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AN EVALUATION OF THE SHEAR BOND STRENGTH OF A FLOWABLE COMPOSITE USED WITH AN INDIRECT BONDING TECHNIQUE

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INTRODUCTION

The ability to treat patients efficiently is of benefit to both patient and provider. Unintended bracket failures are just one of the potential causes of reduced efficiency in the practice of orthodontics. To reduce bond failures, it is important that each orthodontist chooses a bonding system that achieves a clinically acceptable shear bond strength (SBS) of the brackets to the teeth. This minimal acceptable range was determined to be from 5.9 MPa to 7.8 MPa by Reynolds in 1975. Ensuring that brackets remain on the teeth is important, especially in the military where treatment time can be limited. As such, all providers should choose adhesives and systems that reliably achieve a clinically acceptable shear bond strength.

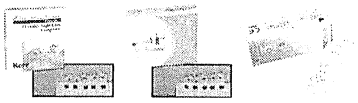
OBJECTIVES

The purpose of this study was to evaluate three bonding systems that are currently available at the military Tri-Service Orthodontic Residency Program (TORP), to determine if there were any significant differences between the groups that might influence future bonding decisions.

Null Hypothesis: There will be no significant difference in the shear bond strength among Revolution 2 flowable composite, Opal Bond Flow, and Transbond XT.

Research Hypothesis: There will be a significant difference in the shear bond strength among Revolution 2 flowable composite, Opal Bond Flow, and Transbond XT.

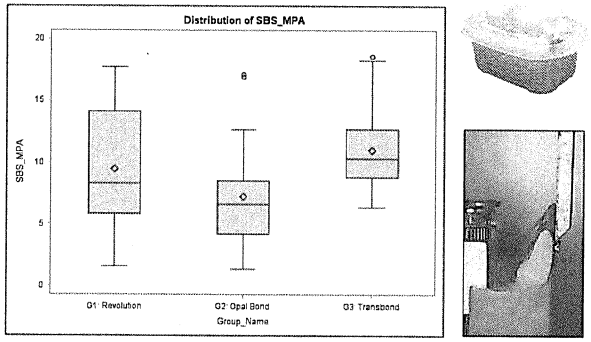
MATERIALS + METHODS

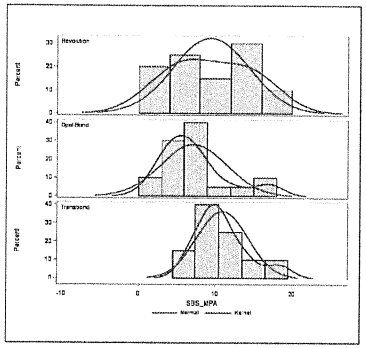


Group 1 Group 2 Group 3

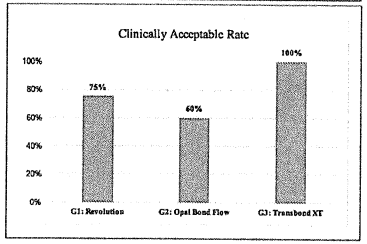
Sixty bovine incisors were chosen for use in this study, divided into three groups of twenty. Each group was bonded with a different adhesive system – Direct bonding with Transbond XT (3M Oral Care), Indirect bonding with Revolution 2 flowable (Kerr Corporation), and Indirect bonding with Opal Bond Flow (Opal Orthodontics). The brackets were then debonded under shear loading forces with an Instron Universal Testing Machine to test the SBS of each bracket. Mean SBS and standard deviations were evaluated along with the clinical acceptability rate of each system.

RESULTS





Group	Mean (MPa)	SD	Minimum	Maximum
G1: Indirect bonding Revolution	9.41	4.95	1.54	17.70
G2: Indirect bonding Opal Bond Flow	7.18	4.29	1.30	17.08
G3: Direct bonding Transbond XT	10.97	3.30	6.32	18.55



A one-way ANOVA was conducted to compare the differences in shear bond strength and showed a significant effect at $p<0.05$ level [$F(2, 57)=4.026$, $p=0.023$]. Post-hoc comparison using the Bonferroni correction indicated that the mean score for Transbond XT was significantly different than Opal Bond Flow. Revolution 2 flowable did not differ significantly from the other two groups. There was a significant difference in clinical acceptability rates (Fisher's Exact Test = 10.74, $p=0.004$). Post-hoc analysis indicated a significant difference between only Transbond XT and Opal Bond Flow.

DISCUSSION

The mean SBS of each of the three test groups exceeded the minimum acceptable SBS of 5.9 MPa. This would suggest that all three methods yield a successful SBS that is appropriate for clinical use.

Differences in Mean SBS. Statistically, the only difference was found between Transbond XT and Opal Bond Flow. The Revolution 2 group was not deemed to be significantly different from either of the other groups. This suggests that Transbond XT will reliably provide a higher average SBS than Opal Bond Flow.

Clinical Acceptability. This value was determined based on the percentage of brackets in each group that met the minimum acceptable value for SBS. It is a method to look at the variability present in each group in a way that correlates with clinical results. Transbond XT had the highest percentage, with all brackets meeting the minimum value. Opal Bond Flow and Revolution 2 had values of 60% and 75%, respectively. Similar to mean SBS, there was only a significant difference between Transbond XT and Opal Bond Flow.

Sources of Error. Error in indirect bonding technique might affect an entire set of SBS values which could lower the overall group mean. Lateral placement of shear load could lead to differences in maximum SBS between more medially and more laterally placed brackets.

CONCLUSIONS

1. All three bonding methods resulted in clinically acceptable mean SBS, but variability was larger in the indirect bonding groups.
2. Mean SBS of Transbond XT (direct technique) was significantly higher than Opal Bond Flow (indirect technique).
3. Clinical Acceptability Rate of Transbond XT (direct technique) was significantly higher than Opal Bond Flow (indirect technique)
4. The data suggests that the highest performance can be achieved by direct bonding with Transbond XT, though not at a level that is significantly higher than Revolution 2 flowable.
5. Due to sources of error identified in the methodology, more studies are needed prior to making conclusions regarding the clinical acceptability of any of the three adhesive systems tested in this study.