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Evaluate Closed Versus Open Reduction of Facial Fractures for Pediatric Facial Fractures: A Systematic Review and Meta-Analysis

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Abstract
Background and aim: The occurrence of facial fractures is usually relatively rare in children and should be considered separately from adult facial fractures for diagnostic and therapeutic reasons. The present study examines and compares Closed Versus Open Reduction of Facial Fractures for Pediatric Facial Fractures.
Method: Databases of PubMed, Scopus, Web of Science, EBSCO and Embase were searched for systematic literature between 2011 to August 2021. Newcastle-Ottawa Scale (NOS) used to assess quality of the cohort studies. For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included.95% confidence interval for risk ratio with fixed effect model and Mantel-Haenszelmethod were calculated. Meta-analysis was performed using Stata/MP v.16 software (The fastest version of Stata).
Result: In the initial review, duplicate studies were eliminated and abstracts of 126 studies were reviewed, the full text of 28 studies was reviewed by two authors, finally, six studies were selected. Risk ratio of complications rate between intervention and control groupwas 2.18 (OR, 2.18 95% CI 1.59, 2.76; p=0.00).
Conclusion: Complications rate was higher in Open Reduction of Facial Fractures compared to Closed Reduction of Facial Fractures.
Key words: Facial Fractures, children, Conservative, Open reduction

Introduction

The occurrence of facial fractures is usually relatively rare in children and should be considered separately from adult facial fractures for diagnostic and therapeutic reasons(1).In children, due to the greater elasticity of the bones and the fact that their teeth do not grow completely, there is more thickness of the surrounding adipose tissue and good stability in the

maxilla and mandible(2, 3).Significant strength and energy are required to fracture the growing bones of children(4).According to statistics, the prevalence of facial fractures in children is about ten percent, most of the fracture rate occurs at the age of 5 years(5, 6)Social, cultural and environmental factors are responsible for changing the epidemiology of cranial and facial trauma(7, 8).Facial fractures are more common in boys than girls(9). There are few studies in this field that are related to the treatment of facial fractures in children(9, 10).According to studies, an absorbent stabilization system or titanium mini-plates are used to treat facial fractures in children(11, 12). Therefore, in the present study, we tried to provide sufficient and stronger evidence in this field by reviewing previous studies; therefore, the present study examines and compares Closed Versus Open Reduction of Facial Fractures for Pediatric Facial Fractures.

Method

Databases of PubMed, Scopus, Web of Science, EBSCO and Embase were searched for systematic literature between 2011 to August 2021.A review of the results of studies from the last ten years can provide newer results.Use the MeSH Database, to build searches in PubMed:

("Child"[Mesh] OR "Adult Children"[Mesh] OR "Dental Care for Children"[Mesh] OR "Only Child"[Mesh]) OR ("Pediatrics"[Mesh] OR "Pediatric Dentistry"[Mesh])) OR ("Fractures, Bone"[Mesh] OR "Osteoporotic Fractures"[Mesh] OR "Tooth Fractures"[Mesh])) AND "Facial Nerve Injuries"[Mesh]) AND ("Facial Nerve Injuries/surgery"[Mesh] OR "Facial Nerve Injuries/therapy"[Mesh])) AND "Maxillofacial Injuries"[Mesh]) OR ("Mandible"[Mesh] OR "Mandibular Injuries"[Mesh] OR "Mandibular Fractures"[Mesh])) AND "Open Fracture Reduction"[Mesh]) OR ("Open Fracture Reduction/adverse effects"[Mesh] OR "Open Fracture Reduction/instrumentation"[Mesh] OR "Open Fracture Reduction/methods"[Mesh])) OR "Mandibular Reconstruction"[Mesh]) OR ("Mandibular Reconstruction/adverse effects"[Mesh] OR"Mandibular Reconstruction/classification"[Mesh] OR "Mandibular Reconstruction/instrumentation" [Mesh] OR "Mandibular Reconstruction/methods" [Mesh])) OR "Fracture Fixation, Internal" [Mesh].

Key considerations PRISMA was the basis of the present study(13) and PECO strategy to answer the research questions showed in Table1.

Selection criteria

*Inclusion criteria: criteria:*facial fractures, only children,surgical access, Clinical controlled trials, randomized controlled trials, and cohort studies, all language. Case studies, case reports, reviewswere excluded from the study.

Table1. PICO strategy

PICO strategy	Description
P	Population: Pediatric Facial Fractures
I	interventions: open treatment
C	Comparison: closed treatment

O	Outcome: complications

Study selection, Data Extraction and method of analysis
Studies data were reported by study, years, sex, age, number ofpatients andtreatment.
Newcastle-Ottawa Scale (NOS) (14) used to assessed quality of the cohort studies and case-control studies, This scale measures three dimensions (selection, comparability of cohorts and outcome) with a total of 9 items. In the analysis, any studies with NOS scores of 1- 3, 4- 6 and 7- 9 were defined as low, medium and high quality, respectively. The quality of the randomized control trial studies included was assessed using the Cochrane Collaboration's tool(15). The scale scores for low risk was 1 and for High and unclear risk was 0. Scale scores range from 0 to 6. A higher score means higher quality.
For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included.Prior to the screening, kappa statistics was carried out in order to verify the agreement level between the reviewers. The kappa values were higher than 0.80.
95% confidence interval for risk ratio with fixed effect model andMantel-Haenszelmethod were calculated. To deal with potential heterogeneity, random effects were used and I^2 showed heterogeneity. I^2 values less than 50% indicate low heterogeneity and above 50% indicate moderate to high heterogeneity. Meta-analysis was performed using Stata/MP v.16 software (The fastest version of Stata).

Result
The review of the existing literature using the studied keywords, 185 studies were found. In the initial review, duplicate studies were eliminated and abstracts of 126 studies were reviewed. At this stage, 98 studies did not meet the inclusion criteria, so they were excluded, and in the second stage, the full text of 28 studies was reviewed by two authors. At this stage, 22 studies were excluded from the study due to incomplete data, inconsistency of results in a study, poor studies, lack of access to full text, inconsistent data with the purpose of the study. Finally, sixstudies were selected (Figure1).

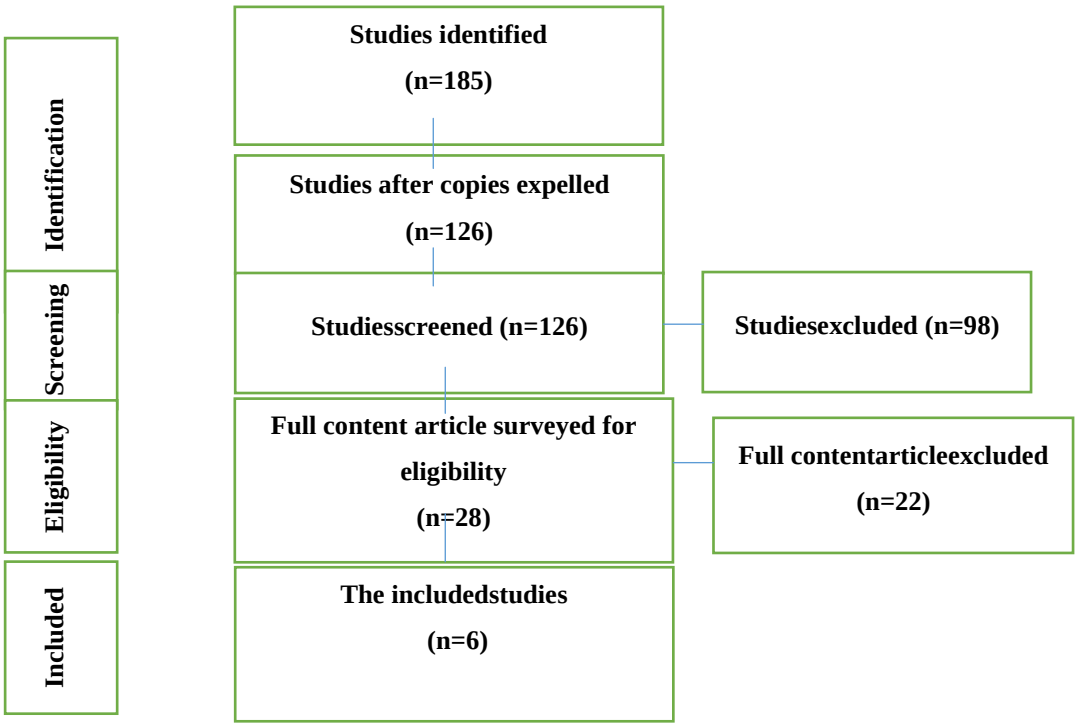


Figure 1. Study Attrition

Characteristics

Sixstudies (Retrospective cohort studies) have been included in present article. The number of participants a total were409 (boys: 278; girls: 131) with meanof age 10.56 years (Table2).

Bias assessment

According to NOS tool, two studies had a total score of 6/9, four studies had a total score of 7/9. All studies had moderate quality or moderate risk of bias (Table3).

Table2. Studies selected for systematic review and meta-analysis.

Study. years	Study design	Number of participants		mean of age (years)	treatment		Follow-up
		boys	girls		open	closed	
Glazer et al., 2011 (16)	Retrospective	41	20	11.3	8	53	6 -24 months
Kambalimath et al., 2013 (17)	Retrospective	72	40	8.9	19	93	6 months
Hoppe et al., 2014 (18)	Retrospective	14		15.9	5	9	NA
Ghasemzadeh et al., 2015 (19)	Retrospective	41	23	8.4	10	54	3 months
Andrade et al., 2015 (20)	Retrospective	60	14	10	16	58	18 months
Theologie-Lygidakis et al., 2016 (21)	Retrospective	50	34	9	4	80	12 months

Table3. Risk of bias assessment (NOS tool)

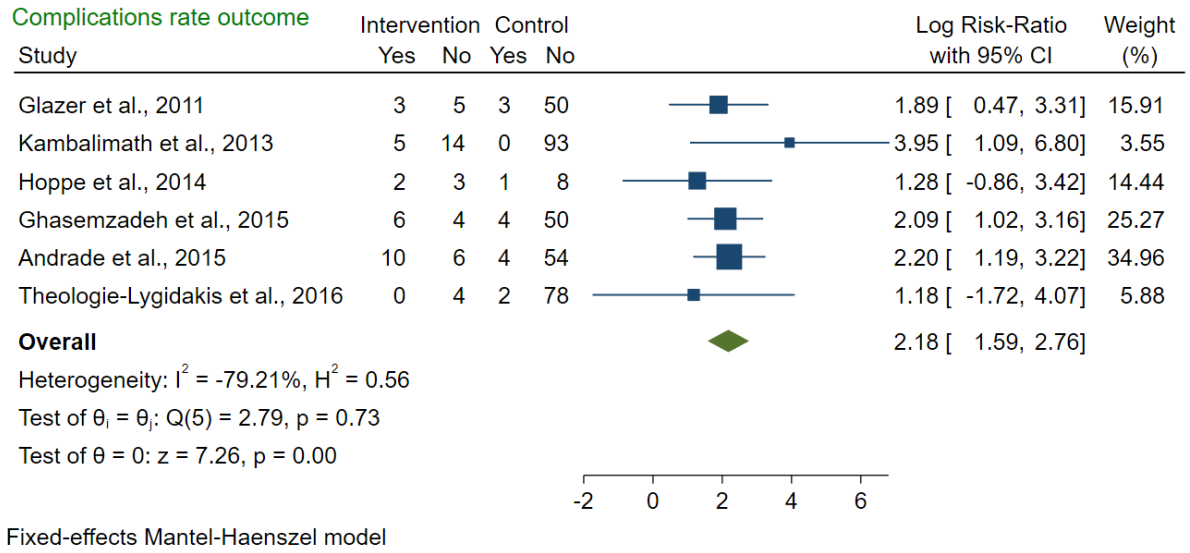
Study. Years	Selection (5 score)				Comparability (2 score)	Outcome (2 score)		Total score
	representative sample	Sample size	Nonrespondents	Ascertainment of the exposure	Based on design and analysis	Assessment of outcome	Statistical test	
Glazer et al., 2011 (16)	1	1	1	1	1	1	1	7
Kambalimath et al., 2013 (17)	1	1	1	1	1	1	1	7
Hoppe et al., 2014 (18)	1	1	1	1	1	1	1	7
Ghasemzadeh et al., 2015 (19)	1	1	1	0	2	1	1	7
Andrade et al., 2015 (20)	1	1	1	0	1	1	1	6
Theologie-Lygidakis et al., 2016 (21)	1	1	1	0	1	1	1	6

Complications rate

Risk ratio of complications rate between intervention and control groupwas 2.18 (OR, 2.18 95% CI 1.59, 2.76; p=0.00)among six studies and heterogeneity found (I^2<0.00%; P=0.73); there wasstatistically significant difference between two groups (p=0.00); Complications rate was higher in intervention groupcompared to control group (Figure 2).

Discussion

The aim of current Systematic Review and Meta-Analysis was evaluate Closed Versus Open Reduction of Facial Fractures for Pediatric Facial Fractures. One of the most important issues in the field of facial fractures is facial fractures in children and adolescents.



According to the researches, randomized clinical trial studies in this field were not found and all the studies found are retrospective; also, the sample size of studies was low. In the present study, 278 boys and 131 girls with a mean age of 10.56 years were studied; According to studies, facial trauma is more common in boys (21-23). Various causes of trauma have been reported, including contact sports, urban violence or physical aggression at school or on the street, and running games(24, 25). In studies on facial trauma in adults, the prevalence of this trauma has been higher in men, but with different causes such as car accidents, domestic violence, accidents (26-29). According to studies on the cause of trauma, car accidents were the most common (19, 30-32). The use of seat belts and car seats for children can significantly reduce facial trauma in car accidents(33-35). Studies show that the rate of mandibular fractures is higher in children(36). Mandibular injury is also much more common in adults(37, 38). conservative methods are most used regardless of age groups; According to the results of conservative methods studies, it is usually used for younger children depending on the location of the trauma(39). Open treatment is performed with rigid internal fixation, especially titanium plates (30, 40). Meta-analysis showed that there was a statistically significant difference between the two groups of Closed Versus Open Reduction of Facial Fractures with respect to complications. The findings of the studies are in line with these results(20). This finding was to be expected, as the likelihood of complications in open therapy is inherently higher due to the use of fixatives and the risk of infection or nerve damage(41).A follow-up period of studies between 3 and 12 months is not possible to report all complications and studies should be done with a higher follow-up period to provide sufficient evidence. The present study had some limitations, including a very small sample size of studies; the quality of mediocre studies was estimated; Methodological heterogeneity was observed; not all related complications were investigated.

Conclusion

Based on the meta-analysis, Closed Reduction of Facial Fractures is usually performed for pediatric facial fractures and showed lower complications than Open Reduction of Facial Fractures. Among the most common methods of this type of treatment are intermaxillary

fixation, intraocclusal block, kinesiotherapy, and splint. The findings of the present study do not provide sufficient evidence for maxillofacial fractures in children and further studies, especially RCT, should be performed in this field and quality studies with low risk of bias should be performed. Finally, it is recommended that the sample size be increased in future studies and that the follow-up period be extended.

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