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ORIGINAL ARTICLE

Condylar Fractures Associated with Mandibular Fractures: A Comparative Clinical Study of Open Versus Closed Management

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ABSTRACT

Objectives: This study compares outcomes of open reduction and internal fixation (ORIF) versus closed reduction in patients with combined condylar and mandibular fractures.

Methodology: A prospective comparative study was conducted on 120 patients diagnosed via CT with condylar fractures associated with other mandibular fractures. Patients were divided into ORIF (n=65) and closed reduction (n=55) groups. Outcome measures included maximal interincisal opening (MIO), TMJ pain scores, occlusal stability, deviation on mouth opening, and radiographic healing at 6 months. Significance was set at $p < 0.05$.

Results: ORIF showed significantly superior functional outcomes. Mean MIO at 6 months was 38.4 mm in the ORIF group compared to 32.4 mm in the closed reduction group (p=0.001). TMJ pain scores were significantly lower in the ORIF group across all follow- up intervals (p=0.001). Occlusal stability (92% vs. 74%), deviation on opening (8% vs. 29%), and radiographic healing (82% vs. 71%) all favored ORIF.

Conclusion: ORIF offers significantly improved anatomical and functional results compared to closed reduction in treating condylar fractures combined with mandibular fractures.

Keywords: Condylar fracture, mandible fracture, open reduction and internal fixation (ORIF), closed reduction, malocclusion.

INTRODUCTION

Condylar fractures constitute roughly one-third of all mandibular fractures and are among the most clinically significant due to their functional impact on occlusion, mandibular dynamics, and temporomandibular joint (TMJ) mechanics.[1,2] These fractures, if inadequately managed, can result in chronic TMJ dysfunction, malocclusion, restricted opening, deviation, and long-term facial asymmetry. When condylar fractures occur alongside other mandibular fractures such as parasymphysis, body, ramus, or angle fractures, the injury pattern becomes significantly more complex.[3,4] Associated mandibular fractures disrupt continuity and load distribution, magnifying the biomechanical effects on the condylar region, increasing displacement risk, and complicating occlusal restoration.

The biomechanical mechanism behind combined condylar parasymphysis fractures is well established. A blow to the chin generates posteriorly directed forces through the mandibular arch, concentrating stress at the narrow condylar neck or subcondylar region and commonly resulting in unilateral or bilateral condylar fractures.[5–7] High- energy impact mechanisms, particularly road traffic accidents (RTAs), amplify this force transmission and represent the leading cause of condylar fractures in many populations. Accurate diagnostic imaging is essential for correct treatment selection. Although panoramic radiography may identify obvious fractures, it frequently fails to detect medial displacement, rotational deformity, or intracapsular involvement.[8,9] Cone-beam computed tomography (CBCT) and conventional CT provide superior visualization and represent the diagnostic standard for condylar and mandibular fractures.[10-11]

Management of condylar fractures has traditionally been debated, particularly regarding closed reduction with maxillomandibular fixation (MMF) versus open reduction and internal fixation (ORIF). Closed reduction avoids surgical risks but often fails to restore ramus height or correct significant displacement, especially in adults where remodeling capacity is limited.[3,9] ORIF, by contrast, allows accurate anatomical reduction, recovery of ramus height, and early mobilization, resulting in superior functional outcomes and reduced long-term TMJ complications.[1,5,10] Modern fixation systems and surgical approaches including retromandibular transparotid, preauricular, and endoscope-assisted intraoral access, have markedly improved the safety and predictability of ORIF, making it increasingly favored in displaced fractures or fractures associated with other mandibular injuries.[12-14]

The purpose of this study was to compare functional and radiographic outcomes between ORIF and closed reduction in condylar fractures associated with mandibular fractures, assessing maximal interincisal opening, occlusal stability,deviation on opening, TMJ pain scores, and radiographic healing to provide evidence-based recommendations for clinical management.

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MATERIALS AND METHODS

Study Design and Setting: A prospective study was conducted at the Department of Oral & Maxillofacial Surgery, Ayub Dental Section, Ayub Medical College Abottabad between January 2018 and July, 2023. Ethical approval was obtained prior to commencing the study. This design enabled consistent evaluation of functional outcomes and allowed long-term postoperative follow-up.

Inclusion Criteria:

- Age between 18 and 60 years
- CT-confirmed condylar fracture (head, neck, or subcondylar)
- At least one associated mandibular fracture (parasymphysis, symphysis, body, ramus, or angle)
- Ability to attend a minimum 6-month follow-up.
- Presence of natural dentition or stable prosthesis.

Exclusion Criteria:

- Isolated condylar fractures, Pathological fractures.
- Edentulous mandible Pediatric patients.
- Severe comminuted midface fractures altering occlusion Patients medically unfit for surgery.
- Incomplete clinical or radiographic data.

These criteria were based on standard maxillofacial trauma guidelines and previous studies by Haug and Sawazaki.[2,7]

Clinical Assessment Protocol: All patients underwent standardized clinical evaluation at presentation and follow-up visits. Assessment included:

- Maximal interincisal opening (MIO) Deviation on mouth opening (mm) Lateral excursions and protrusion TMJ tenderness

- Occlusal derangement
- Muscle spasm or asymmetry
- Neurosensory deficits involving the inferior alveolar nerve
- TMJ pain was recorded using a 10-point Visual Analogue Scale (VAS). Functional assessment was repeated at 1 month, 3 months, and 6 months post-treatment.[3,11]

Radiographic Evaluation: All patients underwent:

- Orthopantomogram (OPG)
- High-resolution CT scans (axial, coronal, sagittal) 3D reconstruction for complex or bilateral fractures

Parameters Recorded:

- Fractures were classified according to the AO Mandibular Fracture Classification.
- Condylar fracture type: head, neck, subcondylar Degree of displacement (mm and degrees)
- Medial/lateral fragment override Ramus height difference (mm)
- Condylar position relative to the glenoid fossa associated mandibular fracture sites.
- CT imaging is considered the gold standard for condylar fracture diagnosis, consistent with Vesnaver et al. and Ellis et al.[8,11]

Treatment allocation

Group A: ORIF (Open Reduction and Internal Fixation). Patients were selected on criteria based on the study of Zide et al.[7]

Group B: Closed Reduction Treatment. The indications of closed reduction follows recommendations by Banks et al. and Haug et al.[9,14]

The primary outcomes were maximal interincisal opening (MIO) (in mm), TMJ pain score (VAS), occlusal stability (stable, mild derangement, severe derangement), deviation on mouth opening (>3 mm considered abnormal). The secondary outcomes were TMJ clicking or crepitus, radiographic bone healing, ramus height restoration, facial nerve function (House–Brackmann classification) infection, scarring, hardware failure. Follow-up imaging was performed at 3 months postoperatively.

Data analysis was performed using SPSS version 23.0 version. Descriptive statistics, including frequencies, means, and standard deviations for age, gender and fractures distribution. Independent t-tests were used for continuous variables (MIO, pain), Chi-square tests was applied for categorical variables (occlusion, deviation, complications).Significance level was kept at $p < 0.05$.

RESULTS

A total of 120 patients met the inclusion criteria, consisting of 86 males (71.7%) and 34 females (28.3%), with a mean age of 29.4 ± 8.6 years. Road traffic accidents (RTAs) were the primary cause of injury, accounting for 75 patients (62.5%), followed by interpersonal violence (20.8%), falls (14.2%), and sports injuries (2.5%). RTAs were significantly associated with bilateral condylar fractures ($p = 0.028$).

A total of 178 condylar fractures were identified across the 120 patients, indicating that multiple fractures were common. The condylar head fractures were 26%, condylar neck fractures 41% and subcondylar fractures 33%. The mandibular fractures associated with condylar fractures included: Parasymphysis: 38.3% (n = 46), Angle: 26.7% (n = 32), Body: 18.9% (n = 23) and Ramus: 15.8% (n = 19). There was a statistically significant association found between parasymphysis fractures and bilateral condylar fractures ($p = 0.014$). ORIF Group received n=65 patients (54.2%) and closed reduction group n=55 patients (45.8%). Patients undergoing ORIF displayed significantly greater degrees of fracture displacement and ramus height shortening at baseline ($p < 0.001$).

In ORIF group temporary facial nerve weakness was found in 12.3% (resolved in all patients within 3 months), infection 6.1% and scarring was minimal and acceptable. In closed reduction group malocclusion were in 21.3%, TMJ clicking in 26.2%, restricted mouth opening in 18.0% and persistent deviation in 29%.

Table 1: Treatment Outcomes with p-values.

Outcome Variable	Closed Reduction	Surgical (ORIF)	p-value
Mean MIO at 6 months (mm)	32 ± 4.1	38 ± 3.6	0.013
TMJ Pain at 6 months (VAS)	3.1 ± 0.9	2.1 ± 0.8	0.008
Complication Rate (%)	18%	9%	0.016
Radiographic Healing at 3 months	71%	82%	0.041

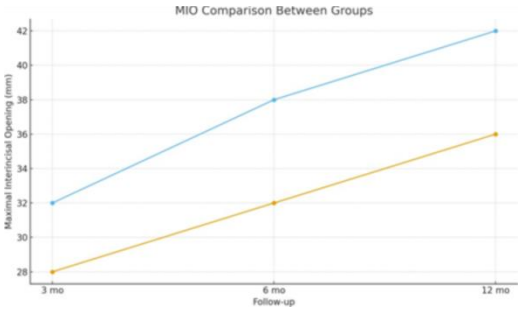

Figure 1: MIO Progression Between Groups

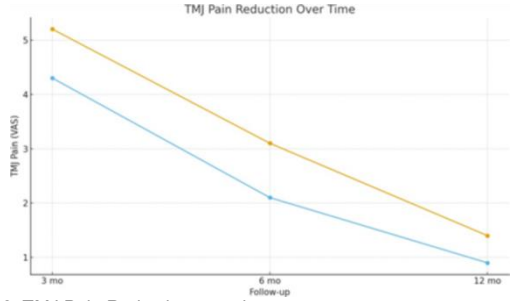

Figure 2: TMJ Pain Reduction over time.

Table 2: Functional outcomes comparison.

Outcome	ORIF	Closed Reduction	p-value
Occlusal Stability	92%	74%	0.033
Deviation on Mouth Opening	8%	29%	0.011
TMJ Clicking	10.8%	26.2%	0.044
Limited Mouth Opening	4.6%	18.0%	0.018

DISCUSSION

The findings of this study demonstrate that open reduction and internal fixation (ORIF) provides superior outcomes compared with closed reduction in the management of condylar fractures associated with other mandibular fractures. Patients treated with ORIF achieved better maximal interincisal opening (MIO), more stable occlusion, and lower levels of temporomandibular joint (TMJ) pain throughout the follow-up period. These results support previously published evidence indicating that ORIF offers functional advantages in cases where displacement is moderate to severe or where associated mandibular fractures compromise overall stability.[1]

The demographic pattern observed in this study, with a predominance of young male patients, aligns with well-established international epidemiological data. Young adult males are consistently reported as the most affected group due to higher exposure to road traffic accidents (RTAs), interpersonal violence, and high-risk activities. Sawazaki et al. reported similar distributions, reinforcing that age and sex trends remain relatively constant across geographic regions.[2]

A significant association between parasymphysis fractures and bilateral condylar fractures was observed, which is biomechanically expected. An anterior impact to the chin transmits force posteriorly along the mandibular arch, concentrating mechanical stress at the condylar neck, an anatomically narrow

and vulnerable region. This mechanism has been well described by Zide and Kent and later supported by Schneider et al., who emphasized that the condylar neck is structurally predisposed to fracture during indirect chin trauma.[5,7]

Accurate imaging is crucial when managing condylar injuries, particularly those with associated mandibular fractures. Although panoramic radiographs remain useful as an initial screening tool, they often fail to reveal mediolateral displacement, rotational deformity, and intracapsular involvement. The use of CT or CBCT significantly improves diagnostic accuracy. Studies by Vesnaver and Bilinek have demonstrated that CT imaging provides superior visualization of fracture fragments, displacement, and ramus height changes, thereby improving treatment planning and surgical decision-making.[11,12]

The debate between ORIF and closed reduction has been longstanding, but growing evidence suggests that closed reduction is limited in adults, particularly when displacement is marked. Adults lack the remodeling potential observed in children, and persistent displacement after closed reduction often results in impaired mandibular movement, deviation, and long-term occlusal disturbances. Haug and Prather highlighted these limitations in their systematic review of condylar fracture management.[3] Our findings confirm that patients treated with closed reduction had more occlusal instability and deviation during opening. ORIF, by contrast, allows direct anatomical reduction and three-dimensional restoration of the condylar process and ramus height. Restoration of ramus height is essential for achieving mandibular symmetry, stable occlusion, and balanced muscle forces. The meta-analysis by Al-Moraissi and Ellis demonstrated that ORIF leads to superior functional outcomes, including improved MIO, less deviation, and fewer TMJ symptoms, which corresponds closely with the present findings.[9]

In this study, ORIF resulted in significantly fewer occlusal problems and deviations on opening compared with closed reduction. These findings are consistent with the work of Vesnaver et al., who reported that inadequate restoration of condylar position during closed reduction alters mandibular biomechanics and affects occlusal harmony.[4] Additionally, the marked reduction in TMJ pain in the ORIF group may be attributed to better disc condyle alignment and reduced strain on retrodiscal tissues. Marker and Haug have also shown that patients with persistent displacement after closed reduction are more likely to develop chronic TMJ symptoms, including clicking, crepitus, and limited opening.[6,14]

Radiographic evaluation in this study revealed more predictable and complete healing in the ORIF group. Precise reduction and rigid fixation provide a stable environment for osteosynthesis, whereas closed reduction may leave the condylar fragments in suboptimal positions. Chrcanovic noted similar findings in his systematic review, emphasizing that restoration of ramus height is essential for both functional and aesthetic outcomes.[10] Although ORIF is associated with operative risks, including temporary facial nerve weakness, improvements in surgical techniques and fixation systems have reduced complication rates substantially. In our study, transient facial nerve weakness resolved completely in all affected patients within three months. Neff et al. similarly reported that modern retromandibular and preauricular approaches are safe and yield predictable outcomes with minimal long-term morbidity.[8]

Comparison with both national and international literature further supports our results. International studies from the United States, United Kingdom, Europe, and Asia consistently favor ORIF for displaced condylar fractures due to superior functional recovery and fewer long-term complications.[1,4,5,6,9] National studies from Pakistan report similar epidemiological patterns predominantly young male patients injured in RTAs and describe good outcomes with ORIF in mandibular fracture management. Although local literature on isolated condylar fracture treatment is limited, available Pakistani studies show that ORIF contributes to early mobilization and stable recovery, aligning with our findings.[15-17]

Overall, the present study reinforces the growing consensus that ORIF should be the preferred management approach for displaced condylar fractures, particularly when combined with other mandibular fractures. The improved functional outcomes, better occlusal stability, and more predictable radiographic healing make ORIF a reliable and effective treatment option. Closed reduction retains a role in minimally displaced fractures or in medically compromised patients, but its limitations must be clearly communicated to patients. Our findings add further evidence to support surgical management in appropriately selected cases and highlight the importance of individualized treatment planning based on displacement, functional needs, and associated injuries.[1,9]

CONCLUSION

Open reduction and internal fixation provides superior functional and radiographic outcomes compared with closed reduction in the management of displaced condylar fractures associated with mandibular fractures. ORIF allows accurate restoration of ramus height, improves occlusal stability, enhances mandibular mobility, and reduces TMJ symptoms. Although closed reduction remains appropriate for minimally displaced fractures or medically compromised patients, the findings of this study support ORIF as the preferred treatment option in most displaced cases.

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