

# Assessment of Shear Bond Strength of Various Self Ligating Systems- An Evaluation of Bonding Efficiency

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## Abstract

**Aim:** To compare and contrast the shear bond strength and adhesive remnant index scores of different Self ligating brackets. **Materials and methods:** A total of 75 extracted human first premolars were selected and divided into 3 groups of 25 for each bracket system. Each sample was then embedded in an acrylic block, till the coronal portion. Instron testing machine model LR LOYD 50 K was used for testing the shear bond strength. SBS values and adhesive failure rates were recorded. **Results:** All the bracket systems considered in the study demonstrated and clinically adequate Shear bond strength. Among the three groups, Damon Q gave the least remnant index score followed by SmartClip and BioQuick. **Conclusion:** The highest bond strength and the least remnant index score were obtained from Damon Q system, followed by Smartclip and BioQuick in the same order.

**Keywords:** Shear bond strength, Adhesive remnant index, Damon Q, Smartclip, Bioquick.

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## INTRODUCTION

The rapid increase in popularity of the self-ligating system is due to the mechanical advantage that they offer in terms of reducing friction and faster treatment [1]. During the past few decades, the bracket systems have went through a major revolution and self-ligating systems are being one of them. There has been a number of studies evaluating the friction and torque expression of self-ligating bracket systems [2, 3]. Studies have also being directed towards the evaluation of periodontal indices, in order to assess the efficiency of the bracket system [4]. The aim of this investigation is to measure the Shear bond strength and compare the Adhesive remnant index scores of different self-ligating bracket systems.

## MATERIALS AND METHODS

Totally 75 freshly extracted human first premolars were collected and stored in a solution of 0.1% (weight/volume) thymol solution, for a period of 15 days to prevent dehydration and bacterial growth.

Inclusion Criteria were freshly extracted first premolar teeth, intact enamel surface, no evident caries and no visible cracks.

The teeth were fixed in acrylic self-cure blocks such that the roots were completely embedded in acrylic up to the cemento enamel junction, to simulate the clinical crown height.

Teeth were divided into 3 groups of 25 samples each. Each group was bonded with different Orthodontic Lingual Bracket system. Group I was Smartclip (3M) Self ligating brackets, Group II was Damon Q (Ormco) and Group III was BioQuick (Forestadent).

3M Curing light 2500 (3M Dental Products) with an intensity of 480nm was used for polymerisation for 20seconds. Each bracket was cured for 4 seconds from gingival, 4 seconds from occlusal, 4 seconds from mesial, 4 seconds from distal and 4 seconds interproximally.

Transbond XT was used for bonding all the 3 groups. The samples were stored in deiodized water at 37°C for 24hrs before debonding.

The Instron Universal testing machine (Model No. LR LOYD 50K-UK) was used to carry out the test for shear bond strength.

The labial surface of all teeth was pumiced and thoroughly rinsed with distilled water. The tooth surfaces were dried and isolated to avoid contamination of the treatment area. Primer liquid was dispensed into the mixing dish, immediately before application and was applied gently and dried with mild airflow. Required amount of the bond was dispensed into a mixing dish and applied to the primed area. After applying bond, a uniform bond film was created using a gentle oil-free airflow; it was light-cured for 10 seconds with curing light. Bracket with adhesive was placed on the tooth surface and firmly pressed in place and was light cured for 20 seconds with visible light curing unit.

The shear bond strength of bonded specimens was tested after 24 hrs of bonding in an Instron testing machine model LP50K with a crosshead speed of 0.5 mm/min.

The acrylic block mounted with specimen was secured to the lower grip of the machine (fixed head) and a custom-made grip was placed in the upper grip (movable head) connected to the load level and the blade was positioned in such a way that it touched the bracket.

The crosshead speed was adjusted to 0.5 mm/min and the force at which the bracket debonded was recorded. The bond strength was calculated in Mega Pascals by using the following formula. Shear Bond strength in MPa = Force in Newton / Surface area of bracket in mm<sup>2</sup>.

### Statistical Analysis

The single step, multiple comparison procedure and statistical test, Tukey test was used in conjunction with an ANOVA (Post-hoc analysis), to find means that are significantly different from each other. F-test was used to compare the statistical models. These statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 17.0 software.

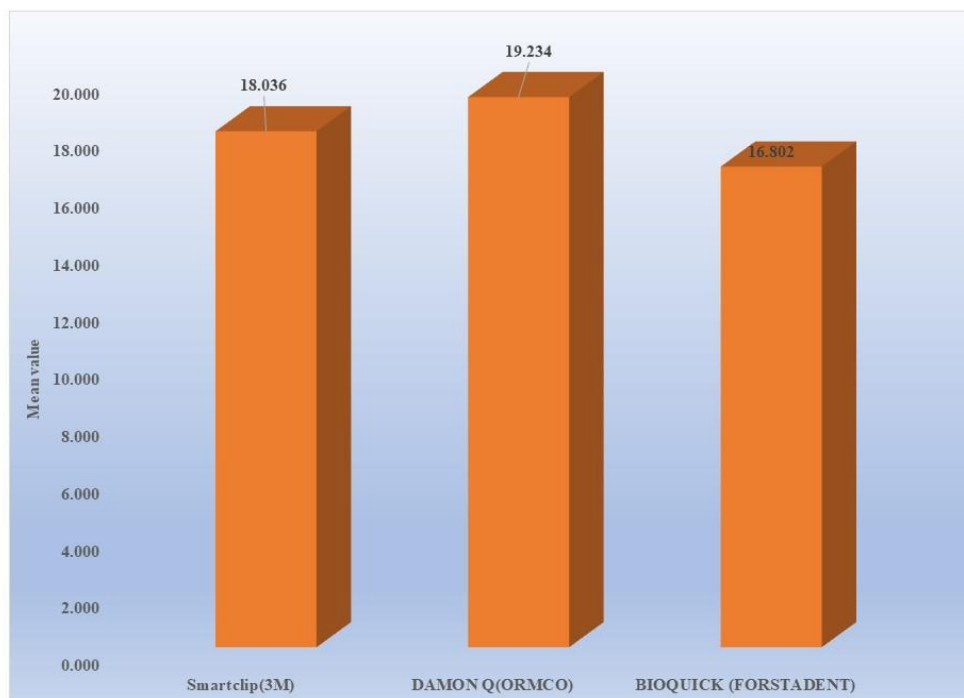
## RESULTS

Damon Q self-ligating bracket system gave superior results with all the bracket systems considered in the study.

Damon Q (Ormco) self-ligating brackets displayed an increased shear bond strength with all the bracket systems that were considered in the study as shown in figure 1 and table 1.

**Table 1: Comparison of Mean of Shear Bond Strengths**

Smartclip (3M)	18.036
DAMON Q(ORMCO)	19.234
BIOQUICK (FORSTADENT)	16.802



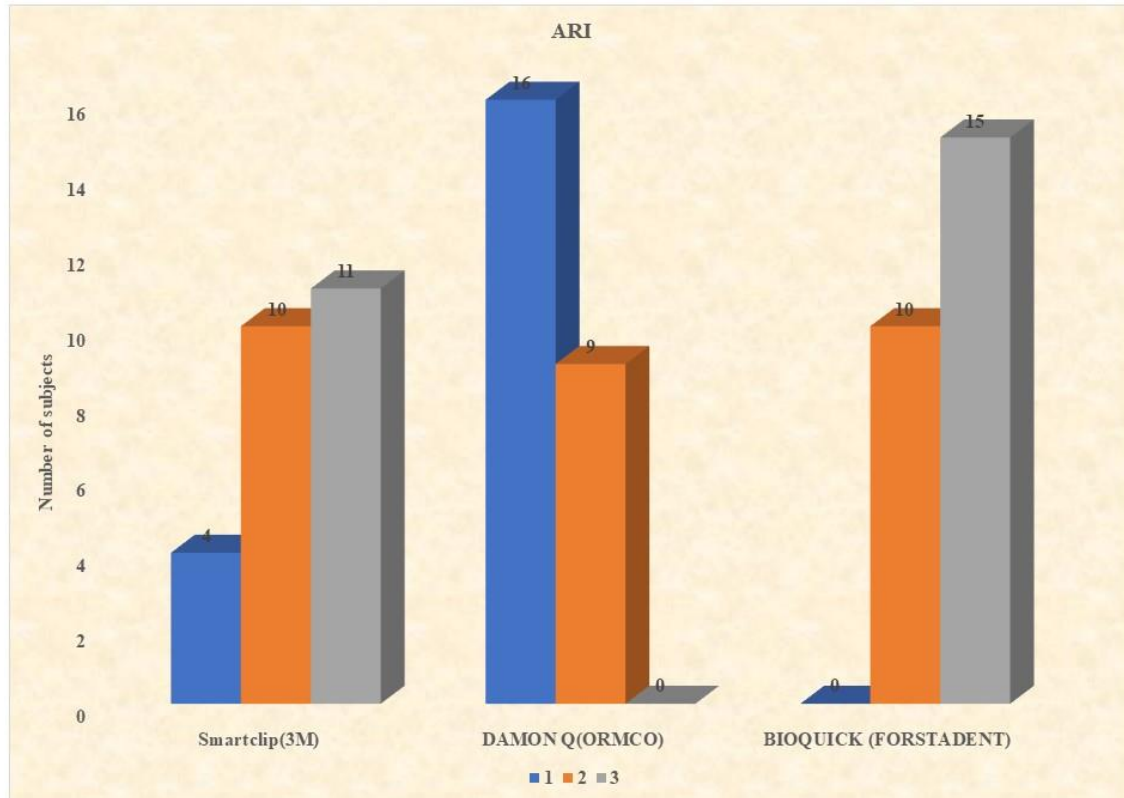
**Figure 1: Mean of Shear Bond Strengths of the three groups**

The Adhesive remnant index score was the lowest for Damon Q system followed by Smartclip

(3M) and BioQuick (Forestadent) as shown in Table 2 and Figure 2.

**Table 2: Comparison of Mean of ARI scores**

Smartclip (3M)	2.2800
DAMON Q(ORMCO)	1.3600
BIOQUICK (FORSTADENT)	2.6000



**Figure 2: Mean of ARI scores of the three groups**

## DISCUSSION

The null hypothesis of the study was rejected. Null hypothesis was that there is no significant difference in SBS values and the debonded surfaces of the teeth in various groups. In the present investigation, Damon Q brackets had significantly higher SBS values than the other groups considered in the study. In the study carried out by Chalgren *et al.*, [3], it was found that there were sufficient bond strengths produced with self-etching primer, gel etchant and liquid etchant. Northrup *et al.*, [4] compared the SBS of conventional and self-ligating brackets using different bonding systems. The self-ligating bracket systems showed a higher SBS value than the conventional bracket systems.

Later Reynolds (1975) [5] reported that a minimum of 6-8Mpa can be considered the minimum bond strength adequate for the clinical situations. These values are considered adequate because it can withstand the masticatory and Orthodontic forces.

Nakamichi *et al.*, 1983 [6], Barkmeier and Erickson 1994 [7] compared the physical properties, composition and bond strengths of bovine and human enamel and concluded that the bovine enamel is a reliable substitute for human enamel in bonding studies.

In the present investigation, ARI scores were determined. An ARI score of 0 indicates higher adhesion of the bonding system more to the bracket base than to the tooth on removal. This is an indication of less time for removing adhesive from the tooth. In contrast to this, an ARI score of 3 indicates failure between the adhesive and bracket, with less risk of enamel fracture during debonding [4].

## CONCLUSION

The results of this investigation revealed the following:

1. All the self-ligating bracket systems considered in the study proved to have adequate shear bond strength to be used in clinical situations.

2. Damon Q gave a superior shear bond strength among the other systems considered in the study.
3. Damon Q gave the maximum frequency of ARI score 1 and Smartclip gave the maximum frequency of ARI score 2.

**Acknowledgement:** Nil

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