Orthodontic And Orthopedic Management of Open Bite in Growing Patients: A Systematic Review

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ABSTRACT:

Background: There is a lack of consensus on the most effective strategies for managing open bite in growing patients due to heterogeneity in treatment protocols, variations in patient-related factors, and variation in the individual growth patterns

Objectives: To evaluate and find the efficacy of different treatment modalities in growing patients related to open bite.

Methods: All controlled trials that compared various appliances performed on growing patients were included in the review. The primary outcome of the review was openbite change in mm. Cochrane CENTRAL, PubMed, Google Scholar and Embase were searched. Data were extracted and the Risk of Bias was analysed by Cochrane RoB2 tool.

Results: Various orthodontic appliances achieved a correction of approximately 3-4 mm in anterior open bite among growing patients

Conclusion: The choice of appliance depends on various clinical factors, but end result may vary between 3-4 mm of correction and stability of these corrections remains uncertain still.

Keywords: Openbite, Adolescent, Growing Patients, Efficacy.

INTRODUCTION

The condition of openbite is defined as a lack of vertical overlap between the upper and lower dentition when jaws are closed (1). Open bite can be in the anterior or posterior region. The etiology of open bite is extensive and most prominant etiology include genetics, habits and skeletal discrepensies. In addition, prolonged use of pacifiers can also lead to open bite (2).

Open bite can be classifed as skeletal, dental, dentoalveolar or a combination of these as dictated by the underlying cause. Skeletal openbite is formed due to excessive vertical growth of dentoalveolar complex leading to greater lower facial height or long face. Dental open is generally present in the anterior region with proclined and/or undererupted anteriors, caused due to habits such thumb sucking, tongue thrusting, etc. The next type, the combination of skeletal and dentoalveolar open bite, both of previous mentioned features can be noted. The major reason for managing the open bite, apart from esthetics are the difficulties associated with speech, biting and mastication. In due course of time, it can also progress to temporomandibular joint disorders (3).

The management of open bite in growing patient is completely different from its management in adults, where orthodontic and surgical management predominate the treatment options. However, in growing patients, the treatment assumes a whole new perspective as it presents unique challenges and opportunities. It requires a comprehensive approach to addresses both dental and skeletal issues with growth modification approach. While an early intervention is essential to harness the power of growth, proper intervention is the key to success. In addition, timing of the treatment is the prime factor in success of the therapy. While early intervention can harness growth, it might not be sustainable. Individual variations in growth patterns can complicate treatment planning and outcomes. Growth spurts can either aid or complicate treatment, making it difficult to maintain long-term stability. (4)

Traditional orthodontic appliances, such as braces and aligners, are often used in conjunction with orthopedic devices like headgear, functional appliances, and rapid maxillary expanders to correct open bite and achieve optimal results.

Inspite of availability of numerous treatment modalities, there exists a lack of consensus on the most effective strategies for managing open bite in growing patients. This inconsistency can be due to the the heterogeneity in treatment protocols, variations in patient related factors, and variation in the individual growth patterns. As a result, a systematic review of the available literature is warranted to provide evidence-based guidelines for clinicians. This review focused on the orthodontic and orthopedic management of open bite in growing patients, evaluating the effectiveness of different treatment modalities and their long-term outcomes.

METHODS

Our present review was prepared according to the PRISMA guidelines. In our systematic review, the research methodology was made based on the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions. (5)

Eligibility Criteria

This review is aimed to find assess and synthesize all randomized controlled trials and randomized clinical trials that compared Functional, fixed or removable appliances to no treatment or another Functional, fixed or removable appliances. Only Studies on growing patients were included in the review. The primary outcome of the review was change in the post-treatment openbite in mm. PICOS criteria of the study were mentioned in table 1.

Participants	Growing patients
Interventions	Functional, fixed or removable appliances.
Comparison	No treatment or Functional, fixed or removable appliances.
Outcomes	Openbite change in mm
Study design	Randomized controlled trials

Table 1. PICOS criteria

Search strategy

Trial registries used for the search were Cochrane CENTRAL, PubMed, Google Scholar and Embase. Searches were run from inception to April 2026. To supplement the database search, we performed hand searches. We followed the PRISMA statement guidelines in the search process (Figure 1). The search was done with MeSH keywords and Boolean operators as follows:

("Orthodontic" OR "Orthopedic" OR "Fixed Appliance") AND ("Open Bite") AND ("Growing Patients" OR "Children" OR "Adolescents")) AND ("SNA" OR "SNB" OR "ANB" OR "LAFH" OR "IMPA" OR "Nasolabial angle") AND ("Randomized control Trial" OR "RCT") NOT ("Case Report" OR " Case Series") NOT ("Adult")

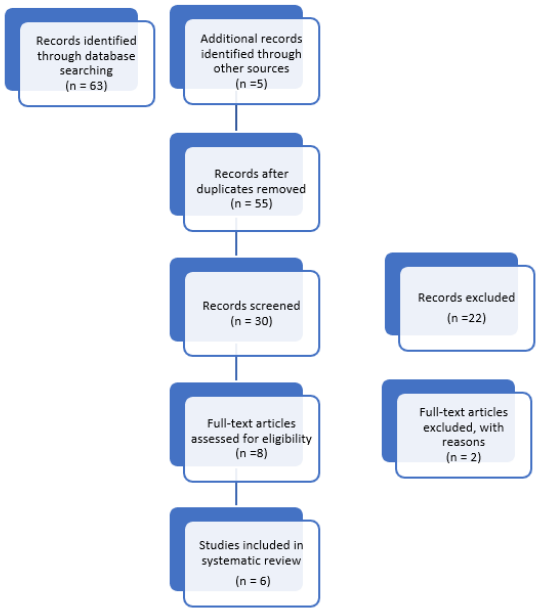

Figure 1. PRISMA flowchart

Study selection and screening

The entire search and screening procedure was carried out by two examiners. Based on the heading and abstracts obtained from the electronic search, the articles were collected based on the inclusion and exclusion criteria.

The first step included exclusion of irrelevant citations. Then all headings and abstracts were analysed to find out whether the article meet our

criteria. When the reviewer was sure about the unavailability of information of any article, it was immediately removed from the study. In case of any query, the full article was downloaded for thorough study, and the second thought to be given by another reviewer. The articles collected through first step were evaluated by two examiners to find out whether they met the eligibility factors. The articles with lack of proper design and necessary data and those not referenced correctly were excluded. All final articles were thoroughly gone through and relevant data obtained.

Data Extraction

A standardised form was used for data extraction of characteristics of studies, outcomes and risk of bias. Authors extracted the following data from included studies:

- Types of studies: randomized controlled trials
- Methods that the study used: study authors, year, study design
- The intervention/s of interest: type of intervention and the comparator/s used: no treatment, usual care
- Characteristics of the participants studies included: age, sample size
- Any reported outcomes of interest, such as: Openbite change (primary outcome)

Assessment of the Risk of Bias The risk of bias for each study was evaluated using the Cochrane Risk of Bias 2 tool. It included five domains such as D1- Randomization process, D2- Deviations from the intended interventions, D3- Missing outcome data, D4- Measurement of the outcome data, D5- Selection of the reported result. The risk of bias of the included studies were depicted in table 2 which showed all the studies have low risk of bias except Almeida et al which showed questionable risk with some concerns.

Study	D1	D2	D3	D4	D5	Overall
Castillo et al	+	+	+	+	?	+
Dias et al	?	+	+	?	+	+
Mousa et al	+	+	+	+	+	+
Rossato et al	+	+	+	+	+	+
Almeida et al	-	?	?	?	+	?
Erbay et al	+	+	+	+	?	+

+ Low, ? questionable, - high

Table 2. Risk of bias of the included studies

Dealing with missing data

We contacted investigators or study sponsors to provide missing data.

RESULTS:

Search and Selection

The PRISMA flowchart illustrated the process of study selection for the systematic review, beginning with the identification of research records from multiple sources. A total of 63 records were retrieved—4 from databases and 1 from a register. These records were initially screened for duplicates, but none were removed at this stage.

In the screening phase, all 63 records were reviewed based on their titles, and 27 records were excluded due to irrelevance or non-compliance with the inclusion criteria. This left 36 records for further evaluation, where the abstracts were carefully examined. As a result, 30 records were excluded after abstract screening, leading to 8 reports being sought for full retrieval and detailed assessment.

In the final stage, the eligibility of these 6 reports was thoroughly evaluated, resulting in 6 studies being deemed suitable for inclusion in the systematic review. This rigorous, step-by-step process ensured that only the most relevant and high-quality studies

were included, enhancing the validity of the review's findings.

Characteristics of the included studies:

The characreristics of the included studies were tabulated in table 3. Aliaga-Del Castillo et al (2021) studied Bonded spur with posterior buildup and Conventional bonded spurs, concluded that openbite correction was Similar in both groups. (6) Dias et al (2021) studied bonded lingual spurs, chincups, fixed palatal crib, and removable palatal crib compared with no treatment group and concluded that openbite correction had insignificant difference amongst the test groups but has significance difference from no treatment control group. (7) Mousa et al (2021) studied removable posterior bite plane with a tongue crib and Open Bite bionator, concluded that openbite correction was similar in both groups.(8) Rossato et al (2018) studied bonded spurs, chin cup, fixed palatal crib, and removable palatal crib and Nil, concluded that openbite correction were equally effective.(9) As per Almeida et al (2005), the treatment group did not have closure of the anterior open bite in six patients, and the control group had spontaneous closure of the open bite in four patients. So, in the control group, 26 patients did not have closure of the anterior open bite (RR = 0.23 (95% CI 0.11 to 0.48)). As per Erbay et al (1995), The mean overbite changed from -3.9 (standard deviation (SD) 1.3) mm before treatment to 1.1 (SD 0.9) mm after treatment in the intervention group; with difference of 5.0 (SD 1.3), $P < 0.001$, indicating that skeletal anterior open bite was successfully corrected in all patients. However, overbite remained negative in the control group, ranging from -3.5 (SD 1.4) mm initially to -2.1 (SD 1.8) mm in the end; with difference of 1.4 (SD 1.8) mm, $P < 0.01$. Risk ratio (RR) = 0.02 (95% confidence interval (CI) 0.00 to 0.38)

Table 3. Characteristics of included studies

Author et al	Type of study	Sample size	Population age	Intervention	Control	Outcome Measure (Change in openbite in mm)	Result
Aliaga-Del Castillo et al (2021)(6)	RCT	49	7-11	Bonded spur with posterior buildup	Conventional bonded spurs	Test 4.06(1.4) Control 3.88(1.6)	Similar in both groups
Dias et al (2021)(7)	RCT	99	7-10	BS- bonded lingual spurs; CC-chincup; FPC-fixed palatal crib; RPC- removable palatal crib	Nil	0.46; 1.10; 0.40; 0.15	insignificant difference
Mousa et al (2021)(8)	RCT	40	7.5 to 10.5	removable posterior bite plane with a tongue crib	Open Bite bionator	(con)4.91(0.4); (test)3.43(0.3)	Effective
Rossato et al (2018)(9)	RCT	99	7-9	bonded spurs, chin cup, fixed palatal crib, and removable palatal crib	Nil	BS 3.09(1.74) CC 2.26 (1.85) FPC 3.6(1.83) RPC 3.32(2.06)	Equally effective
Pedrin F et al (2006) (10)	RCT	60 (43 girls 17 boys)	7-10	Removable appliance with palatal crib with high pull chin cup	Nil	RR = 0.23 (95% CI 0.11 to 0.48)	Effective
Erbay et al (1995) (11)	RCT	40	Mixed dentition	Frenkel functional regulator 4	Nil	FR 5.0 1.3 Control 2.1 1.8	Effective

DISCUSSION

Management of anterior open bite in growing patients frequently involves the use of various orthodontic appliances to correct the bite by modifying the jaw growth and moving the teeth. Functional Appliances like the Frankel appliance or the Twin Block are indicated in these cases and work by guiding the lower jaw forward and by promoting proper bite closure. In case of high-pull headgear, it applies upward and backward force to the maxilla, to control the vertical growth to close the developing anterior open bite. The vertical pull chin cup on the other hand works to manage lower jaw growth by applying a vertical force to reduce the open bite. Another appliance, rapid maxillary expander is used in combination with high-pull headgear, to widen the upper jaw and aid in closing an open bite. In combination with braces, vertical or anterior elastics can be used to pull the dentition, aiding in bite closure. For milder cases, clear aligners can be used to adjust tooth position and manage open bites. (10)

Decision making for the treatment of anterior open bite in growing patients considers several factors such as the severity of the open bite, the patient's age, growth patterns, and deleterious habits. If the open bite is due to skeletal problems, habits or soft tissue dysfunction, habit intervention is the first step. Then growth Modification is advised for Skeletal Issues. In cases of severe Skeletal Discrepancy, functional appliances like the Frankel appliance or Twin Block are used. In mild to moderate skeletal issues, High-Pull Headgear/Chin Cup are used. For tooth movement in Mild to Moderate Open Bite, elastics in combination with braces or clear aligners are used to close the bite. In significant dental malalignment, fixed appliances are used to correct tooth alignment and close the open bite. In complex cases, a combination of appliances can be used. (11)

The choice of appliance depends on the severity of the open bite, the age of the patient, and specific growth patterns. A multidisciplinary approach involving orthodontists and sometimes oral surgeons may be necessary for optimal results. As the review focussed on efficacy of various appliances for treatment of anterior open bite in growing patient, during the search certain findings were apparent. Numerous studies reported findings from clinical studies and were excluded because they were not RCTs. However, it is prudent to summarize their findings briefly. Gurton et al.,(2004), Pedrin et al.,(2006), Cozza et al.,(2007), Defraia et al.,(2007), Ferreira et al.,(2012), Albogha et al.,(2015), Leite et al.,(2016), Mucedero et al.,(2017), Turkkahraman et al.,(2017), Mucedero et al.,(2018), Teixeira et al.,(2022), Abdelmonem et al.,(2023), Foot et al.,(2014), Barone et al.,(2024) all have reported such studies and have concluded that about 3-4mm correction of openbite happens with these appliances.(12-25) However, the role of growth has been emphasized universally as having good potential to correct the over bite with proper intervention.

In the next stage it is necessary to analyse the conclusions of relevant previous systematic reviews. Santos et al., (2020) (26) have concluded that higher quality RCTs are needed to assess the correction of openbite. They have also seen a correction of about 3-4 mm. In a meta-analysis by Feres et al., (2017) (27), they have reported that a correction of about +3.1mm in crib therapy which they reported to be the best amongst various therapies. They have shown that all these corrections are liable to be lost during growth. Prior to this study, Pisani et al., (2015) (28) too reported similar findings and pressed the need for long term studies for assessing the stability of corrections. While such studies are found during our search, they were not RCTs and were of lower evidence level. In this systematic review, due to high heterogeneity of methodologies and devices used, meta-analysis was not possible. However, the evidence converges on the same amount of correction.

Growth plays a major role in the correction and maintenance of openbite in the growing patients. In growth modification, timing the treatment is the

most important factor. This can have a major influence in retaining the achieved correction. Patients who have a vertical growth pattern may naturally outgrow a deep openbite as their jaws elongate. In contrast, in patients with horizontal growth patterns, deep bite may be maintained during the growth. Therefore, more RCTs are needed to study these variations so that exact effect of every appliance can be assessed.

With both RCTs and other types of clinical studies observed, the amount of correction remains the same. At current level of evidence, it can be seen that a correction of about +3-4mm can be achieved in the growing patients. The question of stability of dental correction remains unanswered due to absence of high quality RCT studies. The influence of growth on the achieved dental correction needs to be addressed with better focus.

CONCLUSION

The review highlighted that the orthodontic appliances can achieve a correction of approximately 3-4 mm in anterior open bite among growing patients, yet the stability of these corrections remains uncertain due to a lack of high-quality randomized controlled trials. Furthermore, the timing of treatment and the patient's growth pattern are critical factors influencing the effectiveness and retention of the achieved openbite correction.

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