

The Effect of the Mandibular Fixation Method after Bilateral Sagittal Split Ramus Osteotomy on Postoperative Stability: A Literature Review

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Abstract

Context: Using a reliable fixation method after ramus sagittal split osteotomy in order to reduce the chances of treatment relapse and condyle changes is still one of the most noteworthy issues discussed among maxillofacial surgeons. In this study, the results of the up-to-date papers were collected, which identify the effects of the fixation method on the post-operative results, to give the reader a comprehensive view of the new concepts.

Evidence Acquisition: The most frequent mandibular surgeries, setbacks, and advancements via the bilateral sagittal split osteotomy technique were used for a literature search due to the abundance of related articles. Consequently, the following keywords were applied: sagittal split ramus osteotomy, orthognathic surgery, rigid fixation, non-rigid fixation, postoperative relapse, and postoperative stability.

Results: The articles were classified according to the surgery procedure: mandibular advancement surgery or mandibular setback surgery. The relapse pattern can be divided into two categories: an early relapse, which is strongly related to the surgery procedure, and a late relapse, which can be attributed to the physiologic changes, such as a growth map. The contributing factors can be considered to be the following: a change in ramus in inclination, the mandibular plane, and the fixation type.

Conclusions: Using rigid fixation techniques after bilateral sagittal split ramus osteotomy will optimize the stability, but this stability is not influenced by the method of this rigid fixation; although the most commonly suggested technique, bicortical screws, is in the inverted-L position

Keywords: Sagittal Split Ramus Osteotomy, Jaw Fixation Technique, Stability

1. Context

Using a reliable fixation method after ramus sagittal split osteotomy in order to reduce the chance of treatment relapse and condyle changes, is still one of the most noteworthy issues discussed among maxillofacial surgeons. After introducing rigid fixation methods, in a short period of time, they become a standard of care. There are several reasons for this change in surgeons' approach: In using these methods, little or no intermaxillary fixation is needed; patients experience greater comfort; there is little or no movement in proximal and distal segments; and rapid bone repair occurs. These factors have been claimed to optimize the final stability of the treatment results. Using internal rigid fixation methods may help in more rapidly maintaining the condyle position intraoperatively (1-3). Now, by considering the advantages of the rigid fixations, an important concern is raised about the quality of this rigidity. Is it mandatory to use the most rigid techniques for optimizing the results, or can more flexible methods accomplish better results?

The common techniques of fixations can be classified

in the following ways:

- Non-rigid fixation
- Wire osteosynthesis
- Rigid fixation
- Two bicortical screws
- Three bicortical screws (L form, Linear form, Triangular form)
- Miniplate with mono-cortical screws
- Hybrid technique including a miniplate with bicortical screws

The importance of the level of rigidity is its effect on the condyle position (4). Furthermore, this factor can affect the postoperative stability and relapse rate. Despite the easiness of condyle repositioning with rigid techniques, condylar head remodeling is lower with non-rigid or semi-rigid techniques (5). However, some authors do not accept this concept; they believe that rigid techniques are the key factor of treatment success (6-9). In this study, the results of the up-to-date papers were collected, which identify the effects of the fixation method on the post-operative results, in order to give readers a comprehensive view of the new concepts.

2. Evidence Acquisition

The surgical procedures focused on in this study are the setback and advancement of the mandible by a bilateral sagittal split osteotomy (BSSO) with or without maxillary surgery. These two procedures were chosen because they are the most frequently performed operations, and the literature contains the most information regarding stability with their use. By using the following keynotes, a literature search was performed: sagittal split ramus osteotomy, orthognathic surgery, rigid fixation, non-rigid fixation, postoperative relapse, and postoperative stability. For doing a comprehensive search, the following databases were used: Pubmed, Web of Science, and Google Scholar. Articles were classified according to the types of fixation and surgery (i.e. setback or advancement surgery) they addressed.

3. Results

The articles were classified according to the surgery procedure: mandibular advancement surgery or mandibular setback surgery. The statistics of the retrieved articles is shown in [Table 1](#).

Table 1. Literature Search Summary

Year	Surgery		Total
	Mandibular Setback	Mandibular Advancement	
2016	1	0	1
2014	1	2	3
2013	3	0	3
2012	4	0	4
2011	1	2	3
2010	2	3	5
2009	1	1	2
2008	2	0	3
2005	2	1	3
2004	1	0	1
2000	1	3	4
1999	1	0	1
1998	1	0	1
1991	1	0	1
1989	3	1	4
1985	0	1	1
Total	25	14	33^a

^aThe total number is less than the sum of the mandibular setback and advancement columns because of the repeated articles in both groups.

The stability of the mandibular advancement or setback surgery after orthognathic surgery still is one the most important concerns of the surgeons. The relapse of the changes after BSSRO can be divided into two categories: early relapse, which is strongly related to the surgery procedure, and late relapse, which can be attributed to the physiologic changes, such as a growth map. In early relapse, the important elements that must be considered and examined are the condylar position, the latent bad fracture, and failure to get enough fixation after jaw movements. Also, late relapse may occur due to inadequate fixation and the extent of the movements. In addition, as mentioned previously, the rigidity of fixation can influence both early and late relapse. Unfortunately, there is still no long-term prospective randomized clinical trial study that has assessed the outcomes of different types of mandibular fixation after BSSRO. There are several studies concerning mandibular setback outcomes after BSSRO, but there are fewer studies concerning mandibular advancement outcomes after BSSRO.

3.1. Mandibular Setback Stability After BSSRO

By using miniplate, monocortical osteosynthesis could obtain stable postoperative outcomes after a mandibular setback surgery; several authors have confirmed this suggestion. There is no significant difference in treatment outcomes between plate fixation and bicortical screw techniques when no intermaxillary fixation is applied (10-13).

However, Paeng (2012) warned against using resorbable bicortical screws because of the unfavorable effects they have on the vertical stability of mandibular surgery. In 1997, it was demonstrated that using poly-L-lactic acid (PLLA) screws in the osteosynthesis of a mandibular fracture after setback surgery must be conducted with caution because of the probable instability of the outcomes (14-16).

Some surgeons have used two bicortical screws instead of three bicortical screws and the hybrid technique also known as the semi-rigid fixation technique. Utilizing two bicortical screws after BSSRO would not influence the results, simultaneously making orthodontists capable of correcting minor occlusal discrepancies after jaw surgery (17). These results have also been confirmed in other studies (10, 18-22).

There are several in vitro studies focused on mechanical aspects of the fixation methods that can be considered as valid guidance for clinical utilization. Sato et al. stated that three bicortical positional screws presented better mechanical resistance and stress distribution patterns than the hybrid technique; they also increased the resistance and improved the stress distribution of mini-

plate/monocortical screw fixation, maintaining most of the advantages of this technique (6).

Some articles reveal no superiority of rigid fixation upon wire osteosynthesis. In a clinical trial, it was shown that neither rigid fixation nor wire osteosynthesis have a significant effect on long-term results, because inherently the bimaxillary surgery is stable. These results were reported by Buckley in 1989; he believed that there is no difference between wire and rigid osteosynthesis outcomes only between patients' comfort levels (7, 23).

3.2. Mandibular Advancement Stability After BSSRO

Unfortunately, few articles have assessed the stability of mandibular advancement after BSSRO in bimaxillary surgery. Sato et al. compared different methods of fixation (i.e. bicortical screws, a miniplate with monocortical screws, or the hybrid technique) in a clinical study, but he concluded that there is no significant difference between these methods (24). Dolce et al. and Berger et al. both reported the excellent results of bicortical fixation versus wire osteosynthesis (8, 24-26). Furthermore, Moen et al. described the insignificant skeletal changes that happen after mandibular advancement using the rigid fixation technique; meanwhile, however, he believed that the minor changes that happen after surgery are due to dental relapse (27). In 2000, Van Sickels et al. showed that initial advancement, change in ramus inclination, and change in the mandibular plane are the main factors influencing the long-term results of using any type of fixation technique (9). As mentioned before, there are not enough research articles about the comparative outcomes of different fixation methods for mandibular body fractures after BSSRO in Cl II patients. However, by considering the available studies, use of rigid fixation with three bicortical screws could be supposed to have more stable postoperative results.

4. Conclusions

The aim of this literature review was to compare existing articles about rigid fixation methods in orthognathic surgeries, giving readers the opportunity to judge the results for themselves. As reported by various researchers, using rigid fixation techniques after bilateral sagittal split ramus osteotomy will optimize the stability, but this stability is not influenced by this rigid fixation method, although the most commonly suggested technique is bicortical screws in inverted-L position (6, 21, 28-33). Furthermore, rigid fixation will facilitate positioning and stabilizing of the proximal segment, which is an important factor of early relapse. However, there were evidences that showed no differences between the methods of fixation,

especially in Cl III patients. Also, using intermaxillary fixation after orthognathic surgery when using the internal rigid fixation techniques is questionable, because it does not influence the long-term results significantly (34, 35).

Footnote

Authors' Contribution: Study concept, design, and manuscript preparation, Shapoor Yaripoor; literature review and manuscript preparation, Pejman Janbaz.

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