JOURNAL OF HEALTHCARE SCIENCES
Volume 3 Issue 12 2023, Article ID: JOHS2023000803
http://dx.doi.org/10.52533/JOHS.2023.31231
e-ISSN: 1658-8967

Review

The Evolution of Self-Ligating Brackets in Orthodontics

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Received: 24 December 2023, Accepted: 26 December 2023, Published: 28 December 2023

Abstracts

Orthodontic treatment has significantly evolved with the introduction of self-ligating brackets, revolutionizing the use of fixed appliances. These brackets, first conceptualized in the early 1900s and gaining popularity in the 1970s, have undergone substantial design improvements, enhancing treatment efficiency and patient comfort. Self-ligating brackets, characterized by an internal mechanism like a sliding door or clip, eliminate the need for external ligatures, thus reducing friction and facilitating more precise tooth movement. This design not only improves patient comfort through easier hygiene maintenance but also potentially accelerates treatment progress. Despite these advantages, the clinical significance of self-ligating brackets, particularly in reducing treatment times, remains a subject of debate. Factors such as case complexity and the orthodontist's skill play a crucial role in determining treatment outcomes. Furthermore, the higher initial cost of these brackets poses economic considerations for both practitioners and patients. Recent advancements have led to a diversity of self-ligating bracket systems, each with unique features focusing on low friction mechanics, torque control, or ease of use. Orthodontists now have the flexibility to choose systems aligning with their treatment philosophies and patient needs. Continuous research is essential to enhance our understanding of their biomechanics, long-term results, and comparative effectiveness. The ongoing development of self-ligating brackets represents a commitment to balancing treatment efficiency, patient comfort, and cost-effectiveness in orthodontic care.

Keyword: *Self-ligating brackets, Orthodontics, Biomechanics, Treatment efficiency, Patient experience*

Introduction

Over the years, orthodontic treatment has made progress in the design of brackets, which has greatly improved treatment efficiency and patient comfort (1). The introduction of self-ligating brackets has been a game changer in orthodontics completely transforming the method of using fixed appliances (2). The concept of self-ligating brackets can be traced back to the 1900s when the first designs were introduced around the 1930s (3). However, it took until the 1970s for these brackets to gain popularity among orthodontists. Early versions faced challenges such as mechanics and limited clinical control, which hindered their use. However, with advancements in research and technology came a generation of self-ligating brackets in the 20th century that featured simplified designs and improved functionality (4). Biomechanically speaking, self-ligating brackets work by reducing friction and increasing tooth movement efficiency. Unlike brackets that use ligatures or metal ties to hold the arch wire in place (causing friction that slows down tooth movement) self-ligating brackets have an internal mechanism like a sliding door or clip that eliminates the need, for external ligatures (5). This particular design aims to reduce friction resulting in more precise tooth movement. Self-ligating brackets offer benefits in settings including improved patient comfort, easier hygiene maintenance and faster treatment progress. The reduced use of ligatures has advantages for patients including increased comfort and improved hygiene. Without ligatures there are no places for plaque to get trapped making it easier for patients to maintain hygiene during orthodontic treatment (6, 7). Additionally, self-ligating brackets have been found to reduce treatment times compared to brackets due to less friction and more efficient force delivery. However, it's important to consider that the clinical significance of these findings is still debated (8). Some studies suggest that the differences in treatment time may be small and influenced by factors like case complexity and the skill of the orthodontist (9, 10). It's also worth noting that self-ligating brackets can be more expensive initially which may impact both practitioners and patients economically. In years advancements in materials and design have led to improved self-ligating bracket systems, with features and claimed benefits. Different manufacturers offer designs that prioritize low friction mechanics, torque control or ease of use. There is a range of self-ligating brackets which highlights the constant development in this field. Orthodontists have the freedom to select systems that're in line with their treatment approaches and patient requirements (11). As self-ligating brackets continue to evolve ongoing research focuses on improving our understanding of biomechanics evaluating long term results and comparing the effectiveness of bracket systems (12, 13). The pursuit of finding the balance between treatment, patient comfort and cost effectiveness is a key focus in orthodontic research and practice. The development of self-ligating brackets in orthodontics has undergone a journey from designs to more streamlined systems. These brackets are based on principles that aim to reduce friction, improve patient comfort and speed up treatment progress. Self-ligating brackets offer advantages such as hygiene and potentially shorter treatment times making them a viable option in modern orthodontic practice. However ongoing research and critical evaluation are necessary to understand their significance, address any limitations they may have and guide orthodontists in choosing the most suitable brackets for different patients. The evolution of self-ligating brackets brings hope for improvements providing professionals with a diverse range of tools to deliver effective and patient centered care. This review aims to provide an overview of the development of self-ligating brackets in orthodontics.

Review

The development of self-ligating brackets in orthodontics has brought about changes in the way patients are treated. The use of self-ligating brackets reduces friction, which has implications for tooth movement and treatment duration. This advantage emphasizes the importance for practitioners to adjust their treatment plans accordingly optimizing the sequence of arch wires and the force applied for results. The benefits extend beyond aspects as it also affects resource utilization by reducing chair time

http://dx.doi.org/10.52533/JOHS.2023.31231

and minimizing adjustments needed during appointments leading to improved efficiency in treatment. Additionally, patient experience is a consideration in management. The absence of ligatures in self-ligating brackets reduces sources of discomfort and irritation providing comfort for patients (14, 15). Effective communication with patients about the advantages of self-ligating brackets is crucial in managing expectations and ensuring an experience. Furthermore, oral hygiene management becomes simpler with ligature less design as it minimizes plaque traps and encourages compliance. However, it is important to monitor hygiene practices to prevent any potential complications that may arise from using self-ligating bracket systems due to the wide array of options available, from various manufacturers. The variety in systems requires a grasp of their distinctive characteristics and advantages. This enables healthcare professionals to customize their treatment approaches to match their beliefs and the requirements of each patient. Ongoing education is crucial for practitioners to stay updated on the developments in self-ligating bracket technology ensuring its incorporation into clinical practice.

Clinical Manifestation

The advancement of self-ligating brackets in orthodontics has brought about changes in the way treatments are conducted, impacting both orthodontists and patients. These changes can be observed in aspects such as treatment efficiency, biomechanics, patient comfort, oral hygiene and overall clinical outcomes. One notable change is the improvement in treatment efficiency. Self-ligating brackets work by reducing friction resulting in tooth movement. This translates to treatment durations compared to traditional bracket systems. Studies have investigated the impact of self-ligating brackets on the rate of tooth movement. Have found that reduced friction contributes to progress (16, 17). Orthodontists experience this advantage firsthand as they can achieve desired tooth displacements with adjustments saving time and resources. From a perspective self-ligating bracket brings about changes in force systems. The absence of ligatures eliminates sources of friction that're typically present with brackets. This reduction in forces alters the way teeth move, leading to efficient force delivery. Clinically this means a predictable response to orthodontic forces potentially reducing the need for complicated mechanics and additional devices (18, 19). Practitioners have noticed an improvement in their ability to accurately position teeth leading to treatment results. Patient comfort is an aspect that has greatly benefited from the advancements in self-ligating brackets. The design of these brackets has been created to eliminate the need for ligatures, which helps reduce sources of irritation and discomfort for patients. This advantage becomes particularly noticeable during the stages of treatment when patients often experience heightened sensitivity. Practitioners have observed that patients treated with self-ligating brackets tend to report discomfort due to the absence of ligatures resulting in a positive clinical experience. An important clinical benefit influenced by self-ligating brackets is the impact on oral hygiene maintenance. Traditional brackets with ligatures can create spaces where plaque gets trapped making oral hygiene practices more challenging for patients. On the hand self-ligating brackets without ligatures make it easier for patients to brush. Floss their teeth effectively. In settings practitioners have noticed oral hygiene in patients using self-ligating brackets potentially leading to fewer instances of white spot lesions and gingival inflammation. However, it's crucial to acknowledge that different self-ligating bracket systems may have variations in their effectiveness. Not all self-ligating brackets are identical; there can be differences, in design materials used, as claimed benefits. The specific choice of bracket system can influence treatment outcomes, patient experiences and overall satisfaction levels. It's important for practitioners to consider these nuances and stay updated about the evolving landscape of self-ligating brackets in order to make decisions. The way self-ligating brackets have evolved and how they are perceived and adopted by the community has an impact on the clinical outcomes. Orthodontic professionals are experiencing a change in their treatment methods as they incorporate self-ligating brackets (20). This shift is evident in the discussions among experts,

http://dx.doi.org/10.52533/JOHS.2023.31231

who are collectively exploring the advantages, challenges and long-term effects of using self-ligating brackets. These discussions influence how practitioners make decisions as they carefully consider the evolving evidence and individual patient factors. The impact of this evolution goes beyond theory; it brings about improvements in treatment efficiency, biomechanics, patient comfort and oral hygiene practices. As the orthodontic community continues to engage with and assess self-ligating bracket systems this evolution shapes the way orthodontic care is provided and experienced. Constantly exploring these changes is essential for refining practices and achieving outcomes, for both practitioners and patients in this ever-evolving field.

Management

The management of self-ligating brackets in orthodontics involves an intricate approach that integrates advancements, treatment planning considerations and patient centered care. Self-ligating brackets have an impact on aspects of clinical management including treatment planning, biomechanics, patient experience and advancements in orthodontic technology (21). To effectively incorporate self-ligating brackets into management it is crucial to understand their biomechanical characteristics. These brackets work by reducing friction, which affects the force applied to the teeth. Clinicians must adapt their treatment planning strategies due to this shift. Reduced friction allows for control and efficient tooth movement potentially influencing the selection of archwire sequences and force levels. Adjusting treatment protocols may be necessary to utilize the advantages of self-ligating brackets. The clinical management of patients undergoing treatment with self-ligating brackets requires consideration of treatment efficiency. Compared to brackets there is a need for frequent adjustments leading to potential time savings for both clinicians and patients during chair visits. This has implications for scheduling appointments. Optimizing resource utilization in practices with regards to overall treatment efficiency enhancement. The field of biomechanics is crucial in the treatment of cases that involve using self-ligating brackets. Orthodontists need to customize their approaches to make the most of the qualities offered by these brackets (5). The absence of ligatures has an impact on reducing friction, which in turn affects the force systems and patterns of tooth movement. From a standpoint this can lead to a controlled and predictable treatment outcome. However, it is important to consider the balance between the benefits of friction and the need for appropriate force levels to ensure optimal results in patient care. The experience of patients plays a role in management when using self-ligating brackets. The design without ligatures contributes to improved comfort for patients by eliminating sources of irritation associated with ligatures (22). It is crucial for practitioners to manage expectations and explain the advantages of self-ligating brackets in terms of reduced discomfort. Additionally, addressing any concerns or misunderstandings that patients may have about this advancing technology is part of fostering an experience. Oral hygiene management is an aspect to consider when using self-ligating brackets. The design without ligatures simplifies oral hygiene practices for patients compared to brackets with ligatures. Practitioners have a role in educating patients about oral hygiene routines and providing guidance on effective brushing and flossing techniques. Regular monitoring and reinforcement of hygiene practices are elements in managing orthodontic cases using self-ligating brackets with the aim of minimizing complications such as white spot lesions. Clinical management goes beyond treating patients in the term. It also includes considering the long-term results and advancements in technology. Practitioners must keep up with the research and technological advancements, in self-ligating brackets. The changing landscape may bring materials, designs or treatment methods that could impact how clinical management is approached. Continuous education and professional growth are essential to incorporate the developments into clinical practice. Therefore, managing the evolution of self-ligating brackets in orthodontics requires a flexible approach. Practitioners navigate through aspects such as biomechanics, treatment efficiency, patient experience and oral hygiene management.

http://dx.doi.org/10.52533/JOHS.2023.31231

The continuously evolving technology and dynamic patient care emphasize the need for an informed and adaptable clinical management strategy. As self-ligating brackets continue to shape orthodontics practitioners play a role in utilizing their advantages to optimize outcomes and drive progress in the field.

Conclusion

Advancements made in self-ligating brackets within orthodontics have greatly impacted aspects of management. These brackets have influenced treatment planning, biomechanics, patient experience and oral hygiene practices. The reduced friction associated with these brackets provides advantages by facilitating efficient tooth movement and potentially shortening treatment duration. Implementing self-ligating bracket systems requires practitioners to adapt their treatment protocols and navigate the intricacies involved. Patients benefit from the ligature less design, which enhances comfort and satisfaction. However, it is important to acknowledge considerations when managing self-ligating brackets. Continuous research is necessary to understand the significance of differences in treatment duration and address any limitations. Additionally, practitioners need to evaluate the costs versus long term benefits while considering economic implications for both them and their patients. As discussions within the community continue the trajectory of self-ligating brackets will further evolve, promising treatment options for practitioners and enhanced experiences, for patients.

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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