JOURNAL OF HEALTHCARE SCIENCES
Volume 4 Issue 12 2024, Article ID: JOHS2024000989
http://dx.doi.org/10.52533/JOHS.2024.41229
e-ISSN: 1658-8967

Review

Short and Long-Term Stability of Open Bite Correction

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Received: 15 December 2024, Reviewed: 24 December 2024, Accepted: 25 December 2024, Published: 26 December 2024.

Abstract

Open bite correction presents significant challenges in orthodontics due to the multifactorial nature of the condition and the high risk of relapse. Short-term stability is influenced by precise control of vertical tooth movements and the use of temporary anchorage devices (TADs), which provide effective molar intrusion while minimizing reliance on patient compliance. Behavioral factors, such as tongue posture and swallowing patterns, play a critical role in early relapse, necessitating adjunctive therapies like myofunctional exercises and habit cessation training. Retention strategies, including fixed and removable retainers, are essential for maintaining short-term outcomes, with hybrid retention approaches showing superior efficacy. Long-term stability depends on addressing both skeletal and dental factors, particularly in cases involving growth-related changes. Orthognathic surgery remains a cornerstone for severe skeletal open bite correction, offering significant improvements in vertical relationships. However, relapse can occur due to neuromuscular adaptation or insufficient stabilization of the skeletal framework. Long-term outcomes are enhanced through tailored retention strategies and ongoing monitoring to detect early signs of relapse. Technological advancements, such as three-dimensional imaging and virtual surgical planning, have improved diagnostic precision and treatment predictability. These tools facilitate individualized care, ensuring that patient-specific anatomical and functional factors are addressed comprehensively. Interdisciplinary collaboration further supports stability by integrating orthodontic, surgical, and behavioral interventions. Achieving stable outcomes in open bite correction requires a holistic approach that combines innovative techniques, robust retention protocols, and patient-centered care. Addressing both short- and long-term challenges with a focus on individualized treatment planning and continuous follow-up is critical for reducing relapse and improving functional and aesthetic outcomes. Emerging technologies and multidisciplinary care offer promising avenues for enhancing stability and ensuring lasting success in the management of open bite cases.

Keywords: *Open bite, stability, relapse, retention, orthodontics*

Introduction

Open bite, characterized by the lack of vertical overlap between the maxillary and mandibular anterior teeth when the posterior teeth are in occlusion, presents a complex challenge in orthodontics (1). This condition can impair not only aesthetics but also function, impacting chewing, speech, and overall oral health. Open bite can be classified as anterior or posterior, with anterior open bite being more frequently encountered in clinical practice. Its prevalence is influenced by genetic, developmental, and environmental factors, making it a condition with multifactorial etiology.

The origins of open bite are rooted in a combination of skeletal, dental, and soft tissue anomalies. Skeletal open bite often arises from vertical maxillary excess or deficiencies in mandibular growth. Meanwhile, dentoalveolar open bite may result from disruptions in normal eruption patterns of anterior teeth. Environmental factors, such as prolonged habits like thumb sucking, tongue thrusting, and mouth breathing during critical growth periods, have been identified as contributors to the development and perpetuation of open bite (2). These etiological factors complicate treatment planning and underscore the need for individualized therapeutic approaches. Treatment modalities for open bite correction vary, encompassing orthodontic, surgical, and combined approaches. Orthodontic interventions aim to control vertical dimensions through techniques like intrusion of over-erupted posterior teeth or extrusion of anterior teeth. The advent of temporary anchorage devices (TADs) has revolutionized treatment by allowing for greater control over vertical movements and offering less invasive alternatives to surgery in selected cases (3). However, in cases with pronounced skeletal discrepancies, orthognathic surgery remains the gold standard for achieving functional and aesthetic outcomes.

The stability of open bite correction has been extensively studied, with relapse being a prominent concern. Relapse can occur due to the persistence of etiological habits, incomplete neuromuscular adaptation, or continued growth, particularly in younger patients. Short-term outcomes are often influenced by retention protocols and patient compliance, while long-term stability is closely tied to factors such as skeletal maturity and adaptive changes in the soft tissues (4). Addressing these aspects during treatment and retention phases is critical for minimizing relapse risks. Emerging technologies have significantly enhanced the precision of diagnosis and treatment planning for open bites. Advances such as three-dimensional imaging and computer-aided design and manufacturing (CAD/CAM) systems enable clinicians to better visualize complex craniofacial relationships, improving treatment predictability. Such tools also facilitate multidisciplinary collaboration, particularly in cases requiring surgical intervention or combined orthodontic-surgical approaches (5). This review will discuss short and long-term stability of open bite correction and explore strategies that can enhance both short and long-term stability.

Review

The stability of open bite correction remains a critical concern in orthodontics, with relapse rates varying based on the treatment modality and patient-specific factors. Short-term stability largely depends on the retention phase and the effectiveness of controlling vertical tooth movement during treatment. For instance, TADs have shown promising results in maintaining corrected vertical relationships by reducing posterior dental extrusion, a common contributor to relapse in nonsurgical cases (6). However, even with robust retention protocols, patients with persistent etiological habits, such as tongue thrusting or mouth breathing, are at a higher risk of relapse, emphasizing the need for behavioral intervention alongside mechanical corrections.

Long-term stability presents additional challenges, particularly in cases involving underlying skeletal discrepancies. Growth-related changes, especially in younger patients, can lead to relapse even after comprehensive treatment. Orthognathic surgery combined with orthodontics is often employed in severe cases, as it addresses both skeletal and dental

http://dx.doi.org/10.52533/JOHS.2024.41229

components. Studies indicate that patients who undergo surgical correction demonstrate better long-term stability when compared to those managed solely with orthodontic methods, primarily due to the resolution of vertical skeletal imbalances (7). Nonetheless, long-term monitoring and individualized retention strategies are critical to mitigate the risk of relapse and ensure sustained treatment outcomes.

Short-Term Stability Following Open Bite Correction

Short-term stability after correcting open bite is influenced by various treatment modalities and patient-specific factors. Orthodontic techniques, particularly those incorporating TADs, have demonstrated significant efficacy in maintaining outcomes during the initial post-treatment period. TADs allow for precise vertical control by limiting posterior tooth eruption and enhancing anterior tooth intrusion, which are essential for closing the bite. Studies have shown that the strategic placement of TADs in the posterior maxilla not only helps achieve the desired occlusion but also reduces the likelihood of early relapse by providing a stable anchor during treatment (8).

In patients treated non-surgically, relapse within the first-year post-treatment is commonly linked to the persistence of detrimental habits. Behaviors such as tongue thrusting or atypical swallowing patterns exert anterior forces that can disrupt the achieved occlusal relationships. While appliances like tongue cribs or habit trainers are often used adjunctively, their effectiveness depends largely on patient compliance. Moreover, soft tissue factors, including lip and cheek muscle tone, play a significant role in stabilizing anterior teeth. A study investigating lip-seal training as part of the post-treatment protocol reported notable improvements in short-term stability, particularly in patients with reduced muscular control (9, 10).

Retention devices are critical for preventing early relapse, with fixed and removable retainers being the most commonly used. Fixed retainers provide continuous stabilization, particularly in the anterior region, where relapse risk is highest. However, challenges such as patient discomfort and hygiene maintenance can affect their long-term use. Removable retainers, while convenient, require strict adherence to wearing schedules, which can be inconsistent among patients, particularly adolescents. Evidence indicates that the success of removable retainers in maintaining short-term stability is significantly influenced by patient motivation and the frequency of follow-up visits, underscoring the importance of regular monitoring (11).

In some cases, adjunctive techniques, such as the use of occlusal adjustments or temporary occlusal buildups, may be employed to enhance post-treatment stability. These methods aim to distribute occlusal forces more evenly, reducing strain on the anterior teeth and mitigating relapse risk. Occlusal stability has been shown to be a determinant factor in the short-term success of open bite correction, as uneven force distribution can lead to premature contacts and reopening of the bite. A retrospective analysis comparing cases with and without occlusal adjustments post-treatment revealed significantly lower relapse rates in the adjusted group, highlighting the role of precision in occlusal management (12).

Age and growth status also influence short-term stability outcomes. Younger patients undergoing treatment during active growth phases are more susceptible to changes in dentofacial structures, which can compromise the results. In contrast, adult patients tend to exhibit more stable outcomes due to reduced growth potential. Stability in adolescent versus adult patients treated with aligners exhibits superior retention of the achieved occlusion during the first six months, likely attributable to the absence of ongoing growth-related changes (13). This reinforces the importance of considering patient age and skeletal maturity when planning treatment and retention protocols. Short-term stability is a dynamic process shaped by a combination of mechanical, behavioral, and biological factors. While advancements in orthodontic techniques and adjunctive therapies have improved outcomes, consistent monitoring and tailored retention strategies remain critical to

http://dx.doi.org/10.52533/JOHS.2024.41229

maintaining the achieved correction during the early post-treatment period.

Long-Term Stability and Relapse Trends in Open Bite Correction

The long-term stability of open bite correction presents significant challenges, with relapse frequently reported across various treatment modalities. One of the primary factors influencing long-term outcomes is the inherent growth potential of the patient. Continued craniofacial growth, particularly in younger patients, can lead to vertical skeletal changes that compromise the stability of the correction. Longitudinal studies have shown that patients treated during active growth phases often experience reopening of the bite, emphasizing the importance of growth modulation during treatment (14). In contrast, adults typically exhibit more stable long-term outcomes, as skeletal maturity minimizes the influence of post-treatment growth.

Orthognathic surgery combined with orthodontics is considered the gold standard for severe skeletal open bites. Surgical interventions, such as Le Fort I osteotomy with superior repositioning of the maxilla, aim to address vertical discrepancies at the skeletal level. While these procedures are effective in achieving significant corrections, long-term studies suggest that relapse rates can vary depending on factors such as post-surgical healing, neuromuscular adaptation, and changes in mandibular position. A study analyzing relapse following Le Fort I osteotomy found that anterior open bites tended to reappear in cases with inadequate vertical stabilization of the posterior maxilla (15). This highlights the critical role of surgical precision and postoperative management in ensuring long-term stability.

Retention strategies play an integral role in maintaining long-term stability. Fixed retainers are often preferred for open bite cases due to their ability to provide consistent stabilization over extended periods. However, challenges such as wire breakage, plaque accumulation, and patient discomfort can impact their effectiveness. Removable retainers, while offering flexibility, depend heavily on patient compliance, which tends to decrease over time. A longitudinal study comparing fixed and removable retention methods reported that patients with fixed retainers demonstrated superior long-term stability in maintaining vertical occlusal relationships (16). These findings underline the importance of individualized retention planning based on the patient's lifestyle and risk factors.

Neuromuscular factors, including tongue posture and function, are also critical determinants of long-term stability. Tongue thrust and low tongue posture exert continuous forces on the anterior teeth, which can disrupt the achieved occlusion. Behavioral therapies, such as myofunctional exercises, have been explored as adjunctive treatments to address these issues. While the evidence on their long-term efficacy is mixed, some studies have reported promising outcomes in reducing relapse rates by promoting favorable tongue and lip muscle patterns (17). Incorporating these therapies into post-treatment protocols may be beneficial in selected cases.

Additionally, advancements in digital orthodontics and three-dimensional imaging have facilitated more precise diagnosis and treatment planning, contributing to better long-term outcomes. The ability to assess craniofacial structures in detail allows clinicians to predict potential relapse patterns and tailor treatment strategies accordingly. Recent innovations, such as virtual surgical planning and customized orthodontic appliances, have enhanced the predictability of long-term stability by addressing patient-specific anatomical and functional considerations. A retrospective study evaluating the use of digital planning in orthognathic surgery reported improved long-term outcomes in terms of both occlusion and esthetics, suggesting the potential of these technologies to reduce relapse risks (18). Long-term stability in open bite correction is influenced by a multifactorial interplay of skeletal, dental, and neuromuscular factors. Ongoing monitoring, patient education, and advances in orthodontic and surgical techniques will remain essential to optimizing outcomes and minimizing relapse.

http://dx.doi.org/10.52533/JOHS.2024.41229

Strategies to Enhance Stability Across Both Short and Long Terms

Achieving and maintaining stability in open bite correction requires a combination of treatment strategies and post-treatment management tailored to address both short- and long-term challenges. One critical approach involves controlling vertical tooth movements with precision, particularly in the posterior region. TADs have gained widespread acceptance for their role in providing controlled intrusion of molars, which is pivotal in reducing vertical maxillary excess. A clinical trial assessing molar intrusion with TADs demonstrated significant improvement in stability across the early and late phases post-treatment, as these devices minimize reliance on patient compliance during active therapy (19).

Retention strategies must be individualized and robust to prevent relapse. Fixed retainers, particularly bonded lingual wires, are highly effective in maintaining anterior tooth alignment and vertical relationships (20). However, their effectiveness depends on proper placement and long-term maintenance. To enhance retention outcomes, combining fixed retainers with removable retainers during the transition from short- to long-term retention has been suggested as a hybrid approach. This dual strategy addresses the high relapse risk during the initial months while allowing flexibility for long-term use.

Behavioral and functional adaptations are another critical focus for stability. Tongue posture and orofacial muscle function significantly influence the maintenance of corrected occlusion. Myofunctional therapy, which includes exercises to train proper tongue positioning and swallowing patterns, has shown promise in promoting neuromuscular adaptation. While its effectiveness varies, studies indicate that patients who adhere to myofunctional exercises post-treatment demonstrate improved stability in both short and long terms. Integrating these therapies into the retention phase can be particularly beneficial for individuals with habits such as tongue thrusting, which are known contributors to relapse (21, 22). Additionally, patient education on avoiding behaviors like nail-biting and object-chewing can further support long-term stability.

Digital technologies are playing an increasingly important role in enhancing stability. Advanced imaging tools, such as cone-beam computed tomography and three-dimensional modeling, provide clinicians with detailed insights into the craniofacial anatomy, enabling precise planning for both orthodontic and surgical interventions. These technologies facilitate the design of individualized appliances and surgical guides that optimize treatment outcomes and improve stability. A study on digital planning in orthognathic surgery demonstrated that the use of customized splints and virtual surgical simulations resulted in more predictable outcomes, reducing the likelihood of skeletal and dental relapse (23).

Interdisciplinary collaboration between orthodontists, oral surgeons, and other healthcare professionals is essential to achieving comprehensive stability. For complex cases, integrating orthodontic correction with orthognathic surgery and adjunct therapies ensures that both skeletal and dental components are addressed. Orthognathic surgery alone can correct skeletal discrepancies but combining it with precise orthodontic treatment enhances the overall stability. Long-term follow-up protocols, often involving periodic monitoring and adjustments to retainers or other appliances, are critical in detecting and addressing early signs of relapse. Multidisciplinary care allows for timely interventions, improving the chances of sustained stability over time.

Conclusion

The stability of open bite correction relies on a multifaceted approach encompassing precise treatment planning, effective retention strategies, and behavioral adaptation. Short-term stability is bolstered by innovations like TADs and robust retention protocols, while long-term outcomes benefit from addressing skeletal discrepancies and neuromuscular factors. The integration of digital tools and interdisciplinary care further enhances predictability and reduces relapse risks. Continued

http://dx.doi.org/10.52533/JOHS.2024.41229

research and individualized care are vital for optimizing outcomes in open bite correction.

Disclosure

Conflict of interest

There is no conflict of interest

Funding

No funding

Ethical consideration

Non applicable

Data availability

Data that support the findings of this study are embedded within the manuscript.

Author contribution

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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