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Self-ligating bracket claims

Although the self-ligating edgewise bracket was introduced to orthodontists 75 years ago, recent advances in bracket technology have resulted in a number of new self-ligating bracket "systems" and greater interest in their use. Much of this interest is in response to information comparing the benefits of self-ligating systems with conventional edgewise brackets. Often, this information comes from marketing materials and nonrefereed sources claiming that self-ligating bracket systems provide superior treatment efficiency and efficacy. In response to and in support of these claims, there have been numerous articles in refereed journals.

Adherence to the tenets of evidence-based orthodontic practice requires that, for any orthodontic intervention applied to a patient, 3 factors must be integrated: the relevant scientific evidence, the clinician's expertise, and the patient's needs and preferences. On the topic of self-ligating bracket systems, the current challenge for the clinician is to assess the merit of the assertions supporting the superiority of self-ligating brackets. Meeting this challenge requires knowledge of the strength of the evidence of these claims.

The American Association of Orthodontists' Council on Scientific Affairs (COSA) looked at this topic from this viewpoint. Specifically, COSA asked: what is the strength of the research evidence to support claims that self-ligating systems are superior to conventional brackets? For the most noteworthy claims, the answers to this question are given below.

Does lateral expansion of the dental arch by self-ligating brackets "grow" buccal alveolar bone?

This claim is weakly supported by low-level evidence that has not been independently confirmed. Currently, no peer-reviewed scientific evidence supports this claim. The evidence in support of this assertion comes from a few case reports providing weak evidence that should be interpreted with caution.[1] Evidence that does not corroborate this assertion, found in a thesis[2] and an abstract,[3] also provide only weak evidence that should be interpreted with caution.

Is lateral expansion of the dental arch by self-ligating bracket systems comparable with lateral expansion gained by rapid maxillary expansion (RME) followed by conventional edgewise treatment?

This claim is weakly supported by low-level evidence that has not been independently confirmed. Currently, no peer-reviewed scientific evidence supports this claim. The evidence supporting this claim comes from a thesis and should be interpreted with caution until it is independently confirmed by peer-reviewed data.[4] No peer-reviewed studies were found in the literature comparing lateral dental-arch expansion between self-ligating bracket systems and conventional edgewise bracket systems with or without RME.

Is lateral expansion of the dental arch gained by self-ligating bracket systems stable in the long term?

This claim is weakly supported by low-level evidence that has not been independently confirmed. Currently, there is no peer-reviewed scientific evidence that lateral expansion of the dental arch with a self-ligating bracket system has long-term stability.

A few case reports have evaluated the long-term stability of lateral dental arch expansion with self-ligating systems.[1] These case reports provide only low-level evidence, and their findings should be interpreted with caution until they are independently confirmed by peer-reviewed data. In contrast, the long-term stability of RME has been evaluated by a systematic review of clinical trials.[5] Residual expansion at 1 year postretention from treatment with RME and fixed appliances measured as intermolar width is approximately 4 mm.[5]

Are self-ligating bracket systems more efficient and more effective than conventional edgewise bracket systems in treating malocclusions?

Current evidence does not support the assertion that self-ligating bracket systems are more efficient or more effective in treating malocclusions.[6,7] Data from a few studies do indicate that chair time is, on average, 20 seconds less per arch, and final mandibular incisor inclination is, on average, 1.5° less for self-ligating bracket systems.[6] Current evidence does not indicate differences between self-ligating systems and conventional systems for treatment time, rate of alignment, rate of space closure, final arch dimensions, or occlusal outcomes.

This question was evaluated in a recent systematic review of clinical studies (in-vivo studies) comparing the 2 bracket systems.[6] Treatment efficiency was determined by the treatment outcomes: total treatment time, rate of mandibular incisor alignment, rate of en-masse space closure, chair time, and bracket failure rate. Treatment effectiveness was determined by the treatment outcomes: occlusal indexes, arch dimensions, and mandibular incisor inclinations after incisor alignment or at the end of treatment. Fifteen studies met the inclusion criteria for this systematic review. Six of the outcomes—total treatment time, rate of mandibular incisor alignment, rate of en-masse space closure, bracket failure rate, occlusal indexes, and arch

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dimensions—were not significantly different between the 2 bracket systems.[6] Only 2 outcomes, chair time and final mandibular incisor alignment, showed significant differences. Chair time was more efficient with self-ligating bracket systems because it took 20 seconds less per arch to open self-ligating slides compared with removing elastomeric ligatures. In a meta-analysis of data from 3 studies, mandibular incisor inclination was found to be 1.5° less for self-ligating bracket systems compared with conventional edgewise treatment.[6]

Do self-ligating bracket systems provide less friction between archwire and bracket?

The evidence for less friction between archwire and self-ligating brackets presently comes from results found under specific laboratory conditions, which do not fully emulate a clinical setting. In-depth understanding of friction between bracket and archwire in vivo, and its relationship to tooth movement, remains uncertain.

Reduced friction between bracket and archwire is the key to a number of assertions regarding self-ligating brackets. Proponents insist that reduced friction is coupled with lower, more physiologically harmonious forces during tooth alignment that promote alveolar bone generation and allow for greater lateral expansion of the dental arch—similar to lateral expansion seen with RME.[1] Greater lateral expansion, in turn, minimizes unwanted incisor proclination during nonextraction treatment of crowding and lessens the need for extraction treatment.[1] Also, the lower clinical force from reduced bracket-archwire friction is claimed to reduce orthodontic treatment pain.[8] Low friction is also presumed to be responsible for faster tooth movement—thus, shorter treatment time.[8]

Is there evidence for reduced friction in self-ligating bracket systems?

In a review of the literature, no in-vivo studies evaluating friction between bracket and archwire were found. To date, some in-vitro studies have addressed the question of friction and were recently evaluated in a systematic review.[9] Under selected laboratory conditions where bracket slots are aligned parallel with the archwire, small-diameter round wires slide more freely through self-ligating brackets than conventional edgewise brackets ligated with steel or elastomeric ties. However, the surface contact between bracket, ligation instrument, and archwire is only 1 factor that opposes the motion of a bracket along an archwire in vivo. When force is applied (at the level of the bracket) between teeth fitted with an edgewise appliance in vivo, the biologic response of the alveolar bone produces tooth (and thus bracket) tipping. This, in turn, causes friction from a separate bracket—archwire interaction, termed binding, which has not been accounted for in most in-vitro experiments. When measurement of binding between archwire and bracket is part of an in-vitro experimental design, the results suggest that self-ligating brackets and conventional brackets behave similarly.[10] That is to say, under the conditions where tooth tipping is emulated in vitro, conventional and self-ligating brackets are not different in their resistance to sliding along an archwire.[10] Moreover, additional oral environmental variables, including forces of mastication, degree of malocclusion, host response of the periodontal ligament and alveolar bone, bracket slot angulation and dimension, interbracket distance, temperature, and moisture that cannot be adequately duplicated in vitro, make any laboratory experiment difficult to extrapolate to the clinical setting.[9] At this time, the exact role of frictional forces opposing motion of a bracket along an archwire in vivo is not clear, and the relationship between bracket-archwire friction and tooth movement remains to be elucidated.

Do self-ligating bracket systems provide lower clinical forces compared with conventional brackets?

At present, no studies have measured the forces in vivo to answer this question. Two in-vitro studies suggest that initial forces on buccally or lingually displaced teeth might be greater in self-ligating systems compared with conventional brackets.[11,12] This evidence is considered preliminary and should be interpreted with prudence until it is independently confirmed.

Do patients treated with self-ligating bracket systems experience less pain during treatment?

At this time, there is insufficient data that compare self-ligating bracket systems and conventional bracket systems with regard to the pain experienced by patients during orthodontic treatment.

Three clinical trials (1 prospective cohort split-mouth design, 2 randomized clinical trials) compared the pain felt by patients treated with self-ligating brackets and conventional brackets.[13-15] These studies showed variations in the subjective pain experience measured within the first 8 days after tying in the initial 0.014-in diameter copper-nickel-titanium archwire (self-ligating brackets significantly less painful,[13] nonsignificant tendency to be less painful,[14] or no pain difference compared with conventional brackets[15]). When tying in the second archwire (0.016 × 0.025-in diameter copper-nickel-titanium), a study reported that patients with self-ligating brackets experienced greater pain than those with conventional brackets.[13]

These results should be interpreted with caution because of potential study bias. The prospective cohort study[13] is considered to have a moderate to high risk of bias because it lacks sample size calculation, adjustment for confounders, and assessor blinding.[6,7] The randomized trial[14] also has a moderate risk of bias. Although bracket type was allocated to patients randomly, "clinician and patient blinding of the bracket type was impossible."[14] A recent systematic review of these and other studies comparing subjective pain experience for treatment with conventional brackets or self-ligating brackets found that neither system has an advantage in the first week after appliance placement.[7] At this time, additional studies are needed to fairly and fully answer this claim.

Are conventional edgewise brackets less hygienic than self-ligating brackets?

Evidence does not support the claim that conventional edgewise brackets are less hygienic than self-ligating brackets.

Some published reports suggested that elastomeric ligation of brackets is associated with increased plaque retention and aggravation of clinical periodontal health during orthodontic treatment.[16-20] Four trials made a direct comparison, in vivo, of conventional and self-ligating brackets on these issues.[21-24] Van Gastel et al[21] used a prospective cohort design (split-mouth technique; n = 16) to evaluate clinical periodontal parameters and the presence of anaerobic and aerobic bacteria associated with teeth bonded with conventional and self-ligating brackets over the 7 days immediately after bracket bonding. No significant differences in gingival bleeding or probe depths were noted between the cohorts. Plaque accumulation was greater on teeth bonded with self-ligating brackets, with the plaque containing more anaerobic bacteria.

Pandis et al[22] used a prospective cohort design to evaluate 50 patients bonded with conventional brackets and 50 patients bonded with self-ligating brackets. The outcomes of interest were plaque, gingival, and calculus indexes, and probing depths. The 2 bracket cohorts showed no differences in these periodontal indexes after an average of 18 months of orthodontic treatment.

Pellegrini et al[23] measured bacteria counts around conventional brackets and self-ligating brackets at 1 week and 5 weeks after appliance placement. Using a split-mouth experimental design (n = 14), they measured total bacteria and total oral streptococci. At 1 week, the total bacteria and total oral streptococci were greater around conventional brackets ($P < 0.05$). However, at 5 weeks, total bacteria were not significantly different on the 2 bracket types, whereas total oral streptococci remained elevated around conventional brackets.[23] In contrast, Pandis et al[24] conducted a more recent prospective cohort study (n = 32) and failed to corroborate a difference in total bacteria when comparing conventional and self-ligating brackets at 12 weeks after appliance placement. These studies have been evaluated in a systematic review, with the conclusion that there is insufficient evidence that self-ligating brackets are more hygienic that conventional brackets.[7]

CONCLUSIONS

Two of the 14 most notable assertions made in support of self-ligating bracket systems— reduced chair time and control of mandibular incisor inclination—are supported by the current evidence. The evidence for 9 of the 14 claims regarding self-ligating bracket systems have some peer-reviewed data, but the evidence does not indicate clear differences at this time for reduced friction between archwire and bracket, reduced clinical forces, reduced treatment time, faster alignment, faster space closure, different arch dimensions, better alignment and occlusal outcomes, less patient pain, and more hygienic. Three of the 14 claims in support of self-ligating bracket systems—lateral expansion of the dental arch grows buccal alveolar bone, lateral expansion of the dental arch is comparable with expansion by using RME and conventional edgewise brackets, and lateral expansion of the dental arch is stable in the long term—have no supporting peer-reviewed data at this time.

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