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ORIGINAL ARTICLE

Bond Strength of Resin Composite Posts Placed in Primary Teeth: A Comparison of Adhesive Systems

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ABSTRACT
Objective: In this study, researchers used two different adhesives to determine which ones had the strongest push-out connection between resin composite posts and primary teeth's intracanal dentin.
Methods: Fifty primary lateral incisors were split into two groups (n = 25) and treated with either Adper Single Bond 2 (ASB group) or Clearfil SE Bond 2 (CSE). Resin composite was used to fill the canal in the root's coronal one-third. A universal testing equipment was used to conduct the push-out evaluation. The data was analyzed using t-test.
Results: Strengths of push-out bonds were found to be significantly different amongst the two groups using t-test (p=0.000). The mean±S.D push-out bond strength of the samples in ASB group was 8.41±4.83 Mpa, while mean±S.D push-out bond strength of the samples in CSE group was 14.21±4.03 Mpa. Most failures were adhesive, and there was no difference (p=0.327) in the fracture mode distribution between bonding agents.
Conclusion: In terms of push-out bond strength, CSE group was clearly superior to ASB group. When placing resin composite posts in primary anterior teeth, it is advised to utilize a universal adhesive system and self-etch adhesives from the sixth generation. Due to their simplicity of use, reduced technical sensitivity, and reduced number of required clinical processes, bonding agents may be a desirable choice for repairing primary teeth with short resin composite posts.
Keywords: Adhesive system, bond strength, primary teeth, resin composite

INTRODUCTION
Due to its destructive effects on the teeth's coronal structure, caries in young children is a leading cause of premature loss of front teeth (1). For severely decaying primary front teeth, extraction was the sole option prior to the development of bonding agents (2). Thanks to recent developments in restorative materials, most of these teeth are now salvageable. Restoration of primary anterior teeth (3) may be accomplished using a variety of methods, including the use of resin-modified glass ionomer, resin composites, zirconia, and celluloid crowns. The dentist has to weigh the benefits and drawbacks of each material before deciding which is ideal for each patient's unique set of teeth (4). Due to its long lifespan, great aesthetic quality, excellent adherence to the tooth structure, and simple application, resin composites are often used to restore primary teeth (3). When primary teeth sustain extensive carious lesions, the pulp is commonly affected since the crowns are so small and the teeth are still developing. Due to the little amount of healthy tooth structure left, these teeth are notoriously difficult to repair (5). Both etch-and-rinse and self-etch systems are examples of bonding agents you can buy right now. From three steps in the fourth generation of bonding agents to one step in the seventh and eighth generations (3). One-step self-etch adhesives may be helpful for kids, particularly young ones who are difficult to treat because of their easy clinical application, quicker application, and reduced technical sensitivity. These adhesive solutions have historically only been applied in total-etch, selective-etch, or self-etch modes (3, 6). However, recent generations of these adhesives allow for all three. Dentinal tubule density and size are both larger in primary teeth. Furthermore, compared to primary teeth, the bonding surface area of primary teeth is much less. All of these considerations have led some to question whether or not primary tooth restorations are as strong or as long-lasting as those in primary teeth(7). Intracanal retention is required for the endurance of resin composite restorations in badly deteriorated incisors when pulpectomy is performed due to the limits of bond strength in primary teeth. Prefabricated posts, orthodontic wire cast posts with macro-retentive materials, reverse metallic posts, resin composite posts, fibre posts, and biologic posts are only some of the options for posts in pediatric dentistry (8). Most typically utilized are resin composite posts (9). There isn't many research that have looked at the binding strength of adhesive systems in primary teeth using the push-out test (1). In this investigation, the binding strength of several adhesives was measured using the push-out test. This study aimed to evaluate the push-out bond strength of resin composite posts to the intracanal dentin in primary teeth using different adhesive systems, as there have been few studies evaluating the efficacy of novel one-step adhesive systems for bonding intracanal resin composite posts in primary teeth.

METHODOLOGY
After the ethical approval from institute review board, this cross sectional study was conducted at Rawalpindi hospital from September 2022 to November 2022. 50 Primary lateral incisors from the maxilla were analyzed, all of which had somewhat uniform root canal widths. The parents decided against having the teeth repaired, so they had them extracted. Physiological root resorption was less than a quarter of the total root length. Furthermore, there were no cracks, chips, or carious lesions on the root surface. After the gum tissue was cleaned off the removed teeth, they were kept in a 0.5% chloramine T solution for a week. As a precaution against drying out, the teeth were kept in distilled water throughout the duration of the research. The dental crowns were cut using a diamond disc and water coolant 1 mm above the cementoenamel junction. Using the step-back method, the root canals were instrumented with K-files ranging in size from 15 to 45. When finished with a root canal filing, saline solution was used to flush out the canal. Calcium hydroxide paste containing iodoform was put into the canals after that #45 paper points were used to dry the root canals. A small spoon excavator was used to scrape calcium hydroxide-iodoform paste from the orifice down to the 4 mm depth of the root canal, and then 1 mm of self-cured glass-ionomer cement was placed in the prepared post area. A small spoon excavator was used to chip away at the cement lining the post space's walls. After the teeth and intracanal space were prepared, they were randomly divided into two groups (n = 25) according to the bonding agent used: Adper Single Bond 2 and Clearfil SE Bond 2. Root canal was irrigated and dried for 10 seconds after a 15-second conditioning with 37% phosphoric acid was applied to the dentin surface. A micro-brush was used to spread the ASB adhesive over the dentin. The glue was then light-cured for 20 seconds after being exposed to a mild air stream for 5 seconds to

evaporate the solvent. Root canal surface primer was applied, allowed to sit for 20 seconds, and then dispersed using a soft air stream for 5 seconds. A micro-brush was then used to spread the adhesive across the surface. Twenty seconds of light curing time was given to the primer and bonding agent. The dentin surface was conditioned for 10 seconds before to GP bonding, and then the adhesive was applied, thinned with air for 5 seconds, and cured in the sun for 20 seconds. The dentin surface was coated with GP bonding agent, then dried under mild air flow for 5 seconds before being exposed to light for 20 seconds. Each group's root canals were prepared and bonding chemicals were administered before resin composite was placed in increments of no more than 2 mm in thickness to make resin composite posts. In addition, an LED light-curing equipment with an 800 mW/cm^2 light intensity was used to cure each layer individually for 40 seconds. Z250 resin composite, 2 mm in thickness, was used to fill and seal the root canal apex. The samples were placed in clear acrylic blocks at right angles to the tooth's longitudinal axis. Next, a CNC cutting machine was used to segment 1 0.05 mm thick slices from the root's mid-coronal region. A universal testing equipment was used to conduct the push-out evaluation. Using a 5 KN load cell applied to the post's centre, we applied a force to the specimens at a crosshead speed of 0.5 mm/min in the apicocoronal direction via the column-shaped tip. The instrument's metal point had a diameter of 1 mm. All debonding forces were measured in Newtons to determine the strongest force that could break each specimen (N). The formula for the bond strength in megapascals (MPa) is as follows: bond strength (MPa) = force (N)/cross- (mm2). All specimens were imaged using a stereomicroscope to determine their cross-sectional area before the bond strength test was carried out. Using pictures of each specimen and Motic Image Plus 3.0 software, we determined the root canal's apical and coronal surface areas and the bonding surface's cross-sectional area as follows:

Cross-sectional area (mm2) = 0.5 [coronal surface area (mm) + apical surface area (mm)] height.

Failure mechanisms of the specimens were evaluated using a stereomicroscope at 32 magnifications after the bond strength test. It was determined that cohesive, adhesive, and mixed failure mechanisms existed. SPSS version 26 was used to analyze the bond strength of different bonding agent.

RESULTS

The push-out bond strength (in MPa) of the samples in the two groups is shown in Table 1. Strengths of push-out bonds were found to be significantly different amongst the two groups using t-test (p=0.000). The mean±S.D push-out bond strength of the samples in ASB group was 8.41±4.83 Mpa, while mean±S.D push-out bond strength of the samples in CS group was 14.21±4.03 Mpa. Failure modes are shown as a percentage in Table 2. Most failures were adhesive, and there was no difference (p=0.327) in the fracture mode distribution between bonding agents. In ASB group, 64% were adhesive, followed by Mix (24%) and cohesive fracture (12%). In ASB group, 52% were adhesive, followed by Mix (40%) and cohesive fracture (8%).

Table 1: The average push-out bond strengths of the two types of adhesives to intracanal dentin of primary lateral incisors.

	ASB group	CS group	P Value
N	25	25	0.000****
Mean	8.41	14.21	
S. D	4.83	4.03	
Minimum	1.3	3.5	
Maximum	17	19	

Table 2: Bond failure patterns of two adhesive systems to the intracanal dentin of primary lateral incisors, expressed as a frequency percentage.

		Type of bonding		P value
		ASB group	CS group	
Type of fracture	Cohesive	3 (12%)	2 (8%)	0.327
	Mix	6 (24%)	10 (40%)	
	Adhesive	16 (64%)	13 (52%)	

DISCUSSION

The adhesive system's capacity to produce an effective resin composite-dentin bond is crucial to the clinical durability of resin composite restorations (10). Shear, micro-tensile, pull-out, and push-out tests are only few of the ways that the binding strength of intracanal resin composite posts to intracanal dentin may be determined. The push-out test (1) simulates more closely the conditions seen in the clinic by applying a shear stress to the contact between the resin composite and the adhesive, as well as the adhesive and the dentin. While adhesive agents are often used in juvenile dentistry, there is a lack of knowledge on how adhesive systems work, particularly the innovative systems in primary teeth (6). Furthermore, much of the known research on adhesive systems has been done on primary teeth, and the outcomes have been mixed (11). The morphological and structural distinctions between primary teeth and adult teeth account for these discrepancies (12). Primary teeth have a larger density and wider diameter of dentinal tubules than primary teeth, which makes them more permeable to acid and more prone to demineralization (13). This is because primary teeth have a lower concentration of calcium and phosphorus in peritubular and intertubular dentin. Therefore, it is suggested that 15 second etchings with a gentler acid be used on primary teeth (1). The current investigation found that the binding strength was considerably lower in the ASB group compared to the CS groups. Consistent with the current investigation, Memarpour et al. (14) found that the binding strength of ASB to the coronal structure of primary teeth was much lower than that of Scotchbond Universal (in both self-etch and etch-and-rinse modes). Afshar et al. (10) found that the bond strength of ASB was on par with that of CSE and Single Bond Universal. Bond strength of ASB was found to be comparable to that of Futurabond M, a one-step self-etch method, as reported by Kara et al. In contrast to the current investigation, Lenzi et al. (15) found that the bond strengths of CSE and ASB were quite comparable. The variations in adhesives (1, 10), tests (15), and dentin substrate (coronal dentin) (16) all contribute to this variance in the findings. A common error in the application of the 5th generation of adhesives causes the collapse of collagen fibrils during dentin drying in the etch-and-rinse protocol, which can prevent adequate penetration of resin monomers and subsequently decrease the bond strength of ASB adhesive compared to self-etch adhesives. But self-etch systems are less sensitive to technological details in this regard (16). Bond strength may be affected by a number of variables, such as solvent type, pH, and adhesive filler concentration (10); this is supported by research. On the other hand, Kramer et al. [10] found that pH did not have a significant role on the efficiency of adhesive systems. The self-etch adhesive systems used in this investigation are intermediate in acidity, meaning they have a greater pH than the etch-and-rinse systems. However, clinical trials are necessary to corroborate the findings of in vitro investigations, since the former can only be applied to laboratory circumstances. This in vitro investigation also had limitations since it did not age specimens or assess the adhesive’s efficacy over a lengthy period of time. Therefore, further research is needed to resolve these gaps.

CONCLUSION

As this research shows, primary anterior teeth may have resin composite posts bonded to intracanal dentin using universal bonding techniques (self-etch and etch-and-rinse modes). Primary teeth may benefit from the use of bonding agents because to their reduced technical and clinical complexity and their simplicity of application.

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