

# TREATMENT TIME WITH SELF-LIGATING ORTHODONTIC BRACKETS: A LITERATURE REVIEW

## ABSTRACT

**AIM:** The aim of this study was carry out a literature review on the self-ligating brackets (SLB), identifying publications which evaluated the treatment time with these systems comparing them to the conventional brackets (CB). **MATERIAL AND METHODS:** The following indexing bases were researched: Medline (Medicine online – International Literature on Health Sciences), LILACS (Latin-American and Caribbean Literature on Health Science), IBECS (Spanish Bibliographic on Health Sciences), SciELO (Scientific Electronic Library Online) and Cochrane Library, available on the virtual librarian web site on Health of the Medicine Regional Library – BIREME (www.bireme.br). The following describers were researched: orthodontic brackets and self-ligating brackets and its correspondents in Spanish and English languages. In this study were covered the scientific researches published in the last ten years, available on their complete form. **CONCLUSION:** It was concluded that the treatment time seems not showing clinical significant differences when compared the SLB and CB systems, and that researches as control case studies and randomized clinical trials, with rigorous methodology, should be developed to accurate investigation of concepts and results which involve the matter.

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## KEYWORDS

Orthodontics. Orthodontic brackets. Tooth movement.

## INTRODUCTION

Orthodontics is the oldest specialties on Dentistry, and it was the first one which was organized. It is the dental specialty related to the study of growth of the craniofacial complex, with development of occlusion and with the dentofacial anomalies. Orthodontics therapeutic involves three systems of tissue linked between them: dentition, skeleton and facial muscles.<sup>1</sup>

Several techniques and types of appliances may be used in orthodontics treatments. The appropriate type of appliance for the desired correction depends upon the insightful evaluation by the orthodontist, where removable and fixed orthodontic appliances are used.

The fixed orthodontic appliance systems had great evolution between the decades 1920s and 1930, when Eduard Hartley Angle developed the Edgewise bracket system. In this system, the professional can have greater tridimensional control on orthodontic movement, and nowadays the contemporary orthodontic appliances are considered an evolution from the Edgewise system.

Among the variations of contemporary orthodontic appliances we found the self-ligating brackets (SLB). Despite they had achieved great space in the last years, these brackets are not a novelty on orthodontics: they exist since the 70's, and its concept is that the bracket itself is able to fasten the

orthodontic arches, dismissing elastic and metal ligatures. The absence of these ligatures propitiates reduction of friction generated between the orthodontic wire and the bracket, what would favor the development of a treatment with load levels more appropriate and also a reduction in the treatment time.

However, despite the perspective for the use of SLB system is obtain a mechanical orthodontic with significant reduction of friction between brackets and the orthodontic wire, scientific evidences demonstrating this biomechanical gain over the total treatment time is still contradictory.

Thus, oriented studies for evaluation of SLB systems, especially involving the treatment time comparing them with conventional brackets (CB) systems present great clinical importance and cover the aims of this research.

## MATERIAL AND METHODS

A literature review was carried out about the matter treatment time with SLB. The following databases were searched: Medline (Medicine online – International Literature on Health Sciences), LILACS (Latin-American and Caribbean Literature on Health Science), IBECs (Spanish Bibliographic on Health Sciences), SciELO (Scientific Electronic Library Online) and Cochrane Library, available on the virtual librarian on Health of Regional Library of Medicine – BIREME ([www.bireme.br](http://www.bireme.br)).The

following describers were researched: orthodontic brackets and self-ligating brackets and its correspondents in Spanish and English languages. In this study, issues and scientific researches published in the last ten years were covered; further some publications on academic concern over the matter, available in their full text, classifying them according to their aims, detaching those addressed to the treatment time when comparing SLB and CB.

### LITERATURE REVIEW

Long time dental irregularities positioning as crowding, protruding teeth and other irregularities are uncomfortable for many people, and the attempts to correct these problems are registered at least 1000 years b.C. Rudimentary orthodontic appliances seemingly addressed to regularize teeth were found as archaeological artifacts of ancient civilizations as Egyptians, Greeks and Mayans. With the development of dentistry in 18<sup>th</sup> and 19<sup>th</sup> centuries, several appliances were described for regularize teeth<sup>2</sup>, where the study of growth of craniofacial complex, of development of the occlusion involving treatment of dentofacial anomalies makes the orthodontic therapy acting on the muscle, skeleton and dental systems.<sup>1</sup>

Nowadays, treatments involving fixed orthodontic appliances were originated in the last 1920s and in early 30s. The Edgewise appliance, developed by Edward Hartley Angle,

is one of the most important ones.<sup>3</sup> From the Edgewise system by Angle, other contemporary fixed appliances were developed.<sup>2</sup>

In order to obtain appropriate orthodontic results and with few folds in the wire, the Edgewise system evolved to the called preadjusted appliances. In the philosophy of treatments with preadjusted appliances, the variations of dental and skeleton relations, soft tissues and dental morphology should be considered. Therefore, the preadjustment of appliance is an average of the variations found in the teeth positions of most patients.<sup>4</sup>

Based on the Edgewise brackets and the conventional preadjusted ones, the SLB system was developed. In this system, due to the elimination of metal and elastic ligating, an environment with lower friction is created, allowing a better mechanical efficiency.<sup>5</sup>

According to some manufacturers, the SLB offer many important characteristics and the main of them is the decrease of treatment time. The recent popularity and commercialization of these brackets lead the enterprises of the area to introduce similar systems, and nowadays most of them already offer some type of SLB.<sup>6</sup>

Jacobs et al.<sup>7</sup> performed a study in which evaluated the number of consultations, treatment time and degree of radicular reabsorption of patients who received

orthodontic treatment with SLB and CB. In this study 213 patients were divided into two groups, one treated with SLB (n=139) and another with CB (n=74). The study results showed there was no significant statistically difference on the number of consultations and on the quantity of radicular reabsorption between the groups. However, regarding to the treatment time, the cases treated with SLB took the average of 18.1 months, and the cases treated with CB took 20.7 months. The authors concluded there is no significant statistically difference on the apical reabsorption and the number of consultations between the groups, but the total treatment time was about three months faster with SLB compared to CB.

Prettyman et al.<sup>8</sup> performed a research in order to verify possible clinical differences between orthodontic treatments with SLB and CB realized by experienced orthodontists. A questionnaire was elaborated to determine if the orthodontists observed differences on the clinical performance between the two brackets systems based on his experience. In this research some factors were evaluated as treatment time, discomfort realized by patients and indication of teeth extraction, allowing the orthodontist pointing a preference by SLB or CB, based on the experience and clinical results obtained. The American Association of Orthodontists provided a list of 1,000 members who work in the United States of America, randomly generated, and the

questionnaires were elaborated and sent to them. These questionnaires had a rate of answer of 43%. The results of the research pointed that 90% of professionals already have used SLB, but regarding to the treatment time only 37% of orthodontists participant indicated that SLB offer a faster treatment time.

Eberting et al.<sup>5</sup> performed a research with the aim to evaluate the efficiency of orthodontic treatment with SLB compared to the CB. In this way, they analyzed the treatment time, number of consultations and quality in the results obtained. The inclusion criterion for the study was the use of the same treatment system since the beginning until the end of the treatment. The sample was composed by 215 patients: SLB (n=108) and CB (n=107). Plaster models and panoramic radiographs pre and post treatment were analyzed, and a questionnaire was sent to the patients in order to exam their perceptions on how the orthodontic treatment progressed and was concluded. The results showed that the group of patients who used the SLB had a lower number of consultations and a treatment time mean of 24 months; the group treated with CB had a treatment time mean of 30 months. The authors concluded that the orthodontic treatment with SLB is significantly faster and efficient when compared to the CB.

Wong et al.<sup>9</sup> performed a clinical trial in order to investigate the quantity of closing

space, after pre-molar extraction, in orthodontic treatment with different combination of brackets (SLB and CB) and ligatures, evaluated during a period of three months. Forty five patients participated this study and the inclusion criteria were: age between 12 and 16 years old; patients with indication for orthodontic treatment; necessity of extraction of pre molar and closing space; cases without need of anchoring reinforcement. The participants were distributed randomly in three groups: (1) CB and elastic ligature; (2) CB and low friction elastic ligatures; (3) SLB. The participants were analyzed in week intervals, during three months or until the complete closing space and molding with alginate were obtained in each visit. The results of this study pointed that the combination bracket/ligature did not have significant effect on the quantity of space closing along this period when compared with SLB. The authors concluded that the main determinant of orthodontic dental movement is probably the individual answer of each patient.

Johansson and Lundstrom<sup>10</sup> performed a study that the aim was to evaluate the number of sessions, total treatment time and the results obtained in orthodontic treatments comparing SLB and CB. Ninety adolescents were selected for this study, 44 were treated with SLB and 46 with CB. The age individuals in the beginning of treatment varied between

11 and 18 years old. The inclusion criteria were treatments with fixed orthodontic appliances in at least one of the arches. The exclusion criteria were presence of teeth included, multiple agenesis or need of orthognathic surgery. Study plaster models pre and post-treatment were codified and mixed. The average of treatment time was 20.4 months for the group treated with SLB, and 18.2 months for the group treated with CB. The number of visitations was 15.5 for the group treated with SLB and 14.1 for CB. The results showed that differences found were not statistically relevant between the groups. From these evidences, the authors concluded that orthodontic treatments using fixed appliances with SLB do not have greater efficiency when compared to the CB in the treatment time, number of visitations and results obtained.

Wahab et al.<sup>11</sup> evaluated the difference on the clinical efficacy and treatment time between SLB and CB during the dental alignment phase. The population reference for this study was constituted by 29 patients, 10 men and 19 women, from 14 to 30 years old. Alginate moldings were taken before installing the appliances and in month intervals, during four months. The results of this study showed that in the first two months, CB demonstrated a rate of teeth alignment faster than the SLB. There was no statistically significant difference between the two types of brackets during the remaining period of study. The authors

concluded that, in general, the SLB were not superior when compared to the CB regarding to the treatment time during the stage of alignment and leveling of teeth, although the alignment of incisive teeth during the first month have had a significantly faster rate.

Machibya et al.<sup>12</sup> in their study compared the treatment time, the results obtained and the anchorage loss among patients treated with CB and SLB. They conducted a retrospective study with a sample of 69 patients with mean age of 15 years old in the beginning of the treatment, 21 boys and 48 girls. Cephalometric tracings and plaster models pre and post treatment were evaluated to verify the changes achieved. The results of the research demonstrated that the mean of treatment time for patients treated with SLB was only around two months less than those treated with CB, and there was no differences regarding to the anchorage loss when compared the two brackets systems. Then, the authors concluded that the orthodontic treatment time was not influenced by the type of bracket used.

In another study<sup>13</sup> differences among the number of sessions, treatment time and pain were analyzed during the teeth movement in orthodontic treatment, evaluating SLB and CB. The study was oriented through a literature review. Scientific researches published between the years 1996 and 2012 were evaluated. The differences found

between the two brackets systems were not significant, and the authors concluded that due to the limited number of studies, controlled and randomized clinical trials are still necessary to obtain more data for scientific conclusions.<sup>13</sup>

Sathler et al.<sup>14</sup> conducted a literature review to research studies published regarding orthodontic treatments with SLB, confirming or refusing current speculations about the efficiency of this system. Several characteristics of this system were analyzed, among them the treatment time. The significant reduction in the treatment time disclosed by some manufacturers and authors<sup>15-17</sup> is defended as an advantage of these appliances. Studies<sup>18</sup> demonstrated that the treatment time was reduced until 4 months, and according some researches<sup>15,19</sup> it is probably due to the fact that this systems offer lower indexes of friction between the wire and the orthodontic bracket. The authors concluded that are still necessary studies to evaluate and prove the efficacy of SLB and that today they are only another option to the patients and professionals.

Miles<sup>6</sup> performed a literature review on the SLB analyzing the treatment time, duration and number of consultations and the results obtained comparing with treatments using CB. Among the literature analyzed, some studies<sup>20,21</sup> found that SLB showed lower indexes of friction when compared to the CB

and due to this fact, the alignment of teeth would be faster, showing a significant difference on the total treatment time. Reductions on the treatment time were verified around 4 and 6 months. These studies pointed certain clinical advantage on the efficiency of treatment with SLB, however it is not clear enough to establish what techniques were used and what variables were controlled. Several factors may affect the treatment and randomized prospective studies are preferred. The author concluded that the current evidences regarding to the duration of treatment indicates there is not significant clinical differences between the two types of brackets, but the evidences are limited and studies using the same sequences of wires and orthodontic mechanic are necessary.

Harradine<sup>22</sup> developed a literature review with the aim to verify the efficiency of treatment with SLB. In this research were described some characteristics as installation speed and removal of the orthodontic arch during the consultations, treatment time, friction between the bracket and the orthodontic wire and the pain described by the patients during the treatment. Regarding to the treatment time, studies evaluated<sup>23,24</sup> showed that SLB had faster treatment when compared to the CB. However, similar studies<sup>25-27</sup> did not find statistically significant results between the two brackets systems, what is also supported by some reviews evaluated<sup>28,29</sup> which

concluded there are not enough evidences to affirm that treatments with SLB are faster. The author suggests that by combination of less resistance mechanics to the slipping and better ligation control, the SLB can reduce the duration of treatment. However, none of the controlled randomized studies could evidence reduction in the total treatment time with this system.

Wright et al.<sup>30</sup> reviewed the literature about the SLB system pointing evidences that this system can lead to reductions on the consultation time, particularly when the professional already has experience with the system. However, the authors observed there is no evidence that SLB system offers faster orthodontic results or superior quality over the CB. The authors concluded that evidences available indicate there are no differences on the final results, regarding to the quality and treatment time when the two brackets systems were compared.

Fleming and O'Brien<sup>31</sup> reviewed the literature about SLB in order to evaluate the efficiency on the treatment time. The authors verified that initial researches involving the matter were observational ones, and impaired by uncontrollable factors, as professional experience and use of different types and sequences of orthodontic arches. Surveys evaluated in this study investigated the efficiency on the initial orthodontic alignment during the first 20 weeks of

treatment<sup>32-38</sup>, where the results indicated that the SLB system did not offer advantages regarding to the efficiency on the initial stage of treatment. The authors also verified that studies carried out to evaluate the retraction rate of canine and closing space<sup>37,40</sup> also did not show statistically significant difference when compared the two brackets systems. Related to the total treatment time, the research evaluated<sup>41</sup> indicated that the systems used, both SLB and CB, did not result in treatments significantly faster. Then, the authors concluded there is no finding that SLB offer lower duration on the total treatment time in the alignment stage and on the closing space rate.

Fleming and Johal<sup>28</sup> performed a systematic literature review where evaluated the clinical differences between orthodontic treatments with SLB and CB. For the study, the electronics databases MEDLINE, EMBASE and Cochrane library were searched. Controlled and randomized clinical trials that evaluated the influence of the type of bracket on the efficiency of alignment, dimensional changes on the arch, closing space rates, radicular reabsorption rate and total treatment time were selected. Initially 43 studies were considered relevant for the research, but after detailed analysis only 17 were inside the inclusion criteria. The results showed few differences between treatments with SLB and the CB, and the authors concluded there are no

enough scientific evidences to support the hypothesis that SLB are more efficient when compared to the CB systems, and suggest new controlled researches to elucidate the matter.

Castro<sup>42</sup> in a literature review about the efficiency of orthodontic treatments with SLB, evaluated some characteristics as treatment time, friction generated between the wire and the ligature, retention of bacterial plaque and changes on the facial profile due to the orthodontic treatment. When evaluating the selected studies, the author also concluded that SLB did not showed better mechanical efficiency when compared to the CB.

Burrow<sup>43</sup> in a research in order to compare the canine retraction speed between the SLB system and the CB, evaluated a sample constituted by 43 patients who fill the following inclusion criteria: malocclusion Class II with superior incisive vestibularized or crowded, or Class I with vestibularization of superior and inferior incisor teeth; appropriate periodontal health, indication for extraction of the first superior premolars and retraction of superior canines. For development of the study, SLB were installed in one of the superior canines, and conventional brackets were installed on the opposite one. The quantity of retraction was measured from the mean line of the superior arch until the mesial face of canines with a millimeter rule. All the retraction changes of the canines were measured by the investigator in week



evaluations during one month. The retraction rate of the canines was defined as the travelled distance divided by the interval time necessary for space closing. It was found that the mean movement was 0.07 millimeters with SLB and 0.27 millimeters with CB, presenting statistically significant difference. The author concluded that the retraction rate on the canines trend to be faster with CB when compared to the SLB.

### DISCUSSION

So much has been announced and promised regarding to the orthodontic treatment time with seSLB. This system, because of the absence of metallic and elastic ligatures, creates an environment with lower coefficient of friction and enables the use of load in adequate magnitude during the orthodontic mechanics, with positive influence on the treatment time.<sup>16</sup>

Based on scientific evidences, it is important evaluate if this concept of lower treatment time with SLB is supported by the literature. According to some authors<sup>5-8</sup> the SLB systems is an innovative technique that searches achieve the needs of patients, respecting the physiological limits for each case, allying quickness, reduction of the number of consultations and better esthetical and functional results. The main advantage of SLB is the optimization of the clinical attendance time, which is possible due to the

low friction between the bracket and the orthodontic wire. With this technique, lower intensity strength is necessary to establish the teeth movement, and the treatment is performed in a faster and efficient way; it is possible observe a reduction of treatment time in until 7 months.

However, as some other researches show<sup>9-12,43</sup>, the SLB are able to produce lower indexes of friction when compared to the CB, but this property does not have scientific evidence that offers significant gain over the treatment time. The affirmation that SLB have faster treatment time is supported by some case reports, opinions of experts and manufacturers' promotional materials. However, orthodontic therapy cannot be concretized from these arguments that possess poor scientific evidence when compared to case control studies and randomized clinical trials.

Then, the SLB system should be another option for orthodontic treatments and it needs more investigations to receive all the attributions which are given to it; the affirmations on its advantages still need solid scientific evidences.

### CONCLUSION

Considering the method used and the literature evaluated, we verify that the researches with the aim to evaluate the treatment time with SLB comparing them to

the CB are still poor. It was observed that many researches addressed to the evaluation of the matter did not present scientific rigor, regarding to the methodologies applied, generating imprecise results. We conclude that researches as case control studies and randomized clinical trials, with rigorous methodology, should be carried out in order to a precise find out of concepts and results which involve the matter, and until the moment, researches of this nature seem to point that there is no clinical significant differences when compared the two brackets systems.

#### REFERENCES

1. Moyers RE. Ortodontia. Rio de Janeiro: Guanabara Koogan; 1991.
2. Proffit WR. Ortodontia Contemporânea. Rio de Janeiro: Guanabara Koogan; 2002.
3. Graber N. Aparelhos Ortodônticos Removíveis. São Paulo: Panamericana; 1997.
4. Bishara SE. Ortodontia. São Paulo: Santos; 2004.
5. Eberting JJ, Straja SR, Tuncay OC. Treatment time, outcome, and patient satisfaction comparisons of Damon and conventional brackets. *Clin Orthod Res* 2001;4:228-34.
6. Miles PG. Self-ligating brackets in orthodontics: do they deliver what they claim? *Aust Dent J* 2009;54:9-11.
7. Jacobs C, Gebhardt PF, Jacobs V, Hechtner M, Meila D, Wehrbein H. Root resorption, treatment time and extraction rate during orthodontic treatment with self-ligating and conventional brackets. *Head & Face Med* 2014;10(2):1-7.
8. Prettyman C, Best AM, Lindauer SJ, Tufekci E. Self-ligating vs conventional brackets as perceived by orthodontists. *Angle Orthod* 2012;82(6):1060-6.
9. Wong H, Collins J, Tinsley D, Sandler J, Benson P. Does the bracket-ligature combination affect the amount of orthodontic space closure over three months? A randomized controlled trial. *J Orthod* 2013;40:155-62.
10. Johansson K, Lundstrom F. Orthodontic treatment efficiency with self-ligating and conventional edgewise twin brackets: A prospective randomized clinical trial. *Angle Orthod* 2012;82:929-34.
11. Wahab RMA, Idris H, Yacob H, Ariffin SHZ. Comparison of self- and conventional-ligating bracket in the alignment stage. *Eur J Orthod* 2011;34:176-81.
12. Machibya FM, Bao X, Zhao L, Hu M. Treatment time, outcome, and anchorage loss comparisons of self-ligating and conventional brackets. *Angle Orthod* 2013;83:280-5.
13. Celar AG, Schedlberger M, Dörfler P, Bertl M. Systematic review on self-ligating vs. conventional brackets: initial pain, number of visits, treatment time. *J Orofac Orthop* 2013;74:40-51.
14. Sathler R, Silva RG, Janson G, Castello Branco NC, Zanda M. Desmistificando os braquetes autoligáveis. *Dental Press J Orthod* 2011;16(2):1-8.
15. Berger JL. The speed appliance: a 14-year update on this unique self-ligating orthodontic mechanism. *Am J Orthod Dentofacial Orthop* 1994;105:217-23.
16. Harradine NWT. Current Products and Practices Self-ligating brackets: where are we now? *J Orthod* 2003;30:262-73.

17. Voudouris JC. Interactive edgewise mechanisms: form and function comparison with conventional Edgewise brackets. *Am J Orthod Dentofacial Orthop* 1997;111:119-40.
18. Harradine NWT. Self-ligating brackets and treatment efficiency. *Clin Orthod Res* 2001;4:220-7.
19. Damon DH. The Damon low-friction bracket: a biologically compatible straight-wire system. *J Clin Orthod* 1998;32:670-80.
20. Shivapuja PK, Berger JL. A comparative study of conventional ligation and self-ligation bracket systems. *Am J Orthod Dentofacial Orthop* 1994;106:472-80.
21. Pizzoni L. Frictional forces related to self-ligating brackets. *Eur J Orthod* 1998;20(3):283-91.
22. Harradine NWT. Self-ligating brackets increase treatment efficiency. *Am J Orthod Dentofacial Orthop* 2013;143:10-8.
23. Ehsani S, Mandich MA, El-Bialy TH, Flores-Mir C. Frictional resistance in self-ligating orthodontic brackets and conventionally ligated brackets. *Angle Orthod* 2009;79:592-601.
24. Tagawa D. The Damon system vs. conventional appliances: a comparative study. *Clin Impress* 2006;15:4-9.
25. Vajaria R, Be Gole E, Kusnoto B, Galang MT, Obrez A. Evaluation of incisor position and dental transverse dimensional changes using the Damon system. *Angle Orthod* 2011;81(4):647-52.
26. Ollivere P. Treatment efficiency of self-ligating brackets. *Orthod Update* 2012;5:15-9.
27. Fleming PS, Di Biase AT, Sarri G, Lee RT. Efficiency of mandibular arch alignment with 2 preadjusted edgewise appliances. *Am J Orthod Dentofacial Orthop* 2009;135:597-602.
28. Fleming PS, Johal A. Self-Ligating Brackets in Orthodontics: A Systematic Review. *Angle Orthod* 2010;80:575-84.
29. Chen SS, Greenlee GM, Kim JE, Smith CL, Huang GJ. Systematic review of self-ligating brackets. *Am J Orthod Dentofacial Orthop* 2010;137:726-7.
30. Wright N, Modarai F, Cobourne MT, DiBiase AT. Do you do Damon? What is the current evidence base underlying the philosophy of this appliance system? *Dental Press J Orthod* 2011;38:222-30.
31. Fleming PS, O'Brien K. Self-ligating brackets do not increase treatment efficiency. *Am J Orthod Dentofacial Orthop* 2013;143:11-9.
32. Miles PG. Smart Clip versus conventional twin brackets for initial alignment: is there a difference? *Aust Orthod J* 2005;21:123-7.
33. Miles PG, Weyant RJ, Rustveld LA. Clinical Trial of Damon 2 vs Conventional Twin Brackets during Initial Alignment. *Angle Orthod* 2006;76:480-5.
34. Pandis N, Polychronopoulou A, Katsaros C, Eliades T. Comparative assessment of conventional and self-ligating appliances on the effect of mandibular intermolar distance in adolescent non extraction patients: a single-center randomized controlled trial. *Am J Orthod Dentofacial Orthop* 2011;140:99-105.
35. Scott P, DiBiase AT, Sherriff M, Cobourne MT. Alignment efficiency of Damon3 self-ligating and conventional orthodontic bracket systems: a randomized clinical trial. *Am J Orthod Dentofacial Orthop* 2008;134:470-8.

36. Miles PG, Weyant R. Porcelain brackets during initial alignment: are self-ligating cosmetic brackets more efficient? *Aust Orthod J* 2010;26: 21-6.
37. Ong E, McCallum H, Griffin MP, Ho C. Efficiency of self-ligating vs conventionally ligated brackets during initial alignment. *Am J Orthod Dentofacial Orthop* 2010;138:137-8.
38. Pandis N, Polychronopoulou A, Eliades CT. Self-ligating vs conventional brackets in the treatment of mandibular crowding: a prospective clinical trial of treatment duration and dental effects. *Am J Orthod Dentofacial Orthop* 2007;132:208-15.
39. Miles PG. Self-ligating vs conventional twin brackets during en-masse space closure with sliding mechanics. *Am J Orthod Dentofacial Orthop* 2007;132:223-5.
40. Mezomo M, Lima ES, Menezes LM, Weissheimer A, Allgayer S. Maxillary canine retraction with self-ligating and conventional brackets. A randomized clinical trial. *Angle Orthod* 2011;81:292-7.
41. Hamilton R, Goonewardene MS, Murray K. Comparison of active self-ligating brackets and conventional pre-adjusted brackets. *Aust Orthod J* 2008;24:102-9.
42. Castro R. Braquetesautoligados: eficiência x evidências científicas. *R Dental Press Ortod Ortop Facial* 2009;14:20-4.
43. Burrow JS. Canine retraction rate with self-ligating brackets vs conventional edgewise brackets. *Angle Orthod* 2010;80(4):633-6.