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# Comparision of Shear Bond Strength of Metal Brackets Bonded On Porcelain Surface Using Nano-Ceramic, Restorative Composite and Conventional Orthodontic Composite

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***Abstract:*** *This compared the shear bond strength of metal brackets bonded on porcelain fused to metal crowns with conventional orthodontic composite Enlight (ORMCO) and a nanoceramic, restorative composite Spectra ST (Denstply).*
***Materials and Methods:*** *Sixty extracted human premolar teeth were collected, stored & mounted with acrylic and were divided into two groups of 30 samples each. Crown preparation was done on the teeth mounted and PFM crowns were fabricated and cemented. Stainless steel brackets were bonded on PFM crowns using conventional composite (ormco) in group I and nanoceramic restorative composite (dentsply) in group II as per manufacturer's protocol.The shear bond strength of the brackets bonded was measured on universal testing machine at the speed of 1.25mm/min. The data obtained was statistically analysed using unpaired 't'test.*
***Results:****The results of the present study revealed that in the majority of samples of Enlight, Ormco (conventional composite), the shear bond strength was more in comparision with nano-filled composite (restorative composite). The results of the present study revealed that conventional orthodontic composite (Group I) showed the mean value of 8.83 ± 2.45Mpa and nanoceramic restorative composite (Group II) showed mean 6.13±2.82. However, these differences were statistically significant (P<0.001).*
***Conclusion:*** *This study concludes that the shear bond strength of Group I with ENLIGHT, conventional composite displayed higher shear bond strength whereas nano-composites, NEO SPECTRA™ values came between the range of 5.9-7.8Mpa suggestive of it's use during bonding of PFM crowns, if supplied in a low viscosity form by the manufacturer*
***Key Word****: Metal brackets, Shear Bond Strength, PFM crowns, Enlight Ormco, Spectra ST Denstply.*

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## I. Introduction

As the number of adults seeking orthodontic treatment increases, bonding of orthodontic brackets to teeth restored with porcelain crowns is a new challenge. Since glazed porcelain surfaces are not amenable to resin penetration for orthodontic bonding.[1]While various types of composites such as microfilled, microhybrid and flowable are available, the latest development in this field has been the introduction of nano-filled composites that are claimed to achieve higher wear resistance and appropriate mechanical properties[2]. They also enhance the hybrid layer, increase marginal seal and reduce polymerization shrinkage due to their higher filler content.[3]

Porcelain surfaces are considered relatively inert in nature (i.e. does not adhere or bond readily to other materials).Chemical alteration of the procelin surface can be achieved by either etching or by changing porcelain bonding affinity to adhesive materials[4]. Some modification have been made in the chemical formulation of theses adhesives as compared to previous generations, which necessitate further studies on their bonding properties[5,6] Silanes also known as adhesion promoters and function by adsorbing onto, and altering, the surface of a solid material (in this case porcelain), by either a chemical or physical process, to increase its interaction with other materials[7]. The aim of this study was to evaluate the shear bond strength of metal brackets bonded on porcelain surface using nano-ceramic restorative composite and conventional orthodontic composite and evaluate the possibility of their clinical application in bonding orthodontic bracket to PFM crowns.[8,9,10]

## II. Material And Methods

Sixty extracted human premolar teeth were collected and stored in normal saline until use. The water was changed weekly to avoid bacterial growth. Teeth with intact buccal surfaces without any evidence of cracks, caries, hypoplastic areas or other enamel abnormalities were selected. Each tooth was then mounted vertically within self-curing acrylic resin. The mounted teeth were divided into two groups of 30 samples each and crown preparation (Figure.1) was performed on the teeth mounted. Porcelain fused to metal (PFM) crowns were fabricated and cemented.

Figure. 1 Crown prepared tooth

The buccal surfaces of PFM crowns were etched with 10% hydrofluoridic acid gel (ANGELUS PORCELAIN ETCHANT) for 1 minute and then dried until a chalky appearance was visible. Thin layer of silance coupling agent (ANGELUS SILANO) [Figure2.] was applied on the etched surface of PFM crowns and light cured according to manufacturer's protocol. Standard stainless steel 0.022" x 0.028" MBT premolar metal brackets (ORMCO MINI) were bonded on PFM crowns (Figure.3) using conventional composite Enlight™ (ORMCO) in group I and Neo spectra™ ST (DENTSPLY) nanoceramic restorative composite in group II, respectively.


**Figure. 2**


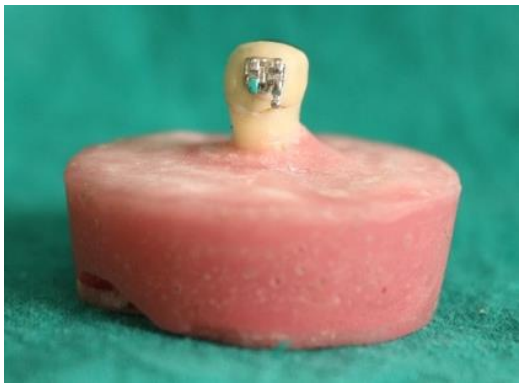

**Figure.3** Metal bracket bonded to PFM crowns

The samples were light cured using a LED light-curing unit as per manufacture protocol. The samples prepared were subjected for shear bond strength measurement to a universal testing machine in a manner that the buccal surfaces of the teeth were parallel to the shearing force. A custom made rod was connected to the machine and an occlusogingival force with a crosshead speed of 1.25 mm/min was exerted onto each sample. The SBS value for each sample was determined and the data obtained was statistically analysed using unpaired 't' test.

**STATISTICAL ANALYSIS**

Descriptive values of the shear bond strength, mean, standard deviation, minimum and maximum values were calculated for each of the various groups of teeth tested. Unpaired 't' test was used to determine whether significant differences existed between the two groups. Significance for all statistical test was predetermined at $P \leq 0.001$.

## III.Results

Descriptive values of the shear bond strength for the two groups are tabulated in Graph 1 and Table 2.

**Graph 1**

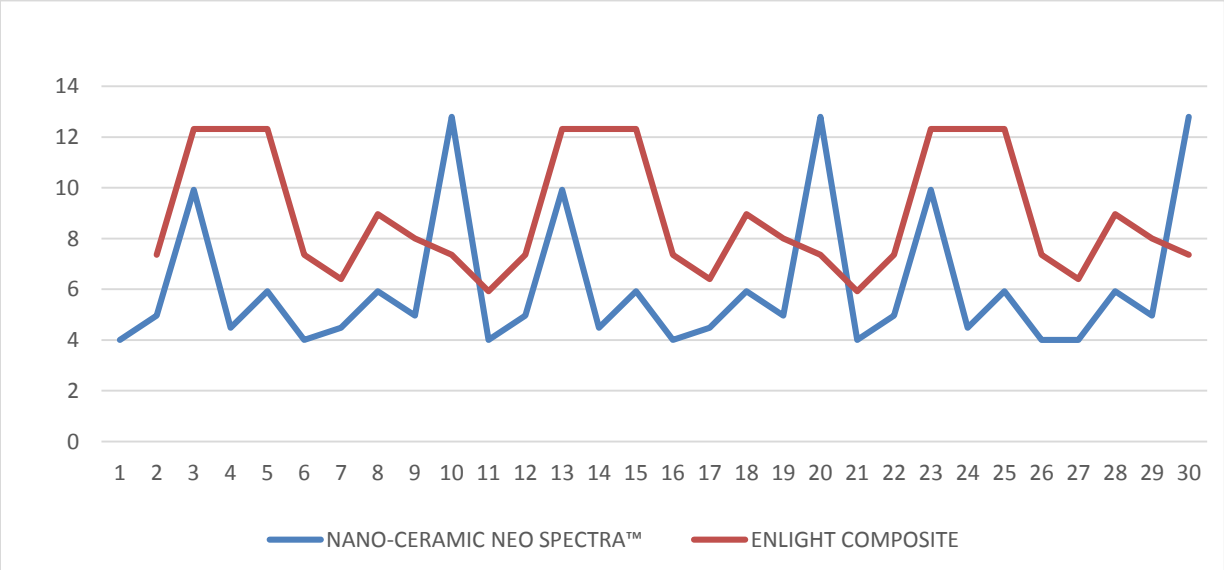


**Table 1**

| GROUP I | BOND FRACTURE LOAD IN $N/MM^2$ OR MPA |
|---|---|
| MEAN | 8.83 |
| STANDARD DEVIATION | 2.45 |
| GROUP II | |

| | |
|---|---|
| MEAN | 6.13 |
| STANDARD DEVIATION | 2.82 |
| P VALUE GP I/II | 0.0002 |
| | < 0.001(HS) |

## IV. Discussion

Sixty extracted human premolar teeth were collected, stored & mounted with acrylic and were divided into two groups of 30 samples each. Crown preparation was done on the teeth mounted and PFM crowns were fabricated and cemented. Stainless steel brackets were bonded on PFM crowns using conventional composite (Ormco) in group I and nanoceramic restorative composite (Dentsply) in group II as per manufacturer's protocol. The shear bond strength of the brackets bonded was measured on universal testing machine at the speed of 1.25mm/min. The data obtained was statistically analysed using unpaired 't' test.

The results of the present study revealed that conventional orthodontic composite (Group I) showed the mean value of 8.83 ± 2.45Mpa and nanoceramic restorative composite (Group II) showed mean 6.13±2.82. However, these differences were statistically significant (P<0.001).

As study conducted by Ostertag AJ, Dhruv VB, Meyer RA regarding bond strength of composites have utilized adhesives with different size/concentration of filler, it is difficult to compare their results accurately [11]. This is further complicated by different medians and thermocycling rounds as showed in the study performed by Jaffer S, Oesterle LJ, Newman SM[12]. The results of this study are consistent with that of Bishara et al. [13]. The nano-composite tested in this study resulted in lower bond strength values than the conventional orthodontic adhesive but demonstrated SBSs which were within the range previously suggested for clinical acceptability by Reynolds[10]. On the other hand, the results of this study were inconsistent with that of Uysal et al., whereby comparison of SBS of a nano-composite (Filtek Supreme Plus Universal) and a nano-ionomer (Ketac ™ N100 Light Curing Nano-Ionomer) with Transbond XT revealed a significantly higher SBS value of Transbond XT [14].

However, such different findings may be due to a number of factors; in the study by Uysal et al., the teeth were polished with nano-fluoridated pumice, which may have interfered with the entrance of nano-filler into the etched enamel surface, and led to decreased bond strength.

The results of the present study revealed that in the majority of samples of Enlight, Ormco (conventional composite) i.e group I, the shear bond strength was more in comparison with nano-filled composite (restorative composite).

Therefore, it can be concluded that there is a significant difference in shear bond strengths of conventional & the nano-composites. According to a study Reynolds et al., an appropriate adhesive for orthodontic purpose should meet a SBS value of at least 5.9-7.8MPa However, the nano ceramic restorative composite also displayed SBS of 6.13 MPa which is higher than the acceptable SBS value required for orthodontic bonding. So, this can be potentially used for orthodontic bonding on PFM crowns.

## V. Conclusion

From the results of this study, the following conclusion can be drawn

- Conventional orthodontic composite (Enlight,, Ormco) showed a higher mean shear bond strength when compared with nano-ceramic composite (Neo spectra, dentsply) with significant difference. However the mean SBS of nano-ceramic composite, dentsply was within the clinically acceptable range for orthodontic bonding to PFM crowns
- This study is suggestive of nano ceramic composite for clinical application during bonding of brackets in orthodontics. However the manufacturer could consider the formulation of Neo, spectra (Dentsply) to reduce the viscosity that can increase the ease of handling the material during orthodontic bonding.
- The nano-ceramic composite showed SBS within the range of 5.9-7.8MPa suggested by Reynolds.
- This study evaluated the comparison of SBS between conventional orthodontic composite and nano-ceramic composite for bonding of metal brackets on PFM crowns. There is a future scope for evolving the properties of newley introduced material in orthodontics.

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