



## Highlight the major clinical studies on orthognathic surgery in the correction of anomalies in Class III patients: a systematic review

Esther Zaquelo Reis Augusto<sup>1</sup>, Julia Higa Viudes<sup>1</sup>, Eduardo Bassi Rezende<sup>1</sup>,  
Andreia Borges Scriboni<sup>1,2\*</sup>

<sup>1</sup> UNORTE - University Center of Northern São Paulo, Dentistry department, São José do Rio Preto, São Paulo, Brazil.

<sup>2</sup> UNIPOS - Post graduate and continuing education, Dentistry department, São José do Rio Preto, São Paulo, Brazil.

\*Corresponding author Dra. Andreia Borges Scriboni.

Unorte/Unipos – Graduate and Postgraduate education,  
Dentistry department, São José do Rio Preto, São Paulo, Brazil.  
Email: abscriboni@hotmail.com

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### Abstract

**Introduction:** In the setting of orthognathic surgery, malocclusion is the third most common oral health problem after caries and periodontal diseases. Malocclusion is found in ages between 7 and 15 years with a prevalence of 6% in Brazil. **Objective:** The present study aimed to highlight the main considerations and findings of clinical studies on the importance of orthognathic surgery in the correction of anomalies in class III patients. **Methods:** The systematic review rules of the PRISMA Platform were followed. The search was carried out from February to April 2023 in the Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases, using articles with different dates up to 2022. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed accordingly, according to the Cochrane instrument. **Results and Conclusion:** A total of 112 articles were found, 70 articles were evaluated and 56 were included and developed in this systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 12 studies with a high risk of bias and 20 studies that did not meet GRADE. Based on the results, the treatment of Class III must be fundamentally based on the diagnosis so that the treatment can be installed in order to correct the compromised structures instead of being compensated in places not affected by this malocclusion. In other words, the degree of involvement of the maxilla and mandible must be evaluated so that the treatment is directed to that bone base and really achieves its goals and impacts of facial improvement. Redirection of growth in Class III cases is indicated as soon as the

anomaly is diagnosed, as the displacement processes that occur in the middle face can only be affected with treatment while the growth zones are able to respond to the biomechanical stimulus. Therefore, the younger the Class III patient is treated, the better the facial correction effects.

**Keywords:** Orthognathic surgery. Malocclusion. Class III malocclusion. Clinical studies.

### Introduction

In the setting of orthognathic surgery, malocclusion is the third most common oral health problem after caries and periodontal diseases [1-3]. The worldwide prevalence of Class III malocclusion in permanent dentition is estimated at 0.7% in Israel and 19.9% in China, being associated with greater facial disfigurement [4]. Malocclusion is found in ages between 7 and 15 years with a prevalence of 6% in Brazil [5]. The greatest number of traumatic injuries in primary teeth occur between one and a half and three years of age and in permanent teeth between 7 and 10 years old, with boys being more prone to dental trauma than girls. In this scenario, Class III malocclusion affects between 5% and 15% of the entire Brazilian population [5].

Orthodontics stands out due to its strong aesthetic compromise and unfavorable treatment prognosis, especially when there is a hereditary component. It is suggested that most cases of Class III malocclusion have maxillary retrusion or hypoplasia, which may or may not be associated with mandibular prognathism [2]. Treatment of Class III malocclusion before late

mixed dentition seems to induce more favorable craniofacial changes, with a significant increase in maxillary sagittal growth. However, a mandibular restriction effect can be achieved in later treatment [2]. Some studies report that disarticulation of circumaxillary sutures enhances orthopedic effects [3,4], however, the use of a face mask at a young age, even without palatal expansion, is effective for the correction of skeletal Class III.

Therefore, expansion should be indicated based on the clinical characteristics of the case. The harmonic functional aspect of the patient is important for the stability of the results. The dental and skeletal modifications of Class III correction produce an improvement in the relationship between teeth, bone bases, and soft tissue [5].

Thus, several treatment modalities are proposed for the correction of Class III malocclusion [6]. Approaches include the use of a protraction face mask with rapid maxillary expansion, face mask without maxillary expansion, face mask with alternating expansion with maxillary constriction, face mask associated with mini-implants on the zygomatic pillar, use of mini-implants orthodontics in the lower arch as an anchorage for maxillary traction using a removable upper appliance, use of mini-implants in the retromolar region, use of mini-implants in the buccal region of the lower arch, posterior region, use of a chin cup, reverse chin cup, functional Fränkel regulator use of acrylic grid and stop, use of removable mandibular retractor, use of reverse twin block, and use of tandem traction bow appliance [7-11].

In this scenario, it is extremely important that the diagnosis is made as soon as possible since skeletal discrepancies are quite difficult to correct due to the complexity of the treatment and the lack of predictability in the patients' growth pattern [12,13]. It is well documented in the literature that, in patients with Class III malocclusions still with growth potential, the most used treatment protocol is the protraction face mask associated with rapid maxillary expansion. Several studies that seek to show other types of treatment use this therapeutic modality as a control group [14-17].

Therefore, the present study aimed to highlight the main considerations and findings of clinical studies on the importance of orthognathic surgery in the correction of anomalies in Class III patients.

## Methods

### Study Design

This was followed by a systematic literature review model, according to the Preferred Reporting

Items for Systematic Reviews and Meta-Analyses (PRISMA) rules. Available in: <http://prisma-statement.org/?AspxAutoDetectCookieSupport=1>. Accessed in: 04/20/2023.

### Data sources and research strategy

The literary search process was carried out from February to April 2023 and was developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar, using articles with different dates up to 2022, using the descriptors (MeSH Terms): "Orthognathic surgery. Malocclusion. Class III malocclusion. Clinical studies", and using the Booleans "and" between the descriptors (MeSH Terms) and "or" between the historical findings.

### Study Quality and Risk of Bias

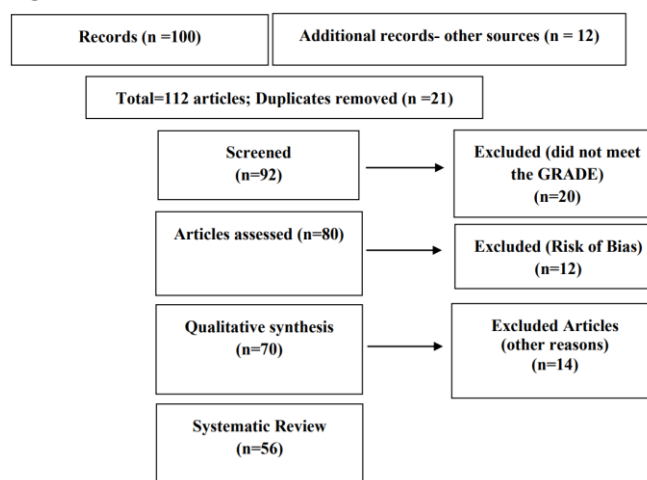
The quality of the studies was based on the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument.

## Results

### Summary of Literary Findings

A total of 112 articles were found. Initially, duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing the articles that did not include the theme of this article, resulting in 92 articles. A total of 70 articles were evaluated and 56 were included and developed in this systematic review study (Figure 1). Considering the Cochrane tool for risk of bias, the overall assessment resulted in 12 studies with a high risk of bias and 20 studies that did not meet GRADE.

Figure 1. Selection of studies.



The two most common dilemmas surrounding the treatment of Class III are the time of treatment and the type of appliance [18]. Various devices have been used to correct a Class III skeletal discrepancy, but little

evidence is available about their long-term effectiveness. Likewise, early treatment of Class III malocclusion has been practiced with growing interest. However, there is no solid evidence of long-term benefits [18,19].

Thus, a meta-analysis study evaluated the effectiveness of orthodontic/orthopedic methods used in the early treatment of Class III malocclusion in the short and long term. Fifteen studies, 9 RCTs, and 6 CCTs were included in this review. In the RCT group, only 3 of the 9 studies were assessed at low risk of bias, and the others were at high or unclear risk of bias. All 6 CCT studies were classified as high risk of bias. Three randomized controlled trials involving 141 participants analyzed the comparison between a protraction mask and untreated control. Results for reverse overjet (mean difference, 2.5 mm; 95% CI, 1.21-3.79;  $p=0.0001$ ) and ANB angle (mean difference, 3.90°; 95% CI, 3, 54-4.25;  $p<0.0001$ ) were statistically significant favoring the face mask group. All CCTs demonstrated a statistically significant benefit in favor of the use of each device. However, studies had a high risk of bias. Therefore, there is a moderate amount of evidence to show that early treatment with a face mask results in positive improvement for skeletal and dental effects in the short term. However, there was a lack of evidence on long-term benefits [20].

Also, Mandall et al. (2010) [17] tested the Class III treatment with the face mask associated with rapid maxillary expansion and concluded to be effective both skeletally and dentally. The only difference in the respective studies was the follow-up time after obtaining a Class I molar relationship, which ranged from 15 months to 36 months. Maxillary expansion prior to treatment with a face mask is used in most cases because it has the benefits of correcting the posterior crossbite when present, increasing the arch length, causing the bite to open, generating a loosening/activation of the circumaxillary sutures, and generate an initiation of movement of the maxillary complex downwards and forwards [21-25]. However, Vaughn et al. (2005) [26], in a randomized clinical trial, testing maxillary protraction in a group with expansion and in another without previous maxillary expansion concluded that the changes produced to the dentofacial complex were equivalent to an improvement in malocclusion Class III, and there is no change in the total treatment time. Maxillary expansion is only necessary in cases of posterior crossbite or space deficiency [27-38]. These data are also according to the systematic review conducted by Kurt et al. (2022) [39].

In contrast to the use or not of maxillary expansion prior to treatment for maxillary protraction, Liu et al. (2015) [36] tested the expansion plus constriction

protocol and observed that there were some statistically significant differences, such as better anterior movement of the maxilla and the rotation of the mandibular and palatal plane in the expansion/constriction group, but these changes did not demonstrate any clinical relevance, as they were less than 1 mm and 10°, respectively.

Chippers have been used to control mandibular protrusion in growing patients for nearly a century [40]. However, a deeper investigation in the literature revealed controversies and contradictions regarding the methodology of use, such as the appropriate age to start treatment and magnitude of force used. The clinical effectiveness is widely debated by authors who use different protocols, obtaining different results [41-44].

Abdelnaby and Nassar (2010) [30] carried out a study in patients aged between nine and ten years with a chin cup with occipital pull using two magnitudes of force. The authors obtained as results a significant decrease in the SNB angle both by the clockwise rotation of the mandible and by the increase in the anterior facial height in the two treated groups when compared to the untreated one, data that is also in agreement with the systematic review elaborated by Chatzoudi et al. (2014) [45]. The results achieved with the use of this apparatus significantly improved the maxillomandibular relationship, however, with few skeletal effects, and the difference in force magnitude generated the same effects.

Faced with so many devices already used and tested for the treatment of Class III malocclusion, due to the fact that they are not very aesthetic, several authors seek to develop new devices that can facilitate their use and, consequently, the acceptance of patients. Showkatbakhsh et al. (2012) [29] developed a new device called a reverse chin strap, with the aim of making a maxillary protraction. In this randomized clinical trial, the age range of patients ranged from seven to ten years and aimed to compare its effectiveness with the face mask. In both treatments, an anterior movement of the maxilla was achieved, as well as a buccalization of the maxillary anterior teeth and a lingualization of the mandibular incisors. The authors mention that, as the face mask is bulky in size, children feel discouraged from using it, especially at school, due to shame and the discomfort it generates. Thus, they suggest that the use of the reverse chin cup, as it is an aesthetically more acceptable method, may be a better option for maxillary protraction.

The use of the lingual grid or the removable upper acrylic stop generates a pressure of the tongue on the bulkhead, causing this force to be transmitted to the maxilla, causing its movement to the anterior [46,47]. When comparing its effects with that of a face mask, the

results are similar in moving the jaw forward. One advantage is that the lingual grid does not cause some unfavorable effects on the mandible (backward and downward rotation) for patients with a vertical growth pattern [47,48].

Also, orthopedic treatments with skeletal anchorage are becoming a new paradigm for the early treatment of Class III malocclusion [49-51]. Several studies cite the use of extraoral apparatus associated with this type of anchorage [52,53]. The use of mini-implants installed bilaterally on the zygomatic pillar associated with a face mask or installed between the roots of the canines and lower first premolars by buccal associated with a removable upper appliance with Class III hooks and elastics can be used to traction the jaw forward. Such treatment modalities, when compared with the use of a face mask, present similar results in the correction of maxillary deficiency. The fact of using devices of smaller size, causing a smaller aesthetic imbalance, can generate a better acceptance of the patient, making the treatment can be started earlier [54-56].

## Conclusion

Based on the results, the treatment of Class III must be fundamentally based on the diagnosis so that the treatment can be installed in order to correct the compromised structures instead of being compensated in places not affected by this malocclusion. In other words, the degree of involvement of the maxilla and mandible must be evaluated so that the treatment is directed to that bone base and really achieves its goals and impacts of facial improvement. Redirection of growth in Class III cases is indicated as soon as the anomaly is diagnosed, as the displacement processes that occur in the middle face can only be affected with treatment while the growth zones are able to respond to the biomechanical stimulus. Therefore, the younger the Class III patient is treated, the better the facial correction effects.

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## Informed consent

Not applicable.

## Data sharing statement

No additional data are available.

## Conflict of interest

The authors declare no conflict of interest.

## Similarity check

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