

Slot Dimension Changes of New and Retrieved Damon Q Passive Self Ligating Brackets

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ABSTRACT

Introduction: In clinical orthodontics, the proper fit between the bracket slot and the archwire is of great importance. Geometry of the bracket slot plays a major role in efficient three-dimensional tooth movement during the orthodontic treatment.

Materials and methodology: Damon Q second premolar brackets with 0.022 × 0.028-inch slot size were used in this study. The study consisted of 2 groups and each group had 10 samples group1 - as received Damon Q brackets, group2 - retrieved Damon Q brackets. These retrieved Damon Q brackets were used along with damon CuNiTi archwires in the oral cavity for a period of 32 weeks. Paired t test was done to compare the mean difference in the slot dimensions (height and depth) between the as received and retrieved Damon Q brackets.

Results: Paired t test showed significant difference in the slot dimensions between the as received and retrieved Damon Q brackets ($P < 0.05$). Slot depth obtained for the retrieved brackets (0.73 ± 0.022) were significantly higher compared to the new brackets (0.66 ± 0.009) and the slot height of the retrieved brackets (0.57 ± 0.009) were less compared to the new brackets (0.61 ± 0.008). **Conclusion:** The slot depth of the Damon Q retrieved brackets were significantly higher compared to the new brackets and the slot height of the retrieved brackets were less compared to the new brackets.

Key words: Damon Q bracket, Slot height, Slot depth, CuNiTi archwires

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INTRODUCTION

Orthodontic brackets have an eminent role in the fixed orthodontic treatment. During the process of orthodontic treatment, the materials are there in the oral cavity for a longer time as a result it might not perform to the manufacturers' specifications. Among all the orthodontic materials, brackets stay for a longer time in the patient's mouth [1]. In clinical orthodontics, the proper fit between the bracket slot and the archwire is of great importance. There could be increase in porosity and roughness of brackets which might result in inaccurate torque expression [2]. Geometry of the bracket slot plays a major role in efficient three-dimensional tooth movement during the orthodontic treatment. It is

important for clinicians to understand changes in the materials and evaluate their clinical behavior, and to modify the treatment process accordingly.

Torque is necessary to alter the inclination of all teeth in orthodontic treatment. The preprogrammed change in the buccolingual inclination of the crowns depends on the wire torque stiffness, bracket design, slot dimensions, and the mode of ligation [3,4]. A self-ligating bracket is defined as a bracket, which utilizes a permanently installed, movable component to entrap the arch wire. These brackets incorporate a locking mechanism (such as a ring, spring, or door mechanism) that holds the arch wire in the bracket slot [5].

A passive self-ligation mechanism has the lowest frictional resistance of any ligation system. Passive edgewise self-ligation system provides very low levels of static and dynamic friction, tight ligation due to the proper closure of the slot by the slide, control of tooth position because there is an edgewise slot of adequate width and depth. These features facilitate short treatment visits, particularly in the early phases of treatment, and reduced treatment times [6].

Damon braces are the concept of orthodontist and inventor, Dwight Damon. Damon developed his high-tech system of braces after observing how tissue and bone responded to reduced force on the mouth. In the course of orthodontic treatment, due frequent opening and closing of the shutter, slot dimension might get distorted. The aim of the present study was to evaluate the changes in the slot dimensions of new and retrieved Damon Q brackets.

MATERIALS AND METHODOLOGY

This study was conducted in subjects who were undergoing fixed orthodontic treatment in the Department of Orthodontics. Patients treated with Damon passive self-ligating brackets were included in the study. Age of the patients ranged from 15 to 30 years. As received and retrieved Damon Q (Ormco, Glendora, CA, USA) 2nd premolar brackets with 0.022 × 0.028-inch slot size were used in this study as they are prone to more occlusal load. This ex vivo study consisted of 2 groups and each group had 10 samples group1 - as received Damon Q brackets, group 2-retrieved Damon q brackets. These retrieved Damon q brackets were used along with Damon CuNiTi archwires in the oral cavity for a period of 32 weeks (Figures 1 and 2).

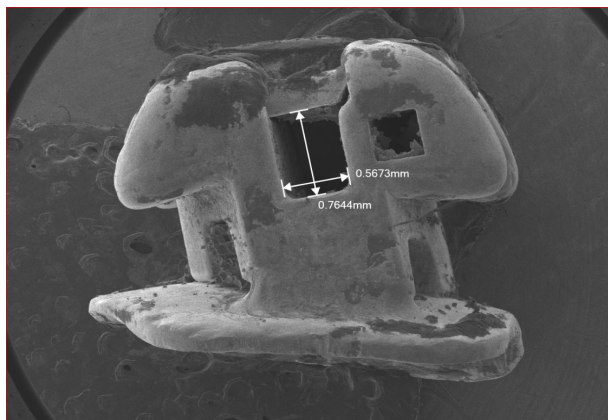


Figure 1: SEM image of retrieved Damon Q second premolar bracket showing slot depth and slot height measurements.

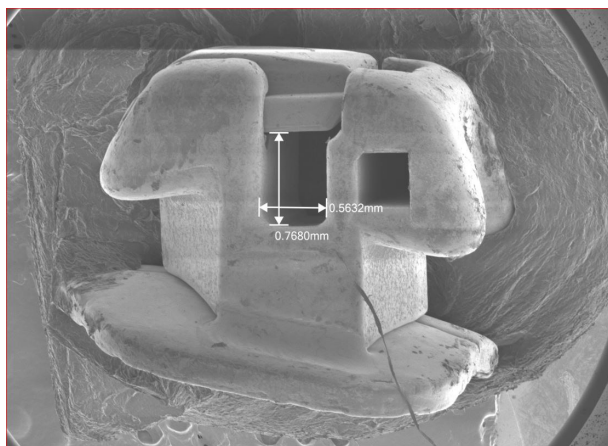


Figure 2: SEM image of as received Damon Q second premolar bracket showing slot depth and slot height measurements.

Table 1: Table gives mean and SD of slot dimensions (slot height and depth) in mm of as received and retrieved Damon Q second premolar brackets and the results of the Paired t test done to assess the difference in slot dimensions between the two groups.

Slot dimensions(in mm)	As received(group 1)	Retrieved (group 1)	P value
	Mean and std.dev	Mean and std. dev	
Occluso- gingival(height)	0.61 ± 0.008	0.57 ± 0.009	0
Bucco-lingual(depth)	0.66 ± .009	0.73 ± 0.022	0

RESULTS

A statistical analysis was performed using IBM SPSS software version 23.0. Normality test was done with Shapiro-Wilk test and the data was found to be normally distributed. Paired t test was done to compare the mean difference in the slot dimensions (height and depth) between the as received and retrieved Damon Q brackets. The results of the present study showed that the bracket slot depth obtained for the retrieved brackets (0.73 ± 0.022) were significantly higher compared to the new brackets (0.66 ± .009) and the slot height of the retrieved brackets (0.57 ± 0.009) were less compared to the new brackets (0.61 ± 0.008)(P<0.05) (Table 1).

DISCUSSION

Damon® (Ormco) and In Ovation® (Dentsply GACTM) self-ligating brackets with slide or clip opening and closing systems for ligature free systems (involving the elimination of certain utilities or materials such as elastomeric modules) have recently been developed and have become popular due to their presumed advantages, which include greater patient comfort, and less frictional resistance. Due to the absence of the ligature ties and modules, the slide open-close method of self-ligating brackets improves chairside efficiency.

All edgewise appliances depend on the slot dimensions and characteristics of the predetermined brackets by the manufacturers [7]. In the self-ligating bracket system, the built-in shutter or the door closes and opens the edgewise slot. In the self-ligating bracket system, the slide or clip open-close system improves the chair-side efficiency by eliminating ligature ties. To express the prescribed tip and torque as required for the treatment, the bracket slot must be of suitable shape, consistent size, hardness, low roughness. The full transmission of the bracket's tip and torque prescription to the tooth and its supporting tissues needs fit of the archwire into the bracket slot delivers. If the slot dimensions might get altered due opening and closure of the shutter or door of the self-ligating brackets, prescribed tip and torque will not be expressed consistently [8].

Precise fit between the bracket slot and the archwire is of major importance in clinical orthodontics as effective three-dimensional tooth movement with fixed appliances is difficult [9,10]. Lombardo et al. suggested that the 'play' between the archwire and the bracket slot, which specifies how many degrees the archwire

must be turned within the bracket before its edges come into contact with the slot wall, is influenced by the bracket slot geometry [7]. Hixson et al. evaluated the slot tolerance of reused brackets from three different manufacturers and found no statistically significant differences [9]. Buchman et al looked at dimensional stability and mechanical properties of the reused brackets from various recycling firms, and the number of brackets with change in slot width was statistically significant although, the differences from the normal measurements were quite minimal [11]. The results of the present study showed that the bracket slot depth obtained for the retrieved brackets (0.73 ± 0.022) were significantly higher compared to the new brackets ($0.66 \pm .009$) and the slot height of the retrieved brackets (0.57 ± 0.009) were less compared to the new brackets (0.61 ± 0.008).

Scanning electron microscopy, optical microscope, contact surface profilometer, and atomic force microscopy (AFM) have all been used in the previous studies to measure the slot dimensions of brackets [8,12-14]. SEM can visualize the surface morphology two dimensionally and gives a quantitative value of the slot dimensions [15]. So in this study SEM was used to measure the slot dimensions of ten brackets. Slot dimensions of this study might be clinically insignificant as reported by one previous study by Buchman et al. [11]. However, more research is required to fully understand the impact of slot dimension values on orthodontic tooth movement. One important finding of the present study was that the open- close slides of the self-ligating brackets were intact even in case of the retrieved brackets.

CONCLUSION

The slot depth of the Damon Q retrieved brackets were significantly higher compared to the new brackets and the slot height of the retrieved brackets were less compared to the new brackets. Also the bracket shutters were intact in the case of retrieved brackets.

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