence
- Comparable fracture stability and radiographic healing to double-plate fixation

Conversely, Group II showed higher complication rates, attributed to the proximity of the superior plate to the dental apices and mental foramen, leading to increased risk of infection and iatrogenic injury. Although the double-plate construct offered excellent rigidity, the clinical advantages were not statistically superior in terms of fracture union or function.

The present findings suggest that single-plate fixation along the inferior mandibular border, supplemented by an arch bar functioning as a tension band, may provide satisfactory clinical stability in selected simple, non-comminuted parasymphysis fractures. Nevertheless, the small sample size and limited number of observed complications prevent definitive conclusions regarding comparative safety, cost-effectiveness or superiority over double-plate fixation.

DISCUSSION

Management of mandibular parasymphysis fractures continues to evolve, guided by the balance between mechanical stability and the minimization of surgical morbidity. The present study compared single-plate versus double-plate fixation in parasymphysis fractures, evaluating functional outcomes and postoperative complications. The management of mandibular parasymphysis fractures requires stable anatomical reduction, restoration of occlusion

and prevention of postoperative complications. Both single-plate and double-plate fixation techniques have been used to achieve these objectives. In the present study, satisfactory fracture healing and occlusal stability were observed in both groups during the six-month follow-up period. Single-plate fixation was associated with shorter operative duration, while iatrogenic dental injuries were observed more frequently in the double-plate group. Padmanaban *et al.* [10] also investigated single-plate and two-plate osteosynthesis for mandibular parasymphysis fractures, providing relevant comparative evidence. However, the present findings should be interpreted cautiously because of the small sample size and limited statistical precision.

The findings of this study suggest that single-plate fixation supported by an arch bar may be a suitable treatment option for selected patients with simple, non-comminuted mandibular parasymphysis fractures. Both fixation techniques achieved satisfactory clinical healing and occlusal stability during the follow-up period. Although shorter operative duration and fewer observed dental injuries were recorded in the single-plate group, the limited sample size prevents definitive conclusions regarding the superiority or comparative safety of either technique. Treatment selection should continue to consider fracture morphology, degree of displacement, dental anatomy, occlusal stability and the clinical judgment of the operating surgeon.

Selection of the fixation technique should consider fracture configuration, degree of displacement, mandibular bone quality, dental root anatomy and the need for additional mechanical stability. Surgeon experience and familiarity with the selected fixation system may also influence operative duration, screw placement and postoperative complications. Therefore, treatment decisions should be individualized according to fracture characteristics and clinical requirements rather than based solely on the number of fixation plates.

Evidence from comparative clinical studies should be interpreted in relation to fracture configuration, fixation system, associated injuries and the methods used to assess postoperative outcomes. Differences in study design and treatment protocols may contribute to variation in reported complication rates and functional recovery. Consequently, the findings of individual studies should be considered alongside the broader clinical evidence when evaluating the relative advantages of single-plate and double-plate fixation.

Biomechanical Considerations

The biomechanical environment of the mandibular anterior segment is characterized by tensile stresses at the alveolar border and compressive forces along the inferior border during mastication. According to Champy's principles, fixation should ideally neutralize these stresses through dual-plate osteosynthesis one at the tension zone and another at the compression zone [1]. However, multiple anatomical and clinical studies have demonstrated that placement of a superior miniplate near the canine-premolar region increases the risk of injury to the dental roots and the mental nerve, especially in patients with minimal vertical mandibular height [2,3].

The biomechanical requirements of fixation in the mandibular parasymphysis region depend on the direction of functional loading, fracture configuration and stability of anatomical reduction. Double-plate fixation provides stabilization at two levels of the mandible and is intended to resist rotational and bending forces across the fracture site. Single-plate fixation reduces the amount of implanted hardware but may require additional support to control tensile forces along the superior mandibular border. In the present study, arch bars were used for occlusal stabilization in both groups, with the lower arch bar retained for five weeks in the single-plate group. This arrangement may have contributed to postoperative stability in selected simple fractures. However, the study did not directly measure biomechanical properties such as construct stiffness, torsional resistance or bite force. Therefore, the observed clinical healing outcomes should not be interpreted as direct evidence of equivalent mechanical strength between the two fixation techniques.

Clinical and Functional Outcomes

In our series, radiographic union was achieved in 87.5% of patients in the single-plate group and 100% in the double-plate group, with no statistically significant difference ($p = 0.302$). These healing rates are comparable to those reported in similar cohorts by Bouloux *et al.* [6] and Farzan *et al.* [7], who documented union rates exceeding 90% following rigid internal fixation. The single case of delayed union in our study was associated with postoperative non-compliance rather than fixation instability, underscoring that proper patient instruction remains a key determinant of success.

Functionally, all patients achieved stable occlusion and satisfactory mouth opening by the end of the follow-up period, further validating the adequacy of single-plate fixation for routine parasymphysis fractures. The mean healing time and occlusal rehabilitation periods were statistically comparable between both groups, confirming that reducing the number of fixation plates does not compromise functional recovery.

Complication Profile

The pattern of postoperative complications in this study reinforces the known drawbacks of double-plate osteosynthesis. Wound infection and dehiscence occurred exclusively in the double-plate group (25%), likely attributable to the subapical plate's proximity to the intraoral incision line and greater foreign body load. Similar findings were reported by Peterson and Hupp who emphasized that the superior plate's placement predisposes to mucosal dehiscence and early plate exposure [8].

The most significant difference between groups was the incidence of iatrogenic dental injury, seen in 50 % of double-plate cases and none in single-plate cases ($p = 0.021$). Root penetration by monocortical screws, especially in the premolar region, remains a critical concern in dual-plate fixation. Radiographic evaluations have shown that buccal cortical bone thickness averages only 2-2.5 mm in this zone, meaning even short screws risk breaching the dental root or injuring the inferior alveolar canal [10].

Transient mental nerve paresthesia was noted in a few patients in both groups but resolved spontaneously within two months. This transient neuropraxia was likely due to intraoperative traction rather than direct nerve trauma. Importantly, none of the patients developed persistent neurosensory deficits, reaffirming that careful subperiosteal dissection and awareness of nerve anatomy mitigate long-term complications [11].

Another clinically meaningful outcome was the significant reduction in operative time for single-plate fixation (mean 72 minutes vs. 84 minutes, $p<0.001$). The shorter duration can be attributed to reduced intraoral exposure, fewer drilling steps and simplified hardware placement. From a public-health perspective, reduced surgical time translates into lower anesthesia exposure, decreased intraoperative blood loss and improved operating-room efficiency, all of which are especially valuable in high-volume trauma centers.

Comparative Insights with Existing Literature

Previous investigations comparing single-plate and double-plate fixation have reported varying clinical outcomes, reflecting differences in fracture morphology, fixation methods and postoperative stabilization. Double-plate fixation provides stabilization at two levels of the mandible and may offer additional resistance to rotational forces. However, placement of an additional plate requires further surgical manipulation and may increase the risk of injury to adjacent dental roots or soft tissues. Single-plate fixation, particularly when supplemented by an arch bar functioning as a tension band, reduces the amount of fixation hardware and may provide satisfactory stability in selected simple fractures. These potential advantages must be balanced against concerns regarding fixation stability in displaced, oblique or mechanically unfavorable fracture configurations. The available evidence should therefore be interpreted according to fracture characteristics and the specific fixation techniques employed rather than assuming that one approach is universally superior.

Our findings corroborate earlier biomechanical and clinical research suggesting that single- plate fixation supported by an arch bar can provide adequate stability for simple linear fractures without increasing the risk of non-union. Van Eijden [12] and Nogami *et al.* [13] demonstrated that the mechanical behavior of mandibular bone during masticatory loading does not necessarily require dual-plate fixation unless the fracture line is oblique or the bone quality is poor.

Moreover, recent randomized controlled trials have emphasized cost-effectiveness and reduced postoperative morbidity with minimal hardware protocols. Bormann *et al.* [14] and Gurung *et al.* [15] reported that the total implant cost and postoperative discomfort were significantly lower in patients managed with single-plate techniques compared with conventional dual-plate systems [14,15]. These observations support a shift toward a more conservative fixation philosophy, especially in resource-limited healthcare environments.

The principal contribution of this study is the prospective clinical comparison of two established fixation techniques in patients with simple mandibular parasymphysis fractures. The findings provide additional clinical observations regarding operative duration, postoperative recovery and fixation-related complications rather than introducing a new surgical technique or fixation device.

Interpretation of the existing literature requires consideration of several methodological differences between studies. Fracture displacement, associated mandibular injuries, dental status, plate dimensions, screw configuration and the duration of postoperative maxillomandibular stabilization may influence treatment outcomes. Differences in follow-up duration and definitions of complications may also affect the reported rates of infection, dental injury, plate exposure and delayed healing. Studies with small sample sizes may be unable to detect clinically important differences in uncommon complications. Consequently, favorable outcomes reported with either fixation technique should not be interpreted independently of the study population and treatment protocol. Further prospective investigations using standardized outcome definitions, appropriate statistical methods and adequate sample sizes are needed to clarify the relative advantages of single-plate and double-plate fixation. Selection of the fixation technique should balance the need for adequate fracture stability against operative duration, implant requirements and the potential for iatrogenic injury. Although single-plate fixation may reduce the amount of hardware used, the present study did not perform a formal cost analysis. Therefore, conclusions regarding comparative treatment costs cannot be drawn from these findings.

Differences in surgeon experience and the degree of fracture displacement may influence operative duration, fixation stability and postoperative outcomes. These factors were not clearly accounted for in the reported comparisons and may have contributed to variability between treatment groups. Future investigations should document fracture displacement and surgeon-related characteristics to permit more reliable evaluation of their influence on treatment outcomes.

Clinical Implications

The clinical implication of this study is that single-plate fixation is a safe, efficient and biomechanically acceptable alternative to double-plate osteosynthesis in selected parasymphysis fractures. The technique is particularly suitable when:

- The fracture is linear and non-comminuted
- The vertical mandibular height is limited, posing a risk of iatrogenic injury
- A functional tension band (arch bar or intermaxillary fixation) can supplement the lower plate

By minimizing surgical invasiveness and hardware burden, single-plate fixation also enhances patient comfort

and simplifies subsequent implant removal if required. Nonetheless, complex fractures with torsional instability or edentulous segments may still necessitate dual- plate stabilization.

CONCLUSIONS

The present comparative study demonstrates that both single and double plate fixation methods are effective in achieving stable fracture union and satisfactory functional outcomes in parasymphysis fractures of the mandible. However, single-plate fixation offers several clinical advantages shorter operative time, reduced risk of dental root injury, fewer wound complications and lower hardware load without compromising fracture stability.

Single-plate fixation may reduce the amount of implanted hardware and operative duration in selected simple parasymphysis fractures. However, the present study did not directly evaluate treatment costs or patient-reported outcomes. Further studies incorporating economic evaluation and patient-centered measures are required to establish whether these potential procedural advantages translate into meaningful clinical and economic benefits.

The present findings provide preliminary evidence that single-plate fixation supported by an arch bar may achieve satisfactory clinical and functional outcomes in selected simple, non-comminuted mandibular parasymphysis fractures. However, the small sample size, limited statistical precision and single-setting design restrict the generalizability of these observations. The results should not be interpreted as establishing the superiority of single-plate fixation over double-plate fixation. Larger, adequately powered multicenter studies with standardized outcome assessment and longer follow-up are required before broader clinical recommendations can be made.

Limitations and Future Directions

The principal limitation of this study was its small sample size of 16 patients, with eight participants in each treatment group. This limited the statistical power and precision of comparisons, particularly for infrequent complications such as infection, plate exposure and non-union. Consequently, the observed differences should be interpreted as preliminary findings rather than definitive evidence of treatment superiority. The study was also conducted in a single clinical setting, which may restrict the generalizability of the results. The six-month follow-up period may not have been sufficient to identify all late hardware-related complications. Larger multicenter studies with adequate sample size calculations, standardized outcome assessment and longer follow-up are required.

The study did not include a formal assessment of treatment costs, patient-reported quality of life, postoperative pain or patient comfort. Although operative duration and the number of fixation plates were compared, these measures alone cannot establish the economic advantages or patient-centered benefits of either fixation technique. Future investigations should incorporate standardized cost assessments, validated patient-reported outcome measures, postoperative pain scores and quality-of-life evaluations to provide a more comprehensive comparison of single-plate and double-plate fixation.

The absence of blinded outcome assessment may have introduced observer bias, particularly for clinical parameters requiring subjective interpretation. Future studies should incorporate independent, blinded assessment wherever feasible to improve the reliability of outcome comparisons.

An additional limitation was the absence of objective bite-force assessment. Although postoperative mouth opening and return to mastication were evaluated, these measures do not directly quantify masticatory strength or functional loading across the fracture site. Bite-force measurements could provide additional information regarding functional recovery and the mechanical performance of the fixation constructs. Future comparative studies should incorporate standardized bite-force assessments at predefined postoperative intervals, together with clinical healing and patient-reported functional outcomes.

Patient-reported outcomes, including postoperative pain, satisfaction and oral health-related quality of life, were not assessed using standardized instruments. These measures, together with objective bite-force assessment, should be incorporated into future studies to provide a more comprehensive evaluation of functional recovery.

Another area worth exploring is the use of three-dimensional (3D) printed pre-bent plates and bioresorbable fixation systems, which may further reduce iatrogenic injury and improve patient outcomes. With increasing emphasis on personalized surgical planning, such innovations could redefine the standard of care for anterior mandibular fractures [15,16].

Future comparative studies should also evaluate conventional miniplate fixation against newer osteosynthesis systems, including three-dimensional plates, locking plates and patient-specific fixation devices. These techniques may differ in mechanical stability, hardware requirements, surgical complexity and anatomical adaptability. Comparative evaluation should include fracture healing, occlusal stability, dental and neurosensory complications, operative duration, patient-reported outcomes and treatment costs. Larger prospective investigations are required to determine whether these alternative fixation systems provide clinically meaningful advantages over conventional single-plate or double-plate techniques in mandibular parasymphysis fractures.

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