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Clinical evaluation of bonded brackets for three composite bonding systems

Hussain A Obaidi
BDS, MSc (Assist Prof)

Dept of Pedod, Orthod and Prev Dent
College of Dentistry, University of Mosul

ABSTRACT

Bonding the teeth with orthodontic brackets via orthodontic adhesive is essential stage in orthodontic treatment. But, still the failure bracket due to orthodontic or functional forces could be the predominant problem through the orthodontic treatment, in addition to the enamel fracture; in cases the bracket failed at the enamel–composite interface completely or partially (scores 0, 1, 2) as suggested by Artun and Bergland.

This study is a clinically attempt to evaluate the failure–bracket number and the bracket failure sites, for three orthodontic composite systems, which were two paste (Concise); nomix (Right ON) and light cure (Transbond). These adhesives were used in bonding a stainless steel brackets to the teeth of adhesive system.

The number of the failed brackets through 18 months of treatment were recorded and the site of the failed brackets were observed by magnifying lens (10×) and recorded according to the Artun and Bergland index.

The results showed that there were no significant differences of failed brackets at $p \leq 0.05$ and 0.01 levels among these three composite systems, but the Concise adhesive had the least failure–brackets.

The failure sites of the failed brackets for the three bonding systems were occurred at scores 2 and 3, while the Concise system had the highest percentage of score 3 site (80%) (composite bracket interface).

Key Words: Failure bracket, bracket failure site, composite system.

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INTRODUCTION

Number of orthodontic adhesives are available and used in bonding the brackets in orthodontic treatment, but still, the orthodontic failure bracket during the treatment is a problem to the orthodontist.

The most efficient bracket bonding is the composite material, which is referred to a three dimensional combination of at least two chemically different materials; the organic filler had been add to amount of binder consisting of a cross–linking polymerizable organic resin.[1] The orthodontic composite adhesive is existed in three systems, which are: Chemically two paste, chemically cured nomix and light cured systems. The chemically cured composite is that resin set rapidly when activated.[2] The two paste system produce strong bond and nomix system is easiest to bond and rebond and has adequate bond strength for anterior teeth, but posterior teeth should be bonded with two paste system.[3] The light cure composite bonding system had adequate bond strength and can fix the bracket with short time light cure exposure and wi-re can be placed immediately.[4, 5]

Various factors could affect the brac-

ket bond strength; among these is acid etching of the enamel surface, which create a tremendous surface area available for bonding and opens up spaces or pores in the enamel into which the adhesive can flow and ultimately polymerize.[6] The most retentive bracket bonding proved to exist with the enamel surface that is etched with 35% phosphoric acid solution for 15–second etching time.[7] The sealant was revealed that it had no significant increase the bond strength of the bracket,[8–10] and the adhesive layer thickness was also studied and it was reported that the thick layer of adhesive gives weaker strength than thin one.[11, 12] The composite orthodontic adhesive was shown to have higher hardness, strength and resistance to abrasion than acrylic resins.[1]

The aim of this study is to evaluate clinically the bonded bracket via two paste system (Concise), nomix system (Right ON) and light cure system (Transbond) and to disclose the predominant bracket failure site.

MATERIALS AND METHODS

The investigated orthodontic composite systems were Concise, two paste chemically cured (3M Unitek, USA), Right ON chemically cured (TP Orthodontics, USA), and Transbond light cured (3M Unitek, USA). Two hundred and forty upper and lower stainless steel orthodontic brackets (TP Orthodontics, USA) were used in treating 15 patients with first premolar extraction.

The orthodontic cases were grouped in three groups; five patients for each gr-oup. The brackets were bonded for each group using one type of composite system according to the manufacturer's instructions. Cementation molars bands (Dentaurum, Germany) and preadjusted orthodontic wire (Dentaurum, Germany) were ligated after 24 hours of brackets bonding. Follow–up the cases for 18 months of treatment, five bonded brackets were failed through the ligation of the first leveling arch wire were excluded, which may be failed due to the errors in bonding process, and they replaced by new bracket.

The number of the failure–bracket failed through 18 months of treatment were recorded for each type of the com-posite system. The failure site of all failed brackets were observed by using magnifying lens (10×) and the scores for each type of composite system by using adhesive remnant index (ARI).[13] The index has four categories: 1) Score 0: No adhesive remaining on the tooth; 2) Score 1: Less than half of the adhesive on the tooth; 3) Score 2: More than half of the adhesive on the tooth; and 4) Score 3: All adhesive on the tooth.

The findings were subjected to the statistical analysis of variance using the Kolmogorov–Smirnov test[14] at 0.05 level of significance.

RESULTS

The failure number of the brackets which were bonded by using Concise, Right ON and Transbond adhesive systems, through the treatment of orthodontic cases for 18 months were shown in Table (1). It was revealed that there was no significant difference among the three types of composite system at $p > 0.05$ significant level, but the Concise was shown numerically the lowest failed brackets in the upper ant-erior and posterior teeth were 0 and 2, and in lower anterior and posterior teeth were 1 and 3; whereas Transbond was shown numerically higher failed brackets in the upper anterior and posterior teeth which were 3 and 4, and in lower anterior and posterior teeth were 4 and 5. While the failed brackets of Right ON was less than that of Transbond in the upper anterior and posterior teeth were 1 and 2, and in lower anterior and posterior teeth were 3 and 4.

The scores of the ARI of the failed bracket were presented in Table (2) which revealed that the bracket–failure sites of the three composite systems score 2 and 3. Total score 2 for the Concise, Right ON and Transbond systems were 20%, 36.3% and 31.2% respectively, but the total score 3 of these three composite systems were 80%, 63.7% and 68.8% respectively.

Table (1): The significant difference for the failure bracket number

Bonded Tooth	Upper Anterior	Upper Posterior	Lower Anterior	Lower Posterior
Sample Number	30	10	30	10
Failure Number (Concise)	0	2	1	3
Failure Number (Right ON)	1	3	2	4
Significance	NS	NS	NS	NS
Failure Number (Concise)	0	2	1	3
Failure Number (Transbond)	3	4	4	5
Significance	NS	NS	NS	NS
Failure Number (Right ON)	1	3	2	4
Failure Number (Transbond)	3	4	4	5
Significance	NS	NS	NS	NS

NS: No significant difference at $p > 0.05$.

Table (2): The adhesive remnant index scores of the bracket failure site

Adhesive	Bonded Bracket	Failure Number	Score 0		Score 1		Score 2		Score 3	
			No.	%	No.	%	No.	%	No.	%
Concise	**UA**	0	-	-	-	-	-	-	-	-
	UP	1	-	-	-	-	-	-	1	100
	LA	1	-	-	-	-	-	-	1	100
	LP	3	-	-	-	-	1	33.3	2	66.7
	Total	5	-	-	-	-	1	20.0	4	80.0
Right ON	**UA**	1	-	-	-	-	-	-	1	100
	UP	3	-	-	-	-	1	33.3	2	66.7
	LA	3	-	-	-	-	1	33.3	2	66.7
	LP	4	-	-	-	-	2	50.0	2	50.0
	Total	11	-	-	-	-	4	36.3	7	63.7
Transbond	**UA**	3	-	-	-	-	1	33.3	2	66.7
	UP	4	-	-	-	-	1	25.0	3	75.0
	LA	4	-	-	-	-	1	25.0	3	75.0
	LP	5	-	-	-	-	2	40.0	3	60.0
	Total	16	-	-	-	-	5	31.2	11	68.8

UA: upper anterior; UP: Upper posterior; LA: Lower anterior; LP: Lower posterior.

DISCUSSION

The results showed that there were no significant differences in the clinical failure of bracket number in the upper and lower, anterior and posterior teeth of the Concise, Right ON and Transbond systems, that express they have relatively the same bond strength. This finding is in agreement with other studies[15, 16] regarding Concise and Transbond adhesive systems, and not matching the results of other studies[17, 18] which found that Concise adhesive had significantly higher bond strength than Right ON adhesive; and coincide with the findings of Bradburn and Pender[19] who stated that there were no significant differences in bond strength between Right ON and Transbond adhesives. But the numerical differences in failure bracket number of these three composite systems may reveal the degree of bond resistance to the orthodontics and functional forces. Concise adhesive system had less failure bracket number than other systems in the upper and lower, anterior and posterior teeth; that express, it has highly bond resis-

tance to orthodontic and functional forces than other adhesive systems, and recommended in bracket bonding the anterior and posterior teeth; while Right ON and Transbond adhesive systems showed higher number of failure–bracket especially in upper and lower posterior teeth; that indicate, they had less bond resistance to orthodon-tic and functional forces and not recomm-ended for bracket bonding of posterior tee-th.

The failure site of the brackets bonded with Concise showed that the majority of the total bracket failed at the composite–bracket interface (score 3), which contributed to 80% of failure with less percentage of score 2 (20%). The high percentage of score 3 expresses the more favorable failure site, avoiding the enamel fracture during bracket debonding. This coincided with the finding of other studies;[19–22] while the total failure site of the bonded brackets with Right ON and Transbond showed moderate percentages of score 3 (63.7% and 68.8%, respectively), and increasing the percentage of score 2 indicate the incr-easing the chance of the enamel fracture through bracket debonding and this is not desirable in orthodontic treatments. The relatively decreasing percentage of score 3 of bracket failure site of these composite systems are matching the findings of other studies.[16, 18, 23]

CONCLUSIONS

There were no significant differences in failed–bracket number among the uses of Concise, Right ON and Transbond bonding systems, but the Concise had the least failed brackets.

The bracket–failure sites of these three composite systems were occurred at scores 2 and 3, while the Concise had the highest percentage of score 3 (80%) of bracket–failure site.

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