Evaluation of bond strength of post and luting agent using different techniques for surface treatment

Nupur Singh¹, Akriti Goel², Divya Bharti³

¹Nupur Singh, Senior Resident, Department of Conservative Dentistry & Endodontics, KGMU, Lucknow
²Akriti Goel, Senior Resident, Department of Conservative Dentistry & Endodontics, KGMU, Lucknow
³Divya Bharti, Junior Resident, Department of Conservative Dentistry & Endodontics, KGMU, Lucknow

Corresponding author: Akriti Goel, akriti.dentist@gmail.com

Abstract- Introduction-Various methods of restoring pulpless teeth have been reported for more than 200 years. Pierre Fouchard in 1728 was first to describe the use of artificial crowns and posts. At that time post were fabricated with gold or silver, and held in the root canal space with a heat softened adhesive called “Mastic”. The artificial crowns used at that time were either made up of natural crowns or crowns made of Ivory.

Material and method-30 cylindrical acrylic resin blocks were made by acrylic resin. The post were embedded perpendicularly in the acrylic block so that post was above the resin block. Specimens were divided into 3 groups with three different surface treatment.

Result- the mean shear stress of samples with different surface treatment was calculated and the data were analyzed initially by using a one–way analysis of variance (ANOVA), and the subsequent multiple comparisons between the different surface treatment groups were performed using Tukey HSD test.

Conclusion: Within the limitation of this In-vitro study, it was concluded that surface treatment with airborne particle abrasion and silanization with two component system resulted in significantly higher bond strength than other methods of surface treatment.

Keywords- post and core, surface treatment, composite resin

INTRODUCTION

Endodontically treated teeth with an extensive loss of coronal structure can be restored using post in order to retain the core in teeth as the endodontically treated teeth are more prone to fracture due to the premature loss of moisture supplied by a vital pulp. The clinical success of a post & core restoration depends on the quality of the post/core interface, where materials of different compositions are in intimate contact¹. Endodontically treated
teeth with defective coronal aspects very often need to be restored with a post and core as foundation for the final restoration. The requirements for an ideal post and core system should consider physical properties such as modulus of elasticity, compressive strength, and coefficient of thermal expansion that are close to that of dentin. Additionally, posts should demonstrate high retention, good biocompatibility, esthetics and retrievability.

Laboratory based studies have shown that fibre reinforced composite (FRC) posts have a high tensile strength and modulus of elasticity similar to dentin. Carbon fibre post are black in color and do not lend themselves to esthetic restoration with all-ceramic units. This led to introduction of silica-fiber posts which are translucent and more tooth coloured. These posts are also called as glass- fiber and quartz- fiber posts. The glass fiber posts that are used after endodontic treatment have additional advantages, like biocompatibility, mechanical strength, resistance to corrosion, improvement of light transmission, and the optical effects of esthetic restorations.

In clinical practice fiber post have been widely advocated. Post along with strengthening the weakened tooth structure, also helps in distributing torquing forces which are produced within the radicular dentin to supporting tissue along their roots. Elastic modulus of fiber reinforced posts is similar to that of dentin which can provide homogeneous post or dentin structure needed for optimal distribution. Failure of restoration using fibre reinforced posts occurs due to dislodgement of the post most frequently at the post adhesive junction. Post surface treatment increases the adhesion between the fibre-reinforced posts and core material. Mechanical and chemical treatments of the post surfaces have shown to influence the bond strength between the core material and the fiber reinforced posts.

**Materials and Methods:**

30 cylindrical acrylic resin blocks (diameter 12mm, height 12 mm) were made by
incremental pouring of the autopolymerizing acrylic resin. The post were embedded perpendicularly in the acrylic block so that 5 mm of post was above the resin block. Specimens were divided into 3 groups (n=10 per group) as follows:

**Group A:** surfaces were sandblasted with 50µm Aluminium oxide for 5 seconds

**Group B:** surfaces were sandblasted using 50µm Aluminium oxide for 5 seconds followed by the application of Monobond N (Ivoclar Vivadent AG, Schaan, Liechtenstein) single component silane coupling agent

**Group C:** surface were sandblasted using 50µm Aluminium oxide and applied with Monobond N followed by the application of Porcelain Liner M (Sun Medical CO.LTD, Moriyama, Japan) two component silane coupling agent.

A metal hexagon was placed onto the exposed post surface after cementing it with dual cure polymerizing resin cement Multilink (Ivoclar Vivadent AG, Schaan, Liechtenstein) to completely fill the metal hexagon nut. All the prepared specimens from each group were mounted in a universal testing machine and compressive load were applied at a cross head speed of 1mm/min until the metal ring gets detached from the posts.

**Result**

The data were analyzed initially by using a one–way analysis of variance (ANOVA), and the subsequent multiple comparisons between the different surface treatment groups were performed using Tukey HSD test.
Graph 1- Max Load [N/mm² / MPa] by different methods

One-way ANOVA for intergroup comparison between Max Load [N/mm² / MPa] by different methods

<table>
<thead>
<tr>
<th>source</th>
<th>sum of squares SS</th>
<th>degrees of freedom df</th>
<th>mean square MS</th>
<th>F statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>treatment</td>
<td>3,569.7754</td>
<td>2</td>
<td>1,784.8877</td>
<td>89.4622</td>
<td>1.2256-12*</td>
</tr>
<tr>
<td>error</td>
<td>538.6855</td>
<td>27</td>
<td>19.9513</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>4,108.4609</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p-value<0.05 is significant.

POST HOC Tukey HSD results

<table>
<thead>
<tr>
<th>treatments pair</th>
<th>Tukey Q statistic</th>
<th>HSD p-value</th>
<th>HSD inference</th>
<th>HSD p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 vs 2</td>
<td>4.2591</td>
<td>0.0149150</td>
<td>* p&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>1 vs 3</td>
<td>18.0914</td>
<td>0.0010053</td>
<td>** p&lt;0.01</td>
<td></td>
</tr>
<tr>
<td>2 vs 3</td>
<td>13.8323</td>
<td>0.0010053</td>
<td>** p&lt;0.01</td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

Surface treatment with different surface conditioning techniques is a common method for improving adhesion between posts and composite resin cores¹. For surface pretreatment
of fiber posts, both chemical and micromechanical treatment protocols have been applied\textsuperscript{8}. Pre-etching of the post surface, is frequently preferred as a chemical post surface pretreatment. The most common micromechanical post-surface pretreatment is sandblasting, which is intended to remove the top layer of resin and render the glass fibers suitable for chemical interaction. The surface treatments produce a roughened surface of the post and enable better interaction with composite resin core. Silane enhances post-resin bond strength by promoting the wetting of the etched post surface and facilitating the diffusion of the fluid composite resin into the retentive spaces among the exposed fibers. When silane is applied on the post surface and dried, two phases are created: an outermost physisorbed layer with few siloxane bonds and a hydrolytically stable chemisorbed layer on the post surface. Further reactions between silane molecules and the organic surface (fiber posts) have been proven to occur, enhancing condensation and providing a more tightly packed configuration of the coupler molecules on the post surface.\textsuperscript{9}

In this study, the shear bond strength with the resin cement was higher for fiber reinforced posts surface treated with airborne particle abrasion followed by silanization with two component silane coupling agent than the remaining various surface treatment group. Here in this study FRC post was used because of its higher shear bond strength. The mechanical action of sandblasting combined with chemical coupling, silane and bonding agent resulted in much improved interfacial strength. The result is similar to the study done by Elisha magni.\textit{et al}, which confirmed silanization with sandblasting to be reliable method for improving the bond strength of resin luting agents to fiber posts\textsuperscript{10, 11}.

In the present study, surface treatment with sandblasting followed by silanization with two component silane coupling agent produced a significantly higher bond strength between the luting agent and the fiber-reinforced post. This result is consistent with previous studies that airborne-particle abrasion with aluminum oxide particles increases the surface area and
enhanced the mechanical interlocking between the cement and the roughened surface of a post.

**CONCLUSION**

Within the limitation of this In-vitro study, it was concluded that surface treatment with airborne particle abrasion and silanization with two component system resulted in significantly higher bond strength than other methods of surface treatment.

**REFERENCES**


