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Clinical outcomes after maxillofacial reconstruction using the free fibular flap in children: A systematic review and meta-analysis

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Abstract---Background and aim: In the present study, an attempt has been made to investigate the complications and consequences of using the free fibular flap after maxillofacial reconstruction in children. Therefore, the present study was conducted with the aim of evaluating clinical outcomes after maxillofacial reconstruction using the free fibular flap in children. Method: Present study is a systematic review and meta-analysis based on PRISMA 2020 Checklist. Databases of PubMed, Scopus, Web of Science, EBSCO, ISI Web of Knowledge, and Embase were searched for systematic literature until 30 November 2022. A 95% confidence interval for effect size with the random effect model and REML method were calculated. Meta-analysis was performed using Stata/MP v.17 software. Result: In the initial review, duplicate studies were eliminated and abstracts of 428 studies were reviewed, the full text of 155 studies was reviewed by two authors, and finally, 15 studies were selected. major and minor complication rate was 7% (ES, 7 95% CI 6%, 14%) and 23% (ES, 23% 95% CI 3%,

42%). Conclusion: Based on the present meta-analysis, the use of a free fibular flap is a reliable and appropriate option in reconstructing the jaw and face of children with few major complications and minor complications.

Keywords---maxillofacial, free fibular flap, children.

Introduction

Free fibula flap was introduced in 1989 for mandibular reconstruction(1). The use of free tissue transfer for head and neck reconstruction in the pediatric population has been proven to be safe and effective(2). One of the advantages of using bone-containing flaps for mandibular correction in children is that dental occlusion is maintained throughout the period(3). However, this method is worrisome due to its long and technical use in children. Free fibular flap is used in the reconstruction of children's jaw and face, however, it is known as a reconstruction challenge; One of the reasons for this is the growth of children and their functional potential(4). The findings of the studies have reported the data related to the postoperative period and the growth potential of the free fibular flap. By comparing the results of these studies, contradictory findings are observed(5, 6). Also, in some studies, the findings indicate that during surgery to preserve the native condyle of the mandible, it is possible to preserve the growth potential of the mandible; It should be noted that neomandibular growth in children is not predictable(4, 7). Complications studies reported for free fibular flap, such as insignificant impact on walking and ankle stability, also based on existing literature, corrective methods are also needed due to unfavorable results(8-10). In the present study, an attempt has been made to investigate the complications and consequences of using the free fibular flap after maxillofacial reconstruction in children. Therefore, the present study was conducted with the aim of evaluate clinical outcomes after maxillofacial reconstruction using the free fibular flap in children.

Method

Search strategy

Present study is a systematic review and meta-analysis based on PRISMA 2020 Checklist(11), All international databases, PubMed, Scopus, Science Direct, ISI, Web of Knowledge, and Embase using keywords related to the objectives of the study until 30 November 2022 were reviewed. Google Scholar search engine was also used to find related articles.

MeSH key words:

((("Pediatrics"[Mesh]) OR ("Child"[Mesh] OR "Adult Children"[Mesh] OR "Only Child"[Mesh])) AND ("Maxillofacial Prosthesis"[Mesh] OR "Oral and Maxillofacial Surgeons"[Mesh] OR "Surgery, Oral"[Mesh] OR "Maxilla"[Mesh])) AND "Fibula"[Mesh]) OR "Free Tissue Flaps"[Mesh].

Data items, Data collection and Selection process

Using a checklist that included the author's name, year of publication, sample size, study design, sex, Dentition Stage, Fibula Recipient Site, Indication and Follow-up was extracted and reported in Table 1; Also, the data required for meta-analysis including clinical outcome, were extracted from the studies. All articles were selected based on the inclusion criteria, two reviewers independently screened each record, and each report was retrieved.

Eligibility criteria

Inclusion criteria: Articles published in English, Randomized Controlled Trial, Prospective Non-randomized Trial, Case-Control, Case Series and Case Report studies that assessed the free fibular flap in children.

Exclusion criteria: reviews papers and letter to editor. Studies without full text access.

Data analysis

Data analysis was performed using STATA/MP. V17 software. 95% confidence interval for effect size with random effect model and REML method 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.

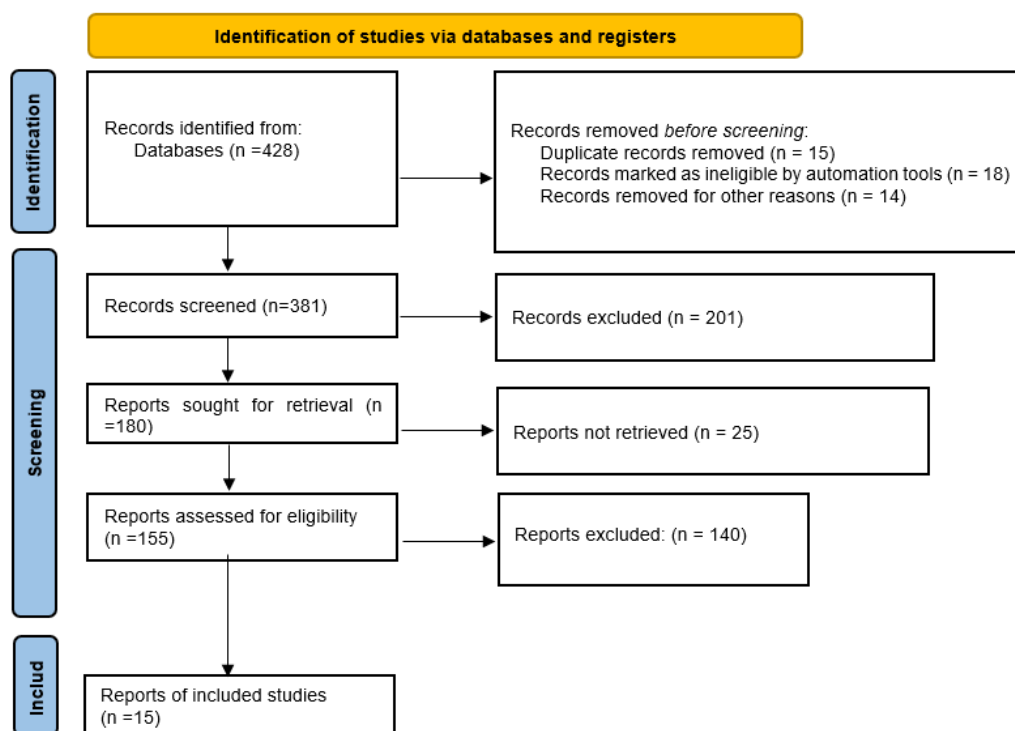


Figure 1. PRISMA 2020 Checklist

Result

Study selection

In the initial search, 428 articles related to the keywords were found. Of these, 15 studies were Duplicate records, 18 articles were removed due to Records marked as ineligible by automation tools, and 14 articles were records removed for other reasons. In the next step, abstracts of 381 articles were reviewed and finally 201 articles were excluded from the research according to the exclusion criteria. The full text of 155 articles was reviewed and according to the inclusion criteria, 140 studies were excluded and finally fifteen studies were selected (Fig 1).

Study characteristics

One prospective study, six case series studies and eight case report studies were selected and included in the study. A total of 297 patients between the ages of 6 months and 18 years were examined. Table 1 shows a summary of demographic data.

Table 1. Summary of data from selected studies

n	Study. Years	Study design	Number of patients		Age (years)	Fibula Recipient Site		Major complication	Minor complication
			male	female		Mandible	Maxilla		
1	Hassanein et al., 2022 (12)	Prospective	38		12-18	-	38	8	3
2	Hassanein et al., 2022 (13)	Prospective	38	46	>18	84	-	6	2
3	Fahradyan et al., 2019 (14)	Case Report	1	0	15	1	-	0	0
4	Ishida et al., 2019 (15)	Case Report	1	-	9	1	-	0	0
5	Maby et al., 2019	Case Report	1	-	6 mo	1	-	0	1
6	Joseph et al., 2017 (16)	Case Report	1	-	9	1	-	0	0
7	Cleveland et al., 2017 (17)	Case Series	5	-	10	5	-	0	0
8	Starnes-Roubaud et al., 2017 (18)	Case Series	57	52	12	NR	NR	1	3
9	Wong et al., 2016 (19)	Case Report	1	-	10	-	1	0	0
10	Han et al., 2016 (20)	Case Series	5	10	10.9	9	6	0	0
11	Temiz et al., 2015 (21)	Case Series	10	-	11	10	-	3	8

12	Pierse et al., 2014 (22)	Case Report	1	0	15	1	-	0	0
13	de la Parra et al., 2013 (23)	Case Report	-	1	7	-	1	0	1
14	Rashid et al., 2012 (24)	Case Series	13	5	12	1	-	2	3
15	Crosby et al., 2008 (7)	Case Series	11	0	14	11	-	5	4

Complications

Major

In the selected studies, major complications are summarized; According to studies, Ankle valgus deformity, Compartment syndrome, Flexion contractures requiring surgery, Pain requiring surgery and flap failure, Fracture, Granulation tissue requiring debridement, Hematoma requiring surgery, Infection requiring surgery, Malocclusion, Necrosis requiring surgery, Thrombosis, Trismus requiring surgery, Chronic TMJ dislocation requiring surgery and hematoma have been reported. according to figure 2, major complication rate was 7% (ES, 7 95% CI 6%, 14%) with high heterogeneity ($I^2=99.48\%$; $P=0.00$) (Fig.2).

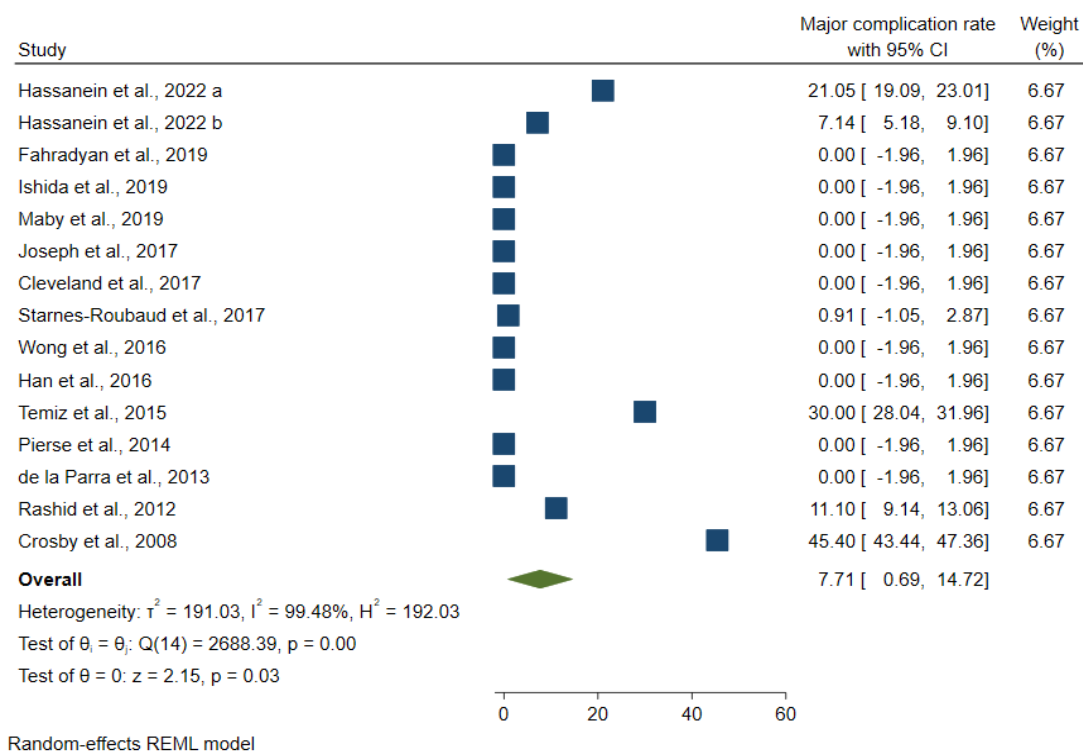


Figure 2. major complication rate

Minor

In the selected studies, minor complications are summarized; According to studies, Dehiscence, Flexion contractures, Gait instability, Hematoma, Paresthesia, Stiffness or pain and Chronic TMJ, Dehiscence, Delayed union, Diet or speech limitations, Facial neuropraxia/labial palsy, Hypertrophic scar, Infection, Mild growth distortion/asymmetry, Skin necrosis, Trismus and Tracheobronchitis have been reported. according to figure 3, minor complication rate was 23% (ES, 23% 95% CI 3%, 42%) with high heterogeneity ($I^2=99.93\%$; $P=0.00$) (Fig.3).

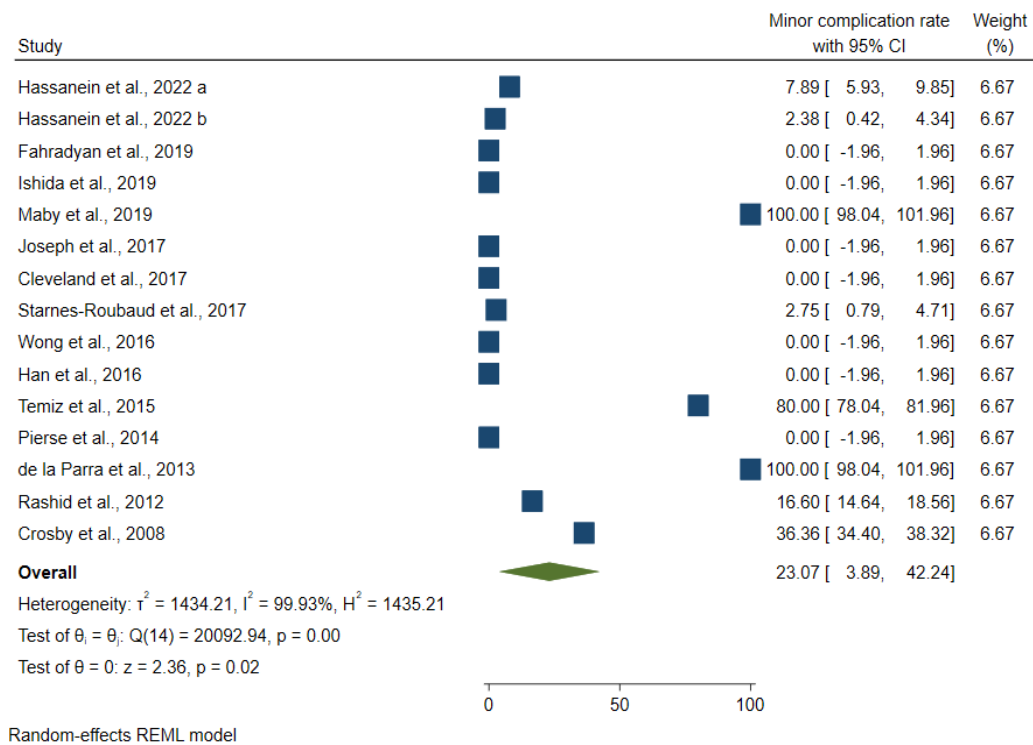


Figure 3. minor complication rate

Discussion

Studies have shown that free fibular flap is a safe and reliable option for jaw and facial reconstruction in the growing age population (25, 26). Also, the advantages of free fibular flap have caused it to be used in the surgical treatment of benign and malignant diseases of the head and neck of children. Its advantages include its elasticity and stability. However, there are many challenges for the use of free fibular flap in children, also there are few studies related to the reporting of postoperative complications, most of which have reported conflicting results; As a result, it is very important to review the findings of the studies and the consensus of the results; Therefore, the present study was conducted with the aim of investigating the complications of using free fibular flap in the maxillofacial of the growing population (children). In the current study, most of the selected studies

were case reports that examined only one patient; Also, due to the high heterogeneity between studies, citing the findings of the present study should be done with caution. According to the present meta-analysis, the major complication rate related to fibular flap in children (6 months to 18 years) was 7% and the minor complication rate was estimated at 23%. Due to the fact that several complications for major complication and minor complication were mentioned in the studies and the sample size was small, subgroup meta-analysis was not performed. Meta-analysis showed that free fibular flap is suitable and highly effective for reconstructing the jaw and face of children. In a recent systematic review, findings consistent with the present study were reported and showed that the overall rate of major complications was 13.5% and the rate of minor complications was 24.5%(27). In the studies in which the use of free fibular flap has been examined in the adult population, high complications have been reported. As a result, it can be said that complications increase with age due to medical risk factors. However, based on the available evidence, despite the complications, the use of free fibular flap in children is reliable. The most reported complications were related to ankle valgus deformity and pain at the fibular extraction site, so they should be considered in predicting surgical corrections so that the treatment process is better. The present study had limitations, such as the follow-up period of the studies was variable, therefore, it was not investigated in the present study, the follow-up period can be effective on the results of the study, and the results of the studies with the same follow-up period are needed. Also, most of the studies were in the form of case reports, which provide weaker evidence because the sample size is small. Another limitation of the study was that the articles published in English were considered and studies in other languages were not reviewed. Prospective studies with high sample size and long follow-up period are needed. In the present study, only two prospective studies were examined.

Conclusion

According to the present meta-analysis, the use of free fibular flap is a reliable and appropriate option in reconstructing the jaw and face of children with few major complications and minor complications. Future studies with prospective data, higher sample size, long-term follow-up period to investigate complications after reconstruction using free fibular flap are needed to provide stronger evidence.

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