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Original Article

Outcomes of Closed Reduction in Pediatric Mandibular Fractures: A Cross-Sectional Study

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Abstract

Background: Pediatric maxillofacial trauma is less common than in adults, with mandibular fractures accounting for nearly half of cases. These injuries often result from falls, sports activities, or road traffic accidents and may lead to complications such as malocclusion, weight loss, trismus, and non-union.

Objective: To determine the outcomes of children with mandibular fractures managed by closed reduction in terms of malocclusion, weight loss, trismus, and non-union.

Methodology: This descriptive cross-sectional study was conducted at the Oral and Maxillofacial Surgery Unit of Mardan Medical Complex, Mardan, between December 2019 and June 2020. A total of 128 children aged 4–12 years with mandibular fractures were treated using closed reduction (maxillomandibular fixation). Clinical and radiographic assessments were performed pre- and postoperatively. Data were analyzed using SPSS version 22, with a p-value ≤0.05 considered statistically significant.

Results: The mean age of participants was 6.46 ± 1.95 years, with males representing 68.8% of the study population. Postoperative complications included malocclusion in 5 children (3.9%), weight loss in 10 (7.8%), trismus in 2 (1.6%), and non-union in 4 (3.1%). No significant differences in these outcomes were observed when stratified by age or gender.

Conclusion: Closed reduction is a reliable and conservative treatment modality for pediatric mandibular fractures, associated with low rates of malocclusion, weight loss, trismus, and non-union. This approach minimizes complications and preserves normal growth potential in children.

Keywords: Closed reduction, Malocclusion, non-union, Pediatric mandibular fractures, Trismus, Weight loss.

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Introduction

Pediatric maxillofacial trauma is significantly less common compared to adults, yet mandibular fractures represent nearly half of such cases in children [1]. The leading causes of pediatric mandibular injuries include falls and sports-related accidents, followed by road traffic accidents, burns, and air-gun injuries [2]. Clinical presentation often involves swelling, pain, bruising, disturbed occlusion, and facial asymmetry [3]. Radiographic evaluation—using orthopantomograms (OPGs) for dentition and jaw visualization and postero-anterior (PA) views for frontal assessment—is considered essential for accurate diagnosis [4].

Management of pediatric mandibular trauma differs substantially from adults due to the unique anatomical and physiological characteristics of children, including developing dentition, ongoing skeletal growth, higher bone elasticity, and faster healing potential [5,6]. Children's skull sutures are more flexible, their bones contain a greater proportion of cancellous tissue, and their healing capacity is superior, all of which favor conservative treatment approaches [7]. Closed reduction, a minimally invasive procedure, takes advantage of this natural healing potential and allows for spontaneous bone realignment [8].

Mandibular fractures in children are typically managed through either closed reduction or open reduction and internal fixation (ORIF), depending on fracture type and the child's growth stage [8]. While ORIF using titanium or absorbable plates provides rigid fixation, it carries risks such as injury to developing tooth buds, interference with mandibular growth, need for secondary surgery, and higher costs [9]. Conversely, closed reduction minimizes these risks and is particularly suitable for the pediatric population, where complications like non-union and significant malocclusion are relatively uncommon [10,11].

Recent trends, however, show an increased preference for ORIF among surgeons, despite its drawbacks. Therefore, evaluating the outcomes of closed reduction remains important to provide evidence for its continued use as a safe, cost-effective, and developmentally considerate approach. The present study was undertaken to determine the outcomes of pediatric mandibular fractures managed by closed reduction in terms of malocclusion, weight loss, trismus, and non-union.

Methodology

Study Design

This study was designed as a descriptive cross-sectional analysis conducted to assess outcomes in pediatric patients with mandibular fractures treated by closed reduction. The design was chosen to allow systematic evaluation of treatment outcomes and complications within a defined population during a specific time frame.

Ethics

Ethical approval was obtained prior to commencement of the study. The study objectives, procedures, risks, and potential benefits were explained to parents or guardians of all participants, and informed written consent was obtained. Confidentiality and anonymity of participants were strictly maintained throughout the study.

Setting

The study was carried out at the Oral and Maxillofacial Surgery Unit of Mardan Medical Complex, Mardan, from December 23, 2019, to June 23, 2020. The hospital is a tertiary care center providing specialized maxillofacial services and serving as a referral unit for surrounding districts.

Participants

A total of 128 children aged 4–12 years presenting with mandibular fractures were included through non-probability consecutive sampling. Inclusion criteria comprised fractures in dentate and non-dentate areas with a duration of less than one week. Exclusion criteria included displaced fractures not amenable to closed reduction, fractures associated with mid-face or other body fractures, and fractures of the mandibular condylar head.

Variables

The primary outcome variables were malocclusion, weight loss, trismus, and non-union following closed reduction. Effect modifiers included age and gender, which were stratified to assess their association with outcomes.

Data Sources/Measurement

Data were collected through structured history-taking, clinical examination, and radiographic assessments, including orthopantomograms (OPGs) and postero-anterior (PA) views. Pre- and postoperative weights were recorded using a digital scale. Malocclusion was identified by premature contacts, crossbite, or open bite; trismus was defined as inter-incisal distance <30 mm and categorized as mild, moderate, or severe; and non-union was assessed

both clinically and radiographically at the fourth postoperative week.

Bias

To minimize measurement bias, standardized operational definitions were applied for each outcome variable. All procedures were performed by a fourth-year resident under senior consultant supervision to ensure consistency. Follow-up assessments were carried out using uniform protocols.

Study Size

The sample size of 128 was calculated using the WHO formula for single proportion, assuming an expected frequency of 9.1%, a 5% margin of error, and a 95% confidence interval [12]. This size was sufficient to detect clinically relevant outcomes with adequate precision.

Quantitative Variables

Quantitative variables included age and pre- and postoperative weight, which were recorded in continuous form and expressed as mean ± standard deviation. Qualitative variables included gender and presence/absence of malocclusion, weight loss, trismus, and non-union, which were expressed as frequencies and percentages.

Statistical Methods

Data analysis was performed using SPSS version 22. Descriptive statistics were computed for both qualitative and quantitative variables. Age and gender were stratified against the primary outcomes to identify effect modification. Post-stratification, Chi-square or Fisher's exact test was applied where appropriate, with a p-value ≤ 0.05 considered statistically significant.

Results

Participants

A total of 128 children aged between 4 and 12 years with mandibular fractures were included in the study. The majority of participants were male (n=88, 68.8%), while females comprised 40 cases (31.3%). Most children (54.7%) were in the younger age group of 4–6 years, reflecting the increased vulnerability of this group to accidental injuries.

Descriptive Data

The overall mean age of the study population was 6.46 ± 1.95 years. The mean preoperative weight of the participants was 17.99 ± 3.42 kg, while the mean postoperative weight was 17.91 ± 3.45 kg, showing a slight decrease following treatment. Age distribution indicated that more than half of the children were clustered in the younger age group, and the predominance of males suggests gender-related exposure patterns, possibly linked to greater outdoor activity and risk-taking behavior.

Outcome Data

The outcomes assessed included malocclusion, weight loss, trismus, and non-union following closed reduction. Malocclusion was observed in 5 children (3.9%), while weight loss of ≥1 kg was documented in 10 children (7.8%). Trismus was relatively uncommon, occurring in 2 children (1.6%), and non-union was detected in 4 children (3.1%). None of these complications occurred at a frequency exceeding 10%, reflecting overall favorable treatment outcomes.

Main Results

When stratified by age groups (4–6 years versus 7–8 years), no statistically significant differences were found for any of the outcomes. Malocclusion and weight loss were slightly more common in the younger age group, but the differences were not significant ($p>0.05$). Similarly, the occurrence of trismus and non-union showed no age-related variation. Gender-based comparisons also revealed no significant associations. Although malocclusion was marginally more frequent in boys (4.5%) and weight loss was slightly higher in girls (12.5%), these differences did not reach statistical significance. Overall, closed reduction resulted in a low incidence of complications, and outcomes were not significantly influenced by either age or gender.

Table 1: Distribution of age, weight, gender and malocclusion of the participants

Variable	Characteristics
Age(years), Mean ± SD	6.46 ± 1.948
Preoperative Weight (Kg), Mean ± SD	17.99 ± 3.42
Postoperative Weight (Kg), Mean ± SD	17.91 ± 3.45
Gender, n(%)	Male: 88 (68.8%)
	Female: 40 (31.3%)
Malocclusion, n(%)	Present: 5 (3.9%)
	Absent: 123 (96.1%)

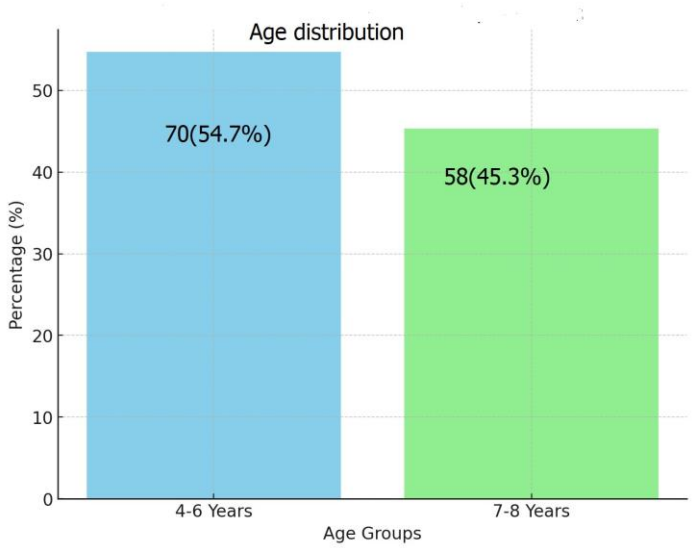


Figure 1: Age distribution of the participants

Table 2. Frequency of malocclusion, weight loss, trismus and non-union among children with mandibular fractures

Variable	Characteristics
Malocclusion, n(%)	Present: 5 (3.9%)
	Absent: 123 (96.1%)
Weight Loss, n(%)	Present: 10(7.8%)
	Absent: 118(92.2%)
Trismus, n(%)	Present: 2(1.6%)
	Absent: 126(98.4%)
Non-Union, n(%)	Present: 4(3.1%)
	Absent: 124(96.9%)

Table 3: Comparison of various outcomes in children with mandibular fractures among age groups

Variable	Characteristics	Age groups		p-value*
		4-6 Years	7-8 Years	
Malocclusion	**Present**	3 (2.4%)	2 (1.6%)	0.81
	Absent	67 (52.4%)	56 (44.4%)	
Weight Loss	**Present**	6 (4.7%)	4 (3.1%)	0.495
	Absent	65 (50.8%)	54 (42.2%)	
Trismus	**Present**	1 (0.8%)	1 (0.8%)	0.703
	Absent	69 (53.9%)	57 (44.5%)	
Non-Union	**Present**	2 (1.6%)	2 (1.6%)	0.616
	Absent	68 (53.1%)	56 (44.4%)	

*Chi-square test/Fisher exact test

Table 4. Comparison of various outcomes in children with mandibular fractures between genders

Variable	Characteristics	Male (N=88)	Female (N=40)	p-value
Malocclusion	**Present**	4 (4.55%)	1 (2.50%)	0.501
	Absent	84 (95.45%)	39 (97.50%)	
Weight Loss	**Present**	5 (5.68%)	5 (12.50%)	0.164
	Absent	83 (94.32%)	35 (87.50%)	
Trismus	**Present**	1 (1.14%)	1 (2.50%)	0.529
	Absent	87 (98.86%)	39 (97.50%)	
Non-Union	**Present**	2 (2.27%)	2 (5.00%)	0.370
	Absent	86 (97.73%)	38 (95.00%)	

*Chi-square test/Fisher exact test

Discussion

The present study assessed outcomes in children with mandibular fractures treated by closed reduction. The mean age of participants was 6.46 years, with the majority belonging to the 4–6 year age group, a period marked by heightened activity and increased susceptibility to accidental trauma [13]. The predominance of male patients (68.8%) observed in this study is consistent with previous literature, which reports a higher incidence of facial injuries among males due to their greater involvement in outdoor activities and risk-taking behaviors [2,14,15].

Post-treatment assessment revealed a low incidence of complications, with malocclusion observed in 3.9% of cases. Although malocclusion can significantly affect occlusal function and dental alignment, its occurrence remained minimal. This finding aligns with earlier reports suggesting that conservative management of pediatric mandibular fractures results in satisfactory occlusal outcomes [8]. Similarly, weight loss was noted in 7.8% of patients, a complication also described in other studies where dietary restrictions following maxillomandibular fixation contributed to postoperative nutritional deficits [11,16].

Trismus was recorded in only 1.6% of cases, reflecting effective healing and rehabilitation following conservative treatment. The rare occurrence of non-union (3.1%) is also consistent with prior reports that pediatric patients, due to their high osteogenic potential, demonstrate a lower risk of non-union compared to adults [10,17]. These results highlight the inherent advantages of closed reduction in children, where natural growth and bone remodeling capabilities facilitate uncomplicated recovery.

When stratified by age and gender, no statistically significant differences were found in complication rates. Younger children demonstrated slightly higher frequencies of malocclusion and weight loss, whereas females showed a marginally greater incidence of weight loss compared to males. However, these differences did not achieve statistical significance, indicating that closed reduction remains equally effective across subgroups.

Compared with open reduction and internal fixation (ORIF), closed reduction offers several advantages in pediatric populations. While ORIF provides rigid stabilization, it is associated with risks such as damage to tooth buds, disturbance of mandibular growth, and the need for secondary procedures [9,18]. Conversely, closed reduction avoids these complications and supports spontaneous healing. This study's findings strengthen the evidence favoring closed reduction as a reliable and conservative modality for pediatric mandibular fractures, particularly in low-resource settings where access to advanced surgical implants may be limited.

Conclusion

Based on the results of this study, closed reduction proved to be a safe and effective management option for pediatric mandibular fractures, with low incidences of malocclusion, weight loss, trismus, and non-union. The outcomes were not significantly influenced by patient age or gender, underscoring the broad applicability of this treatment approach. Given its conservative nature, minimal invasiveness, and ability to preserve normal growth patterns, closed reduction remains a preferred treatment modality for mandibular fractures in children.

Authors' Contributions

All authors meet the ICMJE criteria for authorship. They have reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Author 1: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.

Author 2: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.

Author 3: Analysis and interpretation of data, drafting the manuscript, final approval, agreed to be accountable for all the work.

Author 4: Analysis and interpretation of data, critical revision, final approval, agreed to be accountable for all the work.

Author 5: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.

Author 6,7&8: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.

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