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## **A comparative study on conventional ligation and self ligation bracket systems: An original research**

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**Abstract**---Aim: The purpose of the present study was to evaluate the comparison between conventional ligation and self-ligation bracket system. Methodology: Seven hundred and sixty two patients, consecutively treated with fixed appliances, were evaluated retrospectively. All patients were treated by one orthodontist in a private orthodontic practice. Three hundred and eighty three patients were treated using a conventional pre-adjusted bracket system and

379 patients were treated with active self-ligating brackets. The total treatment time, number of appointments, appointment intervals, number of bracket breakages and number of unscheduled emergency appointments were recorded. Pretreatment characteristics identified by the ICON were related to these variables. Results: The average treatment duration was 15.7 months (Range: 4.1–40.5 months; SD: 5.6 months). Comparable amounts of time were spent in rectangular and round archwires by both appliances. Overall, there was no statistically significant difference between the durations of treatment with active self-ligating brackets and conventional pre-adjusted brackets. The number of debonded brackets and other emergency visits was significantly higher in patients treated with active self-ligating brackets. The treatment characteristics associated with prolonged treatment were: extraction of teeth, a Class II molar relationship and the degree of maxillary crowding or spacing. Conclusion: Active self-ligating brackets appear to offer no measurable advantages in orthodontic treatment time, number of treatment visits and time spent in initial alignment over conventional pre-adjusted orthodontic brackets.

**Keywords**---orthodontic brackets, self adjusting brackets, fixed appliances.

## **Introduction**

Orthodontic mechanotherapy is primarily dependent upon the material science and design. Bracket designs and archwires greatly affect the efficiency of treatment. In recent years self-ligating brackets (SL) have been accepted by the profession as an alternative to conventional pre-adjusted orthodontic brackets. Some of the advantages claimed for self-ligating brackets over conventional brackets include: shorter treatment times, reduced friction, savings in chairside time, improved oral hygiene and patient comfort.<sup>1-11</sup> In spite of significant exposure of these brackets in the orthodontic marketplace there is limited in vivo evidence to support these claims. The treatment efficiency of self-ligating brackets compared with conventional brackets has been measured at the end of treatment and at selected stages during treatment.<sup>3,6,12,13</sup> These studies, which are predominantly retrospective, have provided conflicting evidence: on one hand self-ligating brackets result in improved treatment efficiency and on the other that they offer no such advantage.<sup>3,6,9,12,13</sup> For example, Harradine reported a significant 4 month reduction in the duration of treatment when Damon SL brackets were compared with an unspecified conventional, pre-adjusted twin bracket.<sup>3</sup> More recently, Miles et. al. found no advantage in treatment efficiency when either Smart Clip or Damon 2 SL brackets were compared with conventional brackets.<sup>13,14</sup> There is, however, one consistent finding from these studies which may impact on the efficiency and cost of treatment with self-ligating brackets: they have a higher rate of bond failure than conventional brackets.<sup>3,6,9,12,15,16</sup> As more orthodontic offices up-date or expand existing sterilization techniques to meet current requirements, a greater demand is placed on the doctor-staff time to maintain the same level of efficiency in patient care. To assist in balancing this

new equilibrium the significant decreased time factor associated with the use of self-ligating brackets may be one of the greatest hidden virtues of the ligatureless system. Some of the more recent articles have highlighted the increasing use of selfligating bracket systems 3,16 and the role they may play in affecting the level of friction in the system. With the introduction of the Edgelok bracket in 1972, the SPEED system in 1980, and the Activa bracket in 1986, several independent claims have been made that share a common theme. All three inventors report a significant reduction in the level of friction, in addition to shorter treatment time- and chairtime, when compared with conventional bracket systems.<sup>17</sup> Hence it is important to determine if self-ligating brackets are more efficient than conventional pre-adjusted brackets when used in a specialist practice setting.

### **Aim of the present study**

The purpose of the present study was to evaluate the comparison between conventional ligation and self-ligation bracket system.

### **Methodology**

This study was a retrospective case analysis of 800 patients. The patients were treated with full fixed orthodontic appliances in a suburban, specialist orthodontic practice. The records for each patient were retrieved where Group 1 consisted of 400 patients consecutively treated with conventional, pre-adjusted single wing 0.022 x 0.028 inch orthodontic brackets. Group 2 comprised 400 patients consecutively treated using 0.022 x 0.028 inch active self-ligating brackets. The same archwire sequences and mechanics, including segmental mechanics where indicated, were used with both appliances and a number of patients in both groups had an initial phase of treatment with either the Herbst or pendulum-type appliances. After this initial treatment a significant period of 'settling' followed before fixed appliances were placed. The duration of treatment (3-month intervals), the number of appointments and length of time each type of archwire was used (months) were recorded from the time an appliance was bonded to the time it was removed. Bracket bond failures during the course of appliance treatment were tallied as an overall figure for each patient. Molar attachment breakages were not included in this assessment. To determine if the groups were similar at the start of the study and at the end of treatment, the pretreatment and post-treatment study models were assessed with the Index of Complexity, Outcome and Need (ICON).<sup>18</sup> For completeness the ICON score and the two components that make up the ICON score were used in separate analyses to look for associations with the aforementioned treatment characteristics. A general linear model approach was used to examine the effects of the method of ligation ('Conventional' or 'Self-ligating'), malocclusion ('Class I', 'Class II' or 'Class III') and extraction of teeth ('Yes' or 'No') against the treatment duration, the number of scheduled appointments and the number of days either round or rectangular archwires were used. A two-stage analysis was then performed to assess the number of bond failures and the number of unscheduled emergency appointments. Odds ratios are presented for significant effects.

## Results

There were no significant group differences in the durations of treatment and the number of appointments (Mean treatment duration: Group 1 (conventional, pre-adjusted brackets), 15.8 months; Group 2 (self-ligating brackets), 15.5 months. (Table 1) Number of appointments: Group 1, 13.2; Group 2, 12.5). Patients with a Class II molar relationship required more appointments (6–7 per cent) than patients with a Class I molar relationship ( $p = 0.016$ ). Treatment also took 26 per cent longer ( $p = 0.005$ ) and required 26 per cent more appointments ( $p < 0.001$ ) in patients who had extractions compared with the patients who were treated nonextraction. Of the 762 patients investigated only 44 had ICON scores between 3 and 5. The number of patients with moderate to severe crowding/spacing (ICON score  $>2$ ) was associated with significantly longer treatment when compared with patients with mild crowding/spacing (ICON score  $<2$ ) for both bracket types (Mean difference: 1.7 months,  $p = 0.01$ ). More patients treated with active self-ligating brackets experienced bond failures than patients treated with conventional brackets: 80.2 per cent and 53.0 per cent respectively (Odds ratio: 3.52; 95% CI: 2.55, 4.87). When the analysis conditional on having bond failure was carried out, patients in the selfligating group had significantly more bond failures than those in the conventional group (Mean difference in bond failures: 1.41;  $p < 0.001$ ). (Table 2) Statistically significantly more breakages occurred in the self-ligating group in the first six time periods i.e. 18 months (All time periods,  $p < 0.05$ ).

## Discussion

In agreement with previous studies including several small prospective studies, we found no significant differences in the durations of treatment or the number of appointments required to treat patients with either conventional pre-adjusted brackets or self-ligating brackets. A few previous studies with relatively small numbers of randomly selected or matched cases have reported shorter treatment times with selfligating systems.<sup>3,4</sup> The mean treatment durations for the conventional and active self-ligating bracket groups in our study are 15.8 and 15.5 months respectively. We found a high number of bond failures (54 per cent) in the active self-ligating bracket group. These findings disagree with a previous study, which reported equivalent breakage rates for a passive selfligating system and edgewise brackets. The higher failure rate in our study may be due to the bracket profile, the base design and/or the active clip.<sup>19</sup> As a rule, bracket breakages prolong the duration of treatment and should be avoided if possible. It could be postulated that active self-ligating brackets will outperform their conventional bracket counterparts when the problem of breakage/bond failure is solved.<sup>20</sup> The majority of breakages occurred during the levelling and alignment phases of treatment and, somewhat surprisingly, there were fewer breakages if teeth had been extracted. Malocclusions of equal difficulty, as determined by the pretreatment ICON, would presumably be treated in the same time frame by both brackets. Furthermore, patients can expect the quality of the final outcome to be equal, as demonstrated by the post-treatment ICON, irrespective of the bracket type employed. These findings may reflect shortcomings in the sensitivity of the ICON<sup>21</sup> as a measure of patient complexity and outcome, although several

studies have demonstrated that the ICON is an acceptable method of measuring treatment outcome.

### **Conclusion**

The results of this retrospective study indicate that active self-ligating brackets and conventional preadjusted orthodontic brackets treat malocclusions in similar periods of time and with a similar number of appointments. More breakages/bond failures occurred with active self-ligating brackets than with conventional brackets.

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## Tables

Table 1- Treatment duration and number of scheduled appointments in patients treated with conventional and active self-ligating brackets

		Conventional/pre-adjusted		Self-ligating	
		Number (%)	Treatment duration (Mean± SD)	Number (%)	Treatment duration (Mean± SD)
Molar relationship	Class I	169 (44)	15.0 (6.0)	131 (34)	14.7 (4.7)
	Class II	202 (53)	16.5 (6.0)	223 (59)	15.9 (5.4)
	Class III	12 (3)	17.7 (8.4)	25 (7)	17.2 (5.5)
Extractions	Yes	102 (27)	18.2 (6.5)	76 (20)	18.5 (5.5)
	No	281 (73)	15.1 (5.8)	303 (80)	14.8 (4.8)
Overall		383	15.9 (6.1)	379	15.6 (5.2)

Table 2- Bracket bond failures in patients treated with conventional and active self-ligating brackets

		Conventional/pre-adjusted Treatment duration (Mean± SD)	Self-ligating Treatment duration (Mean± SD)
Molar relationship	Class I	1.2 (2.0)	3.2 (3.0)
	Class II	1.2 (1.6)	3.0 (2.7)

	Class III	1.4 (1.3)	2.2 (2.6)
Extractions	Yes	1.2 (2.0)	2.1 (2.4)
	No	1.3 (1.7)	3.2 (2.9)
Overall		1.2 (1.8)	3.0 (2.8)