



INTISARI SAINS MEDIS

Published by Intisari Sains Medis

Open reduction versus close treatment in management of children mandibular fracture: A systematic review



Made Surya Dharmawan^{1*}, Raden Ratu Kania Tiaraningrum¹,
Ida Ayu Cempaka Dewi Yatindra¹, Ratna Rayeni Natasha Rooseno²

ABSTRACT

Mandibular fractures in children are the most common facial bone injury, which is 39% of all fractures. Adequate treatment of mandible fractures was still debated to restore the best physiological and aesthetic outcome. This systematic review aims to compare open reduction and closed treatment outcomes in children with mandibular fractures based on evidence from the current study. Four electronic databases were used: PubMed, ScienceDirect, Directory of Open Access Journals (DOAJ), and Google Scholar. Studies included were randomized and non-randomized clinical studies written in English and published in the last 10 years (2014). Children patients under 18 years of age, of any sex, with any mandible fracture treated with any functional appliance. Data was

collected using a standard form agreed upon by two independent reviewers. The risk of bias and quality were assessed using the Newcastle-Ottawa Quality Assessment Scale (NOS). Ten studies were selected for this systematic review, including 554 patients. Half of studies chosen had a high risk of bias, 4 were deemed to have a moderate risk of bias, and one had a low risk of bias. Comparing ORIF and close treatment, we get the incidence of complications versus cases respectively, 9/182 versus 5/372. The data collected, although there is still a lot of bias in this review. We support close treatment as the first line treatment for children's mandible fractures because the minimal number of possible complications.

Keywords: children; mandible; fracture; systematic review.

Cite This Article: Dharmawan, M.S., Tiaraningrum, R.R.K., Yatindra, I.A.C.D., Rooseno, R.R.N. 2024. Open reduction versus close treatment in management of children mandibular fracture: A systematic review. *Intisari Sains Medis* 15(1): 396-401. DOI: 10.15562/ism.v15i1.1982

¹Intern doctor of Plastic Reconstructive Surgery Department, Mangusada Hospital, Badung, Bali, Indonesia;

²Departement of Plastic and Reconstructive Surgery, Mangusada Hospital, Badung, Bali, Indonesia.

*Corresponding author:

Made Surya Dharmawan;
Intern doctor of Plastic Reconstructive Surgery Department, Mangusada Hospital, Badung, Bali, Indonesia;

sdharmawan3@gmail.com

Received: 2024-01-22

Accepted: 2024-03-16

Published: 2024-04-08

INTRODUCTION

Protrusion, anatomical shape and an open position of mandible causing it more often experienced trauma in comparison with other facial bones. From all over facial fracture, about 61% of cases were mandibular fracture.¹ Also in children, mandibular fractures are the most common facial bone injury, 39% of all fractures. At birth, the ratio of cranium and face is 8:1, and slowly declines until adults it becomes 2.5:1. With increasing age, the growth of facial skeleton is forward and downward direction, becomes more prominent and the occurrence of facial fracture increases.² The common causes of mandible fracture in children population worldwide are falls from height, road traffic accidents, sport injuries, and bicycle accident.³ Adequate

treatment of mandible fracture was still debated to restore the best physiological and aesthetic outcome. Treatment must consider ongoing mandibular growth and concern for possible disruption in children patients.⁴ Children bone has unique physical properties along with space occupying developing dental, that give rise to different patterns of fracture in adults. Bone fragments in children may become partially united within 4 days and difficult to reduce by the seventh day.⁵ This systematic review aimed to compare the outcome treatment of open reduction and close treatment in children's mandibular fracture. This systematic review follows the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement.

METHODS

Information sources

Four electronic databases were used; PubMed, ScienceDirect, Directory of Open Access Journal (DOAJ), and Google Scholar. The electronic search was conducted in January 2024.

Search Strategy

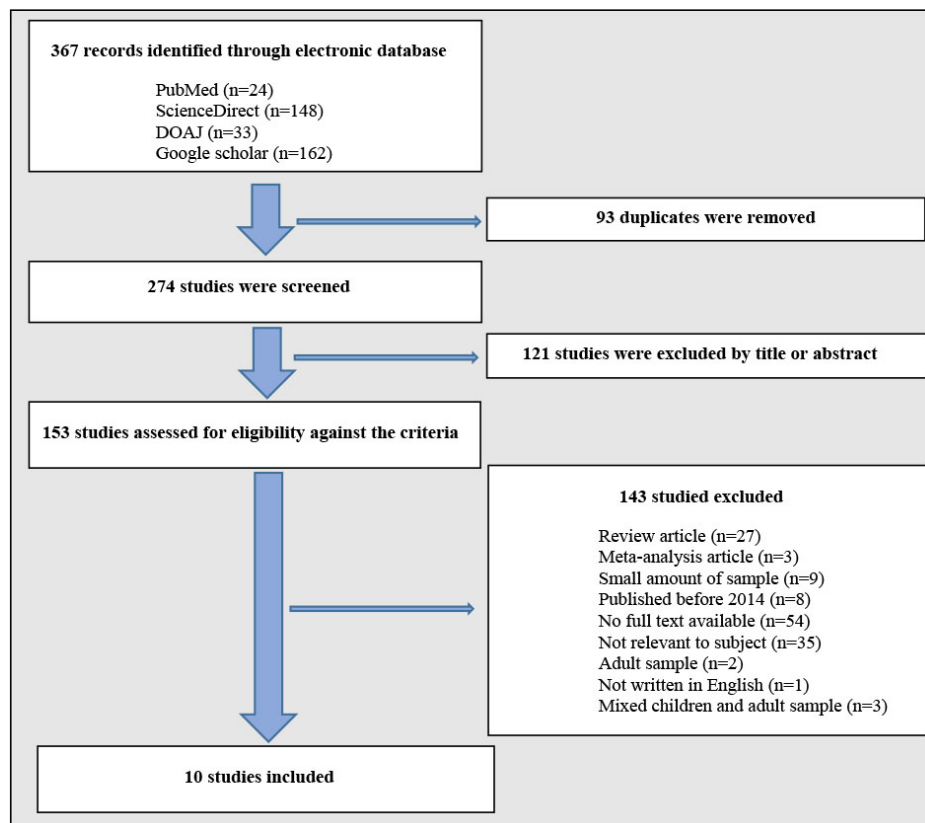
The following terms were searched: {(pediatric OR children [All Fields]) AND (mandible fracture OR jaw fracture [All Fields]) AND (open OR closed OR surgical OR nonsurgical OR ORIF OR conservative [All Fields])}. PICOS guideline was used to focus the search strategy (Table 1).

Selection process

All search study were merged, and duplicate reports removed. Two authors

Table 1. PICOS guidelines

Population (P)	Patient age <18 years old with mandible fracture
Intervention (I)	Surgical approach to reduction and fixation of the fracture
Comparison (C)	Non-surgical management
Outcome (O)	Proper healing and any other complication
Study Design	Original papers

**Figure 1.** Preferred Reporting Items for Systematic Reviews and Meta-Analysis flow diagram.

(S.D and R.R.) review the title and abstract to identify articles that potentially meet the inclusion criteria and irrelevant articles being discarded. Disagreement between S.D. and R.R. were resolved by consulted with the other authors. Full text articles were obtained for studies that met inclusion criteria (Figure 1).

Inclusion and exclusion criteria

The inclusion criteria were randomized and non-randomized clinical studies written in English and published from last 10 years (2014). Children patient who under 18 years of age, any sex, with any type of mandible fracture treated with any kind of functional appliance were included. Studies in animals were excluded as were those in adult cases, other than English, and published before 2014.

Data collection process

Data collection was conducted using standard agreed form by two independent reviewers. Process was carried out manually, with two independent reviewers S.D and R.R involved and no final data disagreement between reviewers.

Data item

Tables with the following fields were agreed upon and completed for each study. Data included: publication author and year of study, total patient, type of mandibular fracture, patient age, treatment modality, follow-up, and outcome. Treatment modality was grouped into two major categories: open reduction internal fixation (ORIF) and close treatment. Any surgical approach to reduction and internal fixation were classified into ORIF,

contrary any non-surgical treatment including close reduction, external stabilization, maxillomandibular fixation (MMF), physical therapy, and soft diet were classified into close treatment. Outcome was pooled from objective evaluation of bone healing and any complications.

Risk of bias assessment

The risk of bias and quality were assessed using Newcastle-Ottawa Quality Assessment Scale (NOS) due to the concerned with evaluating risk of bias in estimates of effectiveness or safety of intervention from studies. All of selected studies were assessed using the NOS by two independent authors.

RESULTS

Study selection

Total of 367 studies were found from the electronic database. After duplicate record were removed, 274 were screened, and exclude 121 studies after screened title and abstract. Thirteen of 153 were included for full text analysis. Further, 3 article with mixed adult and children sample were excluded. Finally, 10 studies were selected.

Study Characteristics

The final data extraction of the included 10 reports is displayed in Table 3. All of these 10 articles were retrospective study, with publication years ranging from 2014 to 2024. The studies include total of 554 patients, with age under 18 years. All papers included mandibular fracture with various types from single anatomical site to multiple fracture sites. The most involved anatomical site was condyle, as displayed in Table 3. ORIF was used in papers⁶⁻¹⁵ with total of 182 cases and close treatment was used in papers^{8,10-15} with total of 372 cases. All surgical that used open reduction and internal fixation technique were all grouped into ORIF, while close treatment involved close reduction, external stabilization, MMF, physical therapy, conservative management with observe and soft diet, splint and arch wire. All studies recorded different lengths of follow-up, where in some studies stated that not all patient adhered to the follow-up schedule. The outcome section states the result of fracture healing and complications in each

Table 2. Risk of bias

Study	NOS Scale						Score	Risk of Bias
	Selection		Comparability		Outcome			
Iatrou et al. (2015) ⁶	*	*	*	**			5/9	High
Joshi et al. (2015) ⁷	*	*	*	**	*	*	7/9	Moderate
Smith et al. (2013) ⁸	*	*	*	*	*	*	6/9	High
Saad (2017) ⁹	*	*	*	**	*		6/9	High
Ghasemzadeh et al. (2015) ¹⁰	*	*	*	**	*		6/9	High
Li et al. (2023) ¹¹	*	*	*	**			5/9	High
Yang et al. (2022) ¹²	*	*	*	*	*	*	7/9	Moderate
Zhao et al. (2014) ¹³	*	*	*	*	*	*	7/9	Moderate
Bansal et al. (2021) ¹⁴	*	*	*	**	*	*	8/9	Low
Kao et al. (2019) ¹⁵	*	*	*	**	*		7/9	Moderate

study, some compare the result of ORIF with close treatment.^{8,10,14}

Risk of bias in studies

The classification of potential risk of bias in each study followed Newcastle-Ottawa Quality Assessment Scale (NOS), with three main outline; selection of sample, comparability of the design or analysis, assessment and adequacy of outcome including follow-up. A study can be awarded a maximum of nine star, which determine the classification of potential risk of bias. Half of selected studies had high risk of bias, other studies^{7,12,13,15} were deemed to have a moderate risk of bias, and study¹⁴ which had low risk of bias (Table 2).

Result of individual studies

Open reduction and internal fixation were used in papers^{6-10,14,15} with 182 cases. Most of them used titanium plate, except on paper Kao et al., using one resorbable plate, and Saad et al divided their sample by 3 groups; Group (1): treated by ORIF using monocortical non compression miniplates/ screws system. Group (2): treated by ORIF using microplates/ screws system. Group (3): treated using biodegradable resorbable bone plates/ screws systems. All ORIF was done with general anesthesia and incision through intraoral approach. Most of them was done alongside with MMF.^{6,10,15} In Ghazemzadeh et al., study, no isolated condyle fracture were treated with ORIF, only some condylar fractures with additional mandibular arch fracture. Kao et al., mention that in their study, children over 12 years old were more likely to treat by ORIF. Satisfaction bone healing was

successfully achieved in several studies using the ORIF.^{6,7,14} On the other side Daren et al., mentioned that ORIF were more likely to have adverse outcome than conservatively managed fracture but not significantly affect mandibular function and growth.

Adverse outcome were TMJ click (8), dental trauma (7), hardware failure (4), TMJ deviation (3), and other (4). Saad et al mentioned three patients treated with ORIF had minor occlusal discrepancies. Ghazemzadeh et al., mentioned nine of ten patients with complication had condylar with additional arch fracture, which six of these patients were managed with ORIF.

Close treatment was used in papers^{8,10-15} with total of 372 cases. Several studies used MMF with soft diet, but none of study described their type of MMF. Zao et al. used occlusal splint, which created a slightly open mouth position and caused mandible to have space and adequate time to heal. All studies that used close treatment stated that achieving good bone healing succeeded after being evaluated clinically and radiograph examination. Almost all patients had no complications except in the study of Bansal et al., one patient deranged occlusion in closed treatment group.

DISCUSSION

The samples in all studies in this review are all non-randomized control trials with a greater possibility of bias than randomized control trials. Published studies on children's mandibular fractures generally include case series and cohorts.¹⁶ Mandible fracture in children is challenging for clinicians because mandible growth must

also be considered apart from restoring its function. Therefore, the treatment modality used must be appropriate. In this review of the 10 studies used, most authors chose close treatment over ORIF, respectively 372 versus 182 in total of 554 patients. In children under 12 years of age, close treatment is also often chosen, as mentioned by Kao et al.¹⁵ In contrast to cases with multiple mandibular fractures, most ORIF is chosen as the treatment modality. However, this cannot yet be a future reference for clinicians in choosing a treatment modality, because there are still many other variables. In other words, the variable bias in this review could be very high, one example is that this review does not specifically discuss the anatomy of mandibular fractures because it could be that the treatment chosen adjust to the location of the mandibular fracture according to anatomical classification. The duration of follow-up in this review study was insufficient to see growth disturbance in the fracture mandibles of children. Five years after treatment is considered sufficient time to see growth disturbances, whereas in the all studies in this review no duration of follow-up exceeded 5 years. The most prolonged follow-up duration was in the study of Zhao et al.,¹³ and the shortest was the study of Kao et al.¹⁵ Otherwise, 4 months post treatment is enough time to see bone healing and other complications. All studies used objective parameters to assess the result of their treatment. The parameters used are clinical symptoms and radiological examination. These parameters are considered sufficient to prove result with minimal bias. Bone healing in all studies was reported to be satisfactory to

Table 3. Data extraction

Author	Total Patient	Type of Mandibular Fracture	Age of Patient (years)	Treatment modality	Follow-up	Outcome
Iatrou et al. (2015) ⁶	6	Angle (3) Angle + condyle (1) Angle + body (1) Angle + symphysis (1)	5 - 14 years	ORIF + IMF (6)	12 - 18 months (mean 14.7 months)	All fracture heal uneventfully observed through panoramic radiograph. No cases of infection, osteomyelitis, neurological disturbance or malocclusion.
Joshi et al. (2015) ⁷	10	Body + parasymphysis (2) Parasymphysis (3) Body (2) Parasymphysis + angle (2)	4 - 12 years (mean 7.6)	ORIF (10)	4 months	All case showed satisfactory bone healing without any growth disturbance, no site of infection, and occlusion was stable and satisfactory.
Smith et al. (2013) ⁸	120	Condyle (52.5%) Ramus (3.7%) Angle (10.7%) Body (6.0%) Parasymphysis (23.3%) Symphysis (3.7%)	10 months - 18 years	ORIF (41) Close treatment: including CREF, external stabilization, and physical therapy (79)	mean 19.5 months	Operative management fractures were more likely to have adverse outcomes than conservatively managed fractures ($p < 0.05$) but did not significantly affect mandibular function and growth. Adverse outcome were TMJ click (8), dental trauma (7), hardware failure (4), TMJ deviation (3), and other (4).
Saad et al (2017) ⁹	36	Symphysis (8) Parasymphysis (7) Body (12) Angle (9)	5 - 12 years (mean 6.5)	ORIF (36)	1 week - 6 month	All patient significant bone healing through radiograph examination. No sign of infection. Three patient had minor occlusal discrepancies.
Ghasemzadeh et al. (2015) ¹⁰	64	Condyle (29) Condyle + concomitant (35)	<18 years	ORIF without MMF (21) Close treatment: including MMF and conservative (43)	35 - 294 days	Ten patient had complications which five of them had malocclusion, two patient had asymmetry. Nine of 10 patient with complication had condylar with additional arch fracture, which six of these patients were managed with ORIF.
Li et al. (2023) ¹¹	6	Symphysis (1) Symphysis + angle (1) Symphysis + condyle (4) Condyle (22)	1 - 8 years	Close treatment: using quartz splint fiber and circumdental arch wire (6) Close treatment: conservative (22)	1 - 12 months	Good bone fracture healing after 12 weeks and no complication after treatment.
Yang et al. (2022) ¹²	22	Condyle (22)	2.4 - 11 years (mean 6.68 ± 2.36 years)	Close treatment: conservative (22)	31 - 415 days	All the displaced fragment fused. No patient presented ankylosis of temporomandibular joint during follow-up.
Zhao et al. (2014) ¹³	40	Condyle (40)	3 - 16 years	Closed treatment occlusal splint (40)	4 years	Satisfactory healing and no complications.
Bansal et al. (2021) ¹⁴	100	Parasymphysis (22) Condyle (21) Symphysis (11) Body (5) Angle (3) Combination (38)	<12 years	ORIF (23) Close Treatment (77)	1.08 ± 0.24 years	Bone healing was observed in all patient with no significant difference, and no infection and nerve paresthesia in any patient. One patient had mobility, and 1 patient deranged occlusion in closed treatment group.

Author	Total Patient	Type of Mandibular Fracture	Age of Patient (years)	Treatment modality	Follow-up	Outcome
Kao et al. (2019) ¹⁵	150	Condyle (60) Angle/ramus (69) Body (62) Symphysis/parasymphysis (78) Coronoid (10)	Mean 12.8 years	ORIF + MMF (20) ORIF (24) Open reduction only (1) Closed treatment: MMF (63) Observe + Soft diet (38) Closed reduction (4).	113 days	Complication (13) which are: malunion (2), non-union (2), deformity (1), infection (3), hardware extrusion (2), facial numbness (2), and trismus (1). Of these patient with complication, all had 2 or more fracture.

patients and clinicians. This is different from complications, if combined, there will be 9 complications treated by ORIF and 5 complications treated by close treatment. This calculation only come from eight studies, because in the study by Darren et al., and Ghazemsadeh et al., just described about the complications without explaining previous treatment. Comparing ORIF and close treatment, we get the incidence of complications versus cases respectively, 9/182 versus 5/372. As a result of this review, close treatment tends to be safer and the possibility of complications is smaller.

Study Limitation

In reality, many variables influence the choice of treatment modality and influence results. Small amount of sample in some of the study used and not distinguishing between consideration of treatment every part of mandibular anatomy are the study limitations. It is felt that this review cannot provide sufficient evidence regarding the comparison of result between ORIF and close treatment in children mandible fractures. The historical argument discussing the advantages and disadvantages of ORIF and close treatment cannot be refuted in this review. Author suggest more studies that discuss the comparison of ORIF and close treatment in children mandibular fracture are needed, especially discuss each specific part of mandibula.

CONCLUSION

The data collected, although there is still a lot of bias in this review. We support close treatment as the first line treatment for children’s mandible fractures because the minimal number of possible complications.

DISCLOSURES

Funding

The author was responsible for the funding without obtaining financial support.

Conflict of Interest

The authors affirmed that there were no conflicts of interest in this study.

Author Contribution

Author fully contributed to this study and publication of this manuscript.

REFERENCES

1. Astuti R. Angka kejadian fraktur mandibula berdasarkan lokasi anatomis di RSUD Arifin Achmad Provinsi Riau periode Januari 2011-Desember 2023. *JOM FK*. 2015;1(2).
2. Sharma A. Mandibular Fracture in Children: A New Approach for Management and Review of Literature. *Int J Clin Pediatr Dent*. 2019;12(4):356-359. Doi: 10.5005/jp-journals-10005-1643
3. Mukhopadhyay, Santanu. A retrospective study of mandibular fractures in children. *Journal of the Korean Association of Oral and Maxillofacial Surgeons*. 2018;44(6):269-274. Available from: <https://doi.org/10.5125/jkaoms.2018.44.6.269>
4. Panesar K, Susarla S. Mandibular fracture: diagnosis and management. *Semin Plast Surg*. 2021;35:238-249. Doi: <https://doi.org/10.1055/s-0041-1735818>
5. Sharma S. Pediatric mandibular fractures: a review. *International Journal of Clinical Pediatric Dentistry*. 2009;2(2):1-5.
6. Iatrou I, Theologie-Lygidakis N, Tzermpos F, Kamperos G. Internal fixation of mandibular angle fractures using one miniplate in Greek children: a 5-year retrospective study. *J Craniomaxillofac Surg*. 2015;43(1):53-56. doi:10.1016/j.jcms.2014.10.009
7. Joshi S, Kshirsagar R, Mishra A, Shah R. Clinical efficacy of open reduction and semirigid internal fixation in management of displaced pediatric mandibular fractures: a series of 10 cases and surgical guidelines. *J Indian Soc Pedod Prev Dent*. 2015;33(2):161-165. doi:10.4103/0970-4388.155135
8. Smith DM, Bykowski MR, Cray JJ, et al. 215 mandible fractures in 120 children: demographics, treatment, outcomes, and early growth data. *Plast Reconstr Surg*. 2013;131(6):1348-1358. doi:10.1097/PRS.0b013e31828bd503
9. Saad, K.A. Comparison of different alternative types of osteosynthesis for management of pediatric mandibular fracture. *Egyptian Dental Journal*. 2017;63(2):1239-1251.
10. Ghasemzadeh A, Munding GS, Swanson EW, Utria AF, Dorafshar AH. Treatment of Pediatric Condylar Fractures: A 20-Year Experience. *Plast Reconstr Surg*. 2015;136(6):1279-1288. doi:10.1097/PRS.0000000000001811
11. Li L. Conservative management of mandibular fracture in pediatric patients during the growing phase with splint fiber and ligature arch wire. *BMC Oral Health*. 2023;23:601. Available from: <https://doi.org/10.1186/s12903-023-03309-z>
12. Yang RC, Cui MJ, Zhou HH, et al. Fracture fragment of the condyle determines the ramus height of the mandible in children with intracapsular condylar fractures treated conservatively. *Sci Rep*. 2022;12(1):19924. Published 2022 Nov 19. doi:10.1038/s41598-022-24463-4

13. Zhao YM, Yang J, Bai RC, Ge LH, Zhang Y. A retrospective study of using removable occlusal splint in the treatment of condylar fracture in children. *J Craniomaxillofac Surg.* 2014;42(7):1078-1082. doi:10.1016/j.jcms.2012.07.010
14. Bansal A, Yadav P, Bhutia O, Roychoudhury A, Bhalla AS. Comparison of outcome of open reduction and internal fixation versus closed treatment in pediatric mandible fractures-a retrospective study. *J Craniomaxillofac Surg.* 2021;49(3):196-205. doi:10.1016/j.jcms.2020.12.013
15. Kao R, Rabbani CC, Patel JM, et al. Management of Mandible Fracture in 150 Children Across 7 Years in a US Tertiary Care Hospital. *JAMA Facial Plast Surg.* 2019;21(5):414-418. doi:10.1001/jamafacial.2019.0312
16. Jenkyn I, Bosley R, Jenkyn C, Basyuni S, Fowell C. Management of Mandibular Condyle

Fractures in Paediatric Patients: a Systematic Review. *J Oral Maxillofac Res.* 2023;14(2):e2. Published 2023 Jun 30. doi:10.5037/jomr.2023.14202



This work is licensed under a Creative Commons Attribution