Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2016;5:3s:135-140.

# Shear Bond Strength of Recent Core Build up Materials: An In Vitro Study

**Pramod Punchiri Sadan[1] Meenakshi Sharma[2*] Suresh Bindu Madhav[3] Gunjan Singh[4] Lalit Likhyani[5] Damodhar Kappadi[6]**

[1]Assistant Professor, Department of Prosthetic Dental Sciences, Qassim University, Kingdom of Saudi Arabia, Saudi Arabia.
[2]Assistant Professor, Department of Pedodontics and Preventive Dentistry, Government Dental College, Jaipur, Rajasthan, India.
[3]Professor, Department of Periodontology and Oral Implantology, JDC, Sirsa, Haryana, India.
[4]Post Graduate Student, Department of Pedodontics and Preventive Dentistry, Jaipur Dental College, Jaipur, Rajasthan, India.
[5]Assistant Professor, Department Conservative Dentistry, Government Dental College, Jaipur, Rajasthan, India.
[6]Reader, Department of Pedodontics and Preventive Dentistry, NIMS Dental College, Jaipur, Rajasthan, India.

## ABSTRACT

**Background**: Due to increased aesthetic demands in restorative dentistry during the past few years, the use of tooth-colored restorative materials has even been extended to the construction of cores, as a means of building-up badly broken-down teeth, restoring lost resistance and retention, required for proper seating of the future prosthesis. The present study was designed to determine & compare the shear bond strength values of recent core buildup systems.

**Materials and Methods:** Thirty six extracted human molars and premolars were used for the study comprising of twelve specimens for each of the three materials tested. Occlusal surface of each tooth was attended with a model trimmer to eliminate the ferrule effect and to test the core materials solely on its bonding capabilities. Copper rings measuring (2mm diameter x 4 mm height) were placed on the prepared dentinal surface and the different core materials were condensed on to the dentin after doing appropriate surface treatment and according to the manufacturer's instructions. The bond strength between the restorative materials and dentin was measured in the shear mode with a Universal Testing Machine (Instron 4467). The values recorded for each material was tabulated separately and compared.

**Result:** composite dual core cement showed the maximum bond strength (28.0311) and composite light cure showed least bond strength value as a core building material (21.4291).

**Conclusion:** Composite dual cure shows the maximum bond strength amongst the core build up systems tested.

**Keywords:** Aesthetic, core buildup, dentin, restorative material, shear bond strength, tooth colored.

## INTRODUCTION

Due to increased aesthetic demands in restorative dentistry during the past few years, restoration of a tooth with mutilated coronal portion is a prosthodontic challenge. Once the coronal portion is lost either partially or fully, its treatment should not be considered as mere restoration but it should be equipped to withstand or resist the multidirectional forces which will be applied during function. The rationale of the treatment involves building up of the coronal portion in the form of a prepared tooth and then protecting it by the placement of a crown over it. Importance has always been given for the

**Received:** Nov. 2, 2016: **Accepted**: Dec. 17, 2016
*Correspondence Dr. Meenakshi Sharma.
Department of Pedodontics and Preventive Dentistry, Government Dental College, Jaipur, Rajasthan, India.
**Email: dr.mesharma@gmail.com**




pISSN 2278-0076
eISSN 2321-9270


Fig 1: Composite core build-up (BIS-CORETM, Bisco, Inc.) – Dual cured.


Fig 2: Composite core build-up (BIS-CORETM, Bisco, Inc.) – Light cured.


Fig 3: Composite Translucent core build-up (LIGHT-CORETM, Bisco, Inc.) – Light cured.


Fig 4: Universal Dental Adhesive - One-Step– Light cure (Bisco, Inc.)

Fig 5: Copper ring used for holding core material (2mm diameter x 4mm height).

Fig 6: Teeth mounted using color coded acrylic resin in the metallic plug.

Fig 7: Metallic plug and jig.

maintenance of healthy tooth material at the termination area so that the covering crown will always rest on solid tooth structure to ensure structural durability. However, building up core over solid tooth structure is not always practical. Though clinicians prefer to restore the mutilated tooth with a crown having gingival termination solely resting on tooth material, in reality they are

Table 1: Different core materials used in the study.

| | | |
|---|---|---|
| 1. | Composite core build-up (BIS-CORETM) – Dual cured | One Step-Light cured |
| 2. | Composite core build-up (BIS-CORETM) – Light cured | One Step-Light cured |
| 3. | Composite Translucent core build-up (LIGHT-CORETM) – Light cured. | One Step-Light cured |

Table 2: Shear bond strength values of core build-up materials namely, Composite dualcure (Biscore), Composite light cure (Biscore) and Composite Translucent (Light Core). (MPa).

| Specimen No. | Composite Dual Cure (Biscore) | Composite Light Cure (Biscore) | Composite Translucent (Light Core) |
|---|---|---|---|
| 1 | 29.6434 | 21.0481 | 22.0870 |
| 2 | 28.4293 | 20.1087 | 23.5324 |
| 3 | 25.6017 | 22.2622 | 21.7847 |
| 4 | 27.3401 | 21.5256 | 22.5899 |
| 5 | 28.7445 | 23.1205 | 21.3165 |
| 6 | 27.5898 | 25.9387 | 21.9532 |
| 7 | 29.1752 | 20.5394 | 24.4968 |
| 8 | 28.9849 | 19.3877 | 21.4601 |
| 9 | 27.7271 | 18.7635 | 23.2110 |
| 10 | 27.7801 | 19.7248 | 24.7212 |
| 11 | 28.1671 | 23.7135 | 24.0911 |
| 12 | 27.1903 | 21.0169 | 22.8614 |
| *Mean* | 28.0311 | 21.4291 | 22.8421 |
| *SD* | 1.0846 | 2.0482 | 1.1763 |

Table 3: Mean and Standard deviation of shear bond strength values of composite dual cure, composite light cure, composite translucent and the level of significance.

| Type of material | Shear bond strength | | Level of Significance |
|---|---|---|---|
| | Mean | S.D | |
| Composite dual cure | 28.0311 | 1.0846 | F = 64.40; |
| Composite light cure | 21.4291 | 2.0482 | D.F. = 2,23 |
| Composite translucent | 22.8421 | 1.1763 | P < .0001 (H.S.)* |

Table 4: Mean and Standard deviation of shear bond strength values of composite dual cure, composite light cure, composite translucent and the level of significance.

| Type of material | Shear bond strength | | t-value | P-value |
|---|---|---|---|---|
| | Mean | S.D | | |
| Composite light cure | 21.4291 | 2.0482 | 2.072 | P<.05 |
| Composite translucent | 22.8421 | 1.1763 | | (Sig.) |

forced to take resource to a strong foundation restoration [1-3].A number of materials have been tried in the build-up of a core. Being the commonest restorative material, amalgam was used quite popularly. But amalgam had a limitation that it required extensive tooth preparation to provide a mechanical locking [4]. Amalgam as such does not bind to the tooth material. In extreme cases of destruction, the position of amalgam as a core building material stands questionable [5]. Hence, the use of bonding materials has been attempted in the later stages [6]. Another option was the custom

Table 5: Ranking of the core build up materials used in the study.

| Type of material | Ranking |
|---|---|
| Composite ldual cure | I |
| Composite light cure | II |
| Composite translucent | III |

made cast post and core. The latter involves a lot of clinical and laboratory time and hence a directly added core was always preferred. Newer materials such as glass ionomer and light cure glass ionomer have been tried in the buildup of cores and these materials could claim a favorable bonding with the tooth. Glass ionomers have found its usefulness in this context. They adhere to the dentin and prevent dental caries by leaching fluoride [7]. Low abrasion resistance and flexural strength are the disadvantages of this material [8]. A combination of glass ionomer and amalgam was tried next to incorporate the positive features of both in the build-up of a core. Recently introduced core materials are related to resins which could offer both strength and bonding to the tooth. In the changing scenario of getting more bond strength for the core build-up material, the role of ferrule can be subjected to reevaluation. Compressive loading will always be tolerated by a restored tooth, but that is not the case when horizontally directed forces are acting. These forces will attempt to unseat not only the restoring crown but also the foundation restoration. If the bond between the foundation restoration and the tooth can resist the horizontally directed forces, the emphasis on ferrule effect can be made secondary. This was not possible with amalgam bonding cores. The comparison of bond strength of different system with same time avoiding the role of ferrule is not attempted as per our knowledge. In this context the present in-vitro study was designed to test and compare the bond strength of three different core building systems viz. composite dual cure, composite light cure and composite translucent.

## MATERIALS AND METHODS

The present in-vitro study was conducted to determine the shear bond strength of three different core build up materials. The methodology used in the study was adopted from ISO CDTR 11405 Dental materials – Guidance on testing of adhesion to tooth structure [9]. In this study thirty six human molars and premolars were included. All selected teeth were free of caries and attrition and were stored in distilled water until used.

Total of three systems were tested in the present study [Table-1]. Composite dual core (BIS-CORETM), Composite light cure (Biscore) and Composite translucent light cure (Light core) [Fig-1-3]. Universal Dental Adhesive - One-Step (Bisco, Inc.) – Light cured bonding agent was used [Fig-4].

The occlusal surface of each tooth was flattened to expose the dentin with the help of model trimmer. Each tooth was trimmed 1.5 mm apical to the deepest occlusal pit to create flat dentin surface perpendicular to the long axis of tooth. In order to remove smear layer from the dentinal surface, sequential polishing was done with different grit silicone carbide paper (120,240,400,600) under water irrigation. Finally, teeth were cleaned in ultrasonic bath with distilled water. They were not dried to avoid desiccation. The specimens then mounted with clear auto-polymerising resin in a metallic plug [Fig-5]. Color coding was provided to different core materials by incorporating colors in the acrylic resin [ Fig 6]. The plug was fitted onto a metallic jig and diameter of plug was 15 mm and 12 mm deep. Plug was fitted onto metallic jig [Fig -7]. Twelve specimens of each color were prepared for different core materials and specimens were stored in water at 30 $^0$C until used for bonding. Copper rings measuring (2mm diameter x 4 mm height) were used to bond core materials to the dentinal surface and were placed on the prepared dentinal surface and after appropriate surface treatment the materials were packed and condensed onto the dentin surface. These specimens were stored in water at 37$^0$ C for 24 hrs.

The shear bond strength between the restorative materials and dentin was measured using Universal Testing Machine (Instron 4467, Instron Corp, Canton, Mass.). The metallic jig was clamped to the lower arm of the cross head and the metallic plug with the bonded specimen was tightened onto it. A wire was fixed on the upper arm of the cross head. Such that it engaged the bonded specimen at the dentin interface. The shear bond strength was tested at a cross head speed of 1

mm/min. Fracture loads were recorded in kilograms, which was converted to MPa by dividing the loads by the cross sectional areas of the bonded restorative material.

The present study evaluated the shear bond strength of the composite core build-up materials viz. composite dual cure (Biscore), composite light cure (Biscore) and composite translucent light cure (Light core). To find out the relative superiority of each material, the values were subjected to statistical analysis – Analysis of Variance (ANOVA) and student t-test.

## RESULTS

[Table-2,3] shows that the values recorded for composite dual cure (28.0311) is far superior to either composite light cure (21.4291) or composite translucent (22.8421).

From [Table -4], it is evident that composite light cure with that of composite translucent can very well be treated as almost equal.

From [Table - 5], it is obvious that composite dual cure is the best core build up material with the highest shear bond strength of 28.03, placing composite light cure and composite translucent in the second position.

## DISCUSSION

The present in-vitro study was designed to test and compare the bond strength of three different core building systems viz. composite dual cure, composite light cure and composite translucent. Composite as a core build-up material exhibited encouraging results when the shear bond strength was tested. A mean shear bond strength of 28.0311 MPa was obtained with Composite dual cure (Biscore) whereas in the case of Composite light cure (Biscore) it was 21.4291 MPa and for Composite Translucent (light cure) 22.8421 MPa [Table-3]. The values recorded clearly showed that composite dual cure was far superior to either composite light cure or composite translucent. Leirskar J et al., conducted a study to evaluate the shear bond strength to dentine of two resin composites, namely Tetric (Vivadent) and Z-100 (3M dental) with five different dentin bonding agents. The results showed that Tetric attained the highest shear bond strength of 28.0 $\pm$ 9.3 MPa with the bonding agent Syntac (Viva Dent) and the lowest shear bond strength of 9.6 $\pm$ 4.0 MPa with Prisma Universal Bond 3 (DeTrey/ Dentsply).Z-100 exhibited the highest shear bond strength of 28.6 $\pm$ 11.6 MPa with Syntac and the lowest shear bond strength of 7.0 $\pm$ 2.9 MPa with Prisma universal bond 3 [10].

O'Keefe KL and Powers JM conducted another study in which they determined the effect of polymerization mode of resin composite core materials and dental adhesives on the bond strength to dentin. Three core materials namely Fluorocore (Dual cured), Core paste (Self-cured), and Clearfil photo core (Light cured) and two adhesives Prime and Bond NT (dual cure) and Clearfil SE bond (light cured) were used under two etching conditions. The results revealed that Fluorocore (dual cured) exhibited the highest mean shear bond strength with both the adhesives namely Prime and Bond NT (26.7 MPa – with etch and 16.0 MPa – without etch) and Clearfil SE bond (30.4 MPa – with etch and 41.0 MPa –without etch). Clearfil photocore (light cured) gave mean shear bond strength of (23.0 MPa – with etch and 27.2 MPa – without etch) with Prime t Bond NT and (23.0 MPa – with etch and 35.9 MPa – without etch) with Clearfil SE bond [11].

Hagge and Lindemuth investigated the shear bond strength values of an autopolymerising core build-up composite bonded to dentin with nine dentin adhesive systems. The core buildup composite used was Core paste and the dentin adhesive systems used were one multi component system and one single bottle system from the same manufacturer, namely Optibond FL and Optibond solo plus (Kerr dental), Scotch bond Multipurpose plus and Single bond (3M dental) and All-Bond 2 and One-step (Bisco). The results gave the highest mean shear bond strength for Optibond F1(28.19 MPa) followed by One Step (19.66MPa) which was used in the present study. One-step had significantly higher bond strength than all other single bottle systems used in the study [12].

Ehaideb AA and Mohammed H evaluated the shear bond strength of five 1-bottle fifth generation dentin adhesive resin materials. The results gave high mean shear bond strength for One Step (22.51). A comparison of different systems using

bond strength as a parameter and at the same time avoiding the role of ferrule is not attempted before. Hence, it was decided to find out bonding capabilities of popular systems of core buildup materials to provide evidence to the clinician in the choice of an optimum material [13].

## CONCLUSION

Composite dual cure is the best core build up material with the highest shear bond strength , placing composite light cure and composite translucent in the second position.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

## REFERENCES

[1] Anusavice KJ Phillips. Science of Dental Materials 'Phillips' Science of Dental Materials Saunders; 115th ed 2003.

[2] Craig RG, Powers JM. Restorative Dental Materials. Restorative Dental Materials Mosby Inc; 11 th ed 2002.

[3] Walmsley A, Walsh T, Burke F, Shortall A, Lumley P, Hayes-Hall R. Restoration of teeth (Complex Restorations).Restorative Dentistry Chicago: Chuchill. 2002.

[4] Kemper K, Kilian R. New test system of tensile bond strength testing. *J Dent Res*. 1976;55(Spec Iss B):308-18.

[5] Görücü J, Saygili G, Ozgünaltay G. Compressive shear bond strength of core build up Materials. 2006;26(2):183-89.

[6] Noguchi H, Nakano N, Kumasaka A, Etcher Y. Evaluation of Japanese dental adhesives. *Dent Eng*. 1982;60:16.

[7] Janda R, Roulet JF, Latta M, Rüttermann ST. The effects of thermocycling on theflexural strength and flexural modulus of modern resin-based filling materials. *Dent Mater*. 2006;22:1103-08.

[8] Kanchanavasita W, Anstice HM, Peatson GJ. Long-term flexural strength of resin-modified glass-ionomer cements.1998;19:1703-13.

[9] Oilo G. Bond Strength Testing – What does it means? *Int Dent J.* 1993;43: 492-8.

[10] Leirskar J, Oilo G, Nordbo. In vitro shear bond strength of two resin composites to dentin with five different dentin adhesives. *Quintessence Int*. 1998;29:787-92.

[11] O'Keefe KL, Powers JM. Adhesion of resin composite core materials to dentin. *Int J Prosthodont.* 2001;14(5):451-56.

[12] Hagge MS, Lindemuth JS. Shear bond strength of an auto-polymerizing core buildup composite bonded to dentin with 9 dentin adhesive systems. *J Prosthet Dent*. 2001;86(6):620-23.

[13] Ehaideb AA, Mohammed H. Shear bond strength of "one bottle" dentin adhesives. *J Prosthet Dent*. 2000;84:408-12.