CLINICAL EVALUATION OF A DENTIN BONDING SYSTEM

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ABSTRACT

The new generation of dentin bonding materials can withstand the polymerization shrinkage of composite materials. A two-year clinical trial of one material was done on 50 class V restorations, showed an excellent retention rate. Scotch bond multi purpose with Z100 (3 M, USA, St. Paul) was used for this study.

INTRODUCTION

Resin materials that bond reliably to calcified tooth structure aid dental practitioners in preserving dentition in three ways:

1) Bondable materials lend themselves to an extremely conservative approach to restorative dentistry

2) Bondable materials dramatically reduce the need for extensive undercut preparation

3) Bondable materials may be used for a variety of clinical applications such as Class I, II, III, IV, V and VI restorations as well as bonded crowns, bonded bridges, veneers, and inlays

The original dentin bonding resins introduced to the profession in the early 1980's were a step in the right direction but had one major clinical limitation their dentin bond 6 MPa couldn't withstand the setting contraction of composite materials placed on them ¹. Polymerization contraction shrinkage stress inevitably results in the formation of a contraction gap at the resin-dentin interface. The gap ultimately leads to the failure of the restoration in the form of spontaneous loss or micro-leakage in association with recurrent caries, post operative sensitivity or both ².

Undoubtedly, a resin-dentin bonding systems were required in which the bond to dentin can withstand composite polymerization contraction shrinkage without gap formation or micro-leakage at the dentin interface. The current dentin bonding systems includes Scotch Bond Multi Purpose (3M, USA), Panavia 21 (Dentsply), Gluma 2000 (Miles Inc), and Prisma Universal Bond 3 (L.D. Caulk). All offer promising potential in this regard ³.

These systems bond extremely well to enamel, dentin, porcelain and metallic surfaces. Furthermore, they bond to dentin with bond strengths of 18-24 MPa that more closely approximate the strength of resin bond to acid etched enamel.

Barkmeier ⁴,⁵ has reported bond strength of Prisma Universal Bond 3 to dentin as 18.6 MPa and tenure as
18.1 MPa, and that of Scotch Bond Multi Purpose as 22 MPa. Munksgaard and Asmussen\(^6\) have reported high bond values for Gluma. Although these in vitro data are unquestionably meaningful in terms of inferring clinical performance, we need clinical trials to identify their level of reliability'.

Our investigation was carried out keeping in mind the typical eating and social habits of Pakistani populations. The study was designed to evaluate the clinical effectiveness of Scotch Bond Multi Purpose (3M USA) used with Z100 (3M USA) for the conservative treatment of cervical erosion lesions.

**MATERIALS & METHODS**

A total of 50 cervical erosion lesions in 32 patients 42 to 59 years of age were selected for clinical treatment in private practice. The number of operators for the restorative procedure was two; they were following the same protocol for the restorative procedure. Scotch Bond Multi Purpose (2 steps) was used in combination with Z100 the lesions were treated in the following fashion:

- After careful rubber dam isolation, the gingival tissue were carefully retracted with ivory 212 SA retracted clamps (Columbus Dental). A flour of pumice prophylaxis followed.
- A long bevel was placed on the incisal/occlusal enamel with the appropriate diamond instrument.
- Acid etching of enamel and then dentin was applied for 30 seconds
- A thorough water rinse and careful air drying ensued.
- Scotch Bond multi purpose primer was applied and air dried according to the manufacturer's instruction.
- Scotch Bond Multi Purpose bonding resin was applied and light cured for 20 seconds.
- Hybrid composite Z-100 was placed with incremental insertion technique; visible light curing followed.
- The composite restorations were carefully finished, contoured and polished with a 30 fluted tungsten carbide finishing bur followed by soflex finishing disks (3M) from medium to super fine, in that order.

The patients in whom restorations were placed were recalled after 6 months, 1 year and 2 year. At that time, the restorations were evaluated, according to the criteria adopted for this study\(^7,8\), as follows:

1. Retention. Restoration present (A); partial loss—cohesive fracture of part of the restoration (B); absent (C)
2. Color stability. Color: no mismatch—color of restoration and adjacent tooth are the same (A); slight discoloration not requiring replacement (B); discoloration requiring replacement (C)
3. Marginal integrity. This was assessed by a sharp probe. Margins, excellent continuity at resin tooth interface—no ledge, no discoloration (A); slight ledge or ditch at resin tooth interface (B); recurrent caries (C).
4. Marginal discoloration. No marginal discoloration (A); slight marginal discoloration (B); gross marginal discoloration (C)
5. Surface texture. Evaluated directly on dry restoration: smooth and shiny (A); smooth and dull (B); grainy and rough (C)
6. Surface staining; absent (A); present (B)
7. Postoperative sensitivity: Absent (A); present thermally or digitally induced—short duration, 1-4 seconds (B); present thermally or digitally induced—long duration 5-30 seconds.

**TWO-YEAR RECALL RESULTS**

44 of the originally placed 50 restorations were available for the two-year recall evaluation. Above mentioned 7 parameters were used in the evaluation procedure (table 1). Two examiners conducted evaluation of each restoration in all the above mentioned parameters. They were calibrated through careful evaluation of 30 pre selected class V restorations. This resulted in an examiner agreement of 85 %. Examiner evaluation differences were resolved through a third opinion by the senior investigator; this resulted in an examiner agreement of 100 %.
1 Retention. Only one restoration was partially dislodged ‘B’ (2.2%) at the 2 year recall
2 Color Stability. Two restorations were rated as ‘B’ (4.3%)
3 Marginal integrity. Only one restoration was rated as ‘B’ (2.2%)
4 Marginal discoloration. Two restorations were evaluated as ‘B’ (4.3%)
5 Surface texture. All the 44 restorations retained their smooth and shiny texture and were rated as ‘A’ (100%)
6 Surface staining. 3 restorations were rated as ‘B’ (6.4%)
7 Post operative sensitivity. 2 restorations were evaluated as ‘B’ (4.3%)

**DISCUSSION**

The application of acid etchant using total etch technique, primer and bonding resin results in removal of smear layer and dentinal tubular plugs, refreshing the collagen mesh work and formation of resin tags into the tubules and peri-tubular dentin. Thus, effectively sealing the dentinal tubules. This resin rich layer of dentin is known as 'Hybrid layer's. The thickness of this hybrid layer is having a direct influence on the bond strength between the dentin & resin, previous studies have shown that an average thickness of 7-19 microns produces a bond strength value of up to 22 MPa. From a clinical standpoint an ideal dentin bonding material should have at least 12 features:

1 High bond strength to dentin. The bond of resin to enamel is a reliable bond that has been clinically substantiated for almost 30 years now. It is about 18-20Mpa, or 200kg/cm square, or 3000 pounds per square inch. It is reasonable to assume that dentine bonding systems of equal magnitude will be correspondingly effective.
2 Total seal of dentinal tubules, dentinal pain is caused by altered fluid movement within the dentinal tubule. Any stimulus- thermal change, tactile stimulation, acid or sweet foods, for example - results in altered dentinal fluid movement and subsequent pain. Bonding resin, that totally seal and obturate the dentinal tubule effectively eliminate post operative sensitivity.
3 Bondability to moist surface, it is extremely difficult if not possible, to dry a dentinal surface totally because of the presence of fluid in the dentinal tubules. Accordingly, so called "wet bonding" materials that bond at least as well to moist as to dry surfaces may have inherent advantage.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Scotch Bond Multi Purpose</th>
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<tbody>
<tr>
<td>High Dentin bond strength</td>
<td>High/22 MPa</td>
</tr>
<tr>
<td>Total seal of Dentinal tubules</td>
<td>Yes</td>
</tr>
<tr>
<td>Bondability to moist dentin</td>
<td>Yes</td>
</tr>
<tr>
<td>Biological compatibility</td>
<td>Yes</td>
</tr>
<tr>
<td>Light-or dual cure</td>
<td>Light cure</td>
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<tr>
<td>Low film thickness</td>
<td>Yes</td>
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<tr>
<td>Instant bond</td>
<td>Yes</td>
</tr>
<tr>
<td>Multi surface bond</td>
<td>Yes</td>
</tr>
<tr>
<td>Clinically proven</td>
<td>Yes/2 years recall data available</td>
</tr>
<tr>
<td>Gap free bond</td>
<td>Yes</td>
</tr>
<tr>
<td>Ease of handling</td>
<td>Yes</td>
</tr>
<tr>
<td>Composite compatibility</td>
<td>Yes</td>
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**TABLE 1. CLINICAL EVALUATION RESULTS OF SCOTCH BOND MULTI PURPOSE WITH Z100 COMPOSITE, CERVICAL RESTORATION AT 2 YEAR RECALL (N=44)**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retention</td>
<td>43 (97.8%)</td>
<td>1 (2.2%)</td>
<td>0</td>
</tr>
<tr>
<td>Marginal Integrity</td>
<td>42 (97.7%)</td>
<td>1 (2.3%)</td>
<td>0</td>
</tr>
<tr>
<td>Marginal discoloration</td>
<td>41 (95.6%)</td>
<td>2 (4.4%)</td>
<td>0</td>
</tr>
<tr>
<td>Color Stability</td>
<td>41 (95.6%)</td>
<td>2 (4.4%)</td>
<td>0</td>
</tr>
<tr>
<td>Surface Texture</td>
<td>43 (100%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Surface staining</td>
<td>40 (93.4%)</td>
<td>2 (4.4%)</td>
<td>1 (2.2%)</td>
</tr>
<tr>
<td>Sensitivity Post Op.</td>
<td>41 (95.6%)</td>
<td>2 (4.4%)</td>
<td>0</td>
</tr>
</tbody>
</table>

**TABLE 2. THE SCOTCH BOND MULTI PURPOSE SYSTEM RELATIVE TO THE 12 CLINICAL PARAMETERS.**
4 Biological compatibility. Almost any material may be bonded to enamel without having deleterious pulpal sequelae. But dentine bonding systems must be biocompatible and non-irritating.

5 Light or dual cure. Although not an absolutely essential, these resins may be used for a wide range of indication, such as bonded prefabricated or cast posts, bonded crowns and bridges and inlays.

6 Low film thickness. The ideal bonding system should have a film thickness of less than 20 microns so that it can be effectively used for several clinical applications, as materials above.

7 Instant bond. Polymerization contraction shrinkage occurs within seconds of placing a composite material. Bonding resins should instantly develop a high bond strength.

8 Multi surface bond'. It is obviously advantageous to use a single bonding system that bonds equally well to enamel, dentine, cementum, porcelain and metals.

9 Clinically evaluation. The extent to which the bonding system has been clinically proven is by far the most important parameter. This is also the most difficult parameter to demonstrate, as clinical trials are inherently both expensive and time—consuming. Nevertheless there can be no substitute for long-term clinical evaluation in determining the effectiveness of any restorative material.

10 No Micro-leakage. The ideal dentine bonding system must demonstrate a gap-free bond, preferably micro-mechanical, that clearly shows the absence of a contraction gap at the bonded interface. This indicates that the bond of the material to the dentine is sufficient to withstand the polymerization contraction of composite material.

11 Ease of handling. The fewer the steps involved in bonding, the better the clinical success.

12 Composite compatibility. The ideal bonding system should be compatible with all the composite materials regardless of this formulation.

Scotch Bond Multi purpose (Tables 1, 2) shows all of the requisite feature needed for a bonding system. This was evident by excellent results as assessed at 2-year recall. The restorations involved in this study were of one type, Class V. They are commonly regarded as limited to stress-free areas. However, recent research found, that cervical restorations are subjected to a high degree of stress. Tooth flexure during functions causes this stress, especially as seen in bruxism. Thus class V restorations are not stress-free.

CONCLUSION

The extremely high two-year retention rate (97.8%) observed in this clinical study of Scotch Bond Multi purpose system, combined with excellent marginal integrity results and total absence of post operative sensitivity, offers clear-cut clinical evidence that the dentine bond of the material is more then sufficient to withstand the polymerization contraction shrinkage of composite materials. We found the system is highly reliable.

REFERENCES


