

PHD THESIS ABSTRACT

Comparative statistical and biomechanical studies concerning two bracket systems: conventional and self-ligating

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Introduction: Conventional and self-ligating (active and passive) orthodontic bracket systems are widely utilized in the current clinical practice. Over the last decade, there has been a rise in demand for self-ligating brackets and many dental practitioners have settled for one of the techniques or use both of them, depending on the clinical situation and preference. Companies claim certain advantages of the self-ligating system over the conventional system. Self-ligating brackets were originally designed to eliminate stainless steel and elastomeric ligatures, based on the approach that the system would exert lower frictional forces, permitting more efficient sliding mechanics. Thus, the declared advantageous traits comprise: faster overall treatments and reduced chairside time, improved patient comfort, reduced pain and better oral hygiene, reduced friction with enhanced sliding mechanics and superior aesthetic and functional outcomes.

General objectives: Three studies with different purposes were conducted in order to obtain a comprehensive and exhaustive comparison of the two brackets systems starting from the hypothesis that the self-ligating appliance is superior in the above mentioned aspects. This research is intended to add new scientific insight to the state of the art in the field of bracket systems clinical perception and biomechanical properties and it performed an extensive research of the literature.

General methodology: The first statistical research was based on an inquiry addressed to the international orthodontic community while the second and the third one were biomechanical laboratory studies meant to assess essential particularities of bracket appliances. The statistical analysis for all 3 investigations included the use of descriptive and inferential elements and was performed in GraphPad Prism.

Study 1 aimed to evaluate the orthodontist specialists clinical perception on the conventional and self-ligating systems. The professionals were asked to compare the two types of appliance through the lens of their practical experience and interaction with the patient regarding the following: bonding technique, enamel adhesion, patient comfort, oral hygiene, activation time, tooth movement from a frictional point of view, global treatment time, debonding technique, final aesthetic and functional results, quality-price ratio. They were also asked which type of commercially available bracket system they employ in their praxis.

Conclusions of Study 1 were as follows: most orthodontic specialists incorporate both self-ligating and conventional bracket systems in their clinical praxis. They perceive the bonding procedure to be more straightforward with conventional brackets, although there is no notable difference in enamel adhesion between the two systems. Patients undergoing treatment with self-ligating brackets demonstrate improved oral hygiene and greater comfort compared to those treated

with conventional brackets. Patients with self-ligating brackets require less time for adjustment appointments. Self-ligating brackets are considered to offer more effective tooth movement relative to friction and lead to shorter overall treatment times. There is no discernible distinction between the two systems in terms of the process of removing brackets from teeth. The conventional bracket system is deemed to yield superior aesthetic and functional outcomes when evaluated from a final result perspective. In terms of the cost-effectiveness ratio, conventional bracket systems are considered more accessible.

Study 2 is the first in vitro study with the purpose of comparing the frictional aspects of the conventional and the self-ligating bracket systems through laboratory measurements. In order to achieve this, an advanced material testing machine, Lloyd LR5K Plus dual-column, was employed in accordance with the American Society for Testing and Materials compression testing protocol as ninety (90) conventional, active and passive-self ligating brackets bonded on human teeth were tested by sliding the archwire through the slots in the device.

Conclusions of study 2: active self-ligating orthodontic brackets produced the highest degree of frictional resistance, with the conventional system employing stainless steel ligatures coming in a close second, whereas the passive self-ligating orthodontic brackets exhibited the least amount of frictional force.

Study 3 is the second laboratory study conducted in similar conditions as the previous one concerning the materials and its aim was to compare the shear bond strength/adhesion values among the three bracket systems: conventional, active and passive self-ligating. The teeth with the brackets were placed in a load cell while a hydraulic grip holding a metal rod would press between the base and the wings.

Conclusions of study 3: The passive self-ligating system exhibited the greatest shear bond strength, but all three systems demonstrated adequate adhesive strength, in accordance to the literature guidelines.

General conclusions: Most orthodontic specialists incorporate both conventional and self-ligating bracket systems in their clinical praxis and each of the them presents their own features which objectify in advantages or disadvantages during treatments. Clinically, friction is associated with a different series of factors in the intraoral environment compared to laboratory conditions, thus the forces applied need to be sufficiently high to withstand and overcome them but in the same time maintained to reduced levels in order not to affect the movement, the surrounding tissues or the patient's comfort. Reduced levels of friction are desired regardless of the type of bracket system utilized in practice to obtain successful outcomes and avoid unwanted side effects, such as root resorption, bone and soft tissue loss, undesirable tooth movements, appliance damage or pain. All brackets must present sufficient shear bond strength in order to resist the forces applied during any orthodontic treatment and the intraoral environmental factors which act on the appliance. The bonding technique and the adhesive system are of paramount importance. Surface pretreatment is not compulsory in order to obtain proper adhesion, as classical adhesion systems generate sufficient bond strength to withstand forces and the intraoral environmental factors. From a clinical point of view, brackets failure will increase the costs and duration of orthodontic treatments and decrease the degree of satisfaction for the patient and for the orthodontist as well.