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An *in-vitro* comparison of the shear bond strengths of 5th, 6th, and 8th generations bonding agents

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Abstract

Composite is bonded to the teeth using dentin bonding techniques. The effectiveness and calibre of the bonding system used have a significant impact on the clinical success of composite restorations. Forty-eight recently extracted premolars were selected and divided into the following 4 groups: Group i: Adper single Bond 2, a 5th -generation bonding agent; Group ii: Xeno III, a sixth-generation bonding agent; Group iii: Single Bond Universal, a seventh-generation bonding agent; and Group iv: USA's Scotchbond Universal, an eighth-generation bonding agent. The coronal dentin was exposed with an air rotor. The composite was then restored on the previously exposed dentine surface following the application of the dentin bonding agents. The shear bond strength was then examined using universal testing apparatus. The data were analyzed with the help of statistics. The highest shear bond strength was demonstrated by the 8th generation of bonding agent, subsequently by the 5th, 7th, and least with 6th generation bonding agent (p 0.05). The 8th generation of dentin bonding agents showed the greater shear bond strength to dentin and requires fewer application steps.

Keywords: Agents, Bond Strength, Dentin Bonding

Full length article **Corresponding Author,* e-mail: parul.khare@sharada.ac.in

1. Introduction

Various feed additives contribute to the normalization of metabolism in the body as well as an increase in the body weight, productivity, safety, and resistance of the body to various diseases in poultry [1].However, the complex inclusion of individual feed additives in the diet, such as enzymes, probiotics, and acidifiers, is not always economically justified and can increase the cost per unit of production [2-4]. Therefore, it is advisable to use an optimal dosage of multifunctional feed additives as they can play important roles during body metabolism, which leads to an increase in the productivity of poultry and improvement of livestock safety [2, 5].

According to the published studies, it has been established that the industrial use of multifunctional feed additives based on beneficial bacteria ensures the improvement of zoo-technical and economic indicators of poultry cultivation [6, 7], as well as the quality of the obtained products. Many researchers have confirmed that feeding in the optimal dosage of such additives improves the metabolism in the body of poultry, increases their productivity, and reduces feed costs per unit of production [7]. In studies on complex probiotics, the obtained results show the considerable effect of complex probiotics on the productivity and economic efficacy of poultry farms [8-10]. A new approach in poultry nutrition is

using Enzyme-probiotic complex addition instead of single probiotic supplementation [11-12].

The effect of a newly developed Enzyme-Probiotic complex (Cellobacterin-t) on broiler chickens was studied by Ivanova et al. [13]. They reported an improvement in zoo-technical indicators, quality of meat products, and composition of poultry intestinal microflora. The present study aimed to study the effect of enzymatic probiotic Cellobacterin-t on weight gain and digestibility of nutrients in young brown nick cross to make a conclusive report on the efficacy of this new feed supplement in different strains of poultry.

Creating adhesion between the mineralized tooth structure and the restorative material is a fundamental goal of restorative procedures. One of the key requirements for a restorative material is that it must be able to form a true permanent bond with the tooth structure and must have mechanical qualities like strength. The act of attaching one substance to another is known as bonding. A substance that, when applied to the surface of other substances, can bind them together and prevent separation is known as a bonding agent [1]. After pretreating the cavities with an adhesive system, composite restorations are placed [2].In 1955, Buonocore developed an acid etching method using phosphoric acid. Since then, significant developments have been made over the past few decades. Aesthetic restorations without the need for mechanical retention were introduced when Bis-GMA was bonded to etched enamel [1].The use of fifth, sixth, seventh, and eighth generation bonding systems for dentin adhesives has advanced from the first generation, which had bond strengths of only 1-3 MPa [1,3,4]. Through several generations, dental adhesive systems have changed in terms of their chemistry, mechanism, number of steps, application methods, and clinical efficacy [5]. Numerous studies unmistakably demonstrated that the most recent dentin bonding systems give dentin stronger bonds [1].

The composite is attached to the teeth using dentin bonding systems, and weak bonding systems are one of the issues in dentistry, particularly in prosthetic and restorative procedures, which lead to weak restorations. The effectiveness and calibre of the bonding system used, which creates a durable and strong bond between the composite and the tooth structure, are key factors in the clinical success of composite restorations. Dentin bonding systems' bond strength and microleakage are two crucial characteristics that contribute to the durability of composite restorations [3].Self-etch adhesives eliminate the requirement for a separate acid-etch step in 5th generation bonding because they condition and prime enamel and dentin simultaneously by penetrating and dissolving the smear layer and hydroxyapatite to produce a hybrid zone that incorporates minerals and smear layer. The smear layer merges with the bonding substrate in self-etching adhesive systems [6]. Self-etching adhesives are made of an aqueous solution of phosphoric acid esters, which are functional acidic monomers. Additionally, "6th generation" self-etching primer systems have been developed, which combine the primer and etchant in a single bottle to do away with the need for separate rinsing and drying steps [7,8].

The 7th generation" adhesive systems which combines bonding agent, primer, and etchant into a single bottle and are intended to release fluoride when polymerization is complete [7,8]. The sixth generation was simplified by the seventh generation so that all the components are in a single bottle and the enamel bond is desirable [3]. Dentin bonding agent of the eighth generation operated in both self-cure and light-cure modes. It was a brand-new method of administering a single dose that stops solvent evaporation, which is a common issue in many other bonding systems [9].

This research was done to estimate the shear bond strengths of different bonding agents.

2. Materials and methods

48 recently extracted, healthy human teeth were used in this investigation. The teeth were embedded vertically in cold-cure acrylic resin. Under constant water spray, the occlusal surfaces of the teeth were flattened, revealing a flat dentin surface.

For the application of various bonding agents, the prepared samples were divided into 4 experimental groups, each with 12 samples:

• Group i: Adper single Bond 2 -3M ESPE, a fifth-generation bonding agent.

Group ii: Xeno III (Dentsply, India), a sixth-generation bonding agent.

• Group iii: Single Bond Universal by 3M ESPE, a bonding agent of the seventh generation.

• Group iv: Scotchbond Universal's eighth-generation bonding agent (3M ESPE, USA).

The bonding agent was applied to each group's dentine surface in accordance with the manufacturer's instructions, and then it was light-cured. Later the composite was applied in two-mm increments and light cured for 30-seconds. On each sample, a shear bond strength analysis was performed. The shear bond strength was examined using an INSTRON universal testing machine (UTM). It was noted how much shear force was required to rupture the specimen's bond. converted from kgf to N, the bond strength, after being calculated in kgf. The 22nd edition of the Statistical Package for Social Sciences (SPSS) was used to tabulate and statistically analyse the collected data using one-way analysis of variance and post hoc Tukey's test.

3. Results and Discussions

Test used- ANOVA

The average shear bond strength for each of the 4 bonding agents is shown in Table 1. The 8th generation had the highest bond strength (38.9753N), followed by the 5th generation (24.5350N), the 7th generation (20.9768N), and the 6th generation (15.6890N) with the lowest bond strength. Statistics showed that the variation was considerable (p 0.001).

Table 2 indicates the intergroup comparison of shear bond strength. The bond strength was significant for group I over IV and Group II over group IV and Group III over IV.

Table 1: Mean shear bond strength for all the groups

Group	Mean± SD (in Newtons)	p
i- 5th generation	24.5350±7.42474	0.001
ii- 6th generation	15.6890± 4.75932	
iii- 7th generation	20.9768±5.97855	
iv- 8th generation	38.9753±12.43425	

Table 2: Intergroup comparison with Test used- post hoc Tukey's and ANOVA

groups		significance
Group I vs II	0.275	NS
Group I vs III	0.873	NS
Group I vs IV	0.032	S
Group II vs III	0.764	NS
Group II vs IV	0.001	S
Group III vs IV	0.002	S

The development of new adhesive dentistry products is being driven by the demand from patients for aesthetically pleasing restorations and the search for restorative materials that can offer long-term stability. For adhesive restorations to last a long time, the strength of the bond between the resin and tooth structure is crucial [6].Adhesiverestorations strengthen compromised tooth structure by adhering firmly to it. Material (adhesive system), substrate depth, and adhesive/depth interaction are all factors that affect the shear bond strength [10].Three dissimilar 5th generation dentin bonding agents were evaluated by Gangurde et al for their shear bond strength. In comparison to Single Bond, Prime, and Bond NT, they found that Excite dentin bonding agent displayed the highest shear bond strength values [1]. The shear bond strengths of 6th generation and 7th generation bonding agents to dentin were compared by Nair et al. 7th generation adhesives are superior to 6th generation adhesives for bonding dentin, because they require fewer steps, less time, and have stronger bonds [5]. When compared to 5th and 6th generation bonding agents, Deepa et al. found that all-in-one systems had lower bond strengths [10]. The shear strength of three distinct generations of bonding agents was compared by Shafigh et al. Similar to our findings, they came to the conclusion that bond strength was higher in eight-generation bonding systems than in the fifth and seventh generations [3]. In their study, Yaseen and Subba Reddy found that in primary teeth, the 7th generation has higher shear bonds than the 6th generation [11].The shear bond strengths of the fifth, sixth, seventh, and eighth generations of bonding agents are compared by Chauha et al. They concluded that the 8th generation of bonding agent had the maximum shear bond strength, followed by the fifth, seventh, and sixth generations [2]. This is consistent with what we discovered [8]. Ganesh et al. found higher bond strength with the 8th generation compared to other generations [4], which is consistent with our findings.

Kamble et al found that, 8th generation dentine adhesive had highest tensile bond strength compared to 6th and 7th generation dentin bonding agents [12]. Meshki et al found that push-out bond strength of the 8th generation bonding system was higher than 5th, 6th and 7th generation bonding agents [13]. Jamadar et al stated that, pH values did not influence the shear bond strength significantly in the tested (6th and 7th generation) adhesive systems [14]. Sachdev et al found that greatest mean shear bond strength to dentin of primary teeth was exhibited by eighth generation dentin bonding agent due to its less time, fewer steps and higher shear bond strength [15].

Uday Kamath and Arun discovered that the eighth-generation bonding agent had the least microleakage, followed by the seventh and 6th [9]. Microleakage in 5th and 7th generation bonding agents was examined by Varma et al. They discovered that Single Bond Universal-treated preparations displayed less microleakage than Single Bond 2 [7]. At the coronal margins, 7th generation adhesives demonstrated significantly less microleakage than did 5th generation adhesives. This is because Single Bond (5th generation), which uses alcohol and water as solvents in its composition, demonstrates how the primer and adhesive components of the traditional three-step adhesive system function. Alcohol in the adhesive improves diffusion into the dentin, which encourages adhesion. The 7th generation eliminates the need for separate etching, rinsing, and mixing for the light-cured products by combining the acid, primer, and resin in one bottle. The smear layer serves as a bonding substrate for the 7th generation bonding agent [7]. In comparison to the 6th and 7th generation dentin bonding agents, Somani et al. found less microleakage with 8th generation dentin.

When enamel is conditioned with phosphoric acid for the 5th -generation resin penetrates to form "prism-like" resin tags in these microporosities. This results in a primarily micromechanical enamel bonding [2]. Our study's findings show that the eighth-generation adhesive is superior to the 5th -generation and seventh-generation bonding agents (p 0.05), despite the fact that both of them contain cross-linking monomers, functional monomers, inhibitors, solvent, and activators. This is because the eighth-generation adhesive contains a greater number of microsized cross-linking functional monomers. There is no need for a waiting period or new application, which reduces confusion and saves time. Numerous studies have noted that the chemical makeup of adhesive systems affects their clinical success. Eighth-generation adhesive's microsized cross-linking agents and MDP monomers encourage chelation with calcium and the formation of hydrogen bridges with dentin components, which may be a significant contributing factor to the eighth generation's higher shear bond strength values.With the eighth generation, we discovered higher shear bond strength. The results needed to be confirmed by more research.

4. Conclusions

According to the limitations of the current in vitro study, the 8th -generation bonding agent indicated a higher mean bond strength to dentin than the 5th, 6th , and 7th -generation bonding agents.

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