*Original Article*

# An assessment of conventional and self-ligating brackets in Class I maxillary constriction patients

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**ABSTRACT**

**Objective:** To evaluate two different treatment systems with regard to incisor position, transverse dimension changes in maxillary arch, changes in maxillary molar inclinations, clinical periodontal parameters, and pain intensity in patients with a Class I malocclusion.

**Materials and Methods:** Seventeen patients (with a mean age of 14.5 years) underwent orthodontic treatment with the Roth prescribed edgewise bracket systems after expanding the maxillary arch with a quad-helix appliance, and 16 patients (with a mean age of 14.8 years) underwent orthodontic treatment with the Damon 3MX bracket system. Each subject's lateral cephalometric and posteroanterior radiographs and dental casts were obtained at the beginning of the treatment and after debonding. In addition to these, the periodontal index and pain scores were taken.

**Results:** Cephalometric data showed that in both treatment systems, overjet value decreased and maxillary and mandibular incisors proclined. Posteroanterior measurements demonstrated a greater increase in the maxillary molar inclination in the Damon group. Significant increase of maxillary intercanine, interpremolar, and intermolar widths was shown in both systems. Periodontal index and pain score changes between different observation periods were the same.

**Conclusions:** The conventional and Damon systems were found similar with regard to the incisor position, transverse dimension changes in maxillary arch, clinical periodontal parameters, and pain intensity. The only significant difference was that the Damon system inclined the maxillary molars more buccally than the conventional group. (*Angle Orthod.* 2014;84:615–622.)

**KEY WORDS:** Quad-helix; Damon; Edgewise; Maxillary arch expansion

## INTRODUCTION

The treatment of moderate crowding and a constricted maxillary arch in patients with a Class I malocclusion with permanent dentition on a nonextraction basis requires an increase in arch perimeter.[1] This is achieved by both transverse expansion and proclination of the incisors. The quad-helix, developed by Ricketts, is frequently used in conventional orthodontic treatment for transverse expansion of the maxillary arch before the alignment of the teeth with straight-wire edgewise appliances.[2]

Following the introduction of Damon self-ligating brackets, it was claimed that the expansion of the maxillary arch in maxillary constriction cases can be achieved by using broader archwires rather than by using expansion appliances.[3] According to proponents of Damon self-ligating brackets, considerable expansion can be achieved in the buccal segments, producing a broader arch form that is more in balance with the tongue and cheeks.[4] In addition to the expansion obtained in the dental arches, other issues that need to be considered when comparing self-ligating and conventional bracket systems are pain and oral hygiene.

The main purpose of this prospective study was to compare the Damon 3MX bracket system with the conventional treatment (expansion of the maxillary arch with a quad-helix appliance, followed by straight-wire Roth brackets) in patients with a Class I malocclusion and dentally constricted maxillary arch with regard to the incisor position, transverse dimen-

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**Table 1.** Demographic and Clinical Characteristics of the Sample

| Variables | Conventional | Damon | *P* |
|---|---|---|---|
| Age, y | 14.5 ± 1.2 | 14.8 ± 1.0 | .319[a] |
| Mandibular crowding, mm | 3.4 (2.3–4.6) | 3.9 (2.3–5.5) | .094[b] |
| Maxillary crowding, mm | 3.5 (2.4–6.0) | 3.5 (2.4–6.2) | .763[b] |
| Treatment duration, m | 15.3 (10.0–23.0) | 13.2 (10.0–22.0) | .402[b] |

[a] Student's *t*-test.
[b] Mann-Whitney *U*-test.

sion changes in the maxillary arch, changes in maxillary molar inclinations, clinical periodontal parameters, and the intensity of pain.

## MATERIALS AND METHODS

The subjects were 33 patients who were referred to the Department of Orthodontics, Hacettepe University, Ankara, Turkey. Ethical approval was obtained from the University Institutional Review Board (no. 11/06-34). The patients satisfied the following criteria: between 13 and 17 years of age at the start of the treatment, moderate maxillary and mandibular crowding, a Class I malocclusion, and a dentally constricted maxillary arch.

The subjects were randomly allocated to either treatment system. A total of 17 female patients (with a mean age of 14.5 ± 1.2 years) underwent treatment with a 0.022-inch Roth bracket system (Forestadent, Pforzheim, Germany), and 16 female patients (with a mean age of 14.8 ± 1.0 years) underwent treatment with a 0.022-inch Damon 3MX appliance system (Ormco/A Company, San Diego, Calif).

Hayes-Nance analysis was used to calculate the level of maxillary and mandibular crowding on dental casts taken before the treatment. The level of crowding was similar between the groups, as shown in Table 1.

All the patients showed maxillary constriction caused by a dental transverse discrepancy. Therefore, in the conventional group, a quad-helix appliance was applied before the bonding procedure. The maxillary arch was expanded until the lingual cusps of the maxillary first molars were in contact with the buccal cusps of the mandibular first molars. After desired expansion was obtained, a sequence of 0.014-inch, 0.018-inch copper nickel-titanium (Cu-NiTi; Ormco) and 0.014 × 0.025-inch, 0.017 × 0.025-inch Cu-NiTi archwires was used, followed by 0.017 × 0.025-inch and 0.019 × 0.025-inch stainless steel (SS; Ormco) archwires.

In the Damon group, the quad-helix appliance was not used before the bonding procedure. The following Ormco archwires were sequentially used: 0.014-inch, 0.018-inch, 0.014 × 0.025-inch, and 0.017 × 0.025-inch Damon arch form Cu-NiTi, followed by 0.017 × 0.025-inch and 0.019×0.025-inch Damon arch form SS archwires.

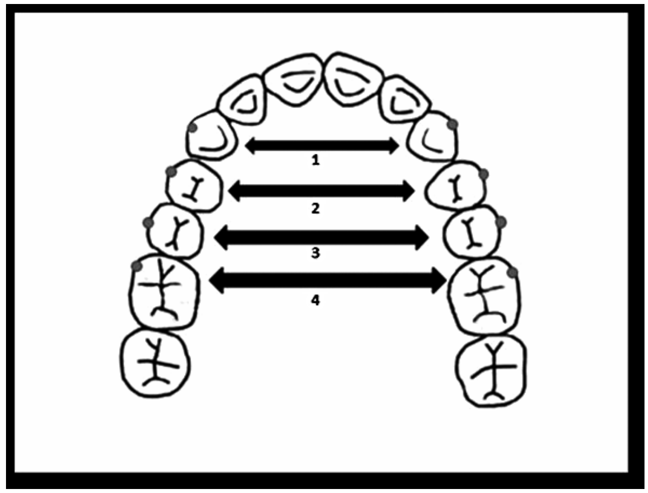


**Figure 1.** Arch dimension measurements on dental study casts. 1: intercanine width; 2: inter-first premolar width; 3: inter-second premolar width; 4: intermolar width.

Power chains or intermaxillary elastics were not used in either treatment system so as not to constrict the maxillary arch. In both groups, the appliances were removed when a Class I canine and molar relationship and an ideal overjet and overbite were achieved. Changes in the arch dimensions were measured from dental study casts taken at pretreatment (T0) and posttreatment (T1) as shown in Figure 1.

Each subject's lateral cephalometric and posteroanterior radiographs were digitally traced using Quick Ceph Studio (Quick Ceph System 2012, San Diego, Calif) software. The pretreatment and posttreatment lateral cephalograms of each patient were traced by one examiner, and 10 cephalometric measurements were identified as seen in Figure 2. The posteroanterior measurements were performed on both pretreatment and posttreatment radiographs (Figure 3).

At the beginning of the treatment, routine oral hygiene instructions were given to all the subjects. For both groups, the following clinical variables were assessed before bonding (T0), 6 months after bonding ($T_p1$), and at the end of the treatment (T1): (1) gingival index (GI), (2) plaque index (PI), and (3) probing depth (PD). The results of the GI, PI, and PD were averaged for all 24 maxillary and mandibular teeth, and the mean value for each subject was estimated.

Following the first archwire insertion (0.014 Cu-NiTi in the conventional group, 0.014 Damon Cu-NiTi in the Damon group), the subjects were given a discomfort diary to complete over the first month. The diary recorded discomfort by means of a 100-mm visual analog scale (VAS) at 4 hours, 24 hours, 3 days, 1 week, and 1 month using the terms *very comfortable*

**Figure 2.** Lateral cephalometric dental angular and linear measurements. 1: U1-SN (°); 2: U1-FH (°); 3: U1-NA (°); 4: U1-NA (mm); 5: IMPA (°); 6: FMIA (°); 7: L1-NB (°); 8: L1-NB (mm); 9: overjet (mm); 10: overbite (mm).

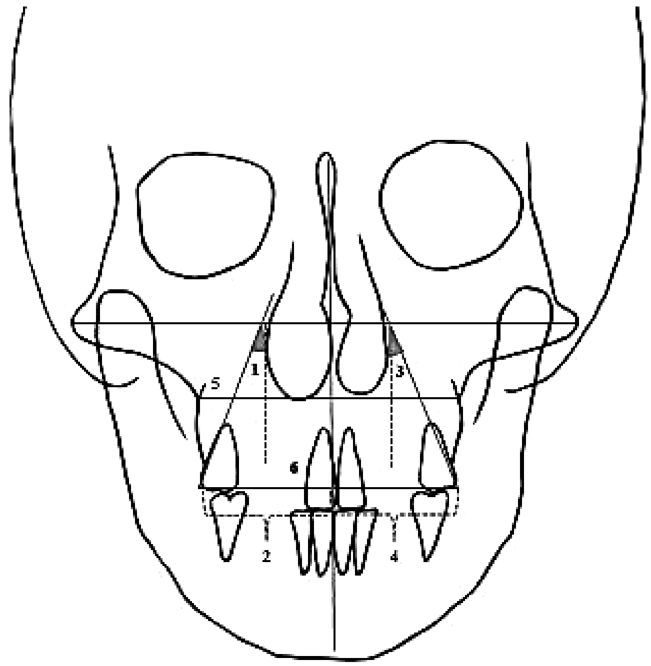

**Figure 3.** Posteroanterior cephalometric measurements. 1: UR6-ML (°); 2: UR6-ML (mm); 3: UL6-ML (°); 4: UL6-ML (mm); 5: JR-JL (mm); 6: UR6-UL6 (mm).

and *very uncomfortable* as peripheral status. The patients completed the VAS diary for both the maxillary and mandibular arches.

### Statistics

The data were analyzed with SPSS version 11.5 software for Windows (SPSS Inc, Chicago, Ill). The differences in the values between the two groups were assessed by the Student's *t*-test and the Mann-Whitney *U*-test. For the values within the groups, the changes were assessed respectively by a paired *t*-test and Wilcoxon signed-rank test when the repeated measurement was two. The Variance and Friedman tests were used when the repeated measures were more than two. The Bonferroni post hoc pairwise comparison test was conducted to define differences in the variables.

The intraexaminer reproducibility of the cephalometric and study model measurements was assessed by replication of the measurements at 4-week intervals on all radiographs and pairs of models using a 95% confidence interval and coefficient of correlation. The intraexaminer reliability coefficients ranged from .951 to .998. High reliability was confirmed for the radiographs and the dental model measurements.

The level of statistical significance was set at $P <$ .05. However, the significance level was set at .025 when the Bonferroni test was used.

## RESULTS

Baseline demographic and clinical characteristics for the patients are given in Table 1. There was no significant difference in total treatment time between the two treatment groups (Table 1).

According to the lateral cephalometric evaluations, the changes in the lateral cephalometric measurements were not significantly different between the groups (Table 2). With the exception of the JR-JL distance, all posteroanterior cephalometric variables showed significant changes in both groups ($P <$ .025; Table 3). There was a statistically significant difference between the groups in the UR6-OH and UL6-OH angles ($P <$ .05; Table 3).

The maxillary intercanine, interpremolar, and intermolar widths were significantly larger after the treatment in both appliance systems ($P <$ .025; Table 4). However, when the level of expansion achieved between the two groups was compared, no significant difference was found (Table 4).

For all periodontal index changes, no difference was found between the two treatment groups (Figure 4; Table 5).

Pain decreased in intensity over time in both groups as shown in Figure 5. During 1 month, the conventional and Damon groups showed the same pattern of changes in the VAS scores between all observation periods (Table 6).

**Table 2.** Lateral Cephalometric Measurements of the Groups at T0 (Pretreatment) and T1 (Posttreatment) Periods

| Variables | T0 | T1 | $P^a$ | Change | $P^b$ |
|---|---|---|---|---|---|
| U1-SN, ° | | | | | .245 |
| Conventional | 102.25 ± 6.85 | 104.19 ± 5.84 | .103 | 1.95 ± 4.64 | |
| Damon | 103.63 ± 7.93 | 107.30 ± 6.74 | <.001* | 3.68 ± 3.64 | |
| U1-FH, ° | | | | | .488 |
| Conventional | 111.93 ± 6.50 | 113.39 ± 5.32 | .291 | 1.46 ± 5.50 | |
| Damon | 113.83 ± 7.06 | 116.54 ± 6.37 | .037 | 2.72 ± 4.76 | |
| U1-NA, ° | | | | | .542 |
| Conventional | 22.82 ± 6.28 | 25.44 ± 5.02 | .048 | 2.62 ± 5.05 | |
| Damon | 23.17 ± 7.47 | 26.93 ± 5.37 | .016* | 3.76 ± 5.56 | |
| U1-NA, mm | | | | | .624 |
| Conventional | 5.12 ± 2.06 | 5.88 ± 2.42 | .111 | 0.76 ± 1.87 | |
| Damon | 5.12 ± 2.60 | 6.22 ± 1.94 | .046 | 1.10 ± 2.03 | |
| IMPA, ° | | | | | .508 |
| Conventional | 92.95 ± 6.29 | 97.91 ± 7.27 | <.001* | 4.96 ± 4.25 | |
| Damon | 96.33 ± 3.40 | 102.44 ± 6.05 | <.001* | 6.11 ± 5.54 | |
| FMIA, ° | | | | | .516 |
| Conventional | 63.02 ± 6.41 | 56.55 ± 6.29 | <.001* | −6.48 ± 4.28 | |
| Damon | 60.71 ± 6.42 | 53.16 ± 6.70 | <.001* | −7.55 ± 5.08 | |
| L1-NB, ° | | | | | .414 |
| Conventional | 23.56 ± 5.72 | 28.87 ± 6.18 | <.001* | 5.31 ± 4.25 | |
| Damon | 26.50 ± 4.16 | 33.10 ± 4.56 | <.001* | 6.60 ± 4.68 | |
| L1-NB, mm | | | | | .197 |
| Conventional | 5.03 ± 2.17 | 6.72 ± 2.23 | <.001* | 1.69 ± 0.86 | |
| Damon | 5.55 ± 2.45 | 7.84 ± 2.27 | <.001* | 2.29 ± 1.60 | |
| Overjet, mm | | | | | .827[d] |
| Conventional | 3.67 ± 1.36 | 2.63 ± 0.64 | .006[c]* | −1.04 ± 1.37 | |
| Damon | 4.04 ± 1.70 | 2.88 ± 0.63 | .019[c]* | −1.16 ± 1.77 | |
| Overbite, mm | | | | | .872[d] |
| Conventional | 2.02 ± 0.33 | 2.01 ± 0.62 | .914[c] | −0.01 ± 0.66 | |
| Damon | 2.11 ± 0.90 | 2.06 ± 0.63 | .660[c] | −0.05 ± 0.45 | |

[a] Comparison of T0 and T1 measurements within groups; the significance level was $P < .025$ based on the Bonferroni test.
[b] Comparison of groups; the significance level was $P < .05$.
[c] Paired *t*-test.
[d] Student's *t*-test.
* Statistically significant.

## DISCUSSION

Recently, expansion of dental arches by means of self-ligating brackets and broader superelastic archwires has become an issue. On the basis of this idea, conventional and self-ligating brackets have been compared regarding maxillary dentoalveolar expansion in several studies.[5–8] Only one study employed a rapid maxillary expansion appliance before straight-wire mechanics in the conventional bracket group.[8] However, no study has compared the application of a conventional straight-wire system after the use of a quad-helix appliance with application of the Damon system in patients with a Class I malocclusion and a dentally constricted maxillary arch.

Thirty-three patients with a Class I malocclusion who showed maxillary dental constriction were included in this study. It was ensured that the degree of initial crowding was similar and not over the limits of a nonextraction treatment protocol.

Vajaria et al.[5] emphasized that ideally the same manufacturer and slot size should be used when comparing conventional and self-ligating bracket systems. We used the same bracket slot size and archwire sequences in both treatment systems to ensure meaningful results. Nevertheless, the type of Cu-NiTi was different between the groups (standard Cu-NiTi in the conventional group and Damon Cu-NiTi in the Damon group). In the Damon group, due to the expansion feature of the Damon Cu-NiTi archwires,[3] the expansion appliance was not used before the leveling and alignment stages. Bite elastics were also not used for expansion in the Damon group to eliminate probable differences in patient cooperation.

Maxillary and mandibular incisor-proclination changes were the same between the groups (Table 2). Therefore, the "lip bumper" opinion, which asserts that incisor proclination will be significantly less using the Damon system,[4] was not supported by our study. Similarly, Pandis et al.[9] stated that the increase in IMPA was insignificant within groups. In another study, Pandis et al.[10] found no significant difference between self-ligating and control groups with respect to the inclination of maxillary incisors. Their results were very

**Table 3.** Posteroanterior Cephalometric Measurements of the Groups at T0 and T1 Periods

| Variables | T0 | T1 | $P^a$ | Change | $P^b$ |
|---|---|---|---|---|---|
| UR6-OH, ° | | | | | .045[e]* |
| Conventional | 26.2 (16.2–30.6) | 29.3 (20.6–31.8) | <.001[c]* | 1.8 (0.4–6.0) | |
| Damon | 27.3 (16.4–30.6) | 29.2 (22.4–34.9) | <.001[c]* | 3.2 (1.2–10.6) | |
| UR6-OH, mm | | | | | .232[f] |
| Conventional | 30.31 ± 1.76 | 31.51 ± 2.22 | <.001[d]* | 1.20 ± 0.94 | |
| Damon | 27.87 ± 1.66 | 29.54 ± 1.99 | <.001[d]* | 1.68 ± 1.30 | |
| UL6-OH, ° | | | | | .010[e]* |
| Conventional | 26.9 (16.8–31.3) | 28.7 (19.9–34.4) | <.001[c]* | 2.0 (0.5–6.9) | |
| Damon | 27.6 (18.8–31.6) | 31.5 (26.3–37.0) | <.001[c]* | 4.1 (0.9–7.6) | |
| UL6-OH, mm | | | | | .135[f] |
| Conventional | 29.53 ± 2.06 | 30.98 ± 1.73 | <.001[d]* | 1.45 ± 0.92 | |
| Damon | 28.31 ± 1.37 | 29.27 ± 1.37 | <.001[d]* | 0.96 ± 0.91 | |
| JR-JL, mm | | | | | .775[f] |
| Conventional | 70.82 ± 3.16 | 71.26 ± 3.11 | >.001[d] | 1.44 ± 1.04 | |
| Damon | 68.89 ± 3.52 | 69.23 ± 3.44 | >.001[d] | 1.34 ± 1.00 | |
| UR6-UL6, mm | | | | | .637[f] |
| Conventional | 59.99 ± 3.43 | 62.04 ± 3.49 | <.001[d]* | 2.05 ± 1.34 | |
| Damon | 56.98 ± 2.47 | 58.78 ± 2.73 | <.001[d]* | 1.80 ± 1.65 | |

[a] Comparison of T0 and T1 measurements within groups; the significance level was $P < .025$ based on the Bonferroni test.
[b] Comparison of groups; the significance level was $P < .05$.
[c] Wilcoxon signed-rank test.
[d] Paired *t*-test.
[e] Mann-Whitney *U*-test.
[f] Student's *t*-test.
*Statistically significant.

similar to those obtained in the current study. Similar to our results, Vajaria et al.[5] and Jiang and Fu[7] indicated that both the conventional and Damon bracket systems cause labial inclination of the incisors. These results emphasize that two different treatment systems proclined maxillary and mandibular incisors in a similar manner, which agrees with the results of our study.

In the present study, overjet was significantly decreased in both groups ($P < .025$; Table 2). The decrease in overjet can be explained by significant mandibular incisor proclination.

Posteroanterior cephalometric evaluation was performed to determine the expansion type and the degree of tipping of the molars. Although there was no significant change in the intermaxillary width, there was a significant change in the intermolar widths in both groups ($P < .025$; Table 3). This supports a dental origin of the expansion. Despite the absence of an active expansion appliance in the Damon group, an increase of the intermolar width similar to that in the conventional group emphasizes that the Damon system can expand the dental arch without using an auxiliary expansion appliance before fixed appliance therapy.

In the conventional and Damon groups, the increase of the UR6-OH and UL6-OH angles and distances indicated buccal tipping of the upper molars. Therefore, our results are not in agreement with the

**Table 4.** Dental Model Measurements of the Groups at T0 and T1 Periods

| Variables | T0 | T1 | $P^a$ | Change | $P^b$ |
|---|---|---|---|---|---|
| Intercanine width | | | | | .452 |
| Conventional | 33.19 ± 3.17 | 35.21 ± 1.96 | <.001* | 2.02 ± 1.67 | |
| Damon | 33.31 ± 3.20 | 35.84 ± 2.10 | <.001* | 2.53 ± 2.16 | |
| Inter-first premolar width | | | | | .372 |
| Conventional | 38.52 ± 2.48 | 44.24 ± 2.07 | <.001* | 5.72 ± 1.70 | |
| Damon | 38.22 ± 2.56 | 43.28 ± 1.96 | <.001* | 5.06 ± 2.41 | |
| Inter-second premolar width | | | | | .858 |
| Conventional | 44.20 ± 3.39 | 49.24 ± 2.25 | <.001* | 5.04 ± 2.15 | |
| Damon | 42.89 ± 2.99 | 47.79 ± 2.58 | <.001* | 4.90 ± 2.55 | |
| Intermolar width | | | | | .517 |
| Conventional | 50.28 ± 3.82 | 54.09 ± 2.87 | <.001* | 3.83 ± 1.57 | |
| Damon | 48.59 ± 3.27 | 52.02 ± 3.15 | <.001* | 3.43 ± 1.80 | |

[a] Paired *t*-test, comparison of T0 and T1 measurements within groups; the significance level was $P < .025$ based on the Bonferroni test.
[b] Student's *t*-test, comparison of the groups; the significance level was $P < .05$. * Statistically significant.

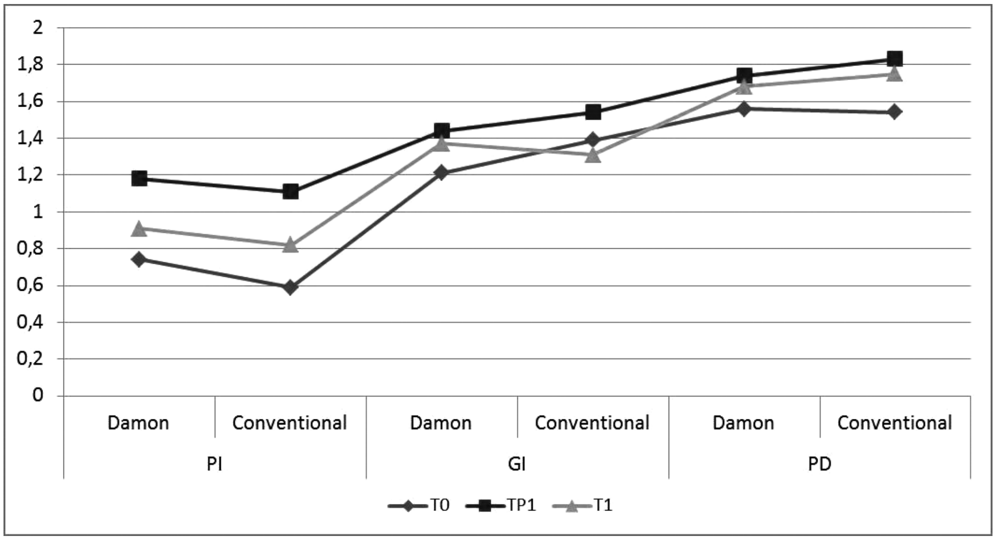


**Figure 4.** Periodontal index score changes of the groups between different periods.

hypothesis of a Frankel-like effect in the Damon system.[11]

Yu et al.[8] compared RME and Damon bracket effects on nonextraction correction of dental crowding. In accordance with our findings, they stated that both groups showed buccal tipping of molars. Cattaneo et al.[12] indicated that transversal expansion of the upper arch was achieved by buccal tipping in a Damon group, which is in parallel with our results.

The Damon group showed a statistically greater increase in the UR6-OH and UL6-OH angles when compared with the conventional group in respect to posteroanterior measurements (Table 3). The increased buccal inclination of the maxillary molars in the Damon group may derive from different causes. One possible cause may be the broader arch form of the Damon Cu-NiTi and SS archwires.[12] Another may be the different torque values on the maxillary molar brackets. The low buccal root torque and increased tipping of the maxillary molars in the Damon group would increase the risk of future relapse. Therefore, it might be interesting to follow up with patients during the postretention period to determine long-term effects.

**Table 5.** Periodontal Index Score Changes of the Groups Between Different Periods[a]

| Observation Period | Conventional | Damon | $P$ Value[b] |
|---|---|---|---|
| PI | | | |
| Tp1-T0 | 0.52 ± 0.40 | 0.45 ± 0.37 | .606 |
| T1-T0 | 0.23 ± 0.52 | 0.17 ± 0.45 | .746 |
| T1-Tp1 | −0.29 ± 0.43 | −0.27 ± 0.31 | .913 |
| GI | | | |
| Tp1-T0 | 0.15 ± 0.60 | 0.22 ± 0.60 | .721 |
| T1-T0 | −0.08 ± 0.62 | 0.16 ± 0.39 | .201 |
| T1-Tp1 | −0.23 ± 0.51 | −0.07 ± 0.38 | .309 |
| PD | | | |
| Tp1-T0 | 0.29 ± 0.25 | 0.19 ± 0.33 | .293 |
| T1-T0 | 0.25 ± 0.35 | 0.12 ± 0.27 | .286 |
| T1-Tp1 | −0.06 ± 0.30 | −0.06 ± 0.32 | .959 |

[a] PI indicates plaque index; GI, gingival index; PD, probing depth.
[b] The significance level was $P < .017$ based on the Bonferroni test.
* Statistically significant.

The results of this study suggest that both types of appliances had the same effect on the arch width. In both systems, the arch widths were significantly larger after the treatment (Table 4). Pandis et al.[9,13] and Vajaria et al.[5] reported greater intermolar arch width increases in patients treated with the Damon system than in conventional treatment groups. However, these studies did not use active expansion appliances before fixed-appliance therapy in the conventional group. Therefore, in contrast to our study, they found a greater increase in the intermolar width in the Damon group. In our study, the two systems had the same effect on the arch width, showing that broader Cu-NiTi and SS archwires in the Damon group expanded the upper dental arch as much as the conventional straight-wire system combined with the quad-helix appliance. In common with the findings of the present study, Yu et al.[8] demonstrated a significant increase in the upper interpremolar and intermolar arch widths in a comparison of the effects of RPE and Damon brackets. In their study, the upper intermolar width increased more in the conventional group than in the Damon group. However, in our study, the increase in the maxillary intermolar width was similar between the two groups. This result may be attributed to the difference in the expansion appliances used in the studies.

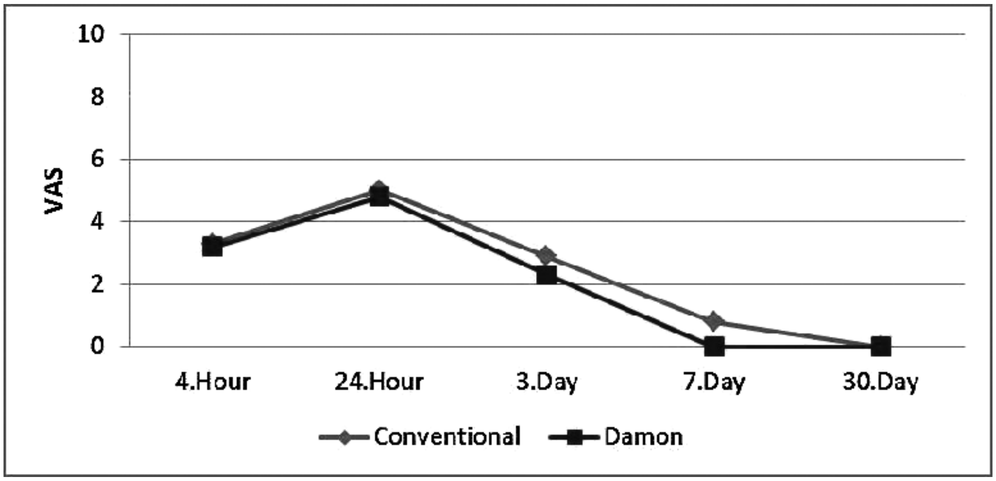


**Figure 5.** Comparison of VAS score changes according to different observation periods.

As the literature lacks evidence on how self-ligating brackets affect periodontal status, we also determined the effect of the bracket type on clinical periodontal parameters at three different times. The mean value changes of periodontal clinical parameters did not show significant differences among the conventional and Damon treatment groups during the different time points (Table 5; Figure 4). This result suggests that self-ligating brackets are not superior to conventional brackets with respect to the periodontal status. This finding may be because the opening and closing mechanisms of the self-ligating brackets provide additional plaque retention sites.

Pandis et al.[14] investigated whether the use of self-ligating brackets was associated with better values for periodontal indices in a prospective study. In common with our results, no difference was found in the indices between the conventional and the self-ligating brackets. Pejda et al.[15] compared Damon 3MX and conventional brackets at 6 weeks, 12 weeks, and 18 weeks after full bonding of orthodontic appliances and concluded that bracket design did not seem to have a strong influence on periodontal clinical parameters, which agrees with our findings. In contrast to these studies, Pellegrini et al.[16] compared plaque bacteria surrounding two bracket types and reported reduced retention of oral bacteria with self-ligating appliances. Similarly, Pejda et al.[15] found a statistically significant higher prevalence of *Aggregatibacter actinomycetemcomitans* in patients with conventional brackets than in patients with self-ligating brackets. The difference in the results of the various studies may relate to several factors, including the variations in the design of the self-ligating brackets, the level of oral hygiene of the subjects, treatment variables, and the age of the subjects.

**Table 6.** VAS Score Changes According to Different Observation Periods

| Observation Period | Conventional | Damon | *P* Value[a] |
|---|---|---|---|
| 4 h–24 h | 1.7 (0.2–2.8) | 1.3 (0.3–2.8) | .465 |
| 24.h–3 d | −2.1 (−4.8–0.1) | −2.4 (−5.5–−1.1) | .363 |
| 3 d–7 d | −1.9 (−3.9–−0.2) | −1.9 (−3.9–0.0) | .763 |
| 7 d–30 d | −0.8 (−1.6–−0.1) | 0.0 (−0.8–0.0) | .709 |

[a] Mann-Whitney *U*-test; the significance level was $P < .05$ based on the Bonferroni test.

* Statistically significant.

In addition to the evaluation of the periodontal status, we also aimed to investigate potential differences in the degree of discomfort experienced during treatment using the Damon and conventional bracket systems. VAS was used for this study. This system is understood by most patients and demonstrates good sensitivity between small changes, good reproducibility, and reliability.[17,18] However, this scale does not allow the sources of discomfort to be distinguished. Analysis of the VAS data showed no significant differences between perceived discomfort with the conventional or with the Damon appliance systems at any time interval (Table 6; Figure 5). Our finding is in agreement with several investigations that showed that pain levels peak at around 24 hours and return to a minimal baseline level by 7 days.[19–21] Scott et al.[22] reported no difference in perceived discomfort when using a Damon3 bracket system or a conventional edgewise appliance system. Similar to our results, the peak discomfort occurred between 4 and 24 hours, decreased by 3 days, and was at a minimal baseline level by 7 days.

On the other hand, some studies indicated that self-ligating brackets were superior to conventional brackets regarding pain experience.[23,24] Although lower friction and force level with self-ligating brackets has been emphasized by in vitro studies, the reflection of this force to dental arches has not been conclusively proven.[25,26] Moreover, pain experience is related to several subjective factors, which can differ among the subjects.[19,27]

## CONCLUSIONS

- The conventional and Damon systems were found to be similar with regard to the incisor position, transverse dimension changes in the maxillary arch, clinical periodontal parameters, and pain intensity.
- The only significant difference between the two systems was that the Damon system inclined the maxillary molars more buccally than did the conventional group.

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