

Evaluation Mandibular Advancement Surgeries For Pediatric Obstructive Sleep Apnea: A Systematic Review And Meta-Analysis

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Research Article

Evaluation Mandibular Advancement Surgeries For Pediatric Obstructive Sleep Apnea: A Systematic Review And Meta-Analysis

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Abstract

Background and aim: Obstructive sleep apnea syndrome is a common condition in children. The aim of current Systematic Review and Meta-Analysis study was evaluation Mandibular Advancement Surgeries for Pediatric Obstructive Sleep Apnea.

Method: From the electronic databases, PubMed, Scopus, LILACS, Web of Science, EBSCO, LIVIVO, and Embase have been used to perform a systematic literature over the last ten years between 2011 and May 2021. Newcastle-Ottawa Scale and Cochrane Collaboration's tool used to assess quality of the cohort studies and randomized control trial studies, respectively. Mean difference with 95% confidence interval (CI), fixed effect model and Inverse-variance method were calculated. Random effects were used to deal with potential heterogeneity and I^2 showed heterogeneity. I^2 values above 50% signified moderate-to-high heterogeneity. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).

Result: In the first step of selecting studies 4571 studies were selected to review the abstracts, in the second step, the full text of 114 studies was reviewed. Finally, eleven studies were selected. Meta-analysis reported reduction Apnea-hypopnea index, mean difference between preoperative Apnea-hypopnea index and postoperative Apnea-hypopnea index was -2.11 events/h (MD, -2.11 95% CI -2.35, -1.87; P= 0.00) among the eleven studies.

Conclusion: change in Apnea-hypopnea index after mandibular advancement surgeries was -2.11 events/h reduction. Studies with long-term outcomes are needed.

Key words: Mandibular Advancement Surgeries, Obstructive Sleep Apnea, children, Pediatric, Apnea-hypopnea index

Introduction

Obstructive sleep apnea syndrome (OSAS) is a common condition in children (1) and characterized by a variable obstruction of the upper airway and different degrees of alteration in gas exchange during the night(2). The prevalence of OSAS is about 55% to 80% in pediatric participants with Down syndrome compared to 1% to 5% in the general pediatric population(3). Early and correct diagnosis and treatment of OSA in children is of great importance. Studies showed that many cases of OSA in children has been found to be the result of anatomical predispositions(4). It is generally accepted that positive airway pressure (PAP) is the firstline treatment modality and that a mandibular advancement device (MAD) can be prescribed when the patient becomes intolerant to the PAP.4 Maxillomandibular advancement (MMA) has been regarded as an effective treatment modality, as it is a permanent osseo-pharyngeal reconstruction procedure(5). Most recently Zhou et al.,2021 in a systematic review and met analysis evaluate and compare the treatment outcome of MMA and multilevel surgery for OSA treatment in adult population(6). The use of MAS for the treatment of OSA in congenital retrognathia has become increasingly common, and previous systematic reviews have been performed that address its success in children (7-9). However, published results are relatively sparse for the procedure's benefit in acquired retrognathia of children, and a meta-analysis of those published results has low to be done to quantify the procedure's benefit. Therefore, it is necessary to provide strong and solid evidence. The aim of current Systematic Review and Meta-Analysis study was evaluation Mandibular Advancement Surgeries for Pediatric Obstructive Sleep Apnea.

Methods

Search strategy

From the electronic databases, PubMed, Scopus, LILACS, Web of Science, EBSCO, LIVIVO, and Embase have been used to perform a systematic literature over the last ten years between 2011 and May 2021. The reason for choosing studies in the last ten years is to be able to provide sufficient evidence in this area and use newer studies. Therefore, a software program (Endnote X8) has been utilized for managing the electronic titles.

Searches were performed with mesh terms:

("Sleep Apnea Syndromes/classification"[Mesh] OR "Sleep Apnea Syndromes/complications"[Mesh] OR "Sleep Apnea Syndromes/rehabilitation"[Mesh] OR "Sleep Apnea Syndromes/surgery"[Mesh] OR "Sleep Apnea Syndromes/therapy"[Mesh])) OR "Sleep Apnea Syndromes"[Mesh]) AND "Mandibular Advancement"[Mesh]) OR ("Mandibular Advancement/adverse effects"[Mesh] OR "Mandibular Advancement/methods"[Mesh] OR "Mandibular Advancement/therapy"[Mesh])) AND ("Child"[Mesh] OR "Only Child"[Mesh])) OR ("Dental Care for Children"[Mesh] OR "Disabled Children"[Mesh])) OR ("Pediatrics"[Mesh] OR "Pediatric Dentistry"[Mesh] OR "Dentists"[Mesh]).

This systematic review has been conducted on the basis of the key consideration of the PRISMA Statement–Perfumed Reporting Items for the Systematic Review and Meta-analysis(10), and PECO strategy (Table1).

Selection criteria

Inclusion criteria: Randomized controlled trials studies, controlled clinical trials, and prospective and retrospective cohort studies; used Mandibular advancement surgeries; Children with sleep apnea; in English. In vitro studies, case studies, case reports and reviews were excluded from the study.

Evaluation Mandibular Advancement Surgeries For Pediatric Obstructive Sleep Apnea: A Systematic Review And Meta-Analysis

Table1. PECO strategy

PECO strategy	Description
P	Population: Pediatric Obstructive Sleep Apnea
E	Exposure: Mandibular advancement surgeries
C	Comparison: pre-surgical VS post-surgical outcome
O	Outcome: surgical outcome

Study selection, Data Extraction and method of analysis

The data have been extracted from the research included with regard to the study, years, study design, age, Apnea/Hypopnea Index. Newcastle-Ottawa Scale (NOS) (11) 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.

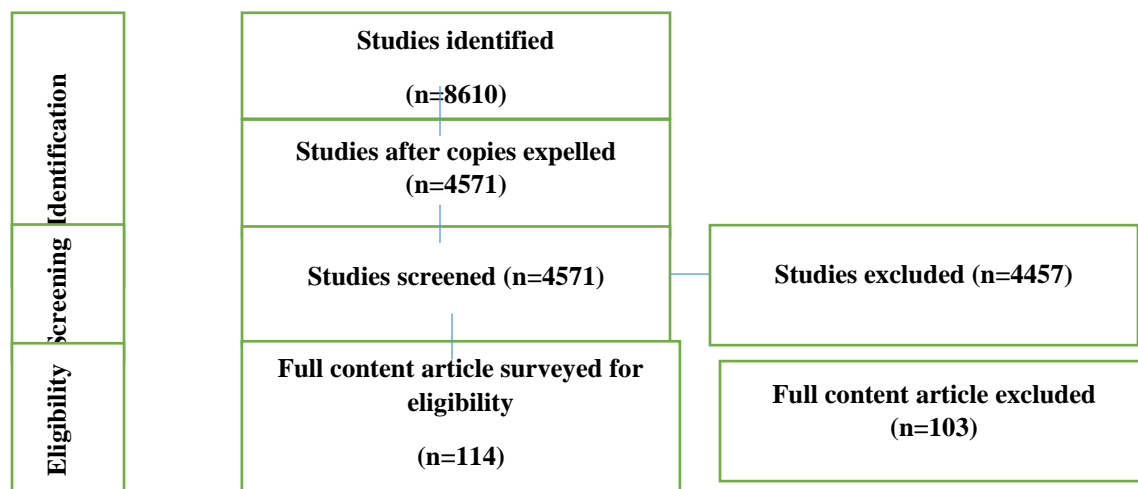
The quality of the randomized control trial studies included was assessed using the Cochrane Collaboration’s tool(12). The scale scores for low risk was 1 and for High and unclear risk was 0. Scale scores range from 0 to 6. A higher score means higher quality.

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.

Mean difference with 95% confidence interval (CI), fixed effect model and Inverse-variance method were calculated. Random effects were used to deal with potential heterogeneity and I^2 showed heterogeneity. I^2 values above 50% signified moderate-to-high heterogeneity. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).

Results

According to the purpose of the study, in the initial search with keywords, 8610 articles were found. In the first step of selecting studies 4571 studies were selected to review the abstracts. Then, studies that did not meet the inclusion criteria were excluded from the study (4457 article). In the second step, the full text of 114 studies was reviewed. Finally, eleven studies were selected (Figure1).



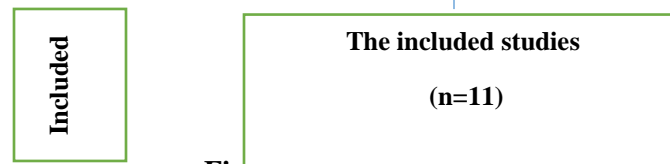


Figure 1. Study Attrition

Characteristics

Eleven studies (five retrospective cohort studies, two Prospective study and four randomized controlled trial) have been included in present article. The number of children was 147 boys and 120 girls, a total 267 with rang of age between 2 to 20 years (Table1). The apnea-hypopnea index reported in table 1.

Bias assessment

According to NOS tool, two studies had a total score of 8/9, one study had a total score of 6/9 and four studies had a total score of 7/9. All studies had high quality except one study that had medium quality (Table3).

According to Cochrane Collaboration’s tool, three studies had a total score of 4/6, and one study had a total score of 4/6. All studies had high quality or low risk of bias (Table4).

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

N	Study. Year	Study design	Sample size		Mean-Range of Age (years)	Apnea-hypopnea index
			boy	girl		
1	Best et al.,2021 (13)	Retrospective	15		14-20	28.9 ± 16.0
2	Chuang et al. 2019 (14)	RCT	31	9	7.95 ± 3.27	3.75 ± 2.48
3	Modesti-Vedolin et al.2018 (15)	RCT	10	8	8.3±2.3	-
4	Idris et al. 2018 (16)	RCT	13	3	9.8±1.1	2.8 ± 3.0
5	Zellner et al.2017 (17)	Retrospective	50		<18	51.3±45.6
6	Zanaty et al.2016(18)	Prospective	17	13	11.13±2.69	52.5±4.95
7	Machado-Junior et al. 2016(19)	RCT	2	6	8.13±1.31	1.66 ± 0.28
8	Goldstein et al.2015 (20)	Retrospective	10	18	<18	32.06±12.51

Evaluation Mandibular Advancement Surgeries For Pediatric Obstructive Sleep Apnea: A Systematic Review And Meta-Analysis

9	Yadav et al., 2014 (21)	Prospective	7	9.9	78.65±60.23
10	Murage et al., 2013 (22)	Retrospective	50	2	37.8±25.6
11	Hammoudeh et al.,2012 (23)	Retrospective	20	4.75	39.7±38.23

RCT: randomized controlled trial.

Table3. Risk of bias assessment (NOS tool)

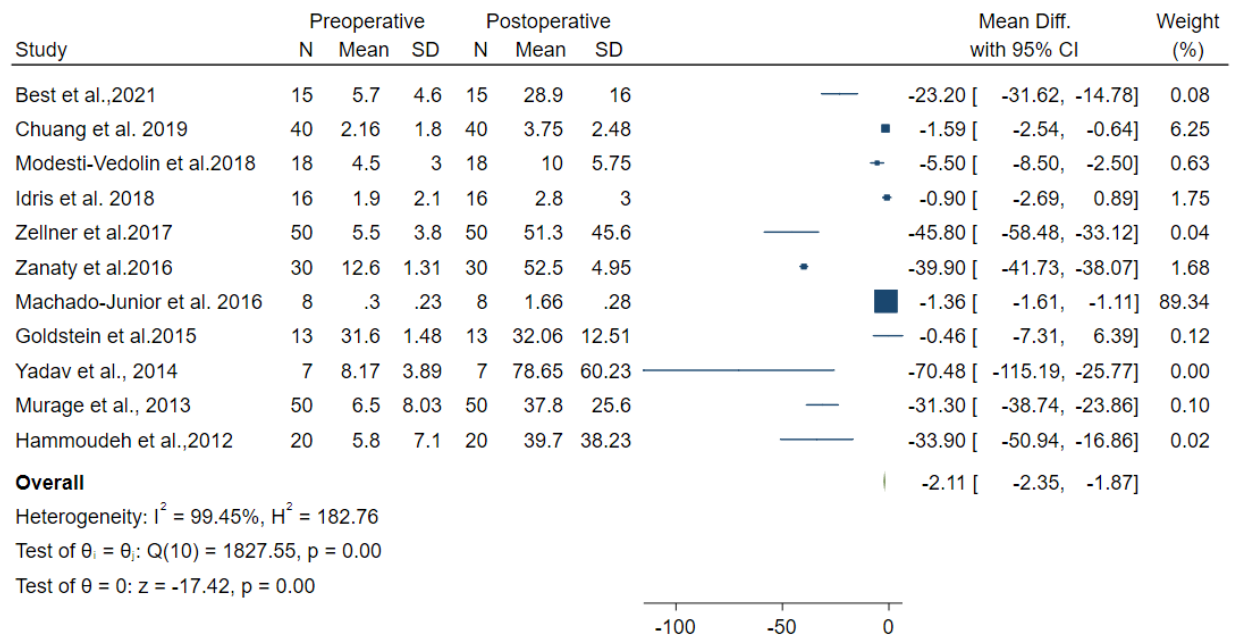
Study. Years	Selection (5 score)				Comparability (2 score)	Outcome (2 score)		Total score
	representative sample	Sample size	Non respondents	Ascertainment of the exposure	Based on design and analysis	Assessment of outcome	Statistical test	
Best et al.,2021 (13)	1	1	1	1	2	1	1	8
Zellner et al.2017 (17)	1	1	1	0	1	1	1	6
Zanaty et al.2016(18)	1	1	0	2	1	1	1	7
Goldstein et al.2015 (20)	1	1	1	0	2	1	1	7
Yadav et al., 2014 (21)	1	1	1	0	2	1	1	7
Murage et al., 2013 (22)	1	1	1	1	1	1	1	7
Hammoudeh et al.,2012 (23)	1	1	1	1	2	1	1	8

Table3. Risk of bias assessment (Cochrane Collaboration's tool(12))

study	Random sequence generation	allocation concealment	blinding of participants and personnel	blinding of outcome assessment	incomplete outcome data	selective reporting	Total score
Chuang et al. 2019 (14)							4
Modesti-Vedolin et al.2018 (15)							5
Idris et al. 2018 (16)							4
Machado-Junior et al. 2016(19)							4

Low (+), unclear (?), high (-)

Meta-analysis reported reduction Apnea-hypopnea index, mean difference between preoperative AHI and postoperative AHI was -2.11 events/h (MD, -2.11 95% CI -2.35, -1.87; P= 0.00) among the eleven studies (Figure2). There was statistically significant difference between preoperative AHI and postoperative AHI (p=0.00). Heterogeneity found ($I^2 = 99.45\%$; p=0.00). This result showed the change in AHI after mandibular advancement surgeries was -2.11 events/h reduction.



Fixed-effects inverse-variance model

Figure2. , mean difference of Apnea-hypopnea index between pre and post-surgical

Discussion

The aim of present Systematic Review and Meta-Analysis was evaluation Mandibular Advancement Surgeries for Pediatric Obstructive Sleep Apnea. Obstructive sleep apnea syndrome is a common pediatric disorder characterized by recurrent events of partial or complete upper airway obstruction during sleep which result in abnormal ventilation and sleep pattern(24). The apnea-hypopnea index (AHI) is the average number of disordered breathing events per hour. Typically, the OSA syndrome is defined as an AHI of 5 or greater. An AHI of 5–15 is considered as mild, 15–30 is moderate and more than 30 events per hour characterizes severe sleep apnea(25). The significant risk factors for OSAS in children include snoring ≥ 3 months, male gender, obesity, tonsillar and adenoid hypertrophy and, surprisingly breast feeding(1). Bue et al.,20200 in a narrative review reported OSA is a common disorder in children and those at risk must be identified, studied, and treated promptly because untreated OSA can be responsible for cardiovascular, metabolic, and neurocognitive morbidities and may induce, sometimes, non-reversible deficits given his insistence on a period of physical and neuro-psychic development(24). The Meta analysis of current study showed mean difference between preoperative AHI and postoperative AHI was -2.11 events/h. Noller et

Evaluation Mandibular Advancement Surgeries For Pediatric Obstructive Sleep Apnea: A Systematic Review And Meta-Analysis

al.,2018 in a systematic review and meta-analysis reported that obstructive sleep apnea has dramatically improved in pediatric patients with mandibular insufficiency when they have been treated with mandibular advancement or mandibular distraction osteogenesis(9). In Yanyan et al., 2019 study subgroup analysis suggested that MAA can be effective for mild to severe patients before the end of the pubertal peak. Long-term treatment (at least six months) may be more effective than short-term treatment(26). Chen et al., 2020 showed lower apnea-hypopnea index (95% CI: -7.23 to -1.89 , $p < 0.00001$), a retracted maxilla and mandible, a narrower airway and a shorter soft palate than non-responders(27). Heidari et al., 2020 reported positive effect of use mandibular advancement surgeries in treating children with mandibular insufficiency and improve obstructive sleep apnea(28). Overall, this systematic review and meta-analysis was well conducted and tried to take all the limitations in previous studies, also included studies with low-quality evidence and I² showed high Heterogeneity among studies. The present systematic review and Meta-analysis suggests that MAS improve AHI in children with OSA. More clinical trial studies are needed to provide better evidence.

Conclusions

reduction of AHI after mandibular advancement surgeries was -2.11 events/h in pediatric patients. mandibular advancement surgeries improved Obstructive Sleep Apnea. Studies with long-term outcomes are needed.

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Evaluation Mandibular Advancement Surgeries For Pediatric Obstructive Sleep Apnea: A Systematic Review And Meta-Analysis

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