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EFFECT OF REPEATED BONDING ON THE SHEAR BOND STRENGTH OF SMARTBOND CYANOACRYLATE ORTHODONTIC ADHESIVE

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ABSTRACT

Background and Aim: For many years, cyanoacrylate adhesive substance has been rendered as the superglue material in the domains of dentistry and medicine. Due to its moisture insensitivity, the adhesive substance can be used as an orthodontic bonding agent in circumstances where isolation is problematic. The present investigation assessed the repeated bonding effect on the shear bond strength (SBS) of smart bond cyanoacrylate orthodontic adhesive.

Materials and Methods: This study was carried out on 30 test specimens of orthodontic adhesive in the Orthodontics and Dento-facial Orthopedics Department of a Tertiary Care Hospital of Lahore, Pakistan. Inclusion criteria of the study were the presence of an intact labial enamel surface and those specimens which were appropriately kept following tooth extraction. Extractions were made of the permanent mandibular premolars and the Smart bond was used for repeated bonding (2-repetitions) of each specimen. The SBS of each specimen was calculated using universal testing machine (UTM).

Results: Mean shear bond strength after first bonding, first re-bonding, and second re-bonding was 6.11 ± 2.28 MPa, 4.21 ± 2.35 MPa and 4.22 ±1.52 MPa respectively.

Conclusion: In general, after de-bonding and re-bonding treatments, the SBS seen after the first and second debonding-rebonding procedures is insufficient for most orthodontic demands. In this regard, the Smart Bond cyanoacrylate adhesive solution provides excellent Shear Bond Strength during first bonding, making it a suitable choice for orthodontic bracket's direct bonding.

Keywords: Cyanoacrylate orthodontic adhesive, De-bonding, Re-bonding, Shear bond strength, Universal testing machine.

INTRODUCTION

Since 1955, the notion of attaching enamel of the tooth to various resins has grown in popularity. Buonocore pioneered acid etch bonding in various aspects of dentistry, including orthodontic bracket bonding [1, 2, 3]. Reduced soft-tissue irritation and less danger of decalcification, improved patient's aesthetic appearance, less incidence of hyperplastic gingivitis, improvement in plaque removal, separation elimination, better caries treatment and detection and less prevalence of post-treatment spaces were numerous advantages of this technique [4]. Kumari et al discovered no significant variations in re-bond strength and initial SBS after reconditioning the enamel surface [5]. Hatipoglu et al reported that absence of tooth surface's bracket reconditioning resulted in the maximum SBS [6]. Mazin et al, on the other hand, discovered that bond recycling and re-bonded orthodontic attachments reduced both SBS and TBS (tensile bond strength) [7].

Despite significant progress in using direct bonding to improve treatment effectiveness, bond failures remain a problem in the orthodontic clinical practice [8]. Composite resins also offer a number of disadvantages such as moisture sensitivity, possible allergic reactions and a flavor/taste issues [9-11]. Cyanoacrylate glues are commonly utilized in dentistry and medicine [12]. A lot of studies have demonstrated that long-term usage of cyanoacrylates within the human body has got no negative effects [13, 14]. As bonding agents, cyanoacrylates in the form of commercial "super glue" have been tested. Scribante et al performed an in vitro test of a cyanoacrylate bonding agent and reported that its effectiveness degraded when stored in saline, making the material unsuitable for clinical usage [15]. The present investigation assessed the repeated bonding effect on the shear bond strength (SBS) of smart bond cyanoacrylate orthodontic adhesive.

METHODOLOGY

This study was carried out on 30 test specimens of orthodontic adhesive in the Orthodontics and Dento-facial Orthopedics Department of a Tertiary Care Hospital of Lahore, Pakistan. Inclusion criteria of the study were the presence of an intact labial enamel surface and those specimens which were appropriately kept following tooth extraction. Extractions were made of the permanent mandibular premolars and the Smart bond was used for repeated bonding (2-repetitions) of each specimen. The SBS of each specimen was calculated using universal testing machine (UTM). The following was set as the exclusion criteria for the specimens: presence of dental caries, dental restorations, enamel flaws such as surface cracking following tooth extraction and an inappropriately stored specimen. To determine their appropriateness for inclusion, all teeth were inspected under regular surgical light setting. Fluoride-free pumice slurry was used for polishing the premolar teeth's enamel surfaces for 10 seconds using a rubber cup. The Universal Testing Machine was tested with a load cell (2 KN) and 0.5mm/min cross-head speed. All apparent leftover bonding was removed with a finishing tungsten carbide bur after each de-bonding.

RESULTS

Mean shear bond strength after first bonding, first re-bonding, and second re-bonding was 6.11 ± 2.28 MPa, 4.21 ± 2.35 MPa, and 4.22 ±1.52 MPa respectively. Table-I presents the SBS statistical analysis of readings taken on the brackets that have been bonded and re-bonded with the Smart bond. When the differences between de-bonding sequences were examined, the results revealed that both adhesives had a considerable drop in SBS between the first and second bonding/debonding processes. There were no significant differences in shear bond strengths between bonding/debonding sequences 2 and 3. Table-II represents the measurement of SBS in terms of mean, standard deviation, range, and *p*-value in Group-I, II, and III.

Table-I: **SBS statistical analysis of readings taken on the brackets that have been bonded and re-bonded with the Smart bond.**

Groups	SBS values (Mean ± SD) MPa	*p*-value
Group-I (SBS)	6.11 ± 2.28	0.002
Group-II (SBS repetition I)	4.21 ± 2.35	0.001
Group-III (SBS repetition II)	4.22 ±1.52	0.894

Table-II: Measurement of SBS in terms of mean, standard deviation, range, and *p*-value in Group-I, II, and III.

Groups	Sample (n)	SBS values (Mean ± SD) MPa	Range	*p*-value
Group-I (SBS)	30	6.11 ± 2.28	7.92	0.002
Group-II (SBS repetition I)	30	4.21 ± 2.35	12.59	0.001
Group-I (SBS)	30	6.11 ± 2.28	7.92	0.002
Group-III (SBS repetition II)	30	4.22 ±1.52	5.49	0.894
Group-II (SBS repetition I)	30	4.21 ± 2.35	12.59	0.001
Group-III (SBS repetition II)	30	4.22 ±1.52	5.49	0.894

DISCUSSION

Orthodontic treatment causing bond failure is a common clinical encounter and is an unpleasant event. The entire duration of treatment might increase due to inconvenience in preparing, cleaning, and new bracket bonding in a busy clinical practice. As a result, the literature presents contradictory conclusions concerning the re-bonded attachments' SBS in cases where re-bonding of teeth is done more than once [17, 18]. According to the current data, SBS is reduced by 33% with Transbond and 61% with Smart Bond adhesives respectively during the second bonding/debonding process. The SBS of both adhesives were virtually maintained between debonding procedures 2 and 3. The debonding/rebonding sequences were performed in <30 minutes to imitate the clinical situation in which a loose bracket of patient has to be substituted while re-attaching the arch-wire as well [19].

Scanning Electron Microscopy (SEM) examination of the enamel surface has revealed that the higher SBS achieved during the first debonding phase was due to the original etched enamel surface providing a considerable level of mechanical retention. The enamel surface underneath the bracket had maintained the traces of the cyanoacrylate bond and the composite adhesive during the two consecutive bonding/debonding procedures. Though the finishing bur for enamel surface cleaning recuperated its sheen, the residual glue was still seen as depicted by the SEM. Furthermore, the etched enamel surface in the form of white chalky areas was exhibited during the first bonding phase of the rebonding procedure. Likewise, enamel surface residual adhesive following carbide bur cleaning clarifies the resemblance or comparable results of SBS during second and third bonding/debonding procedures [20].

In our study, the SBS of each sample of 30 metallic brackets bonded with Smart Bond was 6.11 MPa. Sokucu et al reported similar statistics of SBS during their investigations as well [21]. Al Jabbari et al also got such similar results, observing a similar SBS value for bonding/re-bonding using Smart bond adhesive [22].

CONCLUSION

In general, after de-bonding and re-bonding treatments, the SBS seen after the first and second debonding-rebonding procedures is insufficient for most orthodontic demands. In this regard, the Smart Bond cyanoacrylate adhesive solution provides excellent Shear Bond Strength during first bonding, making it a suitable choice for orthodontic bracket's direct bonding.

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