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Outcome of Open Versus Closed Reduction of Unilateral Mandibular Sub-Condylar Fracture

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ABSTRACT

Condylar fractures are among the most common types in the maxillofacial area, yet their optimal treatment approach remains debated. **Objectives:** To compare occlusion and mouth opening between open and closed reduction for unilateral mandibular sub-condylar fractures in adults. **Methods:** This quasi-experimental study was conducted on 68 patients in Jamshoro using a non-probability sampling technique. Patients aged 18–50 years with unilateral non-comminuted sub-condylar fractures within 48 hours and sufficient dentition for fixation were included, while those with bilateral fractures, undisplaced condyles, or other exclusion criteria were excluded. Participants were divided into two groups: Group A underwent closed reduction with maxillomandibular fixation, and Group B underwent open reduction with internal fixation using titanium mini-plates under general anesthesia. Occlusion, range of motion, and mouth opening were evaluated at 3-month follow-ups. **Results:** Pre-operative assessments showed limited mouth opening (15–20 mm) in 97.1% and 100%, poor occlusion in 100%, and poor range of motion in 100% of patients in both groups. Post-operatively, mouth opening improved to 20–30 mm in 8.8% vs. 67.6% and 30–45 mm in 73.5% vs. 85.3%. Good occlusion improved to 58.8%, 88.2%, and 97.1% in Group A vs. 82.4%, 94.1%, and 100% in Group B over 1, 2, and 3 months, respectively. Range of motion also improved, reaching 94.1% vs. 100% by the 3rd month. **Conclusions:** It was concluded that open reduction with internal fixation was a superior therapeutic option compared to closed reduction for unilateral mandibular sub-condylar fractures.

INTRODUCTION

Approximately 35% of mandibular fractures occur worldwide among facial injuries treated by oral and maxillofacial departments [1]. The condyle is the most frequently involved site, followed by fractures of the angle, symphysis, and para-symphysis [2]. Mandibular condyle fractures may present as unilateral or bilateral injuries [3], with common etiological factors including road accidents, falls, firearm injuries, assaults, sports incidents, and industrial mishaps [4]. The distal portion of the condylar process, anatomically referred to as the subcondylar region, is defined superiorly by a line crossing the sigmoid notch and anteriorly by a line obliquely joining the masseter tuberosity to the sigmoid notch. Given its proximity to critical structures such as the temporomandibular joint and facial nerve, fractures in this region have significant clinical implications. Both the fracture itself and the surgical intervention pose risks of functional impairment. If left untreated, subcondylar fractures may lead to serious functional deficits, including limited mouth opening, malocclusion, impaired lateral excursion of the condyle,

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and deviation upon mouth opening [5]. Management of unilateral sub-condylar fractures includes conservative treatment through observation, closed reduction with maxillomandibular fixation, or open reduction and internal fixation [6]. According to a clinical observation, the patient may exhibit minor to severe symptoms, all of which are based on how much the broken pieces have moved. Condylar fractures are uncommon to occur alone and are often linked to fractures in other facial bone locations [7, 8]. A unilateral condylar fracture is characterized by limited mobility, ear haemorrhage, Battle's sign, otorrhea, haematoma around the broken condyle, displacement of the jaw towards the side of the fracture, and edema above the temporomandibular joint [9]. Patients with bilateral condylar fractures may also have limited mobility, occlusion abnormalities, and related symphysis or para-symphysis fractures; as a result, a thorough examination is required (Contre-coupe fracture) [10-12].

This study aims to determine the outcomes of two different techniques, open reduction internal fixation with closed reduction maxillomandibular fixation in unilateral mandibular sub-condylar fracture in terms of occlusion and mouth opening in adult patient.

METHODS

This quasi-experimental study was conducted on 68 subjects at the Oral and Maxillofacial Surgery Department, Institute of Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro from 1-05-2022 to 30-04-2023. Informed written consent was obtained from all patients. The minimum sample size was calculated using the OpenEpi calculator, based on the mean difference in mouth opening after closed reduction maxillomandibular fixation (28.73 ± 2.8 mm) [13] versus open reduction internal fixation (33 ± 2.61 mm) [13] in mandibular sub-condylar fractures. With a 95% confidence interval and 95% power, the total sample size was determined to be 22 (11 in each group). However, to satisfy the assumption of normality, a sample size of 68 (34 per group) was used. Patients from the age group 18-50 years with either gender having unilateral non-comminuted sub-condylar fracture in the last 48 hours and with ample bilateral dentition to permit Maxillomandibular Fixation are included in this study whereas patients with bilateral sub-condylar fracture, undisplaced condyle with normal occlusion, multiple facial injuries, medically incapable or not willing take part in the research in this study were excluded. Ethical approval for this study was granted by the Research Ethics Committee of Liaquat University of Medical and Health Sciences, Jamshoro (LUMHS/REC/-70). All patients were assessed clinically and radiographically using orthopantomography (OPG) and posteroanterior (PA) views. The participants were divided into two groups: Group A, treated with closed reduction and maxillomandibular fixation, and Group B, treated with open reduction and internal fixation. Patients who received treatment were kept nothing per oral six hours before and after surgery. To gain access to the fracture area, sterile surgical blade no. 15 carbon steel was used for a preauricular, submandibular, and retromolar incision. All surgical procedures were performed under general anesthesia with nasopharyngeal route intubation. Local anaesthesia was administered using Xylocaine with 2% adrenaline 1:100,000. Mini-plates (5 holes' titanium mini-plates with 4 screws of the size of 6 mm) were used to repair the fractured bone after the fracture had been reduced for preventing post-pain and reducing the risk of bleeding. The incision was then stitched in two layers using sterile surgical sutures (Vicryl 3-0) and (Prolene 4-0). The wound was then cleaned out with regular saline. The sufferer received a five-day prescription for antibiotics, an analgesic, and mouthwash; after two days, the patient was released. following up to evaluate the functional impacts, such as range of motion and occlusion. In closed reduction with maxillomandibular fixation 1.8 ml cartridges of local anaesthetic, Xylocaine with adrenaline 1:100000 were administered to the fracture site. First, the length of the mandibular and maxillary arches' arch bars was measured using a hook. The arch length in each jaw should ideally start with the first molars. Stainless steel wires (24 or 26 gauge) were used to fasten the arch bar to the mandibular and maxillary facial/buccal cervical levels of the teeth. Crossed intermaxillary wires were employed to provide pre-injury occlusion and fixation when the arch bar was attached. For four to six weeks, the patient's mouth was closed completely. For five days, standard antibiotics with analgesic syrup were provided, and a soft diet was suggested. During maxillomandibular fixation, patients followed a liquid or pureed diet, consuming food through a straw or syringe. For oral hygiene, they used a small, soft-bristled toothbrush and antiseptic mouth rinses to maintain cleanliness. On follow-up for assessment of functional effects and after five weeks of follow-up, the maxillomandibular fixation was removed. Occlusion was recorded as good if there was maximum intercuspation and poor in cases of deviation or open bite. Range of motion was recorded as good if there was a 10 mm protrusion of the mandible and poor in cases of less than 8mm. Mouth opening was measured in millimetres using a ruler, from the upper incisal edges to the lower incisal edges at maximum opening. SPSS-21 was used for data analysis. Frequency and percentage were calculated for qualitative outcomes such as gender, age groups, mouth opening, occlusion, and range of motion at the 1st, 2nd, and 3rd months. A comparison between the two groups (closed reduction and open reduction) was conducted using the

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Chi-square/Fisher's exact test. p≤0.05 was a significant threshold.

RESULTS

The gender and age distribution of participants in the two intervention groups showed no significant differences. Among those undergoing closed reduction, 26 (76.5%) were male, compared to 31 (91.2%) in the open reduction group (p=0.1). Female comprised 8 (23.5%) of the closed reduction group and 3 (8.8%) of the open reduction group. In terms of age, 24 (70.6%) in the closed reduction group and 22 (64.7%) in the open reduction group were aged 18–30 years. Participants aged 31–40 years accounted for 9 (26.5%) in the closed reduction group and 6 (17.6%) in the open reduction group, while those aged 41–50 years were 1 (2.9%) and 6 (17.6%), respectively (p=0.119) (Table 1).

Table 1: Distribution of Demographics in Both Interventions (n=68)

Variables	Characteristics	Closed Reduction	Open Reduction	p-value*
Gender	Male	26 (76.5%)	31 (91.2%)	0.1
	Female	8 (23.5%)	3 (8.8%)	
Age Categories in Years	18 to 30	24 (70.6%)	22 (64.7%)	0.119
	31 to 40	9 (26.5%)	6 (17.6%)	
	41 to 50	1 (2.9%)	6 (17.6%)	

*Chi-square test

Mouth opening between the two interventions at various time points was compared. Pre-operatively, both groups had similar mouth openings, with most participants in both groups (97.1% in closed reduction, 100% in open reduction) having 15–20mm (p=0.31). At 1-month post-surgery, a significant difference was observed (p<0.001), with 91.2% of the closed reduction group at 15–20mm, compared to 67.6% of the open reduction group at 20–30mm. By the 2nd month, both groups showed similar improvement (p=0.31). At 3 months, both groups showed further progress, with no significant difference (p=0.23), as 73.5% of the closed reduction group and 85.3% of the open reduction group had mouth openings of 30–45mm (Table 2).

Table 2: Comparison of Mouth Opening Between Two Interventions at Various Time Points

Time Point	Intervention	Mouth Opening			p-value*
		15–20mm	20–30mm	30–45mm	
Pre-Operative	Closed Reduction	33 (97.1%)	1 (2.9%)	0 (0%)	0.31
	Open Reduction	34 (100%)	0 (0.0%)	0 (0%)	
Post-Operative 1st Month Follow-Up	Closed Reduction	31 (91.2%)	3 (8.8%)	0 (0%)	<0.001
	Open Reduction	11 (32.4%)	23 (67.6%)	0 (0%)	
Post-Operative 2nd Month Follow-Up	Closed Reduction	0 (0%)	34 (100.0%)	0 (0.0%)	0.31
	Open Reduction	0 (0%)	33 (97.1%)	1 (2.9%)	
Post-Operative 3rd Month Follow-Up	Closed Reduction	0 (0%)	9 (26.5%)	25 (73.5%)	0.23
	Open Reduction	0 (0%)	5 (14.7%)	29 (85.3%)	

*Fisher exact test

Occlusion between the two interventions at various time points was compared. Pre-operatively, both groups had poor occlusion (100%). At the 1st-month follow-up, a significant difference was observed (p=0.033), with more patients in the open reduction group showing good occlusion. By the 2nd month, no significant difference was found (p=0.393), with both groups showing similar improvements. In the 3rd month, both groups showed further improvement, with no significant difference (p=0.314) (Table 3).

Table 3: Comparison of Occlusion Between Two Interventions at Various Time Points

Time Point	Intervention	Occlusion		p-value*
		Good	Poor	
Pre-Operative	Closed Reduction	0 (0.0%)	34 (100%)	–
	Open Reduction	0 (0.0%)	34 (100%)	
Post-Operative 1st Month Follow-Up	Closed Reduction	20 (58.8%)	14 (41.2%)	0.033
	Open Reduction	28 (82.4%)	6 (17.6%)	
Post-Operative 2nd Month Follow-Up	Closed Reduction	30 (88.2%)	4 (11.8%)	0.393
	Open Reduction	32 (94.1%)	2 (5.9%)	
Post-Operative 3rd Month Follow-Up	Closed Reduction	33 (97.1%)	1 (2.9%)	0.314
	Open Reduction	34 (100%)	0 (0.0%)	

*Fisher exact test

The range of motion between the two interventions at various time points was compared. Pre-operatively, both groups had poor range of motion (100%). At the 1st-month follow-up, a significant difference was observed (p=0.05), with 73.5% of the open reduction group showing a good range of motion compared to 50% in the closed reduction group. By the 2nd month, no significant difference was found (p=0.07), with both groups showing improvement. At the 3rd-month follow-up, 100% of the open reduction group and 94.1% of the closed reduction group had a good range of motion, with no significant difference (p=0.15) (Table 4).

Table 4: Comparison of Range of Motion Between Two Interventions at Various Time Points

Time Point	Intervention	Range of Motion		p-value
		Good	Poor	
Pre-Operative	Closed Reduction	0 (0.0%)	34 (100%)	–
	Open Reduction	0 (0.0%)	34 (100%)	
Post-Operative 1st Month Follow-Up	Closed Reduction	17 (50.0%)	17 (50.0%)	0.05
	Open Reduction	25 (73.5%)	9 (26.5%)	
Post-Operative 2nd Month Follow-Up	Closed Reduction	24 (70.6%)	10 (29.4%)	0.07
	Open Reduction	30 (88.2%)	4 (11.8%)	
Post-Operative 3rd Month Follow-Up	Closed Reduction	32 (94.1%)	2 (5.9%)	0.15
	Open Reduction	34 (100%)	0 (0.0%)	

*Chi-square/Fisher exact test

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DISCUSSION

Mandibular fractures comprise 57% of all craniofacial fractures, with the condylar region being the most common site, accounting for approximately 18–57% of cases [14, 15]. In this research, male subjects were more in number as compared to female. Likewise, similar studies have also reported higher male patients such as Hassan *et al.*, [17] report 75.0% male and 25.0% female patients, Hakim *et al.*, [18] report 66.67% male and 33.33% female patients and Balouch *et al.*, report 80.0% male and 20.0% female patients [19]. It has been proved through reporting that male patients are mostly affected with unilateral mandibular sub-condylar fracture as compared to female patients. In this study, pre-operative assessment showed similar results in both groups: mouth opening of 15-20 mm in 97.1% of Group A and 100% of Group B, with poor occlusion and range of motion in 100% of patients in both groups. All similar studies report the deviation from standards in pre-operative assessment after unilateral mandibular sub-condylar fracture [16, 17]. Patel *et al.*, reported similar issues, with a mean mouth opening of 26.6 mm (range: 24–30 mm) in their closed treatment group and 22.66 mm (range: 21–25 mm) in the open reduction group [20]. Hassan *et al.*, also found occlusal disturbances and restricted mandibular movement in condylar fractures [16]. In this study, postoperative assessment shows notable variation between both groups at first-month follow-up, whereas no notable variation between both groups at second and third-month follow-up. Open reduction shows better outcomes at first-month follow-up in terms of mouth opening, occlusion and range of motion as compared to closed reduction. Hakim *et al.*, reported a significant difference between maximal mouth opening, lower extremity functional scale, lateral excursion on the non-fractured side, pain and anatomical reduction in both groups [18]. Patel *et al.*, reported a better but non-significant difference between interincisal opening, mouth opening, occlusion, facial nerve function, and ramus height among both groups [20]. Balouch *et al.*, reported a significant difference between the adequacy of mouth opening at the third and sixth months of follow-up in Group A and Group B [19].

CONCLUSIONS

It was concluded that open reduction with internal fixation is a superior therapeutic option for managing unilateral mandibular sub-condylar fractures compared to closed reduction with maxillomandibular fixation. Patients in the open reduction group demonstrated better outcomes in terms of occlusion, range of motion, and mouth opening at 3-month follow-ups.

Authors Contribution

Conceptualization: SK
Methodology: SK
Formal analysis: MS, MAC
Writing review and editing: AH, AS, AA, MAC

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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