



EFFECT OF SODIUM ASCORBATE AND BAMBOO SALT ON THE PUSH OUT BOND STRENGTH OF FIBER POST CEMENTED TO RADICULAR DENTIN USING SELF ADHESIVE CEMENT

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Abstract:

Aim: The aim of this study is to evaluate the effect of natural antioxidants, sodium Ascorbate and Bamboo Salt on push out Bond strength of Fiber post cemented to root dentin using self Adhesive resin cement.

Materials and Method: Forty-two single rooted extracted human teeth were selected and decoronated at the level of cemento-enamel junction to a standardized length of 14mm. Post space preparation done. The teeth were randomly divided into three groups. Group 1: Saline, Group 2: Sodium Ascorbate, Group 3: Bamboo Salt. All three groups were restored with Fiber post bonded using self Adhesive resin cement. Teeth were mounted on acrylic block and 1mm slices were obtained from coronal third and middle third. These sections were then subjected to Push out Bond strength testing using Universal Testing Machine. Failure patterns were assessed under Stereomicroscope at 20x magnification.

Result: Statistical analysis was done using Kuruskal-Wallis test and Post Hoc Tukey test. Group 3(Bamboo Salt) showed highest Push out Bond strength followed by Sodium Ascorbate.

Conclusion: Within limitations of this study, it can be concluded that both the natural antioxidants, Sodium Ascorbate and Bamboo Salt were able to reverse the compromised bond strength caused by NaOCl. The Push out Bond strength with Bamboo Salt was significantly higher than Sodium Ascorbate.

Index Terms - Natural antioxidants, Sodium Ascorbate, Bamboo Salt, Fiber post, Push out Bond strength

Introduction

Teeth that require endodontic therapy often presents with extensive tooth structure loss due to caries, previous restorative procedures and fractures, root canal procedure further weakens the tooth. A fiber post is used to reinforce the tooth, fiber post is preferred as it has same modulus of elasticity as that of dentin and has even stress distribution.

Among the factors that have the deleterious effect on this bond is presence of smear layer. NaOCl is widely used as irrigant to remove smear layer in post space. But NaOCl itself has negative influence on the bond strength due to its remnants and by products namely hypochlorous acid and hypochlorite ion which interferes with polymerization of methacrylate resin of self adhesive cement. Studies have shown that pretreatment of root canal dentin with antioxidants reverses the adverse effects of NaOCl on the bond strength.

Several studies reported that sodium ascorbate and vitamin c increased the bond strength of teeth irrigated with NaOCl.

Bamboo salt (BS) is a natural product with antimicrobial, antioxidant, and anti-inflammatory properties. It is obtained by packing and repeatedly roasting sun-dried salt, in bamboo trunks sealed by yellow soil, using pinewood and pine resin as fuel. It also contains a wide array of macro- and micro-nutrients (Fe, Sr, Cu, V, and Mn) and trace elements. It is composed of 29.3% Na, 1.4% K, 0.4% S, 0.1% Ca, and 0.08% Mg as macronutrients. It finds therapeutic application in the prevention and treatment of various diseases such as inflammation, allergies, gastritis, circulatory disorders, and cancers; whether it is capable of reversing NaOCl-induced reduction of bond strength between root dentin and fiber post postulated using self adhesive cement is not yet known. Hence, the aim of this in vitro study was to determine the effectiveness of 25% Bamboo Salt in comparison with 10% sodium ascorbate, on the push-out bond strength (PBS) of fiber post bonded to root dentin using self adhesive resin cement.

Materials and method:

42 single rooted premolars extracted for orthodontic reasons are collected and stored in distilled water until use. Teeth are decoronated at cemento-enamel junction to a standardized length of 14mm using diamond disk under water spray. Pulp tissue was removed using no.10k and no.15k files (mani.inc.japan). cleaning and shaping done with protaper gold rotary files till 30 6% using x-mart endomotor at slow speed of 350 rpm at 2.2N cm torque. Peeso reamers (Mani. Inc., Japan) sizes 1, 2, and 3 were used to prepare the post space of 10 mm length the canals were irrigated during post space preparation followed by final irrigation using 5 ml of 3% sodium hypochlorite (Vensons India), 17% EDTA solution (pulp dent EDTA solution, pulp dent corporation), and 0.9% normal saline

Preparation of 10% sodium ascorbate solution

About 10g of ascorbic acid in the powder form is mixed with 100ml of distilled water to obtain 10% sodium ascorbate

Preparation of 25% Bamboo salt

25g of Bamboo salt mixed with 100ml of distilled water to get 25% bamboo salt.

Group 1: The prepared post space is rinsed with only saline

Group 2: The post space is treated with 10% sodium ascorbate solution using 27-gauge open-ended needle.

Group 3: In this group, the custom prepared 25% Bamboo salt was applied to the canal with the help of 27-gauge open-ended needle. Subsequently the fiber post was covered with self adhesive resin cement (Rely x u200) and directly placed in the post space it is kept under light finger pressure and excess cement is removed followed by curing using LED light curing unit for 40s.

The specimen was stored in distilled water for about one week.

Each root was mounted on acrylic block customized for the rotary microtome (Physilab, Germany) and then cut horizontally into 1 mm sections under wet condition. Sections were obtained from cervical third and middle thirds of the root. Each section was marked on its coronal side with an indelible marker.

push-out bond strength test was performed with a universal testing machine (Multitest-i, Mecmesin, England). A load was applied in apicocoronal direction to the post surface that resulted in shear stresses along the luted interfaces. The diameter of the plunger was 1 mm to ensure that it contacted only the post during loading. Loading was performed at a crosshead speed of 1 mm/min until failure. The load needed to dislodge the posts was recorded in Newton (N). To express the bond strength in Mega Pascal's (MPa), the load at failure recorded in Newton's (N) was divided by the area (mm²) of the post/ dentin interface. The failure patterns were assessed under *20 magnification and scores were given.



Teeth samples



Sample preparation



Universal testing machine



Stereomicroscope



SEM Image

Data and statistical analysis

The data were entered into excel sheet and analyzed using IBM SPSS version 25. Differences in bond strength values at middle and cervical third of each group was tested using paired t-test and those between the three groups was tested using ANOVA followed by tukey's post hoc test. A p value $p < 0.05$ was considered significant for all results

Results

Mean and standard deviation of Push out bond strength of all groups at all levels is given in table 1

Table 1

Group	Level of the Root	
	Coronal third	Middle third
Group 1 (Saline)	8.93±0.69	7.98±0.37
Group 2 (Sodium ascorbate)	11.79±0.95	10.18±0.87
Group 3(Bamboo salt)	13.93±0.80	12.82±0.64

Push out bond strength of group 1 (saline) was least and group 3(Bamboo salt) showed highest bond strength. Intra group comparison showed bond strength is higher at coronal third than middle third

Discussion

Mutilated teeth treated endodontically are further weakened by the endodontic procedure aimed at getting optimal access. Rebuilding such teeth often requires use of intra canal posts and core for the retention of crown. Fiber post are preferred over metal post because of its modulus of elasticity near to that of dentin which results in even distribution of stresses thereby minimizing chances of fracture.

The durability of bond between resin and root dentin is very important for the long-term success of the adhesive restoration.

The smear layer produced during cleaning and shaping of root canals and also during post space preparation hinders the penetration of adhesive resin cement in to dentinal tubules thus affecting bond strength.

Irrigation of post space with Naocl and EDTA is recommended for the removal of this smear layer. However, Naocl is reported to form nascent oxygen which affects the bond strength of self adhesive resin.

Also, Naocl breakdown into chloramines and other intermediates and Daumer et al observed these by products have adverse effect on pyridinoline cross links present in type 1 collagen. Thus, Naocl irrigation results in structurally compromised collagen in root dentin.

The structural integrity of collagen is essential for the bond strength and its durability.

Studies have shown that pretreatment of post space with antioxidants reverses this deleterious effect of Naocl and restores the bond strength.

In this study sodium ascorbate and bamboo salt were used to rinse the post space prior to placement of the fiber posts.

It was found that group 2(sodium ascorbate) and group 3(Bamboo salt) showed higher bond strength compared to group 1 (saline). Sodium ascorbate is found to reverse the compromising effect of Naocl on bond strength by restoring the altered redox potential of the oxidized bonding substrate and allow free radical polymerization of the adhesive to proceed without premature termination.

It also helps in the synthesis of hydroxyproline and hydroxylysine in collagen. Intermolecular collagen crosslinks are formed and collagen triple helix gets stabilized by hydroxylysine and Hydroxyproline respectively

Bamboo Salt was also effective in reinstating the reduced bond strength of self adhesive resin. This could be attributed to the antioxidant potential of BS. Om and Jeong studied superoxide dismutase activity of BS and inferred that BS was a potent antioxidant and it inhibited ROS formation. The efficacy of BS was 3.3–7.1 times higher than Vitamin E, a known antioxidant. Zhao et al. (2012) observed that 25% BS exhibited superior radical scavenging ability (81.4%) than solar salt (5%) and purified salt (2%). BS has a pH of 11.4. The abundance of available – OH groups and the alkaline pH of BS contribute to its higher reduction potential. The high concentrations of minerals such as iron, silicon, potassium, calcium, magnesium, and manganese present in BS also confer it with antioxidant properties. These could be the reasons behind the improved bond strength seen in BS-treated specimens.

In this study a significant difference was found in push out bond strength in coronal and middle 3rd of both the groups. This can be due to the fact that visibility is less in deeper areas of the post space and hence less predictable cleaning, and occlusion of debris in dentinal tubules.

Fracture analysis showed mixed pattern of failure in all three groups.

Future studies are also required to assess microtensile bond strength in root canal dentin after modifying the concentration and application time.

Conclusion

Within the limitations of this study, it can be concluded that pretreatment of post space with antioxidants prior to cementation of fiber post significantly increases the bond strength.

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