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Self Ligating Bracket Vs Conventional Bracket

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Abstract
Aim: *This review article examines evidence regarding treatment duration, influence on arch form and the speed of tying and untying self ligating brackets compared with conventional bracket, methods of ligation and its advantage and disadvantage.*
Objective: *To evaluate the clinical differences in relation to the use of self ligating bracket in orthodontics.*
Background: *The self ligating bracket uses a slide mechanism to hold the arch wire, thus reducing the amount of pressure exerted on the teeth. However, there are many similarities to typical braces, such as the fitting on such appliances. Regular cleaning is also essential for effective treatment and desirable results.*
Reason: *The purpose of this review were to identify and review the orthodontic literature with regard to the efficiency, effectiveness, and stability of treatment with self ligating brackets compared with conventional brackets.*

Introduction

Self-ligating brackets are not a new concept in orthodontics – they were invented in the early 1930s by Stolzenberg [1,2] as Russel's attachments. Their main advantage was supposed to be a more efficient arch wire insertion and therefore chair-side time reduction. Due to skepticism by orthodontists and lack of promotion, self-ligating brackets did not become popular and were over-shadowed by traditional brackets. Nevertheless, over the last few decades it has once again become believed that self-ligating brackets have advantages over traditional ones. Due to this fact, many companies had tried to introduce their brackets, but only some of them have become commercially available [3].

Self-ligating brackets do not need additional rubber or metal ligatures for merging the wires. The friction is substantially reduced during the tooth movement and leads to less pain and faster tooth movement. This form of bracket is the latest development in firmly-bonded treatment technology. The specialty of orthodontics has continued to evolve since its advent in the early 20th century. Changes in treatment philosophy, mechanics, and appliances have helped shape our understanding of orthodontic tooth movement. In the 1890's, Edward H. Angle published his classification of malocclusion based on the occlusal relationships of the first molars. This was a major step toward the development of orthodontics because his classification defined normal occlusion. Angle then helped to pioneer

the means to treat malocclusions by developing new orthodontic appliances. He believed that if all of the teeth were properly aligned, then no deviation from an ideal occlusion would exist. Angle and his followers strongly believed in non-extraction treatment.

The revival of interest in self-ligating brackets came in the early 2000s, when Keim said that the key ideas for the future development of orthodontics were 3D imaging, self-ligating systems and temporary skeletal anchorage. Since that time, the development of self-ligating brackets has gained steam, which has resulted in the invention of thirteen types of brackets, which in turn have improved their sales. The commercial effect has undoubtedly been supported by clinical theories regarding not only the reduction of friction in the slot, but also the reduction in time spent per visit during treatment. Other theories have spoken of the widening effect of the appliance, a smaller tendency for resorption, easier hygiene maintenance and wider acceptation by patients [2].

Self-Ligating Brackets:

Definition

Self-ligating brackets are ligature less bracket systems that have a mechanical device built into the bracket to close off the edgewise slot. The cap holds the arch wire in the bracket slot and replaces the steel/elastomeric ligature. With the self-ligating brackets, the moveable fourth wall of the bracket is used to convert the slot into a tube.

History and Development of Self-Ligating Brackets

Self-ligating brackets were first introduced in the mid-1930s in the form of the Russell attachment by Stolzenberg (Fig. 1). The bracket had a flat-head screw seated snugly in a circular, threaded opening in the face of the bracket that allows for quick and simple arch wire changes. Loosening the screw made the system passive and allowed bodily translation on a round wire while tightening it made it active and provided root torquing on a square or a rectangular wire. The bracket system was more comfortable for the patient and resulted in shorter office visits as well. Unfortunately, the Russell attachment did not gain much popularity and virtually disappeared from the market.

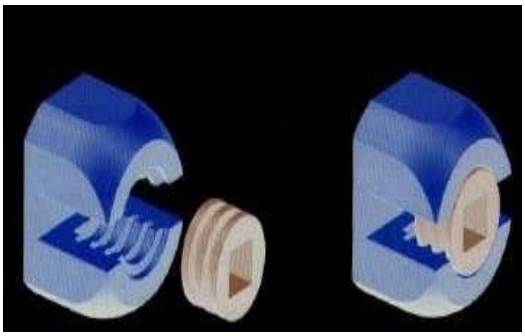

Fig. 1 Russell attachment in open and closed positions

The first modern passive self-ligating bracket (Edgelok- Ormco Corporation, Glendora, CA) was introduced in the early 1970s. The bracket had a round body with a rigid labial sliding cap (Fig.6). Because of its passive nature, orthodontists found precise control of tooth movement to be a challenge. Although many design refinements have been introduced since, the basic design has remained unchanged.

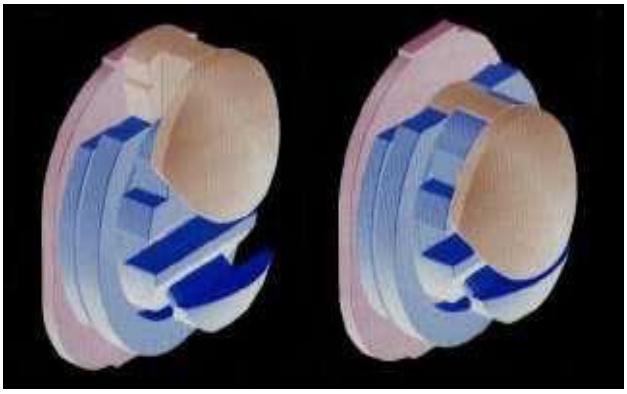

Fig. 2 Edgelok bracket in open and closed positions.

The prototypes of the first active self-ligating bracket (SPEED, Spring-loaded, Delivery) were introduced into the market in 1980. The bracket features a curved, flexible super-elastic nickel-titanium spring clip that embraces the bracket body and passes through the arch wire slot.

In 1986, the self-ligating Active bracket offered another alternative. The Active bracket had an inflexible, curved arm that rotated occlusogingivally around the cylindrical bracket body (Fig. 3). The arm could be moved into a slot-open or slot-close position with finger pressure alone. Once closed, the rigid outer wall of the movable arm converted the bracket slot into a tube. Another self-ligating bracket model, Time entered the marketplace in 1995. The Time bracket (Fig. 4) features a rigid, curved arm that wraps occlusogingivally around the labial aspect of the bracket body. The stiffness of the bracket arm prevents any substantial interaction with the arch wire, thereby rendering Time a passive bracket [4]

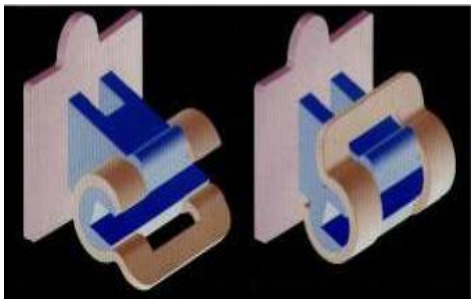

Fig. 3 Active bracket

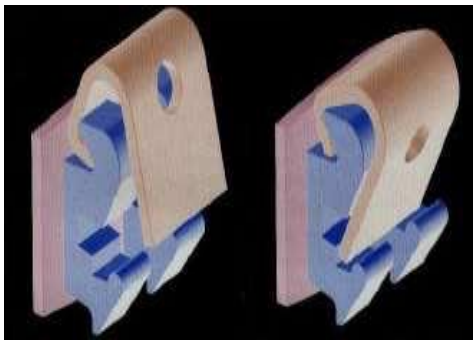

Fig. 4 Time bracket.

Fig 5.Damon TM SL II brackets in open and closed

Fig 6 The GAC In-Ovation RTM and In-Ovation CTM bracket.

Perhaps the most renowned self-ligating bracket system was introduced by Dr. Dwight Damon in 1996. The Damon TM SL I is an edgewise twin bracket with a metal labial cover that straddles the tie wings. In 1999, the next generation Damon TM SL II was brought to the market (Fig. 5). It differed from the original Damon TM SL I by incorporating a flat rectangular slide between the tie wings. A special plier is used to open the metal gates incisally in the maxillary arch and gingivally in the mandibular. Once the slides are closed, the bracket becomes a passive tube. The Damon TM SL bracket system was designed to satisfy the following major criteria [5]

- Andrews Straight-Wire Appliance concept
- Twin configuration
- Slide forming a complete tube
- Passive slide on the outside face of bracket
- Bracket opening inferiorly in both.

In 2002, the In-Ovation RTM by GAC was introduced. This bracket features an interactive clip because it can provide both passive and active control depending on the archwires used. Round levelling wires can freely move to correct rotations during the initial leveling and aligning phase, while full size rectangular wires are fully engaged into the base of the bracket by the clip in the later stages of treatment for better torque control. A new In- Ovation CTM is now available which has a partial ceramic face for better esthetics (Figure 6).

In 2004, 3M Unitek introduced the Smart Clip TM self-ligating bracket, which is different from other self-ligating brackets in that it does not have a slide or clip to hold the wires (Fig.7). Instead it

contains a nickel-titanium clip on each side of the twin bracket that locks in the wire. The arch wire is inserted by using finger pressure to push it past the flexible clip. Remove requires a special instrument from 3M Unitek TM.

With the increasing popularity of self-ligating brackets, many different bracket designs are brought to the orthodontic marketplace each year. Consequently, the use of SLBs has increased exponentially; over 42% of American practitioners surveyed reported using at least one system of self-ligating brackets in 2008 [6]. This figure was just 8.7%in 2002 [7]. When choosing a self-ligating bracket system, it is important to understand the different types of systems (active vs. passive) in order to obtain the best and most efficient orthodontic results.

Classification

Two types of self-ligating brackets have been developed, active and passive. These terms refer to the mode in which they interact with the arch wire. The active type (Fig.8) has a spring clip that encroaches on the slot from the labial/buccal aspect and presses against the archwire providing an active seating force on the archwire and ensuring engagement such as In-Ovation (GAC International, Bohemia, NY, USA), SPEED (Strite Industries, Cambridge, Ontario, Canada), and Time brackets (Adenta, Gilching/Munich, Germany).

In the passive type (Fig. 9), the clip does not press against the archwire. Instead, these brackets use a rigid door or latch to entrap the archwire providing more room for the archwire such as Damon (Ormco/"A"Company), Smart Clip TM (3M Unitek, USA), and Oyster ESL (Gestenco International, Gothenburg, Sweden).

Fig. 7 The unitek smart clipTM bracket

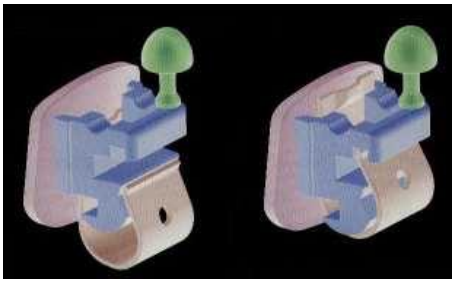

Fig 8 Active self-ligating brackets in open and closed positions.

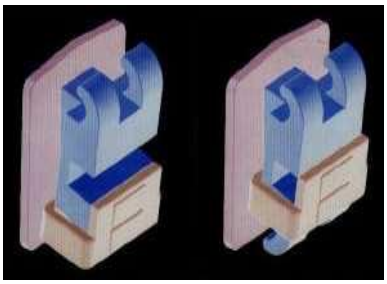

Fig 9 Passive self-ligating brackets in open and closed positions.

Features

Friction

The goal of inventing self-ligating brackets was to eliminate ligating ties, which would create a friction-free background. Uninhibited movement of the archwire in the inflexible slot allowed for more effective sliding, which resulted in biologically accepted reduction of forces and their momentum [8,9]. This idea aroused the interest of clinicians and intense research comparing self-ligating and traditional brackets had begun the point of which was the reduction of friction. The theoretical reduction of friction in self ligating brackets allows for faster space closure in cases required extraction .One of the characteristics of self-ligating brackets is the slot, which becomes shallower on the vertical plane from the occlusal edge towards the gingival edge. This is caused by the difference in the horizontal bracket's walls: the gingival wall is shallower than the occlusal wall. For example, the In-Ovation® bracket's horizontal gingival wall is 0.195 inches and the occlusal wall is 0.285 inches.

Active brackets are equipped with a spring based clip which, pushing on the archwire, al- lows for all the values built in the bracket to be expressed;

it helps to control rotation and torque. Active brackets have an advantage over passive ones due to the presence of friction at the early stages of leveling the teeth, especially when tooth rotation is supposed to oc- cur. Examples of active brackets are: In-Ovation® (GAC International, Central Islip, NY), SPEED® (Strite Industries, Cambridge, Canada), Time® (Adenta) [10,11]. The passive brackets, the horizontal walls (gingival and occlusal) have the same dimensions. The buccal wall is usually equipped with a slide clip, which doesn't enter inside the slot and doesn't decrease it's diameter after closure. The slide clip doesn't push the arch wire in the slot thus allowing for it's uninhibited movement which results in lesser friction in comparison to active brackets [12]. This is however, controversial. It cannot be said that the bracket is passive from the beginning of treatment. The slot can be passive only when the teeth are properly aligned in all three dimensions, so that they express correct angulation and torque, and the full-sized arch wire doesn't have contact with the walls of the slot [10]. This has been evidenced by Brauchlia et al. [13] who compared the in vitro action of passive and active self-ligating brackets, as well as conventional brackets. The authors didn't notice any significant difference in the action of non full-sized arch wires in active and passive brackets until the teeth had been fully leveled. Friction decreased in the passive brackets in later stages.

Shorter Chair-Side Time and Treatment Time

Voudouris [14] had approximately four times shorter chair-side time when using self-ligating brackets in comparison with conventional ones. In cross-sectional studies [15,16] it has been observed that in the case of one arch wire, it takes approximately 20 seconds less time to perform ligature removal on tradition brackets, but this difference is not statistically significant. Nevertheless, a systematic review performed by Fleming and Johal [17] has proved clearly that the advantage of self-ligating brackets is shorter chair-side time thanks to an opening and closing mechanism allowing for quicker arch-wire removal and insertion. Since the shorter chair-side time had been proven, many authors have tried to compare total treatment times depending on bracket type: conventional and self-ligating. Researchers have conveyed total treatment time abridgement of about 4–7 months, based on the assumption that less friction, lesser forces and more physiological tooth movement provide shorter treatment time. The number of appointments could be limited from 4 to 7 [18] as well as their frequency reduced .The authors also emphasised that arch- wire removal and insertion does not require the help of an assistant, which results in a more ergonomic work environment Nevertheless, assessment of real total treatment abridgement with the usage of self-ligating brackets has not been accomplished with a systematic review.

Dental Arch Expansion

Another feature of self-ligating brackets is better action during crowded levelling. They help to expand dental arches in cases that are on the border between extraction and non-extraction treatment. On the basis of the comparison of the actions of passive and active slots, it is known that it is possible not due to free archwire movement in the slot, but due to pressure of the clip toward the arch wire in the slot of an active bracket. Moreover, in contrast to most traditional brackets, self-ligating brackets have narrower bases, so the spans of the arch wire between brackets are longer and the contact between the bracket and the arch wire in the slot is shorter. Due to the fact that the force released by an arch wire is inversely proportionate to its length, a smaller contact between the slot and the arch wire generates lesser forces, and a longer span between adjacent brackets makes the arch wire more flexible and gives it more scope of work [19]. Both of these physical qualities can be the reason for better tooth levelling at the early stages of treatment. Unfortunately, this concept has not been proven in in vivo studies. Miles [20] and Ong et al. [21]

compared the rate of tooth levelling in self-ligating and traditional brackets and were unable to prove any advantages in one type over another in elimination of crowding or expansion of the dental arch. The effectiveness of traditional brackets, regardless of the type of ligatures (elastic or wire), was similar after 20 weeks of treatment.
Expansion of the dental arches generates better conditions for minor tooth proclination; therefore indicators for extraction may be restricted. This has not been proven in studies by Pandis et al. [22] and Fleming et al. [23] who achieved the same proclination of the upper and lower teeth and same inter-canine dimension regardless of the appliance used. However, randomised research [24] and a systematic review performed by Chen et al have proven that proclination of the incisors was about 1.5 mm less in self-ligating brackets in comparison to traditional ones due to the advantage of transverse forces over sagittal ones. Space on an alveolar may be created by the widening of the circuit of the dental arch rather than by it's elongation and has a greater dental arch expansion of the level of molars in self-ligating bracket in comparison to traditional ones.

Minor Tendency for Root Resorption

Contrary to expectations, there is no unequivocal evidence confirming minor root resorption after treatment with self-ligating brackets. Pandis et al. [25] found no statistical significance in root resorption in comparative studies. Moreover, Scott et al. [24] reported larger root resorption when using Damon's brackets than in conventional brackets – 2.26 in the former versus 1.21 in the latter.

Easier Intra-Oral Hygiene

The oral cavity is a rich ecosystem with a plethora of microorganisms. While both periodontal disease and caries are considered multifactorial diseases, plaque bacteria are the major factor in their onset and progression. However, there are situations which comprise what has been termed 'ecological stress', referring to the shift of the microbiological balance, creating conditions conducive to the growth, and appearance of cariogenic and/or periodontopathic bacteria .In theory, smaller brackets dimensions and less retention spaces (such as the ends of metal ligatures and elastic ligatures) may provide easier hygiene maintenance. Pellegrini et al. [26] proved in studies a lower level of Streptococcus in the presence of self-ligating brackets, however Pandis et al. [27] did not find any correlation between the type of brackets and the level of the bacteria the evaluation of the accumulation of plaque, calculus and gingivitis in 50 patients wearing conventional brackets and 50 patients wearing self-ligating brackets during an 18-month treatment period showed no difference in the mentioned indexes in either groups. In turn, Fortini et al. [28] claim that the hygiene around the brackets is impeded regardless of its type and it should be conceded that controversy about this is still ongoing.

Similarities and Differences from Conventional Braces

One of the most significant differences from conventional dental braces is the absence of elastic ligature (bands or ties). Self-ligating braces typically are smaller and more aesthetic since a metal door is required to hold wires in place (this prevents "invisible" or clear options of these braces, with the exception of 3M Unitek who have devised a hybrid bracket called the "Smartclip"). They also tend to stand off the teeth further toward the lips and cheeks. The ties on this type of brace are used to hold the arch wire in place. The self-ligating braces uses a slide mechanism to hold the arch wire, thus reducing the amount of pressure exerted on the teeth. However, there are many similarities to typical braces, such as the fitting on such appliances; self-ligating braces are glued onto the teeth and are not removable until treatment is complete. Regular cleaning is also essential for effective treatment and desirable results. The consumption of too much sugar (in food, and especially drinks) and poor dental

hygiene can result in demineralisation which can lead to permanent damage, dental caries (decay).

Analysis has also shown treatment times are longer when self ligated orthodontic brackets are used compared to conventional orthodontic brackets.[29]

Conclusion

Self-ligating bracket systems were built on the philosophy of delivering light forces on a low-friction basis, thus insuring more physiologic tooth movement and at balanced oral interplay. These systems have been gaining popularity in recent years with a host of claimed advantages over conventional appliance systems relating to reduced overall treatment time, less associated subjective discomfort, promotion of periodontal health, superior torque expression, and more favourable arch dimensional change. Other claimed advantages include possible anchorage conservation, greater amounts of expansion, less proclination of anterior teeth, less need for extractions, and better infection control.

References

1. Chen S.S., Greenlee G.M., Kim J.E., Smith C.L., Huang G.J.: Systematic review of self-ligating brackets. Am. J. Orthod. Dentofac. Orthop. 2010, 137, 726.e1–e18.
2. Rinchuse D.J., Miles P.G.: Self-ligating brackets: present and future. Am. J. Orthod. Dentofac. Orthop. 2007, 132, 216–222.
3. Harradine N.: The history and development of self-ligating brackets. Semin. Orthod. 2008, 14, 5–18.
4. Berger, J. L. & Byloff, F. K. (2001). The clinical efficiency of self-ligated brackets. Journal of Clinical Orthodontics, Vol. 35, No. 5, pp. 304–308, ISSN 1147-5540.
5. Damon, D.H. The Damon low-friction bracket: A biologically compatible straight-wire system. (1998). Journal of Clinical Orthodontics, Vol. 32, No. 11, pp. 670-680, ISSN 1038-8398.
6. Keim, R. G.; Gottlieb, E. L.; Nelson, A. H. & Vogels, D. S. (2008). Study of orthodontic diagnosis and treatment procedures. Part 1: results and trends. Journal of Clinical Orthodontics, Vol. 42, no. 11, pp. 625–640, ISSN 1907-5377.
7. keim, R. G.; Gottlieb, E. L.; Nelson, A. H. & Vogels, D. S. (2002). Study of orthodontic diagnosis and treatment procedures. Part 1. Results and trends. Journal of Clinical Orthodontics, Vol. 36, No. 1, pp. 553-568, ISSN 0168-0786.
8. Megat Abdul Wahab R., Idris H., Yacob H., Zainal Ariffin S.H.: Comparison of self- and conventional-li- gating brackets in the alignment stage. Eur. J. Orthod. 2011, Advance Access published April 8, 2011. [Epub ahead of print].
9. Pandis N., Eliades T., Partowi S., Bourauel C.: Forces exerted by conventional and self-ligating brackets during simulated first- and second-order corrections. Am. J. Orthod. Dentofac. Orthop. 2008, 133, 738–742.
10. Rinchuse D.J., Miles P.G.: Self-ligating brackets: present and future. Am. J. Orthod. Dentofac. Orthop. 2007, 132, 216–222.
11. Harradine N.W.T.: Self-ligating brackets: where are we now? J. Orthod. 2003, 30, 262–273.
12. Baccetti T., Franchi L., Camporesi M., Defraia E.: Orthodontic forces released by low-friction versus conven- tional systems during alignment of apically or buccally malposed teeth. Eur. J. Orthod. 2011, 33, 50–54.
13. Brauchli L.M., Senn C., Wichelhaus A.: Active and passive self-ligation – a myth? Angle Orthod. 2011, 81, 312–318.
14. Voudouris J.C.: Interactive edgewise mechanisms: form and function comparison with conventional edgewise

brackets. Am. J. Orthod. Dentofac. Orthop. 1997, 111, 119–140.

15. Harradine N.W.: Self-ligating brackets and treatment efficiency. Clin. Orthod. Res. 2001, 4, 220–227.
16. Fleming P.S., DiBiase A.T., Sarri G., Lee R.T.: Efficiency of mandibular arch alignment with 2 preadjusted edge-wise appliances. Am. J. Orthod. Dentofac. Orthop. 2009, 135, 597–602.
17. Fleming P.S., Johal A.: Self-ligating brackets in orthodontics. A systematic review. Angle Orthod. 2010, 80,575–584.
18. Eberting J.J., Straja S.R., Tuncay O.C.: Treatment time, outcome, and patient satisfaction comparisons of Damon and conventional brackets. Clin. Orthod. Res. 2001, 4, 228–234.
19. Proffit W.R., Fields H.W. Jr, Sarver D.M.: Zasady mechaniki w kontroli sił ortodontycznych. In: Ortodoncja Współczesna. Wyd. IV. Tom II. Eds.: Komorowska A. Elsevier Urban & Partner, Wrocław, 2010, 31–66.
20. Miles P.G.: SmartClip versus conventional twin brackets for initial alignment: is there a difference? Aust. Orthod. J. 2005, 21, 123–127.
21. Ong E., McCallum H., Griffin M.P., Ho C.: Efficiency of self-ligating vs conventionally ligated brackets during initial alignment. Am. J. Orthod. Dentofac. Orthop. 2010, 138, 138.e1–e7.
22. Pandis N., Polychronopoulou A., Eliades T.: Self-ligating vs. conventional brackets in the treatment of mandibular crowding: a prospective clinical trial of treatment duration and dental effects. Am. J. Orthod. Dentofac. Orthop. 2007, 132, 208–215.
23. Fleming P.S., DiBiase A.T., Sarri G., Lee R.T.: Mandibular arch dimensional changes with 2 preadjusted edge-wise appliances. Am. J. Orthod. Dentofac. Orthop. 2009, 136, 340–347.
24. ScottP.,DiBiaseA.T.,SherriffM.,Cobourne M.:AlignmentefficiencyofDamon3self-ligatingandconventional orthodontic bracket systems: a randomized clinical trial. Am. J. Orthod. Dentofac. Orthop. 2008, 134, 471–478.
25. Pandis N., Nasika M., Polychronopoulou A., Eliades T.: External apical root resorption in patients treated with conventional and self-ligating brackets. Am. J. Orthod. Dentofac. Orthop. 2008, 134, 646–651.
26. Pellegrini P., Sauerwein R., Finlayson T., McLeod J., Covell D.A. Jr, Maier T., Machida C.A.: Plaque re- tention by selfligating vs elastomeric orthodontic brackets: quantitative comparison of oral bacteria and detection with adenosine triphosphate-driven bioluminescence. Am. J. Orthod. Dentofac. Orthop. 2009, 135, 426.e1–e9.
27. Pandis N., Vlachopoulos K., Polychronopoulou A., Madianos P., Eliades T.: Periodontal condition of the mandibular anterior dentition in patients with conventional and self-ligating brackets. Orthod. Craniofac. Res.2008, 11, 211–215.
28. Fortini A., Lupoli M., Cacciafesta V.: A new low-friction ligation system. J. Clin. Orthod. 2005, 39, 464–471.
29. Papageorgiou; et al. (2014). "Clinical effects of pre-adjusted edgewise orthodontic brackets: a systematic review and meta-analysis.". Euro J orthod. 124 (4): 350–363. doi:10.1093/ejo/cjt064. PMID 24062378.