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## Treatment time, outcome, and patient satisfaction comparisons of Damon and conventional brackets

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**Abstract:** Efficiency of treatment mechanics has been a major focus throughout the history of orthodontics. Self-ligating brackets were developed on the premise that elimination of ligature ties creates a friction-free environment and allows for better sliding mechanics. It is expected that the self-ligating bracket will reduce the treatment time. This study was designed to compare the effectiveness and efficiency of Damon self-ligating (SL) brackets to those brackets ligated with either steel ligatures or elastomeric 'O' rings. Not only treatment time and the number of appointments needed were addressed, but the quality of the treatment outcome was also assessed. American Board of Orthodontics (ABO) grading criteria for models and panoramic radiographs were employed. Additionally, a nine-question survey was sent to the 215-patients in this study (108 Damon, 107 conventionally-ligated) to elicit their perceptions of how their orthodontic treatment progressed and finished. The results showed that patients treated with Damon SL brackets had significantly lower treatment times, required significantly fewer appointments, and had significantly higher ABO scores than those treated with conventionally-ligated edgewise brackets. There were no significant differences in Damon or non-Damon ABO scores with respect to gender. Damon patients over the age of 21 had significantly higher ABO scores. Conversely, the non-Damon patients under the age of 21 had significantly higher ABO scores. For pre-treatment Angle classification, no significant differences were noted. Patient responses showed that Damon patients perceived their treatment time as being shorter than expected. It appears that faster orthodontic treatment can be better as measured by the ABO criteria.

**Key words:** American Board of Orthodontics; Damon SL; edgewise bracket; patient satisfaction; treatment outcome; treatment time

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## Introduction

During the course of orthodontic treatment invariably the patient will ask the orthodontist when his or her treatment will be completed. Over the years, orthodontic technology has evolved to provide a good answer to this question: a reduction in treatment time. Aside from the obvious biologic and anatomic obstacles that affect the rate of tooth movement, there are the physical issues of bracket, wire, and ligature friction. The type of bracket, wire or ligature utilized during treatment might determine how quickly the teeth will move and consequently, the duration of treatment. The self-ligating bracket was introduced to create a 'friction-free' environment, with the belief that it will allow for better sliding mechanics (1); as the teeth move more rapidly treatment time is decreased. Additionally, the self-ligating bracket is suggested to reduce chairside time, promote better oral hygiene and allow for better infection control. While all these claims might be true, one is left asking: Does faster necessarily mean better?

The basic premise of the self-ligating bracket is that the closing or opening mechanism of the bracket turns the bracket slot into a tube that passively or actively contains the wire. In the absence of wire or elastomeric ties presumably frictional resistance is dramatically reduced and tooth movement occurs at a greater velocity (2). It is also claimed that Damon self-ligating (SL) brackets simplify treatment mechanics, improve the work environment for the staff (less percutaneous injuries from steel ligatures and transmission of HBV, HCV, and HIV), improve practice efficiency and profitability, and attract more adults to seek orthodontic treatment (3).

Initial reports have indicated that Damon SL brackets made archwire placement easier and reduced the frictional forces – an advantage when sliding mechanics are used (4–7). Damon further states that the bracket design serves as a 'mini lip-bumper' and that the forces of the lips and cheeks help move the teeth to their physiologic positions (1). When this factor is added to the frictionless situation that exists between the archwire and the bracket, the oxygen tension in the periodontium is uncompromised by the decreased vascular supply normally seen in tooth movement. Because periodontal remodeling is not constrained,

the treatment time is reduced. Indeed, chairtime was noted to be substantially decreased an average of 7 min per patient (8). In addition, the support staff report that self-ligating brackets are easy to use, reduce time, and enhance infection control (9). In the midst of these claims the question still remains: are Damon brackets really faster, and can faster produce better esthetics and occlusion? What is the patient's perception of the orthodontic treatment outcome?

This study was designed to compare the performance of the Damon SL bracket in the hands of different practitioners both in extraction and non-extraction cases. Success of orthodontic treatment was determined objectively by the American Board of Orthodontics (ABO) criteria.

## Materials and methods

### Sample selection

The sample was selected randomly from a pool of available orthodontic patients treated by both Damon brackets and conventionally-ligated brackets at each of the following three practices: Bayonne, NJ; Easton, PA, and Temple University School of Dentistry, Department of Orthodontics, Philadelphia, PA. The criteria for inclusion in the parent sample required that patient treatment was started and completed using the same method of ligation (Damon or conventional) and that an even distribution of extraction and non-extraction cases be maintained for Damon patients and conventionally-ligated patients. The parent sample consisted of 215 patients with 108 being Damon and 107 conventionally-ligated (hereafter referred to as 'non-Damon') patients. All of the orthodontic practices in this study take complete records on every patient on a routine basis including post-treatment radiographs and study models. The sample size was limited due to the inclusion criteria that were established prior to data gathering. All of the parent sample met the above criteria.

The following information was gathered using the patient's treatment record, personal history form, post-treatment panoramic radiograph, and post-treatment study models: name, address, age of the start of treatment, gender, Angle classification at the start of treatment, extraction or non-extraction, treatment time in months, number of appointments to complete treatment and post-treatment ABO score.

### Model analysis

The 215 post-treatment study models and panoramic radiographs were divided into Damon and non-Damon cases and evaluated using the model grading criteria established by the ABO. The eight component scores are added together, yielding the overall ABO score, which is out of 380 points. While there is currently no 'passing score' *per se*, it is acknowledged that a case with less than 20 points deducted passes and greater than 30 points deducted fails (10).

### Survey analysis

A survey was sent to each patient in the parent sample. The patient was asked nine questions regarding the quality of his or her orthodontic treatment by placing a mark on a visual analog scale (Fig. 1). An 'ND' marking placed on the return envelope of the non-Damon respondents differentiated the Damon survey responses from the non-Damon responses.

### Statistical analyses

Means and standard deviations were calculated for the treatment times, number of appointments, and

ABO scores for each of the three practices. Mean ABO scores and standard deviations were determined based on age (21 years and under and over 21 years), gender, and pre-treatment Angle classification. The Student's *t*-test was used to detect statistically significant differences between the averages reported for Damon and non-Damon patients. For the survey analysis, means and standard deviations were calculated for each of the nine responses, and the Student's *t*-test was used to detect significant differences between averages.

### Error study

An error study was conducted to test the examiner's accuracy and consistency in evaluating the study models and panoramic radiographs using the ABO grading criteria. One case was selected at random and measured 15 times in a short period of time (about 3 h). A second case was selected at random and measured once every 2 days a total of six times. Mean ABO scores and standard deviations were determined for each study. The standard of deviation was divided by the average score and multiplied by 100 percent. The resulting value was the percent error. Both studies, when rounded to the nearest hundredth of a percent, gave a margin of error of less than 1.09%.

#### PATIENT POST-TREATMENT SURVEY

1. When brackets (braces) are initially put on, they tend to cause irritation and discomfort to the cheeks, lips, and gums. Please mark the degree of discomfort caused by the brackets to these areas of the mouth.
2. Please mark on the line below whether wax was used to alleviate this discomfort to the cheeks lips and gums and if used, how much.
3. When your wires were changed or "tightened," did you feel any pain to your teeth after the appointment? Please indicate on the line below the intensity of the pain.
4. With braces, patients find that tooth brushing and oral hygiene become a greater challenge. Please indicate on the line below the degree of difficulty for you to keep your teeth clean.
5. Were you satisfied with the outcome of your orthodontic treatment, particularly your straightened teeth?
6. Were you satisfied with the overall appearance of your smile?
7. Do you think that your "finished" smile shows too much, too little, or the right amount of teeth?
8. Were the appointments at sufficient time intervals? Was the interval too long or too short?
9. Was the length of your orthodontic treatment shorter than expected or longer than expected?

Fig. 1. Questions in the patient post-treatment survey instrument. Patients were to mark their answers on a visual analog scale.

## Results

### Survey analysis

Of the 215 surveys sent, 100 responses were received (46.5% response rate), 52 were Damon responses and 48 were non-Damon. Means and standard deviations were calculated for each of the nine responses in each group. For all of the responses except for that to question 9, no significant differences were noted between Damon and non-Damon patients. For question 9, which asked patients whether they felt their length of treatment was shorter, longer, or exactly what was expected, a significant difference was noted between Damon and non-Damon patients ( $p < 0.05$ ). Damon patients thought their length of treatment was slightly shorter than expected whereas non-Damon patients thought their treatment took longer than expected (Table 1).

**Table 1. Descriptive statistics for differences in patient responses based on bracket type**

	Damon		Non-Damon		<i>t</i>	DF	<i>p</i> -value
	Mean	SD	Mean	SD			
Q1	6.32	3.14	7.18	2.94	1.41	98	0.158
Q2	3.19	3.33	3.93	3.76	1.03	92	0.304
Q3	7.04	3.09	7.67	2.85	1.06	98	0.288
Q4	6.09	3.14	5.65	3.20	0.69	97	0.488
Q5	10.66	1.61	10.30	3.11	0.70	69	0.482
Q6	10.79	1.47	10.44	2.25	0.93	80	0.353
Q7	6.27	0.87	6.35	1.03	0.43	93	0.666
Q8	6.74	1.67	6.52	4.39	0.71	97	0.477
Q9	5.66	3.36	7.64	2.74	3.23	97	0.001

DF = degrees of freedom.

**Patient record analysis**

Analyses of treatment times and number of appointments required to complete treatment yielded significant differences between Damon and non-Damon patients. For treatment time, each of the three practices showed a significantly lower treatment time for Damon cases ( $p < 0.05$ ). For all three practices together, there was a significant decrease in treatment time for Damon cases (Table 2).

For the number of appointments required to complete the treatment, each of the three practices showed a significant decrease in the number of office

visits for Damon patients ( $p < 0.05$ ). For all three practices together, a significantly lesser number of appointments was required for Damon patients (Table 3).

**Model analysis**

Our study revealed significant differences in the ABO scores between Damon and non-Damon patients. Two of the three practices (Bayonne and Easton) showed significantly higher ABO scores for Damon patients ( $p < 0.05$ ). Temple clinic showed an increase in the ABO score for Damon patients, but this increase was not significant. For all three practices together, there was a significant increase in the ABO score for Damon patients (Table 4).

When ABO scores were compared based on age, we were unable to compare two of the three individual practices due to an inadequate sample size. Overall, for the younger and older patients, each group shows a significant increase in ABO score when Damon brackets are used ( $p < 0.05$ ). When each age group is compared, the older group shows a significantly higher ABO score for Damon cases than the younger group, whereas the younger group shows a significantly higher ABO score for non-Damon cases than the older group.

Gender differences were analyzed next. In the Bayonne and Easton samples, both males and females each showed significantly higher ABO scores for Damon cases ( $p < 0.05$ ). Overall, males and females each

**Table 2. Descriptive statistics for differences in treatment times (months) based on bracket types**

Office	Brackets	# patients	Mean	SD	<i>t</i>	DF	<i>p</i> -value
Bayonne	Damon	48	22.33	4.41	6.14	72	4.00E-08
	Non-Damon	47	30.38	7.85			
Easton	Damon	52	27.63	6.57	3.16	101	0.002
	Non-Damon	52	31.96	7.37			
Temple	Damon	8	17.63	5.58	2.22	11	0.048
	Non-Damon	8	26.63	10.01			
All	Damon	108	24.54	6.45	6.46	205	7.41E-10
	Non-Damon	107	30.87	7.85			

**Table 3. Descriptive statistics for differences in number of appointments based on bracket types**

Office	Brackets	# patients	Mean	SD	t	DF	p-value
Bayonne	Damon	48	18.58	4.07	5.44	75	6.20E-07
	Non-Damon	47	24.81	6.72			
Easton	Damon	52	25.35	6.56	5.30	101	6.65E-07
	Non-Damon	52	32.63	7.42			
Temple	Damon	8	14.38	4.57	2.60	11	0.024
	Non-Damon	8	22.75	7.85			
All	Damon	108	21.53	6.63	6.81	203	1.05E-10
	Non-Damon	107	28.46	8.19			

had significantly higher ABO scores for Damon cases. When males and females were compared to each other within each Damon/non-Damon subset, only one significant difference emerged. In the Easton practice, female, non-Damon patients showed significantly higher ABO scores than males. In the Bayonne practice, both male groups showed higher ABO scores than their respective female groups. In the Easton practice, female Damon patients scored significantly higher ABO scores than male Damon patients ( $p < 0.05$ ). In Temple's clinic, female Damon patients scored a higher ABO score than males. Male, non-Damon patients had a higher ABO score than females. Overall, female, Damon patients had a slightly higher ABO score than males whereas, both male and female non-Damon patients had almost identical ABO scores.

For pre-treatment Angle classifications, only Class I and Class II division 1 patients could be fully analyzed. Class II division 2 and Class III patients did not have enough of a sample to generate any meaningful comparison. For Class I patients, Damon cases showed a significantly higher ABO score in the Bayonne practice and for all three practices combined ( $p < 0.05$ ). The Easton practice had its Damon cases score higher than the non-Damon case, albeit, not significantly. The Temple clinic's non-Damon patients had the higher ABO score, again not significantly. In Class II division 1 cases, Damon patients had a higher ABO score than non-Damon patients. In the Easton practice and for all three practices together, the difference between the Damon ABO score and the non-Damon ABO score was. When comparing Class I ABO scores to Class II

**Table 4. Descriptive statistics for differences in ABO scores based on bracket types**

Office	Brackets	# patients	Mean	SD	t	DF	p-value
Bayonne	Damon	48	351.81	9.77	4.15	90	7.51E-05
	Non-Damon	47	342.68	11.58			
Easton	Damon	52	349.08	7.03	3.69	85	0.00039
	Non-Damon	52	342.21	11.43			
Temple	Damon	8	341.00	8.75	0.05	13	0.96
	Non-Damon	8	340.75	11.23			
All	Damon	108	349.69	8.85	5.31	200	2.93E-07
	Non-Damon	107	342.31	11.38			

division 1 ABO scores, no significant difference was noted for each of the three practices and for all three practices together.

## Discussion

This study was designed for intra-practitioner comparisons, and not to compare one clinician against the other. The purpose was threefold: first, we compared the Damon SL bracket to a conventionally-ligated standard edgewise bracket and evaluated whether there were any differences in the treatment time and in the number of appointments required to complete treatment. Second, we evaluated the quality of the treatment outcome by measuring post-treatment study models and panoramic radiographs using the grading criteria for certification as set by the American Board of Orthodontics. We further analyzed whether age, gender, or pre-treatment Angle classification affected the ABO score. Third, we surveyed all members of our parent sample and asked them nine questions about their perceptions of their orthodontic treatment ranging from hygiene and discomfort to length of treatment and satisfaction of result. We then evaluated whether there were statistically significant differences between the averages for the Damon and non-Damon responses.

The total sample size was 215 patients – 108 treated with Damon SL brackets and 107 treated with mini-twin edgewise brackets and conventional ligation. All of the practices had been using the Damon SL bracket since its availability in 1997. Prior to 1997, the three practices used mini-twin edgewise brackets and conventional ligation. The orthodontists had been practicing for 22 years (Bayonne), 5 years (Easton), and 29 years (Temple). All three practitioners had the same experience with Damon SL brackets. It bears mentioning that orthodontic residents treated the cases at Temple so that while the supervising orthodontic faculty had many years of clinical experience, the residents had little to no experience with regard to clinical application. The results were explicit that Damon cases required significantly lower treatment times with significantly fewer appointments than non-Damon cases. In terms of the quality of the treatment outcome, all three practices each showed higher ABO scores for

Damon cases. Damon patients over the age of 21 tended to have significantly higher ABO scores. Conversely, the non-Damon patients age 21 or younger had significantly higher ABO scores. There was no significant difference in Damon or non-Damon ABO scores with respect to gender. Class I and Class II division 1 Damon cases showed significantly higher ABO scores than non-Damon cases, but no significant difference was noted when Class I cases were compared to Class II division 1 cases for both Damon and non-Damon.

The survey results show that both Damon and non-Damon patients had similar perceptions about their treatment. One must bear in mind that these results are entirely subjective and that each respondent had no basis for comparison between Damon and non-Damon treatment. The only significant difference was for question 9 where Damon respondents felt that they had finished treatment a little earlier than expected and non-Damon respondents felt their treatment time went a little longer than expected. It can be assumed that the patient's frame of reference for the length of treatment is shaped by peers who have gone through similar treatment or by the orthodontist. Some practitioners may give a longer treatment time for a short case. Others may erroneously guess at the treatment time and be well off the mark.

While it should be considered that the number of years of experience may have an effect on treatment time and quality of outcome, one would expect all three practitioners to be on a level playing field with regard to their experience in using Damon SL brackets. This may not necessarily be the case. The advantage of using the Damon SL bracket is that sliding mechanics are achieved more easily and more efficiently. For finishing wires, the quality of the result rests in the hands of the experienced orthodontist. One might consider, however, that when practitioners embrace new orthodontic technology, they may pay closer attention to bracket positioning and thus, achieve a better treatment outcome. Additionally, the higher cost of the Damon SL bracket may influence the practitioner to focus more closely on bracket positioning.

One interesting comparison noted among the three practitioners is the average number of appointments needed to complete treatment. The Temple clinic treated patients, both Damon and non-Damon, with

the least amount of appointments and the lowest treatment time. The Bayonne office came next followed by the Easton office. The reason for the major decrease in treatment time at Temple may be due to the fact that orthodontic residents treat these patients. Since a resident is required to finish a certain amount of cases in order to graduate from the 27-month program, they might have rushed the treatment. This may also explain why the ABO scores for Temple patients are not as high as the other two offices.

In summary, this study states faster can indeed be better.

### Structured Abstract

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*Objectives* – To compare the orthodontic treatment efficiency, outcome and patient satisfaction of the Damon-SL system to conventional bracket and ligation methods.

*Design* – A retrospective analysis of the objectives in three different practices. The study was designed to be an intra-practitioner analysis.

*Setting and Sample Population* – 215 patients, divided as 108 Damon and 107 conventional ligation. Angle classification of the patients were Class I and Class II division 1. They were also categorized according to age and gender.

*Experimental Variable* – Damon and non-Damon treatments were analyzed for frequency of appointments, treatment duration, patient satisfaction and ABO grading criteria.

*Outcome Measure* – Student's *t*-test values.

*Results* – Overall, Damon patients were treated with fewer appointments, in shorter time and with better results. Patient satisfaction was better as well. There were no gender differences. Only the younger patients (under 21) had better ABO scores with conventional brackets and ligation.

*Conclusion* – This study demonstrated that Damon SL system yields faster and better treatment results with fewer appointments for all clinicians.

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