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Original Research

Assessment of shear bond strength of orthodontic brackets using direct and indirect bonding methods

[1]Kuldeep Singh, [2]Rajesh Chaudhary

[1]MDS, Orthodontics and Dentofacial Orthopaedics, Zonal Hospital, Dharamsala, Kangra, HP, India;
[2]MDS, Orthodontics and Dentofacial Orthopaedics, India

ABSTRACT:
Background: To assess the shear bond strength of orthodontic brackets using direct and indirect bonding methods. **Materials & methods**: In this study, total of 40 maxillary and mandibular 1st premolars extracted from orthodontic purposes were taken. Specimens were randomly allocated in two groups - direct technique group (N=20) and indirect technique group (N=20). Shear bond testing was performed. SPSS software was used for analysis. **Results:** Indirectly bonded specimens showed higher mean shear bond strength (7.33 MPa) than directly bonded specimens (7.96 MPa), but the difference was not statistically significant. **Conclusion:** Shear bond strength comparison between direct and indirect-bonded attachments showed no significant difference between the two groups.
Keywords: direct methods, indirect methods, shear bond strength, orthodontic brackets.

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Corresponding author: Rajesh Chaudhary, MDS, Orthodontics and Dentofacial Orthopaedics, India

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INTRODUCTION

All orthodontists share the goal of achieving excellent results when clinically treating patients. Despite its complexity, treatment success relies on correct positioning of brackets during bonding, which will simplify subsequent phases of orthodontic treatment in addition to increasing predictability of results. [(1)] Orthodontic brackets are cemented either to labial or to lingual tooth surfaces and act as a medium for the delivery of forces applied by the archwire and auxiliaries to the teeth. The factors that are the main contributors for the successful transfer of orthodontic forces to a tooth include the following: the preparation of the enamel surface for bonding; the type of adhesive cement used; and the shape, material, and surface finish of the bracket.[(2,3)]

Maintaining the orthodontic treatment results after the completion of treatment is highly important. [(4)] Retention is mandatory following orthodontic treatment to prevent relapse. Relapse is an unpredictable phenomenon which is variable in different individuals. [(5)] Several factors are involved in the occurrence of relapse following completion of orthodontic treatment such as the abnormal function of the muscles, occlusal stresses, and regeneration of periodontal fibers. [(6)] A recent development of orthodontic adhesives especially designed for the usage with the indirect bonding technique has helped a greater applicability of this technique in orthodontics. [(7,8)] The direct bonding implies a direct fixation of the brackets using orthodontic adhesives, while with the indirect bonding technique the brackets are first placed on the plaster model and later on transferred to the teeth using transfer tray. The indirect method of bracket bonding enables orthodontists to visualize the tooth in three dimensions, which allows a more accurate placement of orthodontic brackets. The indirect bonding also optimizes the doctor's time spent in the clinic, improves the patient's comfort, and allows a convenient removal of excess bonding material.[(9)] Several studies have been published on the analysis of both direct and indirect techniques in relation to the share bond strength of orthodontic brackets. Variations in mean bond strength obtained in different studies could be attributed to the fact that many in vitro studies fail to report test conditions that could significantly affect their outcomes. [(10)] Hence, present

study was conducted to assess the shear bond strength of orthodontic brackets using direct and indirect bonding methods.

MATERIALS & METHODS

In this study, total of 40 maxillary and mandibular 1st premolars extracted from orthodontic purposes were taken. Specimens were randomly allocated in two groups - direct technique group (N=20) and indirect technique group (N=20). In the direct technique group, buccal surfaces of teeth crowns were cleaned using polishing rubber cones mounted on low-speed drill without abrasive paste usage, followed by rinsing and drying with oil-free air. In the indirect technique group, alginate impressions of each tooth in acrylic block were taken and outpoured in hard dental stone. Tooth specimens with brackets from both bonding technique groups were kept for 72 h in distilled water at a temperature of 37°C. Shear bond testing was performed. SPSS software was used for analysis.

RESULTS

Indirectly bonded specimens showed higher mean shear bond strength (7.33 MPa) than directly bonded specimens (7.96 MPa), but the difference was not statistically significant. The results regarding the shear bond strength are depicted below. The comparison of resin remnants between the direct and indirect groups suggests no significant difference in ARI index scores.

Table1: Shear bond strength values of brackets bonded with direct and indirect technique

Technique	Number	Min.	Max.	M	SD	Me
Direct	20	3.39	10.26	7.33	1.42	0.21
Indirect	20	4.82	11.21	7.96	1.50	0.24

Table2: Adhesive Remnant Index (ARI) scores by technique

Technique	Number	Min.	Max.	M	SD	Me
Direct	20	0	3	1,3	0.8	0,1
Indirect	20	1	3	1,4	0.7	0,1

DISCUSSION

Indirect bracket bonding technique is still not used by a large number of orthodontists. One of the reasons could be fear that it does not provide sufficient shear bond strength of bracket with the tooth. Voids can be found in composite base in two-thirds of indirectly bonded brackets, which can cause up to 50% lower share bond strength of indirectly bonded brackets. [11]

Another study was to compare the shear bond strength of orthodontic brackets bonded to teeth with either an indirect bonding technique and a new adhesive resin or a direct bonding technique and a light-activated adhesive. Fifty-four extracted premolars were mounted in acrylic blocks and randomly divided into 2 groups (n 27). In one group, orthodontic brackets were bonded to premolars with an indirect bonding adhesive system; in the other, brackets were bonded with the direct method. Seventy-two hours later, the brackets were placed in a testing machine and subjected to a shear force with a crosshead speed of 1 mm/minute. The mean shear bond strengths for the indirect and direct groups were 11.2 and 10.9 MPa, respectively, both exceeding the minimum shear bond strength range of 5.9 to 7.8 MPa often cited in the literature for clinical success. [12] In this study indirectly bonded specimens showed higher mean shear bond strength (7.33 MPa) than directly bonded specimens (7.96 MPa), but the difference was not statistically significant. The results regarding the shear bond strength are depicted below.

Average values obtained in another study for the indirect technique using Sondhi Rapid-Set and Transbond XT (7.82 MPa) and the direct technique using Transbond XT (7.48 MPa) are clinically appropriate in terms of power relationships in accordance with generally accepted standards. [13] The results of this study coincide with the findings of other studies but the presented values are much lower. Another study shows the results using the APC brackets in vitro for the indirect technique reported 11.2 MPa and for direct technique of 10.9 MPa, 13.8 and 16.3 MPa, and other one found 15.0 and 13.9 MPa, respectively. [14,15,16] In our study, further the comparison of resin remnants between the direct and indirect groups suggests no significant difference in ARI index scores.

CONCLUSION

Shear bond strength comparison between direct and indirect-bonded attachments showed no significant difference between the two groups.

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