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A Comparative Evaluation of Conventional Osteosynthesis with Posterior Border Osteosynthesis for Open Reduction and Internal Fixation of Condylar Fracture of Mandible

Dr. Sudhakar Gudipalli[1], Dr. Surekha Kanala[2], Dr. Adepu Abhishek[3], Dr. D. Naga Sujata[4], Dr. Ghanta Chaitanya[5], Dr. Ch. Balakrishna Manohar[6], Dr. Venu Sameera Panthagada[7]

[1,2,3,4,5,6,7] Department of Oral and Maxillofacial Surgery, Government Dental College & Hospital, Vijayawada- 520004

Dr. NTR University of Health Sciences, Vijayawada, Andhra Pradesh, India

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KEYWORDS

Mandible, condyle, open reduction and internal fixation, miniplates, conventional osteosynthesis, posterior border osteosynthesis

ABSTRACT

Introduction: Mandibular condylar fractures (MCF) constitute a significant proportion of facial trauma cases, often requiring surgical intervention for functional and anatomical restoration. Open reduction and internal fixation (ORIF) with miniplates is a standard approach. However, the optimal number of plates for stable fixation remains debatable. The study aimed to compare two plating systems for ORIF of MCF - one using two non- compression miniplates (conventional osteosynthesis) and the other with single non-compression miniplate (posterior border osteosynthesis).

Objectives: To assess and compare the duration of operation. To achieve adequate and painless mouth opening, functional and stable temporomandibular joint and pre-injury occlusion. To assess and compare the post operative complications.

Methods: Twenty-six patients requiring ORIF of MCF were selected for the study and divided into two groups of thirteen. Group 1 received single mini plate fixation. Group 2 received two miniplate fixation. The patients were assessed for intraoperative time, anatomic reduction, articular function, facial nerve injury in both the groups.

Results: Both groups achieved satisfactory healing and functional outcomes. Group 1 demonstrated significantly reduced operative time, facial nerve injury compared to Group 2. No significant differences were observed in anatomic reduction and articular function between the groups.

Conclusions: Single miniplate fixation is a reliable and less invasive option for ORIF of MCF. It provides adequate stability and favourable functional outcomes, with reduced surgical morbidity and operative time when compared to two miniplate fixation. Hence, single miniplate fixation may be preferred for ORIF of MCF.

1. Introduction

Mandible is commonly involved in traumatic injuries, averaging 12% to 56% of all facial fractures.[1,2] Within the mandible, the condyle or sub condylar region accounts for about 29-52%.[3,4] The male-to-female predilection ranges from 3:1 to 2:1 and age predilection is between 20-40 years of age.[5] The reason for high incidence of MCF can be attributed to the binding of the mandibular ramus with a high stiffness and the mandibular condyle head with a low stiffness.[6] The mandible is a class 3 lever because the temporomandibular joint (TMJ) acts as the fulcrum, the angle area is where the effort is, and the dentition is where the load is.[7] Due to the force produced by the masticatory muscles in the condylar neck and base region, a compression zone is created at the posterior border of the mandibular ramus, and a tension zone is created posterior and inferior to the sigmoid notch.[8] The fixation should be able to withstand the compressive and tensile forces within physiological limits.

For a MCF, there are two potential treatment methods: ORIF and closed reduction and

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immobilization. Different fixation options for MCF like single miniplate, two miniplates, geometric plates, resorbable plates are available.[9] Two mini plates fixation were believed to offer more stability than a single plate, lowering the chance of the condylar fragment shifting. [10] A single mini plate fixation is also suitable for distribution of the load concentration positioned along the long axis of the condylar neck's posterior border.[11] However, the optimal number of plates required for stable fixation remains debatable. Hence this study is carried out to compare two plating systems for ORIF of MCF one with two non- compression miniplates (conventional osteosynthesis) and the other with single non-compression miniplate (posterior border osteosynthesis).

2. Objectives

To assess and compare the duration of operation concerning the conventional osteosynthesis and posterior border osteosynthesis to surgically reduce and fix MCF. To achieve adequate and painless mouth opening, functional and stable T M J and pre-injury occlusion. To assess and compare the post operative complications associated with the conventional osteosynthesis and posterior border osteosynthesis.

3. Methods

This study was conducted on patients who reported to our institute with MCF from June 2023 to June 2025 after obtaining approval from the institutional ethical committee (Ref.No. IEC/05/2022-23).

The inclusion criteria included:

1) Patients had to be of age 18 years or older.

2) Patients with unilateral non-comminuted condylar fracture of mandible associated with symphysis and para-symphysis fractures of mandible, reported within 2 weeks for treatment.

Exclusion criteria include:

1) Patients with systemic diseases unfit to be posted under general anesthesia.

2) Patients with history of occlusal disturbances or skeletal malocclusion.

3) Patients with insufficient dentition to reproduce normal occlusion.

4) Comminuted condylar fractures of mandible.

The sample was divided into the following groups: Sample size was calculated to be 26.

Sample size in Group 1: 13

Sample size in Group 2: 13

Two different extra oral approaches; (Transmasseteric anterior parotid approach (TMAP), Retromandibular approach) were used depending on favorability and accessibility for fracture reduction. Prophylactic antibiotic Injection Ceftriaxone 1gm i.v. was given one hour before the surgery. Surgery was carried out under strict aseptic condition. The proximal fracture segment is initially fastened using a 2 mm osteosynthesis system to provide direct fixation. Group 1 comprised of patients treated with a single non-compression 2mm x 4-hole titanium mini plate fixed at posterior border of the condyle of mandible. (Figure 1)

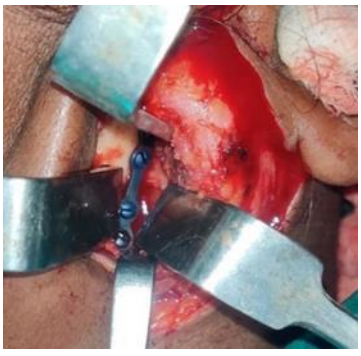

Figure 1: 2mm x 4- hole titanium mini plate fixed at posterior border of condyle of mandible. (Group 1)

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Group 2 comprised of patients treated with two non-compression miniplates, one of which was secured in the same way as Group 1 and the other, 2mm x 2-hole titanium mini plate was fixed anteriorly to the first below the sigmoid notch. (Figure 2)

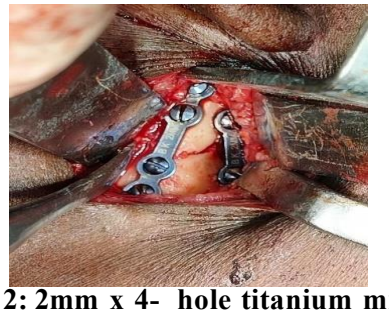


Figure 2: 2mm x 4- hole titanium mini plate fixed at posterior border, 2mm x 2-hole titanium mini plate fixed anteriorly to the first below the sigmoid notch. (Group 2)

Postoperative Orthopantomogram (OPG) was taken for Group 1 (Figure 3) and Group 2 (Figure 4) patients.

Figure 3: Postoperative OPG showing miniplate fixed at posterior border of condyle of mandible. (Group 1)

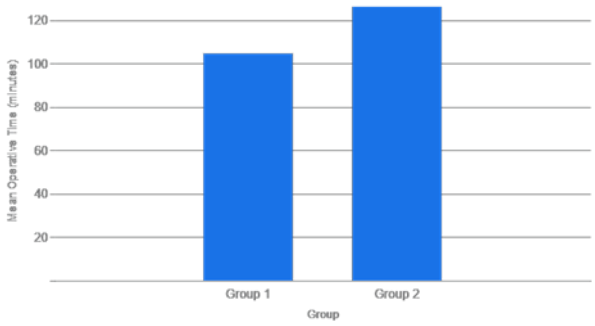
Figure 4: Postoperative OPG showing miniplate fixed at the posterior border and anteriorly below the sigmoid notch of condyle of mandible. (Group 2)

A single surgeon performed all the surgical procedures. All the patients in both groups were given Injection Cefotaxime sodium 1gm i.v. twice a day, Infusion Metrogyl 500mg i.v. thrice a day, Injection Diclofenac sodium 75mg i.m. twice a day, Injection Pantop 40 mg i.v. once a day, Injection Dexamethasone 8mg i.v. as required, Infusion 1-unit Ringer lactate 100 ml/hr for 1 day, Infusion 1-unit Normal saline 100 ml/hr for 1 day for five days post-operatively. Follow up was done for 6 months for all the patients.

4. Results

Group 1 (104.61 ± 19.83 minutes). showed a clinically significant reduction in intra-operative time compared to Group 2 (126.15 ± 32.54 minutes). (Graph 1)

Graph 1: Mean Operative Time between Study Groups



One patient in Group 1 showed inadequate anatomic reduction of the fracture segments and was managed by placing tight maxillomandibular fixation with elastics for 1week followed by active jaw exercises. (Table 1)

Table 1: Intergroup comparative analysis of Anatomic reduction between two study groups (Mann Whitney U test)

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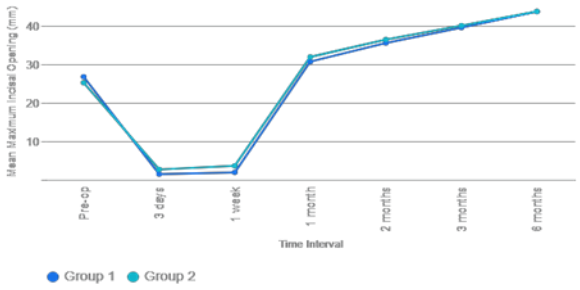
Group 1 and Group 2 patients showed a significant intragroup increase in MIO from baseline (~26 mm) to ~43–44 mm at 6 months, reflecting excellent TMJ functional recovery. (Graph 2)

Anatomic reduction	N	Mean Rank	Sum of ranks	p-value
Group 1	13	13	169	0.317
Group 2	13	14	182	

Graph 2: Maximum Incisal Opening Over Time between Study Groups



One patient in Group 2 presented with buccal branch of facial nerve injury following retromandibular approach, leading to the inability to blow the cheeks. Patient was managed conservatively with medications and full recovery was obtained after 6 months. (Table 2)

Time interval	Group 1		Group 2		p-value
	Mean Rank	Sum of ranks	Mean Rank	Sum of ranks	
3 days	13	169	14	182	0.317
1 week	13	169	14	182	0.317
1 month	13	169	14	182	0.317
2 months	13	169	14	182	0.317
3 months	13	169	14	182	0.317
6 months	13	169	14	182	0.317
p-value	----		----		

Table 2: Intergroup and intragroup comparative analysis of presence or absence of facial nerve injury between two study groups at different time intervals (Mann Whitney U test, Friedmann test)

Within the constraints of this study, posterior border osteosynthesis using a single non-compression miniplate emerged as a reliable, efficient, and safe technique, offering comparable clinical outcomes to conventional dual plating but with added benefits of reduced operative duration and fewer complications.

5. Discussion

MCF constitute a significant portion of facial skeletal injuries and are notably challenging due to their anatomical complexity, proximity to vital neurovascular structures, and pivotal role in mastication, occlusion, and articulation. The condylar region, as part of the TMJ, is integral to mandibular function, and improper management can result in long-term sequelae such as malocclusion, restricted movement, ankylosis, and facial asymmetry. [3,5,6]

ORIF allows precise anatomical reduction, early mobilization, and functional recovery, especially in displaced or bilateral fractures. [3,4,12] The debate now focuses on the ideal fixation strategy—single vs. double miniplate systems.

Traditionally, two miniplates (one at the posterior border of condyle and the other anteriorly below the sigmoid notch) have been employed for their perceived mechanical advantage in counteracting

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torsional and bending forces. [8,12,13] However, this approach often entails longer operative times, increased exposure, and higher risk of complications like facial nerve injury, especially with extraoral approaches. [3,4,12]

Posterior border osteosynthesis with a single miniplate aligns with the neutral axis of the condylar neck—an area of minimal stress—offering sufficient stability with less hardware. [11,13] However, complex fractures (comminuted, high-neck, or severely displaced) may necessitate dual plating to ensure rigid fixation and avoid instability. [5,6] Hence, proper case selection is crucial.

This prospective clinical study targeted condylar fractures neck or base fractures to ensure homogeneity and avoid confounding factors such as intracapsular fractures or prior TMJ dysfunction. [5,6,14]

Operative Time

Intraoperative time reflects technical complexity and potential risk. Group 1 (single plate) had a shorter mean operative time (104.61 ± 19.83 mins) than Group 2 (126.15 ± 32.54 mins), though not statistically significant ($p = 0.053$). This aligns with the principles by Champy et al., advocating minimal hardware use.[15] Rai (2012) and Chen et al. (2024) similarly reported prolonged surgical time with dual plating, without significant clinical benefit. [16,17]

Anatomic Reduction

Anatomic reduction was effectively achieved in both groups, with Group 2 showing a slightly higher mean rank. However, proper reduction was possible with both techniques when adequate exposure and biomechanical principles were applied. Pilling et al. and Wagner et al. stressed that reduction quality is determined by access and technique more than plate number. [8,18]

Maximum Incisal Opening (MIO)

MIO improved progressively in both groups, with final values around 43.7 mm. Early postoperative trismus resolved with physiotherapy. Ashraf et al. (2019) and Al-Moraissi et al. (2018) found that MIO is influenced more by surgical precision and rehabilitation. [19,20]

Facial Nerve Injury

Facial nerve preservation was equivalent between groups ($p = 0.317$). One patient in Group 2 experienced transient buccal branch paresis, resolving with conservative management. Kanno et al., Dalla Torre et al., Lu & Liu et al. confirms that nerve injury risk is higher with transparotid approaches but typically transient. Soft-tissue handling and exposure determine nerve injury outcomes. [21,22,23]

The management of MCF remains a subject of ongoing clinical interest and debate due to the anatomic complexity and functional importance of the TMJ. Within the constraints of this study, posterior border osteosynthesis using a single non-compression miniplate emerged as a reliable, efficient, and safe technique, offering comparable clinical outcomes to conventional dual plating but with added benefits of reduced operative duration and fewer complications. Careful case selection and adherence to anatomical and biomechanical principles remain critical for the success of any surgical intervention. As surgical techniques and technologies evolve, minimally invasive, functionally restorative strategies such as single-plate osteosynthesis may represent the future standard in condylar fracture treatment—particularly in cases where reduced surgical morbidity and early functional rehabilitation are prioritized.

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