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SmartClip versus conventional twin brackets for initial alignment: is there a difference?

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Objective: To compare the effectiveness of SmartClip brackets and conventional twin brackets for initial alignment of the lower arch.
Methods: Fifty-eight patients participated in this prospective trial. The patients were assigned alternately to either a group treated with SmartClip MBT prescription brackets or a group treated with conventional MBT twin brackets. Lower anterior irregularity was measured at the start of treatment, 10 weeks later at the first archwire change and 20 weeks after the start of treatment at the second archwire change.
Results: There was no difference in irregularity at the start of treatment. At 10 weeks subjects treated with conventional brackets had a lower irregularity index than subjects treated with SmartClip brackets (Mean difference: 0.7 mm; $p = 0.005$). After 20 weeks there were no statistically significant differences in irregularity between the two groups (Mean difference: 0 mm; $p = 0.82$).
Conclusion: The SmartClip bracket was no more effective at reducing irregularity during the initial stage of treatment than a conventional twin bracket ligated with elastomeric modules or stainless steel ligatures.
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Introduction

Self-ligating (SL) brackets are becoming more common in the marketplace with many manufacturers offering one form or another. Some SL brackets are promoted on the premise that elimination of ligatures reduces friction and allows for better sliding mechanics. If true, SL brackets could reduce the treatment time.[1] Several studies have investigated the principal factors that may influence orthodontic frictional resistance. These factors include relative bracket-wire clearances,[2] archwire size,[3,4] archwire section (round versus rectangular wires),[5] torque at the bracket-wire interface,[5] surface conditions of the archwires and bracket slot,[6] bracket and archwire materials,[7–10] bracket slot width,[5] bracket type (conventional versus self-ligating brackets),[7,11–13] and the type and force of archwire ligation.[7,11,14–18]

In a study using typodont models having different degrees of malocclusion to simulate low and high friction scenarios, SL brackets outperformed conventional brackets when small dimension archwires were engaged. But when larger archwires were engaged, the two bracket types were more comparable.[19] Damon described the clinical use of his SL brackets and claimed that low friction was a major factor in enabling more efficient treatment, but there is little *in vivo* evidence to support this view.[20]

In a retrospective study of patients treated with either Damon SL brackets or conventional brackets Harradine reported mean reductions of four months in treatment time (from 23.5 to 19.4 months) and of four visits during active treatment (from 16 to 12 visits).[21] Another retrospective study of three practices reported average reductions in treatment duration of six months (from 31 to 25 months) and seven visits (from 28 to 21 visits) for Damon SL cases compared with conventional methods of ligation.[1] These reports support a view of clinically significant improvements in treatment efficiency when using passive SL brackets. However, in retrospective studies such as these it is not clear as to what techniques were used or which variables were controlled. They are also potentially biased, despite apparent matching, as there are many uncontrolled factors which may affect the

outcome, such as: operator experience, different types of archwires, altered archwire sequences, and different appointment intervals. Operator enthusiasm with the new appliance may affect the result as the practitioner may be doing 'a little more' than previously. These factors could play a major role in reducing the duration of treatment.

In a recent prospective study we compared Damon 2 with conventional twin brackets and examined their effectiveness at reducing lower incisor irregularity during initial alignment.[22] We concluded that the Damon 2 bracket was no better for initial alignment than a conventional bracket ligated with elastomeric modules. These findings may not reflect the effect of self-ligation when other bracket types are used. The Damon 2 bracket is somewhat like a single wing bracket and uses a single gate to trap the wire. The SmartClip bracket differs in that it is a twin bracket with the wire engaged by nickel titanium clips adjacent to the wings. The different methods of engaging the wire, the single versus twin bracket designs, as well as different bracket dimensions may affect their ability to align teeth. The purpose of this study was, therefore, to compare the effectiveness of SmartClip brackets and conventional twin brackets for initial alignment of the lower arch.

Subjects and methods

Sixty consecutive patients who met the selection criteria were drawn from the author's private orthodontic practice. Sixteen patients were excluded from the original group of 76 for the following reasons:

1. Five subjects had chosen all aesthetic lower brackets over metal brackets.

2. Five subjects had either asymmetrical extractions or missing teeth.

3. Four subjects had upper arch treatment only.

4. One subject did not have all brackets placed at the same appointment due to a partially erupted tooth that could not be bonded.

5. One subject had the lower brackets turned 180 degrees for torque control.

All patients were informed of the purpose of the study, but were not aware of which bracket was of a newer design. Consecutive eligible patients were assigned alternately to one of two groups. Group 1 had the lower arch indirectly bonded with 0.022 inch SmartClip MBT prescription brackets (3M/Unitek, Monrovia, CA, USA) while Group 2 had the lower arch bonded indirectly with conventional 0.022 inch Victory MBT prescription brackets (3M/Unitek, Monrovia, CA, USA). The subjects were paired in the order they were assigned to the groups. The irregularity index, defined as the summed displacement of adjacent anatomical contact points of the six mandibular anterior teeth, was used to quantify alignment.[23] The irregularity index was measured intra-orally using a digital caliper (150 mm ECP-015D digiMax caliper, Moore and Wright, Buchs, Switzerland) to the nearest 0.1 mm.

As there was no suggested archwire sequence for SmartClip brackets at the start of this study, the wire sequence and 10 week intervals used were the same as those used in a previous study comparing Damon 2 and conventional brackets.[22] The wire sequence was that given in the Damon literature from ORMCO (Glendora, CA, USA). The initial archwire was a 0.014 inch Damon copper NiTi wire (ORMCO, Glendora, CA, USA). The conventional twin brackets were ligated with elastomeric modules (3M/Unitek, Monrovia, CA, USA). At the first wire change at 10 weeks a 0.016 inch x 0.025 inch Damon copper NiTi wire (ORMCO, Glendora, CA, USA) was placed, and the irregularity index measured. The irregularity index was again measured at 20 weeks to assess the alignment achieved by each bracket type. In areas of marked irregularity the wire was chilled and then engaged in the slot by holding it in place with a cotton bud chilled by spraying with Endo-Frost (Coltène/Whaledent, Langenau, Germany). Areas with marked irregularity in the group with conventional brackets were tied with modules twisted in a figure eight configuration or with stainless steel ligatures. SmartClip brackets relied upon the clip to hold the wire in place. If an archwire disengaged from one clip after two attempts of chilling it was left disengaged.

To assess the accuracy of measuring the irregularity index, 10 consecutive subjects not involved in the study were measured twice. Pearson's correlation coefficient and a paired *t*-test were used to assess the accuracy and reproducibility of the method. There was no significant difference between the two sets of measurements (Mean absolute difference: 0.17 mm, $p = 0.69$, r = .99) indicating that the method had acceptable accuracy in measuring the irregularity index.

Table 1. Comparison of SmartClip and conventional twin brackets.

Group		Irregularity Index (mm)	*p**
Initial	SmartClip	5.7	0.86
	Conventional	5.8	
10 weeks	SmartClip	2.3	0.005
	Conventional	1.6	
20 weeks	SmartClip	1.4	0.82
	Conventional	1.4	

* Wilcoxon signed rank test

Results

Of the 60 patients initially included in this study, one measurement was mistakenly not recorded so the matched subject in the alternate group was removed. This left a total of 58 subjects (32 females, 26 males) with an average age of 17.1 years (Range: 11.3 - 52.4 years). As the data from the paired, consecutive patients were not normally distributed the non-parametric Wilcoxon signed rank test was used (Table I).

There was no pretreatment difference in irregularity between the SmartClip group and the conventional twin bracket group (SmartClip: 5.7 mm, Conventional: 5.8 mm; $p = 0.86$). Ten weeks later, at the first archwire change, there was significantly less irregularity in the conventional twin bracket group (SmartClip: 2.3 mm, Conventional: 1.6 mm; $p = 0.005$). By the second archwire change at 20 weeks there was no difference between the groups (SmartClip: 1.4 mm, Conventional: 1.4 mm, $p = 0.82$).

Discussion

Previous *in vitro* studies of SL brackets have clearly shown that passive ligation results in less friction than active ligation.[24] However, it has been assumed that along with low friction *in vitro* comes more rapid alignment and a reduction in treatment time *in vivo*. The results of this study demonstrate that at the end of the initial alignment phase of treatment, the SmartClip bracket group had identical irregularity/alignment to the conventional twin bracket group. Clinically, SmartClip brackets did not perform any better than conventional twin brackets. This is in agreement with a previous study that compared the Damon 2 bracket with conventional module ligation and found no difference in alignment.[22]

The mean difference in irregularity of 0.7 mm at the first archwire change could be due to lesser engagement of the 0.014 inch archwire by the passive SmartClip bracket, which allows 6.8 degrees of rotational play compared with a theoretically fully engaged conventional twin bracket. The second 0.016 inch x 0.025 inch archwire, which has only 1.1 degrees of rotational play in the 0.027 inch slot depth of lower incisor SmartClip brackets (0.0270 inch ± 0.005 inch slot tolerance, data supplied by 3M/Unitek, Monrovia, CA, USA) resulted in no detectable difference. Although this result could be affected by bracket positioning, it is unlikely as all patients were indirectly bonded by the author and presumably subjected to the same degree of bracket placement error. Measurement of irregularity is unlikely to have influenced the outcome as the mean absolute difference was 0.17 mm (SD: 0.15 mm).

One of the differences between the clip mechanism of SmartClip and the gate of the Damon 2 bracket is that the wire can disengage from the clip if the force level is too high. While this may be desirable if the intention is to keep force levels low, it is undesirable if security of engagement is desired. In some cases, the 0.016 inch x 0.025 inch Damon Copper NiTi wire disengaged from the clip despite chilling the wire as it was engaged. For this reason, a wire with a lower force level in the first order, such as a round or square cross-section wire (e.g. 0.020 inch or 0.021 inch x 0.021 inch heat activated NiTi wire), may be desirable as a second archwire if significant irregularity remains after the first archwire. Alternatively, the wire can be ligated with a steel ligature instead of relying on the clip. However, despite some SmartClip brackets not completely engaging the 0.016 inch x 0.025 inch wire this did not result in any lesser reduction in irregularity compared with the conventional twin brackets.

Harradine[21] and Eberting[1] reported a reduction in treatment time and number of visits when using Damon SL brackets. Based upon the results of these studies and our previous study comparing Damon 2 brackets with conventional twin brackets,[22] the savings in treatment time and number of visits did not occur during the initial alignment stage of treatment. Therefore, any time savings must occur later in treatment, possibly during space closure in extraction cases. The sample in this study had a 14 per cent extraction rate versus 40 per cent in the study by

Harradine.[21] Unfortunately, the extraction rate was not mentioned in the study by Eberting.[1] The higher extraction rate in Harradine's study may reflect a more complex series of cases, but as the PAR index was not recorded in the present study our results could not be compared with Harradine's results.

Alternatively, the different extraction rates may simply reflect different approaches to treatment. The reduced treatment times reported by Eberting (25 months) using the Damon SL bracket was still greater than the initial non-Damon times (23.5 months) reported by Harradine.[1,21] This supports the notion that the reduction in treatment times may be due to a change to more efficient treatment systems and not the choice of bracket. Alternatively, average cases may not respond any differently from SL brackets, but more severely crowded cases and extraction cases may. Finally, there may be no time savings and reported differences may be due to other factors such as altered mechanics or unintentional bias. Further prospective research is required to determine if there is any reduction in overall treatment duration. Clinicians can then determine if savings in ligation time and, possibly, treatment duration offset the greater cost of these bracket systems. Importantly, patient preference should also be considered because some patients may prefer coloured modules or a more cosmetic bracket system to the claimed mild to modest reduction in treatment time by SL bracket systems.

Conclusion

For the wire sequence used in this study, the SmartClip bracket was no more effective at reducing irregularity than the conventional twin bracket ligated with elastomeric modules or stainless steel ligatures.

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