



## Evaluation of Effect of Various Teas on Shear Bond Strength of Composite Restorations: An in Vitro Study.

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### ABSTRACT:

**Background:** Bond strength and durability are critically important for the long-term success of the restorations. Consumption of various foods and beverages may affect strength of composites.

**Aim:** The present study was aimed at evaluating the effect of four types of tea on shear bond strength of composite restoration to enamel.

**Material and Methods:** 50 premolar teeth were taken and embedded in acrylic resin blocks. Labial enamel surfaces were flattened, etched, bonded and restored with composite resin (Tetric N Ceram – Ivoclar Vivadent AG, Schaan, Liechtenstein). The specimens were randomly divided into 5 groups: Group I: Green Tea; Group II: Plain Black Tea; Group III: Black tea with milk; Group IV: Oolong Tea; Group V: Mineral water. The specimens were immersed in respective groups for 15 minutes until 30 days. Universal Testing Machine was used to determine the shear bond strength of composite restoration with enamel

**Statistical Analysis Used:** The values were obtained by using one-way analysis of variance and post hoc test with a significant p value ( $P < 0.05$ ), using Graph Pad Prism software version 6.01.

**Results:** Group II showed highest reduction in bond strength, with a mean value  $7.5 \pm 0.64$  Mpa in comparison with control group mean value  $18.9 \pm 0.72$  Mpa.

**Conclusion:** As pH of tea is decreased, shear bond strength between composite to enamel is decreased.

**Keywords:** Green Tea; Oolong Tea; composite resin; shear bond strength; black tea.

### I. INTRODUCTION

Resin composites became most popular material in aesthetic dentistry because of their excellent aesthetic properties, adequate strength and their ability to be bonded to dentin or enamel. Use of composites has become widespread with increasing aesthetic demand. [1]

Restorations are constantly subjected to variety of foods and beverages in the oral environment, which may affect the aesthetic, physical and mechanical properties such as bond strength, micro hardness, surface roughness and colour stability of composite restoration thereby impairing the quality of restorations. [1, 5]

Bond failure in composites is one of the major drawbacks in its use. Causes of bond failure includes poor operator technique, variation in tooth surface, saliva and blood contamination, characteristic of adhesive etc.[2] Tea is the most widely consumed drink after water in the world. Tea, a beverage produced by steeping in freshly boiled water the young leaves and leaf buds of tea plant, *Camellia sinensis*. [7]

Nowadays, teas have become popular worldwide because of their beneficial effect on both physical and mental health. People drink tea for pleasurable experience that is enjoyed at social gatherings or for stress relief. [17]

Various studies have been conducted to determine the effects of tea on colour stability micro hardness, surface roughness of composite restoration, but to the best of our knowledge no study has evaluated the effect of tea on shear bond strength of nanohybrid composite restoration.

### II. MATERIALS AND METHODS

Fifty freshly extracted human premolar teeth were collected. Teeth with cracks, restorations, decay and surface defects were excluded from the study.

Teeth were embedded in acrylic resin blocks with their roots till cemento enamel junction. All the teeth were flattened using abrasive disk. Stereomicroscope (SZX7 Olympus America Inc., Center Valley, Pennsylvania, U.S.A) was used to check dentin exposure. Then the enamel was etched with 35% phosphoric acid (N Etch, Ivoclar Vivadent, Schaan, Liechtenstein) for 30 seconds, rinsed for 15 seconds and then gently air dried for 10 seconds. Bonding agent Tetric<sup>®</sup> N bond(Ivoclar Vivadent AG,Schaan, Liechtenstein)was applied to the enamel and light cured for 10 seconds with a visible light curing unit(Hilux, Ledmax- 550 Benlioglu,Turkey). Finally, all the tooth samples were restored with nano hybrid composite resin (Tetric N Ceram – Ivoclar Vivadent AG, Schaan, Liechtenstein) incrementally using hollow cylinders made of plastic with internal diameter 3mm and height of 4mm.The specimens were cured for 40 seconds. After polymerisation the plastic tubes were removed.



The pH of teas was determined using a pH meter (Digital pH meter 335, Systronics Ltd, India). pH measured and shear bond strength measured in this study are shown in Table 1. All the specimens were randomly divided into five groups as follows:

Group I: Green Tea; Group II: Plain black tea; Group III: Black tea with milk  
Group IV: Oolong tea; Group V: Mineral water.

Each group comprises of 10 teeth. A 100ml hot water (90°C) is taken in a cup and a tea bag was infused in it for 5 minutes. After 5 minutes of infusion tea bag was removed. The specimens are to be immersed in their respective groups and soaked for 15 minutes daily in group I, group II, group III, group IV until 30 days. Group V specimens were soaked in mineral water for 30 days, which was control group. Between the soaking periods the specimens were incubated at 37°C in artificial saliva.

All specimens were transferred to universal testing machine (Autograph AG-X, Shimadzu, Japan) individually. They were subjected to shear bond strength analysis at a cross head speed of 0.5mm/minute, until fracture had occurred.

Data was analysed by Graph Pad Prism software version 6.01 (Graph Pad Prism Software Inc, La Jolla, CA U.S.A) and summarized by mean  $\pm$  standard deviation for continuous data. The comparison of data was done by means of one-way analysis of variance test followed by post hoc Turkey test, with a significant level set at  $P < 0.05$ .

### III. RESULTS

It was found that the highest reduction in the bond strength was observed in group II ( $7.5 \pm 0.64$  Mpa), followed by group III, IV, I. The maximum shear bond strength was observed in group V ( $18.9 \pm 0.72$  Mpa) [Table 2].

### IV. DISCUSSION

The search for restorative material similar to natural tooth both in function and aesthetics in the oral cavity still remains a leading concern to the dentist. [14]

Resin based composite materials are widely used in restorative dentistry. Composites are becoming more durable with advances in the filler particles, monomer matrices, improved adhesive systems, and polymerization devices. The crucial challenge of using aesthetic restorative materials is to maintain their longevity and aesthetic compliance [1].

Bond strength and durability are critically important for the long-term success of restorations. The strength and durability of bond depends on various factors such as variation in enamel surfaces, poor operator technique, moisture contamination, characteristic of adhesive. [2]

**Table 1: Initial pH value and mean shear bond strength (SBS) values in Mega Pascal's.**

| GROUPS              | INITIAL pH (n=5) | MEAN SBS (n = 10) |
|---------------------|------------------|-------------------|
| GREEN TEA           | 6.7              | 13.24             |
| PLAIN BLACK TEA     | 4.2              | 7.54              |
| BLACK TEA WITH MILK | 4.8              | 10.22             |
| OOLONG TEA          | 5.8              | 11.98             |
| MINERAL WATER       | 6.8              | 18.9              |

**Table 2: Comparison of shear bond strength values in Mpa obtained with different groups in the study.**

| Parameters | N  | Minimum | Maximum | Mean    | Std. Deviation |
|------------|----|---------|---------|---------|----------------|
| I          | 10 | 11.00   | 16.20   | 13.2400 | 1.78836        |
| II         | 10 | 6.60    | 8.40    | 7.5400  | 0.64670        |
| III        | 10 | 9.20    | 11.20   | 10.2200 | 0.69570        |
| IV         | 10 | 10.80   | 14.00   | 11.9800 | 0.91627        |
| V          | 10 | 17.80   | 20.00   | 18.9000 | 0.72572        |

In addition to this, restorations in the oral cavity are constantly subjected to different interactions between foods and drinks consumed, certainly causing changes in mechanical and chemical properties of restoration. The acidity of drinks may ruin the properties of composite resins. [3, 5]

In this study Methacrylate – based nanohybrid composite (Tetric N Ceram– Ivoclar Vivadent AG, Schaan, Liechtenstein) was used. Nano composites are a type of composite in which primary filler size in nm range while



secondary filler clusters are in  $\mu\text{m}$  range with improved hardness fracture toughness and wear resistance. They also possess a higher modulus of elasticity, greater flexural, compressive, diametrical strengths, and high polish ability. Hence nanocomposites are being successfully used as aesthetic materials in both anterior and posterior restorations.<sup>[15]</sup>

A fifth generation bonding system Tetric® N-Bond (Ivoclar Vivadent AG Schaan Liechtenstein), was used to bond composite to enamel. It imparts high bond strength to enamel and dentin.

Tea is the most widely consumed drink after water in the world. Most of the commercial teas derived from dried leaves of tropical bush, *Camellia sinensis*, which belongs to Theaceae family.<sup>[7]</sup> It is an aromatic beverage prepared by brewing the tea leaves in boiled water.<sup>[6]</sup> Tea leaves includes tender stems and buds of tea plant.<sup>[24]</sup> Most predominantly consumed tea is Black tea. The best ingredient of tea is caffeine, which gives the beverage its stimulating character. The most important chemicals in tea are the tannins, or polyphenols, which are colourless, bitter tasting substances that give the drink its astringency<sup>[4]</sup>. Based on manufacturing process tea is classified as Fermented (Black Tea), Semi fermented (Oolong Tea), Unfermented (Green Tea).<sup>[6]</sup>

The present study was performed to determine the effect of these 4 main classes of tea: Green tea, Plain black tea, Black tea with milk, Oolong tea. Mineral water was used as control group. The investigation was designed assuming that a young adult patient receiving composite restoration might consume tea daily and the consumption period would be 15 minutes. Mineral water was chosen as control group to simulate wet oral conditions provided by saliva. In the present study the pH of plain black tea was  $4.2 \pm 0.04$  which is slightly acidic than black tea with milk ( $4.8 \pm 0.06$ ), Green tea ( $6.8 \pm 0.02$ ), Oolong tea ( $5.8 \pm 0.05$ ).

Teeth are continuously exposed to saliva which has buffering capacity. Tea is rich in fluoride ions and increase in resistance to acid dissolution is not understood. Within the scope of knowledge, Tea without milk have a high oxalate content.<sup>[6]</sup> The results of the study showed a direct relationship between initial pH of teas and SBS of composite to enamel tested; lower the initial pH lower the SBS.

All the groups showed significant reduction in bond strength irrespective of their exposure compared with control. The highest reduction in bond strength was obtained with group II followed by group III.

Some studies showed that tea effects on composites by reducing its properties. A study was done based on temperature of beverages on hardness of composite restorations. Dos Santos et al (2010) detected significant degradation of resin matrix upon immersion of coffee at high temperatures.<sup>[5]</sup> Emre Ozel concluded that significant differences were observed among teas in surface roughness of composites. Salivary enzymes, pH changes organic solvents, ionic composition of food beverages or saliva may influence quality of restoration.

Tea has complex composition and its consumption is having some dental effects because of their fluoride content. Citrate and oxalate have been considered as major anions making black tea acidic.<sup>[18]</sup> However addition of milk decreases pH due to formation of calcium oxalates.

Green tea is manufactured from fresh leaves preventing oxidation process of polyphenols. Its pH is nearer to water. Due to decreased content of flavanols, organic acids, its pH is more than black tea.<sup>[19]</sup> Oolong tea is derived when the fresh leaves are subjected to a partial oxidation stage before steaming and drying<sup>[6]</sup>. Oolong tea contains polyphenols which are partially oxidised, similar to black tea. Its pH is slightly more than critical pH of enamel.

Although the effect of teas on adhesive resin is not known, softening of the adhesive resin by black tea may be a possibility and can be evaluated as a causative factor on SBS reduction<sup>[2]</sup>. The reduction of shear bond strength could be associated with the pH values of teas which is least in Plain Black Tea-4.2, compared with Black Tea With Milk-4.8, Oolong tea-5.8, Green tea-6.7.

Chemical composition analysis showed that Tea consists of Catechins, oxy aromatic acids, flavanols, theaflavins, theagallins, thearubigens, alkaloids, sugars, amino acids, vitamin c, riboflavin, dibasic acids, cations, metals.<sup>[4]</sup> Dibasic acids such as oxalic, succinic, malic, citric, quinic, aspartic, glutamic acids make tea slightly acidic.

In the present study, the teeth were exposed intermittently to tea at  $37^\circ\text{C}$  and sugar was not added. Certainly, not everyone drinks tea at this temperature. Some people have tea at higher temperatures near to  $50^\circ\text{C}$ . This may consecutively have a effect on destructive potential of teas on bond strength of composites.<sup>[2]</sup>

As the present study was performed in vitro, the oral environment is lacking. In addition, it is difficult to extrapolate the results of this study to in vivo conditions. Further tests are needed to evaluate the effects of tea on shear bond strength of various composite resins to enamel and dentin using various bonding agents.

## V. CONCLUSION

Within the limitations of the study, it can be concluded that the shear bond strength of composite resin to enamel was reduced, with the consumption of tea beverages having low pH. Plain black tea showed highest reduction in shear bond strength.

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### Conflicts of interest



There are no conflicts of interest.

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