

# ESTIMATION OF EFFECTS OF VARIOUS ROTARY CUTTING BURS IN THE SHEAR BOND STRENGTH OF THREE DISSIMILAR FLOWABLE COMPOSITES USED IN VARIOUS PEDODONTIC PROCEDURES- A SCANNING ELECTRON MICROSCOPIC CUM IN VITRO STUDY

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**Abstract: Aim:** There have been tremendous modifications in the composition as well as in properties of composite resins in the recent past. This study was performed to assess the effects of usage of different rotary cutting burs in the shear bond strength of three different flowable composites on tooth surface used in various pedodontic procedures. Surface changes were also evaluated using Scanning Electron Microscopic (SEM). **Materials & Methods:** This study was attempted on sixty freshly extracted permanent mandibular molars. Initially teeth were sectioned at coronal one third and polished with abrasive paper made up of silicon carbide. The samples were separated into 2 groups of 30 teeth each. In group I, teeth were prepared using fissure carbide bur and in group II with coarse taper round end diamond bur. Teeth after preparation were again segregated into 3 groups. In Group A, prepared teeth were applied with Vertise Flow which is a self adhering type of flowable composite resin. In group B, all prepared teeth were applied with Dyad flow (Kerr) SAFC. In Group C samples, Tetric N Bond which is a self-etch adhesive was applied on the dentin surface. Teeth were then subjected to universal testing machine for evaluation of shear bond strength. Surface texture characteristics and changes were further explored by Scanning Electron Microscopy. **Results:** Data thus obtained were compiled for statistical analysis by latest SPSS software package. Shear bond strength (SBS) in group C was 22.4 MPa, in group B was 15.1 MPa and in group A was 12.8 MPa in group I. However when checked in group II, group C had SBS of 18.2 MPa, group B had 12.6 MPa and group A had 11.2 MPa. Therefore, author noticed non-significant difference ( $P = 0.71$ ) in SBS values of flowable composite resin (self-adhering)

*(Group A) for surfaces prepared with carbide (Group I) and diamond (Group II) burs. Conclusion: The shear bond strength (SBS) of Tetric-N Flow was reported to be higher when compared to other tested materials. Dentinal surface those prepared with carbide bur showed higher shear bond strength for Tetric N Flow and Dyad-flow. Clinical Significance: In the present in vitro study, the overall breaking shear bond strength (SBS) was reported higher in samples those prepared with carbide burs. Also, Tetric N Flow expressed highest values among the studied composites. These findings are very crucial and have a clinical applicability in selection of type of burs for critical and prone pedodontic circumstances.*

**Keywords:** *Bur, Tetric N, Scanning Electron Microscopic, Dyad flow, Pedodontics*

## 1. INTRODUCTION

There are different commercially available materials in the market those used for dental restorative procedures. With the arrival of newer better quality materials, shortcomings are minimized. Recently, there have been tremendous modifications in the composition as well as in properties of composite resins. Esthetically composite resins are at upper edge than any other restorative materials. There is minimal tooth preparation with this material as compared to other materials such as silver amalgam.<sup>1</sup> Flowable composites which were in race with other restorative materials entered in the market in mid 90s. It has properties such as resistance to wear, higher flow, lesser polymerization shrinkage, greater elasticity, easy handling, easier insertion and adequate marginal adaptation. It is the choice of materials in class V and class III cavities.<sup>2</sup> Composite resins with different viscosities offer wide range of advantages. The selection of class of composite based on its viscosities is the choice of dentist. There are flowable, microfill and hybrid composite formulations which are used in different teeth based on biting and chewing force.<sup>3</sup> Bonding agents help in adhesion of composite to the dentin. There are several factors which affect bonding of materials. With the cutting of tooth, there is formation of smear layer which is the biggest hindrance in restorative dentistry. Other challenge is selection of different rotary instruments for surface preparation of the substrate which affects the bonding between adhesive and dentin.<sup>4</sup>

### *Aim of Study*

The present study was aimed to assess the effects of various burs in the shear bond strength of three different flowable composites on tooth using universal testing machine. Surface changes were further tested via Scanning Electron Microscopic (SEM).

## 2. MATERIALS & METHODS

This in vitro study was intricately attempted in the department of Pedodontics and Preventive Dentistry of the institute. Authors studied total sixty freshly extracted permanent mandibular molars. Initially the teeth were kept preserved in saline. For getting them stable during bur application, they were mounted on self polymerizing acrylic resin cubes. Teeth were then sectioned at coronal one third while the removal of surface micro irregularities were attempted with 600-grit SiC papers. The sole function of sanctioning of teeth was to reveal the un-diseased dentine. Following these preliminary measures, teeth were segregated into 2 equal groups of 30 teeth. Firstly, in group I, teeth were prepared by means of Fissure Carbide Bur FG - 245 (SS

White Burs Inc. New Jersey, USA) while in group II, they were prepared with coarse taper round end diamond bur (Great White Z Round End Taper 856-018, SS White Burs Inc. New Jersey, USA). The dentinal preparation of sample teeth was completed with high speed hand piece coupled with air-water spray. As per guidelines mentioned in the literature, we ensured to restrict the maximum speed up to 3,50,000 rpm and an air pressure up to 28 psi. We had also ensured to discard the bur after every 6 preparations. All studied samples were further segregated into 3 groups. In Group A, prepared sample teeth were applied with Vertise Flow commercially available composite resin (self-adhering as well as flowable) (Kerr Inc., California, US) and light cured for 18 s. The composite were added to dentinal surface in incremental manner. In Group B, prepared teeth were applied with Dyad™ flow (Kerr) SAFC. A self-etch adhesive namely Tetric N Bond was applied on the dentin surface of Group C samples and restored with Tetric N Flow conventional flowable composite resin (Ivoclar Vivadent AG, Liechtenstein, Europe). Teeth were then subjected programmed controlled breaking force using universal testing machine. The moving head of this machine was programmed on the speed of 1 mm/min and applied at dentin-composite bonding surfaces. Shear Bond strength was recorded as  $1 \text{ MPa} = 1 \text{ N/mm}^2$ , where  $\text{mm}^2$  is the total surface area of the bonded composite. All studied samples were further evaluated for surface changes under scanning electron microscope at 500X magnification with a resolution of  $10\mu\text{m}$  and the voltage potential of 20 kV. Results and inference were arranged logically and sent to suitable statistical analysis/tests using SPSS latest package 21.0. Data was illustrated in mean with Standard Deviation if any. ANOVA and Mann Whitney test was employed to compute bond strength. P value less 0.05 was considered as significant one.

### 3. RESULTS

All remarkable outcomes were gathered and sent for suitable statistical tests. Table 1, graph 1 illustrates shear bond strength (SBS) in group I and group II. Maximum SBS values were noticed in samples prepared with carbide bur (Group I). Here, group C showed 22.4 MPa followed by group B (15.1 MPa) and group A (12.8 MPa). Similarly in group II (those prepared with diamond bur), group C samples showed 18.2 MPa while group B showed 12.6 MPa and group A showed 11.2 MPa respectively. A significant difference was found when group A was compared with group C. Similarly, significant difference was drawn when group B was compared with group C. These significant findings were noted down in both group I and group II studied samples. Table 2 and graph 2 shows statistically non-significant values ( $P = 0.71$ ) in SBS values of Vertise Flow (Group A) for surfaces prepared with carbide (Group I) and diamond (Group II) burs. However, it was noticed to be statistically significant ( $p < 0.05$  significant) in SBS values of Dyad flow (Group B) and Tetric N flow (Group C) ( $p$  value more than 0.05 significant) for samples exteriors grated with carbide and high speed diamond cutting burs respectively. The scanning electron microscopic assessment showed remarkably noticeable changes on the dentinal surfaces of studied samples. All macroscopic surface changes were revealed as shadowy lined striations. SEM evaluation of Group I samples showed numerous finer and dense closely packed striations while Group II samples showed somewhat medium and less closely packed light striation on prepared dentinal surfaces (Fig. 1 & 2).

Table 1: Shear bond strength of different restorative materials

Parameters	Groups	Mean (MPa)	SD	P value	Sig diff	P value
Group I	Group A	12.8	2.2	0.02*	Group A vs group B	0.42
	Group B	15.1	1.6		Group A vs group C	0.01*
	Group C	22.4	2.4		Group B vs group C	0.04
Group II	Group A	11.2	2.1	0.01*	Group A vs group B	0.91
	Group B	12.6	2.3		Group A vs group C	0.02*
	Group C	18.2	1.4		Group B vs group C	0.04*

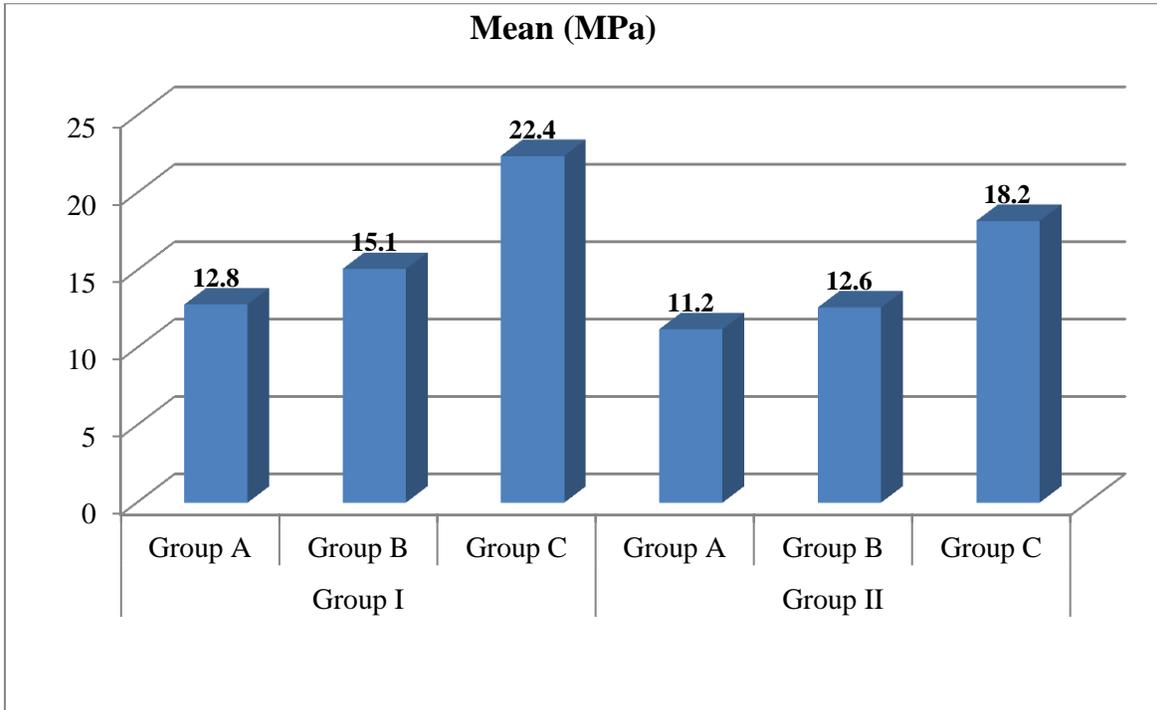
\*p<0.05 significant

Table 2: Comparison of shear strength in Group A, B &amp; C under different conditions

Group	Technique	Mean SBS	SD	P value
Group A	Group I	12.8	2.2	0.71
	Group II	11.2	2.1	
Group B	Group I	15.1	1.6	0.001*
	Group II	12.6	2.3	
Group C	Group I	22.4	2.4	0.002*
	Group II	18.2	1.4	

\*p<0.05 significant

Graph 1: Shear bond strength of different restorative materials



Graph 2: Comparison of shear strength in Group A, B & C under different conditions

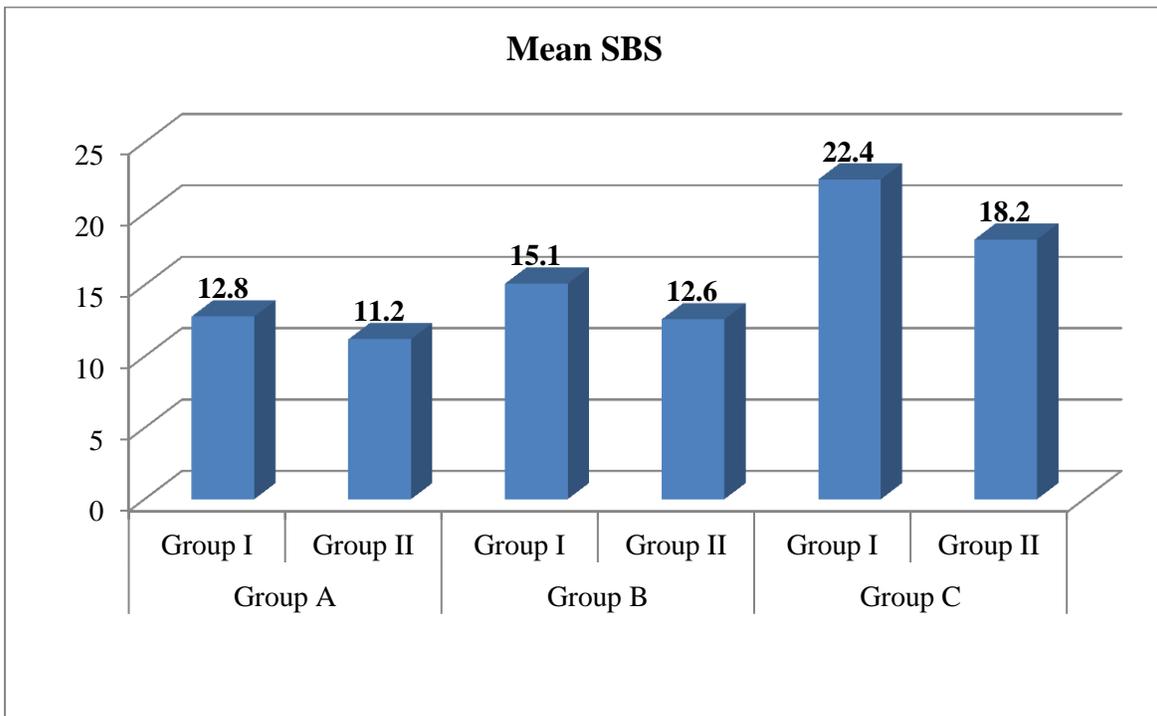




Figure 1: SEM evaluation of Group I samples illustrating several finer and dense closely packed striations

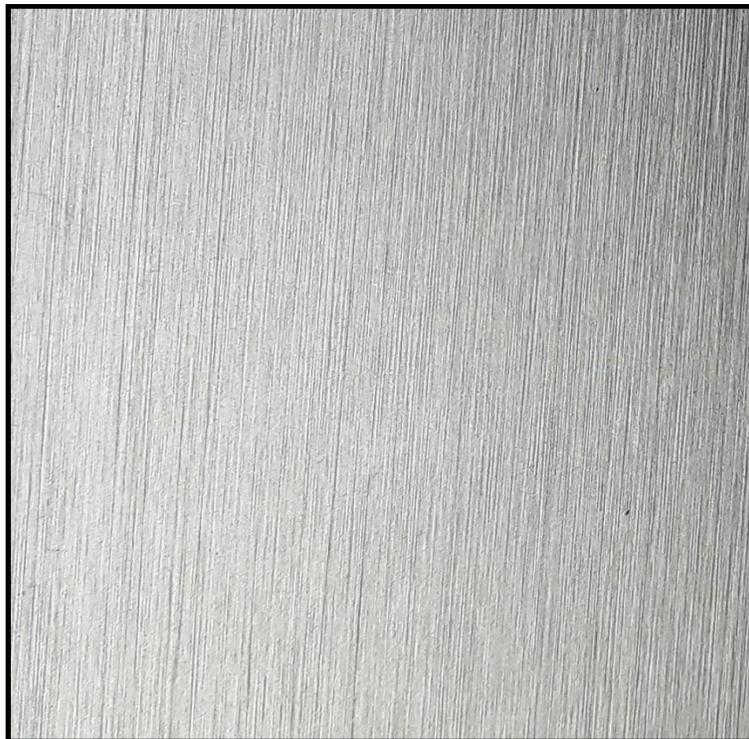


Figure 2: SEM evaluation of Group II samples illustrating less closely packed light striation on prepared dentinal surfaces

#### 4. DISCUSSION

The property of self adhesion in composite resins has popularized their use in restorative and prosthetic dentistry. With the latest modifications in composite resins such as smaller filler particle, there is better polish ability. There are consequently enhanced physical properties, composite resin viscosity and resistance to wear with the addition of fillers.<sup>5</sup> Satisfactory preparation of tooth surface is attained by rotary instruments which may generate formation of smear layer over dentin. Flowable composite has additional benefit and advantage of less thickness which permit these composites to be easily injected into prepared cavities of spaces. Literature has well evidenced that the majority of flowable composites are usually filled between 41-53% by volume which further represents itself up to 56-70% by weight.<sup>6</sup> Due to its flexibility, it has popularized in cases of class V restoration, abfraction and erosion and. They can be easily polished because of presence of high resin proportions in it. They permit more polymerization shrinkage. However, few imperative research showed that their shrinkage is minimal as and when they are employed in little quantities such as cavity liner.<sup>7</sup> Gwinnett in his study of morphological considerations of smear layer suggested that smear layer formation is not beneficial for adhesion of composite resin with dentin surface.<sup>8</sup> It has been observed that speed of the rotary instrument, the nature of the rotary cutting bur and the usages of water moistures directly influences the disreputable smear layering. In present study, 60 teeth were studied and segregated into 2 groups of 30 each. When we study group I, teeth were reduced by fissure carbide bur and in group II with coarse taper round end diamond bur. Teeth after preparation were separated in 3 study groups. Group A contained Vertise Flow composite resin. In group B, Dyad™ flow (Kerr) resin and in group C, Tetric N bond was used. We found that maximum SBS was seen in group C with 22.4 MPa followed by group B with 15.1 MPa and group A with 12.8 MPa in group I similarly in group II, group C showed 18.2 MPa, group B 12.6 MPa and group A 11.2 MPa. Yiu CK et al further studied the outcomes of dentinal surfaces preparation on SBS of self-etching adhesives.<sup>9</sup> Their results showed that in carbide fissure group, all the flowable composites exhibited elevated SBS values when compared to the diamond group. These outcomes were quite comparable with our results. Ayad et al studied 150 teeth those were grounded by high speed diamond and carbide burs of identical shape respectively.<sup>10</sup> They examined the dentinal surfaces with a unique instrument called surface profile-meter and scanning electron microscope. They showed that mean surface roughness's were 8.6 μm in teeth shaped with diamond and 6.8 μm in teeth shaped with tungsten carbide burs. They additionally explored its clinical importance and stated that cutting blades/edges of speedy carbide burs enhance the retention of all veneer crowns luted by zinc poly-carboxylate cements. Also, almost all rotary instruments produce roughening on prepared surface which enhances cement and tooth bonding and thereby improving retention. Studies have revealed difference in micromorphology of dentin cut by carbide rotary and diamond instruments. Coarse diamond bur may lead to formation of thick smear layer. This literally checks the competent contact between the dentinal tissue and the restorative material which leads to failure.<sup>11,12</sup> Here in this study we noticed non- significant difference in SBS values of Group A samples for surfaces prepared with carbide in group I samples and diamond bur in specimens of group II. Here, authors noticed significant statistical values in SBS of Dyad flow and Tetric N flow for surfaces shaped with

carbide and diamond burs respectively. Koodaryan et al imperatively examined and studied the effects of unlike bur stones sizes on SBS of restorations bonded by resins.<sup>13</sup> There was significant higher bond strength with SC than that for group F. Our study results were in contrast to these workers outcomes as we found that Dyad-Flow showed higher SBS values of carbide burs than diamond burs. These differences in outcomes could be attributed on the fact that Dyad-Flow consists of GPDM adhesive monomer which has unique polymerization bonding mechanisms. These offer higher interlocking thickness and improved rigidity.<sup>14,15</sup> The one of the possible shortcoming of this study is seems to be its small sample size. Only mandibular molars were selected. Maxillary teeth were not considered in the study. Also inclusion of different teeth could have been provided different and more precise results. Therefore, it is the need of hour to conduct some additional genuine researches using larger sample size and different composites with variable methodologies and bonding.

## 5. CONCLUSION

Author concluded that shear bond strength of Tetric N Flow was relatively superior to the other studied materials in the study. Dentinal surface preparation with carbide bur showed higher shear bond strength for Tetric N Flow and Dyad flow. Moreover, Vertise Flow resin exhibited lesser values of shear bond strength when evaluated on dentinal surfaces prepared with carbide bur. These interrelated findings are of great clinical importance not only in selection of the suitable burs but also in the assortment of suitable self-adhering flowable composites for a particular clinical scenario.

### *Recommendations*

As a well established fact, diamond burs are usually considered superior to carbide burs however; it is not true in every clinical circumstance. In the present in vitro evaluation, the overall breaking SBS was higher in samples those prepared with carbide burs wherein Tetric N Flow expressed highest values among the studied composites. Results also indicated that conventional composites have superior bonding characteristics when compared to self-adhering composites. These findings are imperative and have a clinical applicability in selection of type of burs for critical and prone clinical conditions (like repeated bond failures and micro-leakages). It could efficiently enable clinicians to finalize the appropriate combination of bur type and composite type for a particular scenario.

### *Conflict Of Interest*

Authors stated that there is no any kind of conflict of interest for this study.

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