Self-ligating brackets do not increase treatment efficiency

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The Oxford English Dictionary defines efficiency as “achieving maximum productivity with minimum wasted effort or expense.” Orthodontic pioneers have continuously sought methods of enhancing treatment efficiency by attempting to reduce the duration of orthodontic treatment and the length of orthodontic appointments.1 Although mean treatment times of 1 to 2 years are now typical, the drive to reduce orthodontic treatment duration persists.2,3 Many techniques and appliances, including surgical techniques,4 vibratory stimulation,5 increased customization of wires and brackets,6 eschewal of integral treatment phases,7 and routine avoidance of extractions, continue to be proposed with the expressed aim of furthering this progression. The most high profile of these developments has been self-ligating brackets.8 Unfortunately, the marketing of self-ligating brackets has courted controversy, with some advocates overly optimistic about the potential effects and, consequently, overlooking or ignoring the findings from clinical research studies.9,10 In this article, we will review the evidence for many of the claims made by those who promote self-ligating brackets, even in the face of recently published clinical research.

CHAIR-SIDE EFFICIENCY AND EASE OF USE

Evidence indicating that self-ligating systems result in a consistent but modest reduction in chair-side time compared with conventional appliances is plentiful8,11-15 (Table I). In a meta-analysis,16 results from 2 comparable studies8,15 reported mean time savings of 20 seconds per arch with slide opening compared with ligature removal. No significant time difference was noted, however, for slide closure and replacement of ligatures. Proponents have suggested that the saved time could be used to schedule more patients, increase efficiency, improve patient relations, or allow oral hygiene reinforcement.11 However, it could also be suggested that a saving of 40 seconds per patient is insignificant and would not make many operators change their practice.

EFFICIENCY OF TREATMENT

Early research examining the relationship between self-ligating brackets and overall treatment time was observational.17,18 These studies were invariably compromised by the compelling possibilities of selection bias, observer bias, and confounding, including susceptibility to uncontrolled factors such as varying operator experience and preference, differing archwires and sequences, and inconsistent appointment intervals. These studies were most notable for large reported discrepancies in treatment durations, with mean treatment times for conventional brackets ranging from 23.518 to 3117 months. This inconsistency suggests that any advantage attributable to bracket type is likely to be dwarfed by extraneous factors, including the skills, standards, and ability of the operator. Nevertheless, the enduring message from these studies was that self-ligating brackets were responsible for significantly reducing treatment times and visits without impairing the occlusal outcomes. This assumption remained unchallenged until more robust prospective research began to emerge 4 years later. This prospective research was initially restricted to efficiency during a snapshot of treatment, including the efficiency of the initial orthodontic alignment19-26 and the rate of orthodontic space closure27,28; however, prospective studies encompassing treatment in its entirety have been published more recently.

EFFICIENCY OF ARCH ALIGNMENT

A number of prospective studies have investigated the efficiency of initial orthodontic alignment over periods up to 20 weeks.19-26 The results from these trials...
have consistently indicated that despite their associated costs, self-ligating brackets might offer no advantage with respect to treatment efficiency (Table II).

For example, in a prospective analysis of 48 participants, Miles\(^\text{19}\) compared alignment efficiency with SmartClip (3M Unitek, Monrovia, Calif) and conventional twin brackets. SmartClip was found to be no more effective at reducing irregularity during the initial stage of treatment than the conventional twin bracket ligated with elastomeric modules or stainless steel ligatures, with slightly more irregularity remaining after initial alignment in the group treated with SmartClip; this was attributed to the rotational play allowed by this was attributed to the rotational play allowed by the passive self-ligating system with a 0.014-in aligning nickel-titanium wire. This study was limited by the inclusion of both extraction and nonextraction subjects and measurement of the labial segments only. These findings were mirrored by Scott et al\(^\text{22}\) in a randomized controlled trial reported little difference to align the mandibular arch. The authors of a further randomized controlled trial of Damon 3 (Ormco Corporation, Orange, Calif) and a conventional appliance in subjects treated with mandibular first premolar extractions. In a further clinical investigation of 58 patients, Miles et al\(^\text{20}\) compared efficiency of alignment and patient comfort related to Damon 2 and a conventional twin bracket in nonextraction subjects, using a split-mouth study design. At 10-week and 20-week intervals, the twin bracket had achieved an irregularity index score of 0.2 mm lower than that achieved with the Damon 2 brackets.

Similar findings were reported by Pandis et al\(^\text{21}\) in a controlled clinical trial involving Damon 2 and Micro-Arch appliances (Dentsply International Inc, York, Pa), with no significant difference overall in the time taken to align the mandibular arch. The authors of a further randomized controlled trial reported little difference in alignment efficiency with an initial aligning wire (0.016-in nickel-titanium) with SmartClip and Victory systems (3M Unitek) in subjects treated without extractions.\(^\text{23}\) This study of 65 patients involved 3-dimensional measurements and encompassed 11 mandibular contact points. Similarly, no difference in the rate of alignment could be attributed to ceramic self-ligating brackets compared with ceramic conventional brackets in a further randomized controlled trial over 10.7 weeks.\(^\text{24}\)

Overall, these studies involving 447 participants indicate that if any time saving arises from use of self-ligating brackets, it does not become apparent in the initial alignment phase of treatment. However, alleviation of dental irregularity is difficult to measure perfectly, most trials have failed to control for individual metabolic variations, confounding might occur because of baseline imbalances, and the results could have been unintentionally biased by inaccurate bracket placement. In addition, split-mouth designs might be criticized because of the complexity in handling residual malalignment between the central incisors. Nevertheless, unless time is saved later in treatment, on the basis of these prospective studies it seems unlikely that self-ligating systems counterbalance their costs by resulting in more efficient treatment or better treatment outcomes.

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**Rates of Space Closure and Canine Retraction**

Rates of space closure and canine retraction were first investigated by Miles,\(^\text{27}\) who considered the rate of orthodontic space closure in a split-mouth design negating the influence of metabolic variations. No statistical difference was found between the appliance types. This study had a relatively small sample size, with 4 of 18 subjects failing to complete the study. Posted archwires were used on both sides; this design meant that the rate of space closure on each side might also not have been completely independent of the opposing side. Nevertheless, these findings were reinforced by those of Mezomo et al\(^\text{28}\) in a split-mouth randomized controlled trial comparing the rates of canine retraction with either SmartClip or Gemini (3M Unitek) brackets on the canines. Again, no clinically or statistically appreciable difference in the monthly rate of canine retraction was found; the average monthly rate of retraction was just 0.06 mm more with the self-ligating brackets. These studies consistently indicate that self-ligating brackets might have little benefit with respect to treatment efficiency.

**Overall Treatment Duration**

Recently, a large retrospective study\(^\text{29}\) and several randomized controlled trials\(^\text{30-32}\) investigating the duration of orthodontic treatment in its entirety have been published. The prospective studies were based in hospital or public health care settings and comprised
a total of 192 participants (Table III). Findings from the 3 prospective studies indicate that treatment with self-ligating brackets does not result in shorter treatment times. Importantly, they also included assessment of the quality of treatment outcome achieved by using the peer assessment rating index\textsuperscript{30,31} or the Index of Complexity Outcome and Need (ICON) score.\textsuperscript{32} No statistical difference in treatment outcome was observed in any trial. These studies, therefore, indicate that self-ligating brackets are neither advantageous nor disadvantageous in respect of treatment duration or outcome.
On the basis of this research, it is doubtful whether a fixed appliance system can have a significant bearing on the duration of orthodontic treatment or the number of visits required. Moreover, the skill, experience, and objectives of the treating clinician, in addition to the dictates of the patient’s malocclusion, are likely to override any potential difference in treatment efficiency due to bracket type.

CONCLUSIONS

In total, 9 randomized controlled trials have been cited in this summary. There are also 2 published systematic reviews on self-ligating brackets.\(^{16,33}\) It is, therefore, reasonable to assert that the question of whether self-ligating brackets improve treatment efficiency has been particularly well researched in the context of orthodontic evidence. Furthermore, the consistency of the findings from these prospective studies is remarkable, with none finding that self-ligating brackets translate into enhanced efficiency, during either 1 phase of treatment or overall therapy.

Therefore, despite the preliminary findings from retrospective studies, the contention that self-ligating brackets do not improve treatment efficiency is compelling, highlighting the divergence between retrospective research and clinical reality. The efficiency of a course of orthodontic treatment is based on a complex interaction of parameters including appliance type, compliance, biologic age, and bone remodeling, with biologic processes as the ultimate arbiter dictating the maximum speed of the process. Although technological advances might sound and look alluring, osteoclasts are less easily impressed than clinicians. As our specialty progresses, further technological advancement and greater intrusion from private companies with financial backing are inevitable. It is important that a degree of introspection occurs and that salutary lessons are learned when appraising the benefits of new, heavily marketed appliance systems and “new” philosophies. We should not fall for the “emperor’s new clothes” again.

REFERENCES