



Skeletal class III malocclusion and bilateral sagittal osteotomy: a concise systematic review

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Abstract

Introduction: In the context of skeletal class III malocclusion, orthognathic surgery is a standardized procedure used to improve the patient's facial appearance and to correct maxillary and mandibular deformities resulting from malocclusions, disease, or trauma. Thus, bilateral sagittal osteotomy of the mandibular ramus is a technique widely used in OS for the correction of mandibular deformities. **Objective:** the present study evaluated, through a concise systematic review, the main considerations of mandibular advancements through mandibular bilateral sagittal osteotomies in patients with skeletal class III malocclusion. **Methods:** Clinical studies with qualitative and/or quantitative analysis were included, following the rules of the systematic review-PRISMA. **Results:** A total of 115 articles were found involving "skeletal class III malocclusion". A total of 45 articles were evaluated in full, and 22 were included and discussed in this study. Bilateral sagittal osteotomy (BSO) is the most used technique in mandibular OS, allowing mandibular movements in the sagittal, vertical, and transverse directions. Several studies show good results and few complications. The size of this space is proportional to the mandibular advancement and/or rotation movements required by the patient's maxillomandibular discrepancy. The prevention of inferior mandibular edge defects is an important issue when planning an BSO traditional non-grafted BSO technique produces a large proportion of defects in the lower edge of the mandible. In cases where the advancement is greater than 10 mm and/or the patient is over 30 years old, the risk of the mandibular defect increases significantly. Also, using a bone graft in the intersegmental gap of a sagittal branch osteotomy is considered an effective clinical method to

ensure the desirable intersegmental position as it helps to easily maintain the space. **Conclusion:** The results showed that bilateral sagittal osteotomy is the most used technique in mandibular orthognathic surgery, allowing mandibular movements in the sagittal, vertical, and transverse directions, with good results and few complications. Furthermore, a bone graft can accelerate bone formation in orthognathic surgery.

Keywords: Skeletal class III malocclusion. Orthognathic surgery. Bilateral sagittal osteotomy. Ortho-surgical treatment.

Introduction

In the context of skeletal class III malocclusion, orthognathic surgery (OS) is a standardized procedure used to improve the patient's facial appearance and to correct maxillary and mandibular deformities resulting from malocclusions, disease, or trauma [1-3]. A satisfactory result in OS depends on the surgical technique and the precision of the orthodontic-surgical treatment plan [4]. Bilateral sagittal osteotomy (BSO) of the mandibular ramus is a technique widely used in OS for the correction of mandibular deformities [2].

Thus, mandibular advancement is a procedure with a high risk of skeletal recurrence, due to the difference between the proximal and distal bone segments [5]. The non-ossification between the maxillary bones after osteotomies is an important complication that can occur after performing this surgical procedure [6]. In this context, several studies report that areas of little or no bone contact in both the maxilla and mandible present a greater chance of instability. Furthermore, bone recovery would be inadequate if there is a defect greater than 3 mm

between the segments along the line of osteosynthesis [7].

In this sense, however, studies that correlate the use of biomaterials in areas of osteotomy in OS in order to contribute to bone union and stability of osteotomies are scarce [8]. Authors used a bone substitute between bone gaps and observed faster bone formation [9]. They then suggested that in patients who need wider movements with discontinuity between the stumps, it is important to use bone grafts in order to increase stability and reduce postoperative complications, but they warn that more studies are needed with tomographic evaluation and in longer periods than 6 months for more solid conclusions.

Also, authors using xenogenic bone graft in mandibular advancements greater than 8mm, performed clinical, radiographic, and histological evaluations, and concluded that the material is an effective tool in bone stability and mandibular esthetics and that it does not cause an increase in post-operatives [10]. Using the same material, now in the maxilla in advances of up to 5mm, they also observed promising results in a bone union in Le Fort I osteotomies, with the authors stressing the need for studies with greater maxillary advances and in other areas, such as the chin in genioplasty [11].

Therefore, the present study evaluated, through a concise systematic review, the main considerations of mandibular advancements through mandibular bilateral sagittal osteotomies in patients with skeletal class III malocclusion.

Methods

Study Design

The present study was followed by a systematic literature review model, according to the PRISMA rules. Access available at: <http://www.prisma-statement.org/>

Data sources and research strategy

Clinical studies were included as case reports, retrospective, prospective and randomized trials with qualitative and/or quantitative analysis. Also, some review studies were included. Initially, the keywords were determined by searching the DeCS tool (Descriptors in Health Sciences, BIREME base) and later verified and validated by the MeSH system (Medical Subject Headings, the US National Library of Medicine) to achieve consistent search.

Mesh Terms

The main MeSH Terms were Skeletal class III

malocclusion. Orthognathic surgery. Malocclusion. Ortho-surgical treatment. The literature search was conducted through online databases PubMed, Periodicos.com, Google Scholar, Ovid, Scopus, Web of Science and Cochrane Library.

Study quality and risk of bias

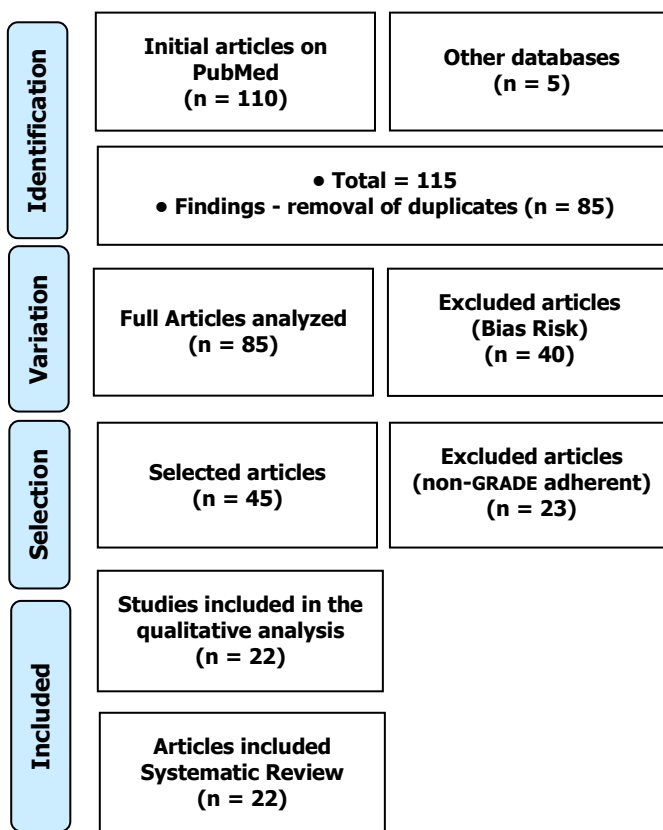
The quality of the studies was based on the GRADE instrument, with randomized controlled clinical studies, prospective controlled clinical studies, and studies of systematic review and meta-analysis listed as the studies with the greatest scientific evidence. The risk of bias was analyzed according to the Cochrane instrument.

Results

Literature Review and Discussion

A total of 115 articles were found involving Skeletal class III malocclusion and bilateral sagittal osteotomy. Initially, was held the exclusion of existing title and duplications following the interest described in this work. After this process, the summaries were evaluated and a new exclusion was held. A total of 45 articles were evaluated in full, and 22 were included and discussed in this study (Figure 1).

Figure 1. The selection process of scientific articles.



Based on the analyzed findings, it was found that bilateral sagittal osteotomy (BSO) is the most used technique in mandibular OS, allowing mandibular movements in the sagittal, vertical, and transverse directions. Several studies show good results and few complications [12-15].

In this procedure, the mandibular body is separated from the proximal fragment and moved to the planned position, creating a space between the segments. The size of this space is proportional to the mandibular advancement and/or rotation movements required by the patient's maxillomandibular discrepancy. This usually occurs without complications, but in some cases, there is a persistent defect at the osteotomy site at the lower edge [16].

Although not widely described, this complication can be a visible and/or palpable defect along the lower edge of the mandible, commonly leading to patient complaints [1]. Therefore, the prevention of inferior mandibular edge defects is an important issue when planning an BSO [2].

Furthermore, a study compared different BSO techniques to prevent the incidence of defects in the lower edge of the mandible. The authors performed a retrospective multicenter cohort study comparing 3 BSO techniques for advancements greater than 5 mm: traditional ungrafted BSO (group A), traditional grafted BSO (group B), and modified BSO (group C). The space created by the mandibular advancement was measured. The presence or absence of defect was determined 1 year after surgery by clinical and radiographic evaluation. Bone defect outcome was associated with potential risk predictors (age, gender, side of BSO, and magnitude of mandibular advancement). A total of 1,002 operative sites in 501 patients were included in the study. Mean age 26.8 ± 11 years, gender (310 women, 191 men), and right mandibular advancement of 9.3 mm and left of 10 mm were similar between groups ($p > 0.05$). The proportions of postsurgical inferior border defects were 54.5% in group A, 1.3% in group B and 10.6% in group C. Traditional graft and modified BSO techniques were significantly more effective in preventing the incidence of defects in the lower edge of the mandible compared to the traditional non-grafted BSO technique ($p < 0.05$). Therefore, this study showed that the traditional non-grafted BSO technique produces a large proportion of defects in the lower edge of the mandible [17].

Furthermore, authors studied 400 post-operative sites in 200 patients and reported post-surgical defects in more than a third of sites with traditional BSO. The risk factors reported were the total inclusion of the lower edge in one or another fragment of the BSO, the mandibular advancement scale, and the patient's age.

The results of this study showed that in cases where the advancement is greater than 10 mm and/or the patient is over 30 years old, the risk of the mandibular defect increases significantly [18].

In this sense, a study with forty-eight patients examined the effects of demineralized bone matrix (DBM) grafts on bone remodeling during sagittal branch osteotomy by measuring three-dimensional (3D) reconstructed images. In the control group, no graft was performed. In the DBM group, grafts were placed between the proximal and distal segments. The 2 groups showed a significant increase in volume. However, over the same period, the volume increase rates of the 2 groups showed significant differences. In the control group, a significant increase in volume was seen until T2, after which an insignificant increase was seen. In the DBM group, a significant increase in volume continued until T3. Therefore, in OS, DBM grafting accelerates bone formation [19].

Also, a retrospective cohort study with 84 patients (168 osteotomies) with a mean age of 27.4 years determined whether bone grafting into the bone defect in BSO surgery would reduce the defect at 1 year postoperatively compared to none bone graft, considering 10 mm or more in advance. Of the 84 patients, 40 underwent bilateral bone graft (BO). The iliac crest bone monocortical block was used as a bone homograft. The final residual defect was measured at 1 year postoperatively on CBCT CT scans. The OS and the group without OS had a mean final defect of 0.7 mm (range 0 to 4.5 mm) and 3.0 mm (range 0 to 5.5 mm), respectively. Complete absence of the defect was achieved in 72% of EO osteotomies and 9% of non-BO osteotomies [20].

Still, another retrospective study with forty patients investigated the osteotomy gap graft during BSO, using a xenograft and fibrin glue. Hard tissue defects at the lower edge of the mandible were evaluated by cone-beam computed tomography performed 1 week and 1 year after surgery. The study group of 20 patients underwent bone grafting during BSO (mean age 26.1 years; mean horizontal displacement of 8.5 mm) and the control group of 20 patients did not (mean age 30.2 years; mean horizontal displacement of 7.6 mm). The graft had a negligible effect on large displacements (9.0-15.0 mm), which could have been due to an inadequate quantity and/or positioning of the graft, or too fragile dimensional stability [21].

Finally, a study determined how the condylar position is affected by bone grafting into the intersegmental space created by the sagittal branch osteotomy. The position of the condyle after sagittal branch osteotomy was compared, without the bone graft (control group, $n=30$) and with the bone graft

(n=30) by means of computed tomography with a thickness of 2 mm. The condylar displacement in relation to the amount of setback of the mandible was significant, especially when it was greater than 10 mm of setback. Therefore, using a bone graft in the intersegmental gap of a sagittal branch osteotomy is considered an effective clinical method to ensure the desirable intersegmental position as it helps to easily maintain the space [22].

Conclusion

The results showed that bilateral sagittal osteotomy is the most used technique in mandibular orthognathic surgery, allowing mandibular movements in the sagittal, vertical, and transverse directions, with good results and few complications. Furthermore, a bone graft can accelerate bone formation in orthognathic surgery.

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

Similarity check

It was applied by Ithenticate@.

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