

# Study to Compare Different Modalities in the Management of Paediatric Mandibular Condylar Fractures: A Meta-Analysis

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## ABSTRACT

**Background:** Mandibular condylar and subcondylar fractures are common among pediatrics. They are important to be appropriately managed for their effect on the normal growth of the mandible and the associated complications. Given these concerns, it is unsurprising to note the variety of treatment approaches including; conservative, closed reduction with arch bar application, and open reduction with internal fixation by plates & screws. This reflects the need to appropriately select the convenient modality according to age, displacement of the fractured segments, and presence of malocclusion.

**Objective:** To compare the functional outcomes of different modalities in the management of pediatric condylar and subcondylar fractures.

**Patients and Methods:** This systematic review was done on ten retrospective and cohort studies published in the English language, from any geographical location, between 2010 and 2021. A total of 626 patients aged less than 15-year-old with condylar and sub-condylar fractures, associated with or without other mandibular fractures, managed with conservative management, closed reduction with application of arch bar or MMF, and open reduction with internal fixation by plates & screws.

**Results:** Pediatric patients managed by conservative management and physiotherapy yielded a significant improvement in occlusion and mouth opening with fewer complications within a reasonable period of 2-4 weeks to achieve functional recovery. On applying closed reduction with arch bar application or MMF, the mouth opening was improved up to >35mm without significant malocclusion or any other complications. It needed about 4-8 weeks for functional recovery to be achieved. In surgical intervention for open reduction and internal fixation, Malocclusion was noted in 2.8% of patients compensated with the growth of the mandible and teeth eruption. In addition, there were significant postoperative complications noted in some patients.

**Conclusion:** Based on the studies, all modalities in the management of pediatric condylar and sub-condylar fractures are clinically accepted and can be applied. However, the point of negotiation is the indications for each modality and the associated possible complications. Conservative management and closed reduction with MMF application prevent the risk

of some functional complications that may occur with the invasive surgical intervention.

**Key Words:** Mandibular fixation – Temporomandibular joint, open reduction and internal fixation – Malocclusion – Mandibular fracture.

**Disclosure:** It was confirmed that there was no conflict of interest and that no financial support was obtained from anybody.

The study was approved by the Ethical Committee of Ain Shams University.

## INTRODUCTION

Mandibular fractures are considered to be one of the most common facial fractures in pediatrics. Specifically, condylar and subcondylar fractures which account for 20% to 25% of mandibular fractures [1].

Condylar fractures may be isolated or combined with other mandibular fractures. Many causes had been incriminated in the etiology of facial fractures as falls, traffic accidents, and assaults [2].

Management of condylar and subcondylar fractures has a great effect on mandibular growth along with temporomandibular joint (TMJ) mobility. Given these concerns, it is unsurprising to note the variety of treatment approaches between conservative management and surgical intervention through closed reduction with the application of arch bar or open reduction and internal fixation by plates and screws [3].

The choice of the proper modality of management in pediatrics depends on the patient's age, stage of teeth development, site of the fracture, and displacement of the fractured segments with the presence of malocclusion [4].

The conservative approach is considered to be a preferred modality of management. It encompasses

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es a soft diet, analgesics, and physiotherapy with regular follow-up [5].

It provides an excellent chance of regeneration and continued normal growth of the mandible after healing within 2-4 weeks [6].

As per surgical intervention, closed reduction with the application of arch bars or maxillomandibular fixation (MMF) can provide fixation for 10-14 days followed by elastics for 2 weeks till functional recovery is achieved [7].

Open reduction and internal fixation (ORIF) ideally restores the normal occlusion by fixation of the fractured segments with plates and screws. It's indicated in severely displaced low subcondylar, mal-united fracture, and condylar fractures associated with other mandibular or maxillary fractures [8].

The goal of managing mandibular condylar and subcondylar fractures in children is to restore the mandibular function and occlusion in addition to preventing complications that may interfere with the growth of the mandible or TMJ movement [9].

## PATIENTS AND METHODS

*Data extraction:* A total of 344 articles were included in the search, 174 studies were excluded as duplicated studies and not related to the inclusion criteria, while the remaining 170 articles were screened. Twenty-seven articles were selected for analysis. However, 17 articles were excluded as they did not provide full patient data. The remaining 10 articles were typically included and analyzed in the review.

*Inclusion criteria:* The present review included studies from any geographical location, in the English language, published from 2010 to 2021. The study design was retrospective and cohort studies (randomized or non-randomized) were done on human subjects. The population included was 626 patients aged less than 15 years old with differentiating between pediatrics in mixed dentition age (6-12 years). Patients presented with condylar and subcondylar fractures associated with or without other mandibular fractures, managed with conservative management, closed reduction with application of arch bar or MMF, and open reduction with internal fixation by plates & screws. The Follow-up period was for more than 6 weeks with documentation of the healing rates and the occurrence of complications as accepted by the scientific ethical committee.

*Exclusion criteria:* Studies that were entirely literature reviews, technical descriptions, or case report studies were excluded. As well cadaveric studies or studies involving non-human subjects or studies with incomplete data or duplication were excluded too. Beyond this, papers not published in a peer-reviewed journal, adult patients with mandibular fractures above 16 years of age, or patients with mandibular fractures not in the condylar or subcondylar regions, all these studies are not included in our study.

*Types of outcome measures:* The outcomes were measured in terms of; the range of TMJ movement, maximal interincisal mouth opening, the status of occlusion, and the occurrence of complications which were measured in terms of a visual analog scale.

## RESULTS

The previous table shows that there was a statistically significant decrease in the incidence of malocclusion with conservative management from 18.2% to 4.4% with a  $p$ -value  $<0.001$ . In addition, It was significantly decreased with closed reduction from 6.3% to 0.0% with  $p$ -value = 0.012. While with ORIF, the percentage decreased significantly from 18.3% to 2.8% with a  $p$ -value  $<0.001$ . It is concluded that there was no statistically significant difference between the three modalities regarding malocclusion with  $p$ -value = 0.111 Fig. (1).

The previous table shows that there was a significant increase in the mouth interincisal opening after conservative management (group I) from 20.9mm  $\pm$ 4.90 to 33.13mm  $\pm$ 6.57 with a  $p$ -value  $<0.001$  and the mean difference was 12.23 mm  $\pm$ 0.79. While with closed reduction (group II), it changed significantly from 15.8mm  $\pm$ 1.2 to 32.87 mm  $\pm$ 1.23 with a  $p$ -value  $<0.001$  and a mean difference of 17.07mm  $\pm$ 0.17. On ORIF (group III), the mouth opening changed from 17.91mm  $\pm$ 3.10 to 34.60mm  $\pm$ 3.70 with a  $p$ -value  $<0.001$  and a mean difference of 16.69 $\pm$ 0.42mm. The table shows that the mean difference was higher in group II and group III as compared to group I with a  $p$ -value  $<0.001$  Fig. (2).

The previous table shows that no patient developed infection with conservative management (group I) or with closed reduction & MMF (group II) while the percentage of patients who developed postoperative infection with ORIF (Group III) is 4.48%. The table shows that there is a statistically significant difference between groups I&II on one side and group III on the other side with  $p$ -value = 0.016 Fig. (3).

Table (1): Characteristics of the included studies (N=10).

Study	Year	Modality of management	No. of patients
Njal et al.	2011	Conservative management	42
Reza et al.	2012	Closed reduction & MMF Versus ORIF	61
Liu et al.	2014	Closed reduction & MMF	30
Zhao et al.	2014	Conservative	40
An et al.	2015	ORIF	39
Andrade et al.	2015	Conservative Versus Closed reduction & MMF Versus ORIF	74
Majed et al.	2018	Conservative Versus Closed reduction & MMF	24
Kao et al.	2019	Conservative Versus Closed reduction & MMF Versus ORIF	150
Asim et al.	2019	Closed reduction & MMF Versus ORIF	66
Adity et al.	2021	Conservative Versus ORIF	100
Total	-	-	626

Table (2): Comparison of the effect of the three different modalities on malocclusion.

Research	Total no.	Group I			Group II			Group III		
		No.	Pre	Post	No.	Pre	Post	No.	Pre	Post
Adity 2021	100	77	33 (42.9%)	1 (1.3%)	-	-	-	23	20 (87.0%)	0 (0.0%)
Zhao (2014)	40	40	0 (0.0%)	0 (0.0%)	-	-	-	-	-	-
An (2015)	39	-	-	-	-	-	-	39	0 (0.0%)	0 (0.0%)
Andrade (2015)	74	10	0 (0.0%)	4 (40.0%)	48	-	-	16	0 (0.0%)	0 (0.0%)
Njal (2011)	42	42	0 (0.0%)	3 (7.1%)	-	-	-	-	-	-
Asim (2019)	66	-	-	-	35	6 (17.1%)	0 (0.0%)	31	0 (0.0%)	3 (9.7%)
Majed (2018)	24	12	0 (0.0%)	0 (0.0%)	12	0 (0.0%)	0 (0.0%)	-	-	-
Total	385	181	33 (18.2%)	8 (4.4%)	95	6 (6.3%)	0 (0.0%)	109	20 (18.3%)	3 (2.8%)
X <sup>2</sup> (p-value) between pre and post		X <sup>2</sup> = 17.191; p<0.001			X <sup>2</sup> = 6.196 p=0.012			X <sup>2</sup> = 14.047 p<0.001		
X <sup>2</sup> (p-value) between groups pre					X <sup>2</sup> = 7.889 p=0.019					
X <sup>2</sup> (p-value) between groups post					X <sup>2</sup> = 4.391 p=0.111					

X<sup>2</sup>: Chi-square test. p>0.05: Non significant. p<0.05: Significant. p<0.01: Highly significant.

Table (3): Comparison of the effect of the three different modalities on the interincisal opening.

Research	Total no.	Group I			Group II			Group III		
		No.	Pre Mean ± SD	Post Mean ± SD	No.	Pre Mean ± SD	Post Mean ± SD	No.	Pre Mean ± SD	Post Mean ± SD
Adity 2021	100	77	20.9±4.90	26.9±2.80				23	17.91±3.10	29.3±1.70
An (2015)	39							39		35.0
Njal (2011)	42	42		40.0						
Liu (2014)	30				30	15.8±1.2	38.6			
Reza (2012)	61				30		37.8	31		37.7±2.50
Asim (2019)	66				35		33.74±1.09	31		36.39±4.72
Majed (2018)	24	12		32.5	12		32			
Total	362	131	20.9±4.90	33.13±6.57	107	15.8±1.2	32.87±1.23	124	17.91±3.10	34.60±3.70
p-value between pre and post		<0.001			<0.001			<0.001		
Difference between pre and post		131	12.23±0.79		107	17.07±0.17		124	16.69±0.42	

\*: Paired t-test.

MIO	Group I No.=131	Group II No.=107	Group III No.=124	Test value*	p-value
Difference between pre and post	12.23±0.79 <sup>a</sup>	17.07±0.17 <sup>b</sup>	16.69±0.42 <sup>b</sup>	59.566	<0.001

p>0.05: Non significant. p<0.05: Significant. p<0.01: Highly significant.

\* One Way ANOVA followed by post hoc analysis using Tukey test; different small superscript letters indicate significant differences between groups.

Table (4): Comparison of the percentage of patients who developed Infection as a post-management complication.

Research	Total no.	Group I Total No. / No. with infection (%)	Group II Total No. / No. with infection (%)	Group III Total No. / No. with infection (%)
Adity (2021)	100	77 / 0 (0%)	-	23 / 0 (0%)
Kao (2019)	150	38 / 0 (0%)	68 / 0 (0%)	44 / 3 (6.82%)
Total	250	115 / 0 (0.0%)	68 / 0 (0.0%)	67 / 3 (4.48%)
X <sup>2</sup> (p-value)			X <sup>2</sup> = 8.294; p=0.016	

X<sup>2</sup>: Chi-square test. p>0.05: Non significant. p<0.05: Significant. p<0.01: Highly significant.

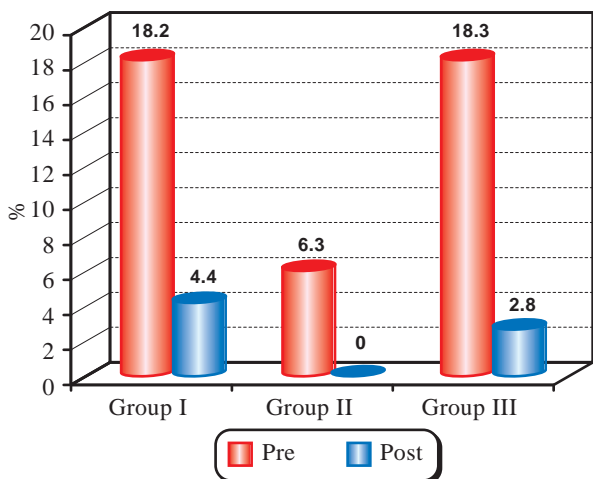


Fig. (1): Comparison between the three studied groups regarding the percentage of patients with malocclusion before and after management.

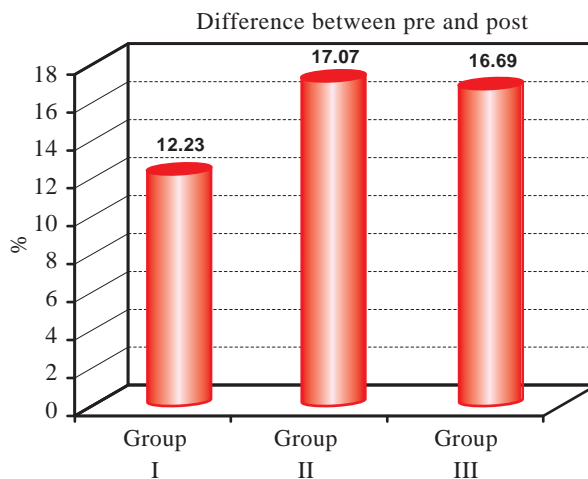


Fig. (2): Comparison among the three studied groups regarding mouth opening.

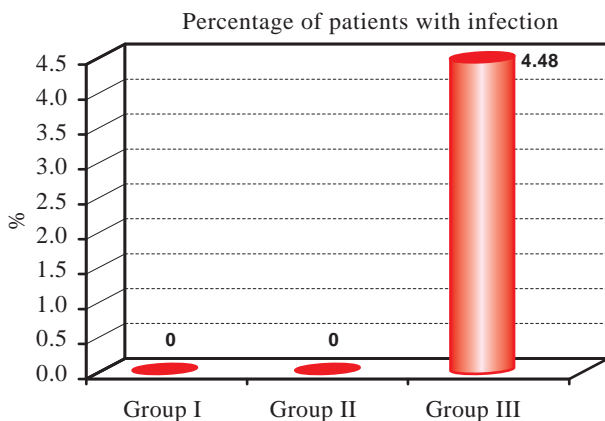


Fig. (3): Comparison between the three studied groups regarding the development of an infection as a complication of management.

### DISCUSSION

The optimal modality in managing pediatric mandibular condylar and subcondylar fractures is still controversial according to; the fracture site, the displacement of the fractured segments, dentition status, and the association with other mandibular fractures [10].

The purpose of this study is to review the literature on the management of pediatric condylar and subcondylar fractures, and retrospectively evaluate the outcomes of each modality according to the incidence of malocclusion, the degree of improvement in limitation of mouth opening, and the occurrence of complications [11].

As for the postoperative occlusal status, Adity et al., [12] introduced a retrospective study on 77 pediatric patients with intracapsular condylar fractures. Patients were classified according to their dentition status and managed using both; conservative management and surgical intervention. The study observed that some degree of malocclusion in pediatrics has been improved by conservative management. On follow-up, it was noted that active mouth exercises and physiotherapy assisted in remodeling of the condylar fracture and greatly helped to prevent the development of TMJ ankylosis resulting from hematoma. Beyond this, It was observed that patients with mixed dentition showed a great improvement in the long-term results with compensatory condylar growth. Teeth eruption in proper occlusion and mandibular growth compen-

sated for some degree of minor derangement. However, malocclusion was greatly improved with surgical intervention [12].

Asim et al., [13] introduced a randomized control trial on 66 pediatric patients with condylar fractures managed by surgical intervention; closed reduction with application of arch bar, and open reduction with internal fixation by plates and screws. The study concluded that on long-term follow-up for more than 6 months, malocclusion was greatly improved by closed reduction with arch bar application than on using open reduction and internal fixation. Similarly, the chin deviation and the mouth opening were significantly affected. It has been explained as the plates used in internal fixation restrict the normal growth of the mandible and it is preferable to be removed after 3-6 months or once healing is achieved [13].

In the literature review, it's proved that condylar fractures with malocclusion necessitate surgical intervention either by closed reduction with arch bar application or by open reduction and fixation with plates & screws. There is no significant difference in the improvement of malocclusion between both modalities of surgical intervention. However, closed reduction with arch bar application is preferred. Beyond this, pediatric patients show high growth potential which helps in spontaneous occlusal readjustment so a mild degree of malocclusion can be managed conservatively.

As per the interincisal distance, Adity et al., [12] calculated the difference in the interincisal distance on applying conservative management and surgical intervention. It is noted that there was no significant difference in absolute value between the two groups. Referring to open reduction and internal fixation, active mouth opening is achieved shortly after postoperative [12].

Asim et al., [13] studied the effect of both modalities of surgical intervention with a long-term follow-up for the maximal mouth opening. The improvement in the mean interincisal distance was  $33.74 \pm 4.72$  mm in the closed treatment group while  $36.39 \pm 4.72$  mm in the open treatment group. There was no statistically significant difference between them. However, open reduction and internal fixation of low subcondylar fractures result in rapid and better functional outcomes, particularly in terms of maximal mouth opening [13].

Based on the above findings, It's concluded that patients managed conservatively show reasonably good clinical results as regards the mouth

opening. Although surgical intervention exhibits more increase in the post-operative interincisal opening, It does not differ significantly whereas the patient is managed by closed reduction with arch bar application or by open reduction and fixation by plates & screws.

Swanson et al., [14] demonstrated a retrospective study on 116 patients to evaluate the complications of different modalities in pediatric condylar fractures management. The study concluded that the rate of complications increases with surgical intervention than on applying conservative management or closed reduction with arch bar application [14].

Kao et al., [15] established a retrospective cohort study on 150 pediatric patients at a tertiary care academic referral center. The study documented the complications of different modalities of management. It is reported that patients managed by ORIF developed post-operative complications such as mental nerve paraesthesia, massive bleeding, and infection. All of these complications could not be found when the fracture was managed conservatively or by closed reduction [15].

In the literature review, it's found that most of the complications occur after surgical intervention by ORIF as infection, nerve affection, plate exposure, and post-operative pain. However, none of these complications could be seen either with conservative management or with closed reduction and arch bar application.

### Conclusion:

Upon this review study, It's concluded that satisfactory results can be obtained by all management techniques. Conservative management is preferred in undisplaced condylar fractures, while closed reduction with maxillomandibular fixation is most commonly used in displaced condylar fractures with malocclusion. Severely displaced low subcondylar fractures with significant malocclusion necessitate surgical intervention for optimal reduction and rigid internal fixation.

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