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The verisimilitude of damon brackets versus damon archwires– The real hero

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ABSTRACT

Introduction: The Damon passive self-ligating system introduced broad archwires and a passive clip with posterior expansion and with minimal tipping of the teeth.
Aim: To evaluate and compare the effectiveness of Damon brackets and Damon arch wires in maxillary arch dimensional changes with that of conventional brackets and conventional archwires.
Materials and Methods : A total of 20 patients were selected for the study and randomly divided into 4 Groups with 5 patients in each group. Records (Study models) were taken before starting the treatment (T0) and at the end of leveling and alignment (T1) for all the 20 subjects. Pre-treatment (T0) and at the end of leveling and alignment (T1) study models were assessed for inter canine width, inter first premolar width and inter first molar width.
Results : There was statistically significant increase in maxillary arch width in Damon system and conventional bracket with Damon archwires when compared to conventional bracket system and Damon brackets with conventional archwires.
Conclusion: The use of conventional or self-ligating brackets does not seem to be an important predictor of change in maxillary arch width in non-extraction patients. The amount of increase in arch width was due to Damon archwires and not because of Damon brackets.

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1. Introduction

Self-ligating (SL) brackets came into orthodontics in the mid-1930s as the Russell attachment followed by Ormco Edgelok (1972), Forestadent Mobil-Lock (1980), SPEED (1980), and "A" Company Activa (1986).[1] The conventional edgewise twin bracket requires elastomeric ligatures or steel wire for arch wire ligation whereas self-ligating brackets use mechanically locking or sliding devices to close the slot, eliminating the need for wire or elastomeric ligatures.[2]

The major advantage claimed for Self-ligating brackets over pre-adjusted edgewise appliances involves reduced frictional resistance between the bracket slot and archwire.[3,4] A study done by Pizzoniand Melson concluded that the friction in the Damon bracket was shown to be lower than other self-ligating brackets.[5] Self-Ligating Bracket systems are reputedly more capable than pre-adjusted edgewise appliances in relieving severe crowding without extractions, mainly due to their ability to increase arch dimensions particularly intermolar width.[6–8]

The Damon system uses passive self-ligation with the use of light forces generated by Copper–Nickel–Titanium (Cu NiTi) archwires to achieve arch development and to relieve

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dental crowding. Since then, both the brackets and the philosophy behind the system have undergone continuous evolution with the most recent bracket being the Damon Q.[9]

This study comparatively evaluates the effectiveness of Damon archwires and conventional archwires when used with Damon brackets and conventional brackets in bringing about maxillary arch dimensional changes. This study will endeavour to measure the amount of maxillary arch expansion using Damon system protocol.

2. Aim

The aim of this study was to evaluate and compare the effectiveness of Damon archwires and conventional archwires when used with Damon brackets and conventional brackets in bringing about maxillary arch dimensional changes.

3. Objectives

1. To evaluate the rate of maxillary arch expansion using Damon brackets with Damon archwires
2. To evaluate the rate of maxillary arch expansion using conventional brackets with conventional archwires
3. To evaluate the rate of maxillary arch expansion using Damon brackets with conventional archwires
4. To evaluate the rate of maxillary arch expansion using conventional brackets with Damon archwires
5. To compare the rate of maxillary arch expansion in between and among the groups

4. Materials and Methods

A total of 20 patients were selected for the study and divided into 4 Groups with 5 patients in each group randomly. Ethical clearance was obtained from the institutional ethical committee of the college.

4.1. Inclusion criteria

1. Borderline cases
2. Patients who require expansion of maxillary and mandibular arches
3. Patients with mild to moderate crowding with Angles class I molar relation

4.2. Exclusion criteria

1. Patients with definite extractions
2. Patients with severe maxillary teeth crowding
3. Patients with expansion appliances
4. Patients with Angles class II and III molar relation
5. Patients who require orthognathic surgery

Groups	Sample size	Procedure
GroupI	5	Damon brackets and Damon archwires
GroupII	5	Conventional brackets and conventional archwires
GroupIII	5	Damon brackets and conventional archwires
GroupIV	5	Conventional brackets and Damon archwires

4.3. Sample distribution groups

4.4. Method of assessing the transverse maxillary dimensions using study models

Records (Study models) will be taken before starting the treatment (T0) and at the end of levelling and alignment (T1) for all the 100 subjects.

Pre-treatment (T0) and at the end of levelling and alignment (T1) study models will be assessed for the following:

1. Inter canine width - the distance between the maxillary right and left canine cusp tips.
2. Inter first premolar width - the distance between the buccal cusp tips of the maxillary right and left first premolars
3. Inter first molar width - the distance between the mesiobuccal cusp tips of the maxillary right and left first molars.

The measurements that were obtained from the models were tabulated and subjected to the statistical analysis.

5. Results

The data collected at the start of treatment (T0) and at the end of levelling and alignment (T1) for all the four groups are subjected to statistical evaluation using IBM Statistical Package for the Social Sciences (SPSS) version 17.0. The statistical analyses were done using One-way ANOVA, Tukey's multiple post-hoc test and Dependent t-test.

Summary of inter canine width, inter first premolar width and inter first molar width in four study groups at T0, T1 time points and the difference i.e., T1-T0 are tabulated in Tables 1, 3 and 5 respectively. These tables show the minimum values, maximum values, mean, standard deviation, standard error, lower bound confidence intervals and upper bond confidence intervals in all the four groups at T0, T1 time points and the difference i.e., T1-T0.

Pair wise comparison of four groups for mean inter canine width, inter first premolar width and inter first molar width in four study groups at T0, T1 time points and the difference i.e., T1-T0 by Tukey's post-hoc procedures are

Table 1: Summary of inter canine width in four study groups at T0, T1 time points and the difference i.e., T1-T0

Time points	Groups	Min	Max	Mean	SD	SE	95% Confidence Interval	
							Lower Bound	Upper Bound
T0	GroupI	29.79	36.42	33.84	2.10	0.66	32.34	35.34
	GroupII	33.58	35.95	34.97	0.84	0.27	34.37	35.58
	GroupIII	33.18	43.91	36.66	3.82	1.21	33.92	39.39
	GroupIV	30.40	36.30	33.75	1.62	0.51	32.59	34.90
T1	GroupI	32.89	38.33	35.93	2.04	0.65	34.47	37.39
	GroupII	34.31	36.14	35.38	0.59	0.19	34.96	35.80
	GroupIII	34.00	43.93	37.55	3.55	1.12	35.01	40.08
	GroupIV	33.31	37.59	35.79	1.39	0.44	34.79	36.78
T0-T1	GroupI	0.87	3.27	2.08	0.77	0.24	1.53	2.63
	GroupII	0.01	0.88	0.49	0.33	0.10	0.26	0.73
	GroupIII	0.01	2.55	0.89	0.78	0.25	0.33	1.45
	GroupIV	1.29	3.68	2.04	0.72	0.23	1.52	2.56

tabulated in Tables 2, 4 and 6. These tables shows Mean Difference, Std. Error, P-value, lower bound confidence intervals and upper bond confidence intervals at T0, T1 time points and the difference i.e., T1-T0 in between the groups.

5.1. Inference

It is inferred from the above table that the mean difference of inter canine width is more in GroupI (2.08mm) followed by GroupIV (2.04mm), then GroupIII (0.89mm) and least in GroupII (0.49mm).

5.2. Inference

Tukey post-hoc test was done to compare p-values. P-value<0.05 is taken as significant. From the above table, it was evident that significant difference was seen between the means of GroupI and other Groups (II, III), GroupII and GroupIV, GroupIII and GroupIV and no significant difference was seen between the means of GroupI and GroupIV, GroupII and GroupIII at inter canine area.

5.3. Inference

It was inferred from the above table that the mean difference of inter first premolar width is more in GroupI (3.77mm) followed by GroupIV (3.44mm), GroupIII (2.33mm) and least in GroupII (1.36mm) where conventional brackets and conventional archwires were used.

5.4. Inference

Tukey's multiple post-hoc test was done to compare p-values. P- value<0.05 is taken as significant. From the above table, it was evident that significant difference was seen between the means of GroupI and other Groups (II, III), GroupII and GroupIV, and no significant difference was seen between the means of GroupI and GroupIV, GroupII and GroupIII, GroupIII and GroupIV at inter first premolar area.

5.5. Inference

It was inferred from the above table that the mean difference of inter first molar width is more in GroupI (2.33mm) followed by GroupIV (1.50mm),then in GroupII (0.35mm) and least in GroupIII (0.30mm).

5.6. Inference

Tukey's multiple post-hoc test was done to compare p-values. P- value<0.05 is taken as significant. From the above table, it was evident that significant difference was seen between the means of GroupI and other Groups (II, III, IV), GroupII and GroupIV, GroupIII vs GroupIV and no significant difference was seen between the means of GroupII and GroupIII at inter first molar area.

6. Discussion

The friction of bracket-arch wire combination has a detrimental effect on the results of orthodontic treatment outcome. Although self-ligating brackets were developed to overcome the disadvantages of conventional stainless steel and elastomeric ligation [7,10] there is no evidence-based support of such a claim**.** Disparate systematic reviews did not show any difference evidently between the efficiency or the effectiveness of self-ligating and conventional bracket systems. [11,12]

The treatment of Class I type 1 malocclusion (moderate crowding) is usually treated with an increase in arch perimeter. This is achieved by both transverse expansion and proclination of the incisors. Following the introduction of Damon self-ligating brackets, it was claimed that the expansion of the maxillary arch can be achieved by using broader Cu NiTi archwires rather than by using expansion appliances.

Table 2: Pair wise comparison of mean inter canine width in four study groups at T0, T1 time points and the difference i.e., T1-T0 byTukey post-hoc procedures

Time points	Groups comparison	Mean Difference	Std. Error	P-value	95% Confidence Interval	
					Lower Bound	Upper Bound
T0	GroupI vs GroupII	-1.14	1.06	0.7070	-3.98	1.71
	GroupI vs GroupIII	-2.82	1.06	0.0530	-5.66	0.03
	GroupI vs GroupIV	0.09	1.06	1.0000	-2.75	2.94
	GroupII vs GroupIII	-1.68	1.06	0.3960	-4.53	1.16
	GroupII vs GroupIV	1.23	1.06	0.6540	-1.62	4.07
	GroupIII vs GroupIV	2.91	1.06	0.0430*	0.06	5.76
T1	GroupI vs GroupII	0.55	0.97	0.9410	-2.07	3.18
	GroupI vs GroupIII	-1.62	0.97	0.3610	-4.24	1.01
	GroupI vs GroupIV	0.15	0.97	0.9990	-2.48	2.77
	GroupII vs GroupIII	-2.17	0.97	0.1360	-4.79	0.46
	GroupII vs GroupIV	-0.41	0.97	0.9750	-3.03	2.22
	GroupIII vs GroupIV	1.76	0.97	0.2870	-0.86	4.39
T1-T0	GroupI vs GroupII	1.59	0.30	0.0001*	0.77	2.41
	GroupI vs GroupIII	1.19	0.30	0.0020*	0.37	2.01
	GroupI vs GroupIV	0.04	0.30	0.9990	-0.78	0.86
	GroupII vs GroupIII	-0.40	0.30	0.5620	-1.22	0.42
	GroupII vs GroupIV	-1.55	0.30	0.0001*	-2.36	-0.73
	GroupIII vs GroupIV	-1.15	0.30	0.0030*	-1.97	-0.33

Table 3: Summary of inter first premolar width in four study groups at T0, T1 time points and the difference i.e. T1-T0

Time points	Groups	Min	Max	Mean	SD	SE	95% CI	
							Lower Bound	Upper Bound
T0	GroupI	37.18	42.76	40.78	2.02	0.64	39.33	42.22
	GroupII	40.35	43.26	41.61	0.83	0.26	41.02	42.20
	GroupIII	37.38	43.95	41.81	2.02	0.64	40.37	43.26
	GroupIV	38.02	42.93	39.86	1.39	0.44	38.86	40.85
T1	GroupI	41.13	46.34	44.56	1.78	0.56	43.29	45.83
	GroupII	41.95	44.72	43.07	0.75	0.24	42.53	43.60
	GroupIII	42.04	46.18	44.14	1.21	0.38	43.27	45.01
	GroupIV	42.05	45.76	43.30	1.28	0.41	42.38	44.21
T0-T1	GroupI	2.44	4.65	3.77	0.64	0.20	3.31	4.23
	GroupII	0.96	2.01	1.36	0.32	0.10	1.13	1.59
	GroupIII	0.12	6.60	2.33	1.95	0.62	0.93	3.73
	GroupIV	2.55	5.09	3.44	0.73	0.23	2.92	3.97

The present in vivo study was done to evaluate the effectiveness of Damon archwires and conventional archwires when used with Damon brackets and conventional brackets in bringing about maxillary arch dimensional changes.

In the present study, the transverse maxillary arch width was measured with digital caliper on Study models before starting of the treatment (T0) and at the end of leveling and alignment (T1) as in the studies by Ezgi Atik et al.[4]

The data collected at the start of treatment(T0) and at the end of leveling and alignment (T1) for all the four groups was tabulated and subjected to statistical evaluation. The statistical analyses were done using One-way ANOVA, Tukey's multiple post-hoc test and Dependent t-test.

6.1. Changes observed in inter canine width

The mean difference of inter canine width was more in GroupI (2.08 mm) followed by GroupIV (2.04 mm), then GroupIII (0.89 mm) and least in GroupII (0.49 mm).

From the table no. 1, it was evident that significant increase in amount of expansion in GroupI (Damon system) when compared to GroupII (conventional bracket system) and GroupIII (Damon brackets and conventional archwires) and no significant difference was seen between the means of GroupI and GroupIV (conventional bracket and Damon archwires) which indicates that Damon archwires brought significant increase in inter canine width.

Significant increase in amount of expansion in GroupIV when compared to GroupII and GroupIII indicates that Damon archwires with conventional brackets showed more

Table 4: Pair wise comparison of four groups with mean inter first premolar width in four study groups at T0, T1 time points and the differencei.e., T1-T0 by Tukey post-hoc procedures

Time points	Groups comparison	Mean Difference	Std. Error	P-value	95% Confidence Interval	
					Lower Bound	Upper Bound
T0	GroupI vs GroupII	-0.84	0.73	0.6680	-2.81	1.14
	GroupI vs GroupIII	-1.04	0.73	0.5000	-3.01	0.94
	GroupI vs GroupIV	0.92	0.73	0.5980	-1.06	2.90
	GroupII vs GroupIII	-0.20	0.73	0.9930	-2.18	1.78
	GroupII vs GroupIV	1.76	0.73	0.0970	-0.22	3.73
	GroupIII vs GroupIV	1.96	0.73	0.0530	-0.02	3.93
T1	GroupI vs GroupII	1.50	0.58	0.0680	-0.08	3.07
	GroupI vs GroupIII	0.42	0.58	0.8880	-1.15	2.00
	GroupI vs GroupIV	1.27	0.58	0.1530	-0.31	2.84
	GroupII vs GroupIII	-1.07	0.58	0.2730	-2.65	0.50
	GroupII vs GroupIV	-0.23	0.58	0.9790	-1.81	1.34
	GroupIII vs GroupIV	0.84	0.58	0.4820	-0.73	2.42
T1-T0	GroupI vs GroupII	2.41	0.49	0.0001*	1.08	3.74
	GroupI vs GroupIII	1.44	0.49	0.0300*	0.11	2.77
	GroupI vs GroupIV	0.33	0.49	0.9120	-1.00	1.65
	GroupII vs GroupIII	-0.97	0.49	0.2190	-2.30	0.36
	GroupII vs GroupIV	-2.09	0.49	0.0010*	-3.42	-0.76
	GroupIII vs GroupIV	-1.11	0.49	0.1280	-2.44	0.22

Table 5: Summary of inter first molar width in four study groups at T0, T1 time points and the difference i.e.T1-T0

Time points	Groups	Min	Max	Mean	SD	SE	95% CI	
							Lower Bound	Upper Bound
T0	GroupI	49.05	53.02	50.85	1.59	0.50	49.72	51.98
	GroupII	46.99	53.05	51.17	2.07	0.65	49.69	52.65
	GroupIII	47.89	53.75	51.53	1.82	0.57	50.23	52.83
	GroupIV	48.80	54.05	50.75	1.48	0.47	49.69	51.81
T1	GroupI	50.91	55.85	53.18	1.68	0.53	51.98	54.39
	GroupII	47.12	53.54	51.52	2.02	0.64	50.08	52.97
	GroupIII	48.12	53.94	51.83	1.77	0.56	50.57	53.10
	GroupIV	50.32	55.66	52.26	1.50	0.48	51.19	53.34
T0-T1	GroupI	1.84	3.48	2.33	0.48	0.15	1.99	2.68
	GroupII	0.01	0.93	0.35	0.29	0.09	0.14	0.56
	GroupIII	0.01	0.73	0.30	0.23	0.07	0.13	0.47
	GroupIV	1.34	1.74	1.50	0.14	0.05	1.40	1.61

increase in inter canine area than conventional bracket system and Damon brackets with conventional archwires. This clearly indicates that significant increase in inter canine width was due to Damon archwires and not because of Damon brackets.

From the table no. 6 (Comparison of T0 and T1 time points for mean inter canine width in four study groups by dependent t-test) it was evident that significant difference was seen within the mean difference i.e., T1-T0 at inter canine area of all the groups.

6.2. Changes observed in inter first premolar width

The mean difference of inter first premolar width was more in GroupI (3.77 mm) followed by GroupIV (3.44 mm), GroupIII (2.33 mm) and least in GroupII (1.46 mm).

A Significant difference was seen between the means of GroupI and other Groups (II, III), GroupII and GroupIV, and no significant difference was seen between the means of GroupI and GroupIV. This indicates that Damon archwires brought more amount of increase in inter first premolar area.

This indicates that significant increase in inter first premolar width is due to Damon archwires and not because of Damon brackets.

6.3. Changes observed in inter first molar width

The mean difference of inter first molar width is more in GroupI (2.33 mm) followed by GroupIV (1.51 mm), then in GroupII (0.35 mm) and least in GroupIII (0.30 mm).

Significant difference was seen between the means of GroupI and other Groups (II, III, IV), GroupIV and GroupII,

Table 6: Pair wise comparison of four groups with mean inter first molar width in four study groups at T0, T1 time points and the difference i.e., T1-T0 by Tukey's multiple post-hoc procedures.

Time points	Groups comparison	Mean Difference	Std. Error	P-value	95% Confidence Interval	
					Lower Bound	Upper Bound
T0	GroupI vs GroupII	-0.32	0.78	0.9760	-2.43	1.79
	GroupI vs GroupIII	-0.68	0.78	0.8190	-2.79	1.43
	GroupI vs GroupIV	0.10	0.78	0.9990	-2.01	2.21
	GroupII vs GroupIII	-0.36	0.78	0.9670	-2.47	1.75
	GroupII vs GroupIV	0.42	0.78	0.9490	-1.69	2.53
	GroupIII vs GroupIV	0.78	0.78	0.7500	-1.33	2.89
T1	GroupI vs GroupII	1.66	0.78	0.1660	-0.45	3.77
	GroupI vs GroupIII	1.35	0.78	0.3280	-0.76	3.46
	GroupI vs GroupIV	0.92	0.78	0.6460	-1.19	3.03
	GroupII vs GroupIII	-0.31	0.78	0.9780	-2.42	1.80
	GroupII vs GroupIV	-0.74	0.78	0.7800	-2.85	1.37
	GroupIII vs GroupIV	-0.43	0.78	0.9470	-2.54	1.68
T1-T0	GroupI vs GroupII	1.99	0.14	0.0001*	1.61	2.36
	GroupI vs GroupIII	2.03	0.14	0.0001*	1.66	2.41
	GroupI vs GroupIV	0.83	0.14	0.0001*	0.45	1.21
	GroupII vs GroupIII	0.05	0.14	0.9860	-0.33	0.42
	GroupII vs GroupIV	-1.16	0.14	0.0001*	-1.53	-0.78
	GroupIII vs GroupIV	-1.20	0.14	0.0001*	-1.58	-0.83

GroupIII and GroupIV and no significant difference was seen between the means of GroupII and GroupIII at inter first molar area.

This clearly indicates that significant increase in inter first molar width is due to Damon archwires and not because of Damon brackets. But Damon system showed significant difference when compared to GroupIV.

(Comparison of T0 and T1 time points for mean inter first molar width in four study groups by dependent t-test) it was evident that significant difference was seen with in the mean difference i.e., T1-T0 at inter first molar area of all the groups.

When GroupI is compared to GroupIII (Damon brackets and conventional archwires) there is statistically significant amount of increase in inter canine area in Damon system, When GroupII (conventional brackets and conventional archwires) was compared to GroupIV (conventional brackets and Damon archwires) there was statistically significant amount of increase in inter canine width in GroupIV, this shows Damon archwires brought significant amount of increase in inter canine width.

The present study showed significant difference in mean inter canine, mean inter premolar, and mean inter molar widths in GroupI (Damon brackets and Damon archwires). In the present study statistically significant increase in the maxillary mean inter molar width in GroupI (Damon brackets and Damon archwires) when compared to GroupII (conventional brackets and conventional archwires). Maxillary mean inter molar width was significantly larger by 1.99 mm after treatment with the Damon group compared with the conventionally ligated group.

Concordant to this study Pandis et al11 and Vajaria et al10observed an overall transverse expansion, which was mostly evident at the level of the premolars, followed by the molars when they evaluated the dental, skeletal, and soft-tissue changes in crowding cases treated with non-extraction approach using the Damon system.

The increase in transverse dimensions and the larger amount of expansion reported at the first molar could be explained by the use of the Damon Cu NiTi broad arch wire shape, which are wider than conventional archwires, particularly in the buccal segments distal to the first premolar.

7. Conclusions

Upon evaluation of the effectiveness of Damon archwires and conventional archwires when used with Damon brackets and conventional brackets in bringing about maxillary arch dimensional changes it can be concluded that:

1. The amount of increase in arch width was due to Damon archwires and not because of Damon brackets.
2. The use of conventional or self-ligating brackets does not seem to be an important predictor of change in maxillary arch width in non-extraction cases.

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9. Conflicts of Interest

There are no conflicts of interest.

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Author biography

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