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Orthognathic surgery in the mandibular advance: a systematic review

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Abstract

Introduction: Orthognathic surgery is a standardized procedure used to improve a patient's facial appearance and to correct maxillary and mandibular deformities resulting from malocclusions, disease or trauma. Bilateral sagittal osteotomy of the mandibular ramus is a technique widely used in orthognathic surgery to correct mandibular deformities. Mandibular advancement is a procedure with a high risk of skeletal recurrence, due to the difference between the proximal and distal bone segments. **Objective:** To carry out a systematic review of orthognathic surgery in the mandibular advance, focusing on the main challenges and importance. **Methods:** The present study was followed by a systematic literature review model - PRISMA rules. The quality of the studies was based on the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** 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. However, this technique can cause mandibular advancements above 10 mm, strongly pointing to the placement of a bone graft in order to avoid defects and their complications. Therefore, in orthognathic surgery, bone grafting can accelerate bone formation.

Keywords: Orthognathic surgery. Maxillary deformities. Mandibular advance. Bone graft.

Introduction

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 [1,2]. A satisfactory result in orthognathic surgery depends on the surgical technique and the precision of the orthodontic-surgical treatment plan [3,4]. Bilateral sagittal osteotomy (BSO) of the mandibular ramus is a technique widely used in orthognathic surgery for the correction of mandibular deformities [5-7].

Mandibular advancement is a procedure with a high risk of skeletal recurrence, due to the difference between the proximal and distal bone segments [8]. The non-ossification between the maxillary bones after osteotomies is an important complication that can occur after performing this surgical procedure [9].

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 [10].

However, studies that correlate the use of biomaterials in areas of osteotomy in orthognathic surgery to contribute to bone union and stability of osteotomies are scarce [11]. The authors used a bone substitute between bone gaps and observed faster bone formation. They then suggested that in patients who need wider movements with discontinuity between the stumps, it is important to use bone grafts 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 [12].

Also, other 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 postoperative complications [13]. 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 [14].

Therefore, this study aimed to carry out a systematic review of orthognathic surgery in the mandibular advance, focusing on the main challenges and importance.

Methods

Study Design

The present study was followed by a systematic literature review model, according to the PRISMA rules [15].

Data sources and research strategy

The search strategies for this review were based on the descriptors: "Orthognathic surgery. Maxillary deformities. Mandibular advance. Bone grafting. The research was carried out from July 2021 to August 2021 and developed based on Google Scholar, Scopus, PubMed, Scielo, and Cochrane Library.

Study quality and risk of bias

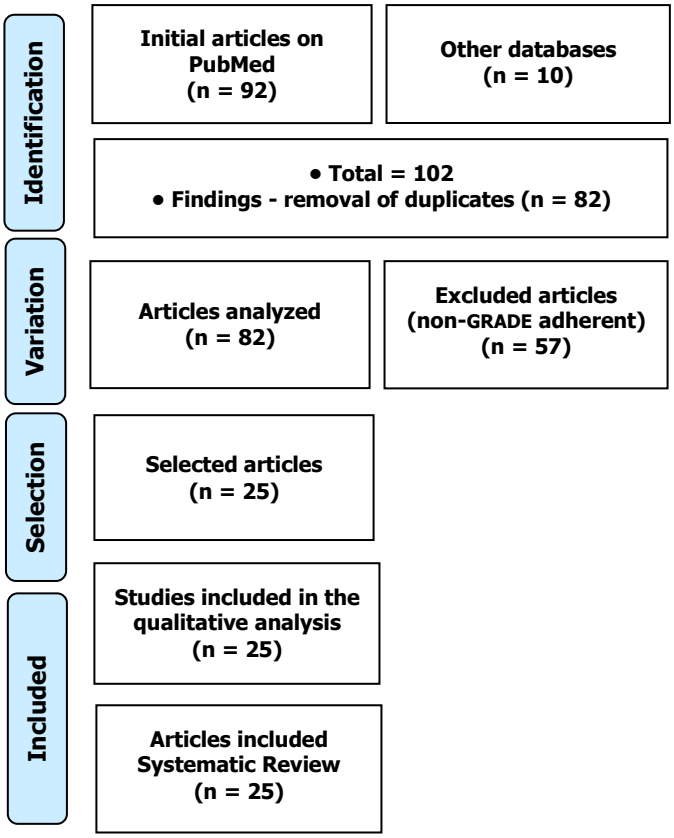
The quality of the studies was based on the GRADE instrument [16], with randomized controlled clinical studies, prospective controlled clinical studies, and studies of systematic review and meta-analysis listed as the studies with the greatest scientific evidence. The risk of bias was analyzed according to the Cochrane instrument [17].

Results

Figure 1 shows the article selection process. Out of a total of 102 articles found, 82 articles were evaluated and 57 were rejected for not meeting the GRADE classification, and only 25 articles were used in this study to compose the textual part. So, it was found that it is known that bilateral sagittal osteotomy (BSO) is the most used technique in mandibular orthognathic surgery, allowing mandibular movements in the sagittal, vertical, and transverse directions. Several studies show good results and few complications [18-20].

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 [21,22].

Figure 1. The selection process of scientific articles.



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].

As literary support for the findings of the present work, 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 [23].

Furthermore, Agbaje et al. [24] studied 400 post-operative sites in 200 patients and reported post-surgical defects in more than a third of sites with traditional BSO. Reported risk factors were the total inclusion of the lower edge in one or another BSO fragment, 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 older than 30 years, the risk of the mandibular defect increases significantly. This strongly points to the placement of a bone graft to avoid defects and their complications.

In this sense, a study with forty-eight patients examined the effects of demineralized bone matrix (MOD) 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 MOD 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 MOD group, a significant increase in volume continued until T3. Therefore, in orthognathic surgery, DOM grafting accelerates bone formation [25].

In addition, 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 (EO). 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-EO osteotomies [26].

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 may have been due to an inadequate quantity and/or positioning of the graft, or too fragile dimensional stability [27].

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) employing computed tomography with a thickness of 2 mm. The condylar displacement 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 [28].

Conclusion

Bilateral sagittal osteotomy (BSO) 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. However, this technique can cause mandibular advancements above 10 mm, strongly pointing to the placement of a bone graft to avoid defects and their complications. Therefore, in orthognathic surgery, bone grafting can accelerate bone formation.

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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