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STABILITY IN ORTHOGNATHIC SURGERY IN CLASS III PATIENTS

ESTABILIDADE EM CIRURGIA ORTOGNÁTICA DE PACIENTES CLASSE III

ESTABILIDAD EN LA CIRUGÍA ORTOGNÁTICA EN PACIENTES CLASE III

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ABSTRACT

Skeletal Class III malocclusion represents a complex dentofacial deformity characterized by discrepancies between the maxillary and mandibular skeletal bases, with significant aesthetic, functional, and psychosocial repercussions. In adult patients, bimaxillary orthognathic surgery has been widely recognized as the standard treatment for the definitive correction of these alterations; however, postoperative skeletal stability remains one of the main clinical challenges, as relapse may compromise the results achieved in the medium and long term. This study aimed to review recent literature on postoperative stability in Class III patients undergoing orthognathic surgery, with emphasis on factors associated with bone and condylar adaptation, three-dimensional planning, and clinical implications for maintaining outcomes. This is a narrative literature review based on studies published in recent years (2022 to 2025) addressing biomechanical, articular, and technological aspects related to orthognathic surgery. The findings demonstrate that bimaxillary surgery promotes significant improvements in facial aesthetics, skeletal symmetry, occlusion, and quality of life. Maxillary positioning and fixation show greater predictability compared to the mandible due to several factors. Postoperative stability is multifactorial and influenced by the magnitude of surgical movements, temporomandibular joint adaptation, neuromuscular response, and the use of three-dimensional virtual planning. Although the incidence of condylar resorption in Class III patients is lower than that observed in other skeletal deformities, this condition remains clinically relevant. It is concluded that bimaxillary orthognathic surgery, when properly indicated, planned, and performed, constitutes an effective and highly stable approach

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for the treatment of skeletal Class III, surpassing orthodontic camouflage in cases with significant skeletal discrepancy.

Keywords: Orthognathic Surgery. Class III Malocclusion. Skeletal Stability. Relapse. Three-Dimensional Planning. Temporomandibular Joint.

RESUMO

A maloclusão esquelética de Classe III representa uma deformidade dentofacial complexa, caracterizada por discrepâncias entre as bases ósseas maxilar e mandibular, com repercussões estéticas, funcionais e psicossociais relevantes. Em pacientes adultos, a cirurgia ortognática bimaxilar tem sido amplamente reconhecida como o tratamento padrão para a correção definitiva dessas alterações, no entanto, a estabilidade esquelética pós-operatória permanece como um dos principais desafios clínicos, uma vez que recidivas podem comprometer os resultados obtidos a médio e longo prazo. Este estudo teve como objetivo revisar a literatura recente acerca da estabilidade pós-operatória em pacientes Classe III submetidos à cirurgia ortognática, com ênfase nos fatores associados à adaptação óssea e condilar, ao planejamento tridimensional e às implicações clínicas para a manutenção dos resultados. Trata-se de uma revisão narrativa da literatura, baseada em estudos publicados nos últimos anos (2022 a 2025), que abordam aspectos biomecânicos, articulares e tecnológicos relacionados à cirurgia ortognática. Os achados comprovam que a cirurgia bimaxilar promove melhorias significativas na estética facial, simetria esquelética, oclusão e qualidade de vida. O posicionamento e fixação da maxila apresenta maior previsibilidade em comparação a mandíbula devido a diversos fatores. Quanto à estabilidade pós-operatória, mostra-se multifatorial, sendo influenciada pela magnitude dos movimentos cirúrgicos, pela adaptação da articulação temporomandibular, pela resposta neuromuscular e pelo uso de planejamento virtual tridimensional. Embora a incidência de reabsorção condilar em pacientes Classe III seja inferior à observada em outras deformidades esqueléticas, essa condição permanece clinicamente relevante. Conclui-se que a cirurgia ortognática bimaxilar, quando corretamente indicada, planejada e executada, constitui uma abordagem eficaz e de grande estabilidade para o tratamento da Classe III esquelética, superando a camuflagem ortodôntica nos casos em que há discrepância óssea significativa.

Palavras-chave: Cirurgia Ortognática. Maloclusão de Classe III. Estabilidade Esquelética. Recidiva. Planejamento Tridimensional. Articulação Temporomandibular.

RESUMEN

La maloclusión esquelética de Clase III representa una deformidad dentofacial compleja, caracterizada por discrepancias entre las bases óseas maxilar y mandibular, con repercusiones estéticas, funcionales y psicosociales relevantes. En pacientes adultos, la cirugía ortognática bimaxilar ha sido ampliamente reconocida como el tratamiento estándar para la corrección definitiva de estas alteraciones; sin embargo, la estabilidad esquelética postoperatoria sigue siendo uno de los principales desafíos clínicos, ya que las recidivas pueden comprometer los resultados obtenidos a mediano y largo plazo. Este estudio tuvo como objetivo revisar la literatura reciente sobre la estabilidad postoperatoria en pacientes Clase III sometidos a cirugía ortognática, con énfasis en los factores asociados a la adaptación ósea y condilar, la planificación tridimensional y las implicaciones clínicas para el mantenimiento de los resultados. Se trata de una revisión narrativa de la literatura, basada en estudios publicados en los últimos años (2022 a

2025), que abordan aspectos biomecánicos, articulares y tecnológicos relacionados con la cirugía ortognática. Los hallazgos demuestran que la cirugía bimaxilar promueve mejoras significativas en la estética facial, la simetría esquelética, la oclusión y la calidad de vida. El posicionamiento y la fijación del maxilar presentan mayor previsibilidad en comparación con la mandíbula debido a diversos factores. En cuanto a la estabilidad postoperatoria, esta se muestra multifactorial, siendo influenciada por la magnitud de los movimientos quirúrgicos, la adaptación de la articulación temporomandibular, la respuesta neuromuscular y el uso de la planificación virtual tridimensional. Aunque la incidencia de reabsorción condilar en pacientes Clase III es inferior a la observada en otras deformidades esqueléticas, esta condición sigue siendo clínicamente relevante. Se concluye que la cirugía ortognática bimaxilar, cuando está correctamente indicada, planificada y ejecutada, constituye un abordaje eficaz y de gran estabilidad para el tratamiento de la Clase III esquelética, superando la camuflaje ortodóncico en los casos en que existe una discrepancia ósea significativa.

Palabras clave: Cirugía Ortognática. Maloclusión de Clase III. Estabilidad Esquelética. Recidiva. Planificación Tridimensional. Articulación Temporomandibular.

1 INTRODUCTION

Class III skeletal malocclusion is a dentofacial deformity of high clinical relevance, characterized by mandibular prognathism, maxillary deficiency, or the association of both, resulting in significant discrepancies between the maxillomandibular bone bases (Alhammadi et al., 2022; Nguyen and Nguyen, 2025). In addition to the impairment of facial aesthetic harmony, this condition is often associated with important functional impairments, including masticatory alterations, respiratory, and phonoarticulatory alterations, as well as significant psychosocial impacts, such as social anxiety and reduced self-esteem (Lathrop-Marshall et al., 2022; Owens et al., 2024).

In adult patients with class III skeletal discrepancies, bimaxillary orthognathic surgery, which combines le fort I osteotomy for maxillary positioning with bilateral sagittal ramus mandibular branch osteotomy (BSSO) for mandible indentation, has established itself as the main therapeutic approach for definitive correction of this condition (Nguyen and Nguyen, 2025). Despite the aesthetic and functional results presented in the immediate postoperative period, skeletal stability over time remains an aspect of great clinical relevance, since late changes can compromise the results achieved (Gal et al., 2025) Elements such as the adaptation of the temporomandibular joints, changes in the dimensions of the upper airways, and the bone remodeling process play a decisive role in the occurrence of recurrences, reinforcing the importance of three-dimensional virtual planning and precise surgical execution for the maintenance of long-term results (Nguyen and Nguyen, 2025; Faria-Teixeira et al., 2025).

The literature shows that stability after orthognathic surgery is a multifactorial phenomenon, influenced by biomechanical and biological aspects, such as condylar adaptation, bone remodeling, neuromuscular response, and changes in the upper airways (Faria-Teixeira et al., 2024; Nguyen and Nguyen, 2025). In this context, recent advances in three-dimensional virtual planning and the use of digital technologies have contributed to greater precision in surgical execution, but they do not completely eliminate the risk of instability, especially in mandibular movements of greater magnitude.

In this scenario, understanding the factors that influence postoperative stability in Class III patients undergoing orthognathic surgery becomes essential for improving planning, surgical execution, and clinical follow-up. Thus, this study aims to critically review the recent literature on skeletal stability in orthognathic surgery of Class III

patients, emphasizing the aspects associated with bone and joint adaptation, three-dimensional planning, and clinical implications for the maintenance of long-term results.

2 METHODOLOGY

This work is a narrative review of the literature, structured with the aim of examining and systematizing the current scientific evidence on Stability in orthognathic surgery of Class III patients. The bibliographic search was conducted in the PubMed database, using the search terms "Orthodontic Surgery", "Malocclusion" and "Angle Class III", associated by the logical operators AND and OR, in accordance with the MeSH (Medical Subject Headings) structured vocabulary. The selection prioritized scientific productions from the last five years, written in English or Portuguese and made available in full text. The exclusion criteria included research without direct correlation with the thematic axis, duplicates, narrative reviews of limited methodological robustness, and literature not indexed in the consulted database. The screening process took place in two phases: initial analysis of titles and abstracts, followed by the full reading of the articles to ratify the relevance. The data collected were consolidated in a descriptive and critical manner.

3 RESULTS

Recent studies indicate that bimaxillary surgery promotes marked improvements in facial aesthetics and skeletal symmetry, achieving Class I occlusion in complex cases (Nguyen and Nguyen, 2025). Regarding stability in specific populations, such as patients with cleft lip and palate, it was observed that mandibular setback via BSSO allows compensation that reduces the need for extreme maxillary advancement, which can attenuate the potential for anteroposterior recurrence of the maxilla (Gao et al., 2025). Three-dimensional cephalometric data revealed that, although there are statistically significant changes between the immediate postoperative period and the eight-month follow-up, such as increased SNB angle and reduced ANB, maxillary positioning (ANS) tends to be more stable (Gao et al., 2025).

Stability is also intrinsically linked to the integrity of the temporomandibular joint (TMJ). Postoperative condylar resorption has been identified as a risk factor for late skeletal recurrence, with an incidence of 37.2% in Class III patients undergoing orthodontic-surgical treatment (Faria-Teixeira et al., 2024). In addition, the condylar position undergoes immediate spatial modifications: in Class III patients, a reduction in

the anterior joint space is often noted after the bimaxillary procedure (Roman et al., 2022). Compared to compensatory treatment (orthodontic camouflage), the surgical approach requires a rigorous incisive decompensation, which, if not monitored via tomography, can deteriorate the alveolar root-bone ratio in the mandibular incisors (Liu et al., 2024).

4 DISCUSSION

The analysis of the evidence demonstrates that postoperative stability is multifactorial. The use of 3D technologies, such as printed splints and virtual planning, has been shown to be effective in increasing the predictability and accuracy of bone movements, facilitating adjustments in multiple planes (Nguyen and Nguyen, 2025). The literature reinforces that orthognathic surgery surpasses orthodontic camouflage in terms of skeletal gains and facial profile harmony, especially in borderline cases, where camouflage results in greater compensatory inclination of the incisors without correcting the bone base (Alhammadi et al., 2022; Liu et al., 2024).

4.1 SKELETAL STABILITY AND DIFFERENTIAL BEHAVIOR BETWEEN MAXILLA AND MANDIBLE

Studies based on three-dimensional reconstructions have shown that postoperative stability in Class III patients undergoing bimaxillary orthognathic surgery does not occur homogeneously between the maxilla and the mandible. Gao et al. (2025), when evaluating patients through serial three-dimensional images, observed that, despite statistically significant changes in mandibular parameters between the immediate postoperative period and follow-up, such as displacements of point B and variations in the SNB angle, measurements related to maxillary positioning, especially point A and the SNA angle, tend to remain stable over time. These findings suggest greater predictability of maxillary advancement performed by means of Le Fort I osteotomy, possibly related to the larger bone contact area, the rigid fixation employed, and the lower direct influence of muscle forces on this structure. The jaw, on the other hand, seems to remain more susceptible to progressive adaptations, which can compromise stability in the medium and long term.

The mandibular instability observed during postoperative follow-up is directly related to the magnitude of mandibular setback and to the adaptations that occurred in the temporomandibular joint. The systematic review and meta-analysis conducted by

Faria-Teixeira et al. (2024) demonstrated that, although the incidence of condylar resorption is lower in Class III patients when compared to Class II, this change remains clinically relevant as a mechanism associated with late skeletal recurrence. Similarly, Roman et al. (2022), using cone-beam computed tomography, identified changes in the condylar position after bimaxillary surgery, including reduction of the anterior joint space. These findings indicate that discrete condylar alterations, often asymptomatic in the short term, can trigger adaptive processes in the temporomandibular joint and, over time, negatively interfere with mandibular stability.

4.2 FACTORS ASSOCIATED WITH POSTOPERATIVE STABILITY IN CLASS III

The biomechanical response of the maxilla and mandible to surgical repositioning occurs in a different way, which has been consistently observed in the literature. While maxillary advancement tends to remain relatively stable throughout postoperative follow-up, the mandible is more prone to late adaptations, especially in cases involving setbacks of greater magnitude. Gradual changes in the positioning of the B-point and in the SNB angle have been associated with skeletal recurrence, reinforcing the need for careful surgical planning and prolonged clinical follow-up in these patients (Gao et al., 2025).

The temporomandibular joint plays an important role in this adaptive process. Although condylar resorption has a lower incidence in Class III patients when compared to other skeletal deformities, it remains a clinically significant finding. Subtle modifications in the condylar position, such as the reduction of the anterior joint space after bimaxillary surgery, reflect bone remodeling processes that, even when they do not produce symptoms evident in the initial period, can interfere with mandibular stability over time (Faria-Teixeira et al., 2024; Roman et al., 2022).

In addition to surgical and joint factors, preoperative orthodontic preparation has a direct influence on postoperative behavior. Adequate decompensation of the mandibular incisors is critical to allow for planned skeletal correction and reduce compensatory dental forces after surgery. However, when these movements are performed excessively, the relationship between the tooth root and the alveolar bone may be compromised, which reinforces the need for careful monitoring through three-dimensional examinations during this phase of treatment (Liu et al., 2024). In situations considered borderline, orthodontic camouflage tends to promote compensatory tooth inclinations without effective correction

of the bone base, which ends up limiting both stability and facial harmony in the long term (Alhammadi et al., 2022).

Although condylar resorption has already been discussed as an important factor of recurrence, recent studies also point to the influence of individual characteristics on the development of these alterations. Evidence suggests that patients with greater facial height, greater magnitude of mandibular setback, and specific growth patterns are more predisposed to unfavorable condylar remodeling. These findings indicate that not only the surgical technique, but also pre-existing anatomical variables and individual biomechanical factors should be considered in preoperative planning, allowing for more accurate risk stratification and closer follow-up in patients with a high risk profile.

Finally, functional aspects should also be taken into account in the evaluation of postoperative stability. Neuromuscular adaptation and volumetric changes in the upper airway may occur after mandibular retreat, although studies suggest that mild reductions in this volume rarely result in relevant functional impairments, such as obstructive sleep apnea (Nguyen and Nguyen, 2025). Even so, the scarcity of longitudinal studies with more robust samples limits the identification of subgroups of patients at higher risk for these complications. Additionally, although factors such as female gender, age between 20-30 years, elevated mandibular angle, and excessive magnitude of mandibular setback are associated with a higher risk of condylar resorption (Faria-Teixeira et al., 2024), preoperative risk stratification to identify patients with a higher probability of postoperative functional complications in Class III remains inadequately explored. These gaps highlight the need for more consistent future investigations that integrate skeletal stability assessment with monitoring of functional complications in Class III patients.

5 CONCLUSION

Bimaxillary orthognathic surgery remains the gold standard treatment for the correction of Class III skeletal malocclusion in adult patients, providing significant improvement in maxillomandibular relationship, facial aesthetics, and occlusal function. The most current findings indicate that the observed results usually present good skeletal stability in the short and medium term, with greater predictability in maxillary positioning compared to the mandible. Postoperative stability is influenced by multiple factors, especially condylar adaptation, temporomandibular joint (TMJ) integrity, and neuromuscular response to surgical movements. Although condylar resorption has a

lower incidence in Class III patients when compared to other deformities, it still remains a relevant factor for the occurrence of late recurrences, reinforcing the importance of constant clinical and imaging follow-up. Three-dimensional (3D) virtual planning and a compatible protocol for orthodontic decompensation in the pre-surgical period significantly favor the predictability of bone movements and the maintenance of long-term results. Thus, bimaxillary orthognathic surgery, when correctly indicated and performed, constitutes an effective and stable approach for the treatment of skeletal Class III, overcoming orthodontic camouflage in cases where there is established bone discrepancy.

In addition to skeletal stability, Class III orthognathic surgery provides significant functional benefits, including improvement in speech articulation, masticatory function, and overall quality of life. Stability is the result of a complex interaction between biomechanical, biological, and technical factors, and it is essential to understand this multifactoriality to optimize results. Clinically, it is recommended that preoperative planning include: (1) risk stratification; (2) 3D virtual planning; (3) strict orthodontic decompensation protocol; and (4) systematic postoperative follow-up. However, important gaps persist in the literature, indicating the need for future more robust investigations that deepen the understanding of the mechanisms of instability in Class III.

Skeletal stability in Class III patients undergoing bimaxillary orthognathic surgery remains a central theme in clinical practice and in the contemporary literature. The studies analyzed demonstrate that, although advances in three-dimensional virtual planning, surgical precision, and biomechanical understanding have increased the predictability of results, postoperative stability continues to be influenced by multifactorial factors.

It was evidenced that maxillary advancement presents greater stability in the medium and long term when compared to mandibular retraction, a behavior that is related both to rigid fixation and greater bone contact of the maxilla, as well as to the direct influence of muscle forces and condylar adaptation on the mandible. The temporomandibular joint proved to be a fundamental component in this process, especially with regard to condylar remodeling and resorption, which, although less prevalent in Class III patients, remain clinically relevant due to their potential to trigger late recurrence.

In addition to the biomechanical and joint aspects, the pre-surgical orthodontic preparation, the magnitude of the planned movements, and individual factors, such as

facial pattern and anatomical characteristics, stood out as important modulators of stability. On the other hand, the functional repercussions, especially related to the airways and neuromuscular adjustment, reinforce the need for longitudinal and interdisciplinary follow-up.

It is concluded that bimaxillary orthognathic surgery constitutes an effective and relatively stable approach for the treatment of skeletal Class III in adults, overcoming orthodontic camouflage in cases with significant bone discrepancies. However, scientific gaps persist that require longitudinal studies with more robust samples, methodological standardization, and integration between skeletal, functional, and technological assessment. The improvement of these parameters tends to consolidate more precise protocols, reduce instability variables, and increase the potential for therapeutic predictability in Class III surgical correction.

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