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COMPARATIVE EVALUATION OF SHEAR BOND STREANGTH OF SEVENTH GENERATION ADHESIVE SYSTEM TO WMTA AND BIODENTINE: AN IN VITRO STUDY

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ABSTRACT:

Aim: This study aimed for similar assessment of shear bond quality of seventh generation bonding system with MTA and Biodentine. Materials and Methods: 80 acrylic blocks with central hole of 4mm diameter & 2mm height were prepared. 40 acrylic cylindrical blocks were completely loaded up with MTA (Group 1) & another 40 with Biodentine (Group2). Samples were put away for 72 hours at 37°C with 100% humidity. Samples from each group were randomly divided into different 2 groups of 20 each Group 1A: MTA WITH BONDING AGENT ;Group 1B: MTA WITHOUT BONDING AGENT (control);Group 2A: BIODENTINE WITH BONDING AGENT; Group 2B: BIODENTINE WITHOUT BONDING AGENT (control).A composite material (Clearfil Mejesty) applied into plastic matrix of cylindrical shaped with an internal diameter of 2mm and height of 2 mm. light-emitting diode light-curing unit was used with an intensity of 1,200mV/cm2 for 20 seconds for Light curing. The polymerized samples were put away for 24 hours in 100% relative humidity at 37°C. In universal testing machine samples were made sure about in a holder set on the platen at that point sheared with a blade edge sharp edge At Cross head speed: 1 mm/minute. Examination of fractured samples test were done under a stereomicroscope. Analysis of obtained Data were done Results: At the

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point when shear bond qualities of adhesive system were analyzed, no noteworthy contrasts were found between both control groups. (p > .05).the bond strength of group 2A introduced altogether higher bond quality values (48.15 MPa) than group 1A (28.51Mpa) (p < .05). Most of the observed modes of failure were cohesive than that of adhesive in both group 1A and 2A.Comparatively Cohesive fractures were more seen in Biodentin than that of MTA.Group 1B and group 2B(control groups) showed more adhesive failure compare to cohesive and mixed.

Keywords: Adhesive Sysytem,Biodentine,Bonding Agent,Composite

Abbreviations: MTA,Mineral Trioxide Aggregate.VPT,Vital Pulp Therapy

I. INTRODUCTION

Vital pulp therapy (VPT) is outlined as a treatment that aims to protect and keep up pulp tissue that has been compromised however not destroyed by decay, trauma, or restorative procedures during a healthy state. Important consideration for the success of VPT's condition of the pulp tissue i.e. signs and symptoms of reversible pulpitis (1); Age of pulp. VPT ought to be performed solely in young patients thanks to the high healing capability of pulp tissue compared to older patients (2,3),An adequate blood supply & presence of a healthy periodontium. (4, 5) An appropriate dressing material. Pulp capping material ought to be biocompatible, noncytotoxic, and antibacterial.(6) with appropriate coronal seal. The prognosis of VPT is considerably reduced in cases with inadequate coronal seal & subsequent microorganism micro leakage. (7)

Since its presentation in 1993 by Torabinejad Mineral Trioxide Aggregate (MTA) has quickly picked up acknowledgment in dentistry (8). However, MTA displays chief restriction such as higher setting time, difficult handling properties, and potential of discoloration of dental tissue (9,10). Recently, Bio dentine (Septodont, Saint-Maur-des-Foss´es, France) is a new tricalcium silicate-based restorative material is introduced with main component i.e. tricalcium silicate, calcium carbonate and zirconium oxide and liquid contains calcium chloride with a water-lessening specialist. Shorter setting time is achived by addition of calcium chloride along with accelerated rate of early strength. Thus increased viscosity and its decreased setting time (12 min approximately) gives upper hand for biodentine over MTA. Nowicka et al. (11 followed by direct capping with MTA and Biodentine in human teeth; evaluation of the pulp-dentin complex was carried out for radio graphical, histological and clinical responses. Clinically they found comparable efficiency and recommended that Biodentine might be viewed as a substitute to MTA in pulp capping treatment in the course of vital pulp therapy.

When considering the possibility of success in vital pulp therapy Along with pulp capping agent; quality of final restoration is relevant. Cox et.al (1985) observed that substandard restorations, which allowed diffusion of microorganisms and their byproducts, results into failure of conservative pulp therapy in long term observation (12).

In extended follow-up of conservative pulp treatment made due to caries removal Barthel et al,(2000) found momentous higher success of pulp capping when final restorations were placed instead temporary restorations which showed tendency to the higher failure rates than permanent restorations(13). Bearing in mind such vital treatments in areas where esthetics is concerned composite resin restorations plays vital role. Proper bonding of composite resins to pulp capping biomaterials produces the adhesive joint, which is proficient of spreading stress comparatively uniformly over the entire region of the bond Hence bonding between composite materials and pulp capping agents, has imperative role in quality of filling and treatment effects(14). However, the prospective of restorative materials to

attach MTA and Biodentine with adhesive systems for the purpose of outcome comparison is not well known. The drive of this study was to compare and evaluate the shear bond strength of seventh generation bonding system with MTA and Biodentine.

II. MATERIALS AND METHODS

3M ESPE SINGLE BOND UNIVERSAL ADHESIVE (3M Deutschland-Germany) were tested in this study and applied as recommended by the manufacturers. The materials used are listed in (Table 1)

Specimen Fabrication

A total of 80 acrylic blocks comprising a central hole with a 4mm diameter and a 2mm height were prepared. MTA and Biodentine was mixed according to the manufacturer's instructions and 40 acrylic blocks were fully occupied with MTA (Group 1) and another 40 with Biodentine (Group2). Then, the specimens were stored at 37∘C with 100% humidity for 72 hours to encourage setting. samples from each group were randomly selected and distributed into 2

TABLE 1. MATERIAL USED IN STUDY

MATERIAL	COMPOSITION	MODE /STEP FOR APPLICATION
MINERAL TRIOXIDE AGGREGATE (white MTA angelus)	Tricalcium silicate, bismuth oxide, dicalcium silicate, tricalcium aluminate, calcium sulfate dehydrate or gypsum	Mix powder/liquid ratio: 1/3.
BIODENTINE(septodent,saint-maur-des-fosses codex, france)	**Powder** Tricalcium silicate, dicalcium silicate, calcium carbonate and oxide, iron oxide, and zirconium oxide **Liquid** Calcium chloride and hydrosoluble polymer	Five doses liquid and powder supplied for 30 s with a mixed amalgamator
3M ESPE SINGLE BOND UNIVERSAL ADHESIVE ,3M Deutschland-German.y	10-Methacryloyloxydecyl dihydrogenphosphate (MDP), bisphenolA-glycidyl methacrylate (bis-GMA), HEMA, hydrophobic dimethacrylates, dicamphoroquinone, ethanol, water, and silanated colloidal silica	(1) Apply bond for 10 s. (2) Dry with mild air for 5 s. (3) Light-cure for 10 s.
COMPOSITE (CLEARFIL MAJESTY), Kuraray Noritake Dental Inc., Okayama, Japan)	Silaned barium glass filler, pre-polymerized organic filler, bisphenol A-glycidyl methacrylate (bis-GMA), hydrophobic aromatic dimethacrylate, and dicamphorquinone	Light-cure for 20 s

different groups of 20 each: Group 1A: MTA with bonding agent; Group 1B: MTA without bonding agent (control);Group 2A: Biodentine with bonding agent; Group 2B: Biodentine without bonding agent (control).A composite material (Clearfil Mejesty, Kuraray Noritake Dental Inc, Okayama, Japan) was applied into a round and hollow molded plastic framework with an inside distance across of 2mm and a tallness of 2 mm. Light curing was directed with light-curing unit (LED)with an intensity of 1,200mV/cm2 for 20 seconds.

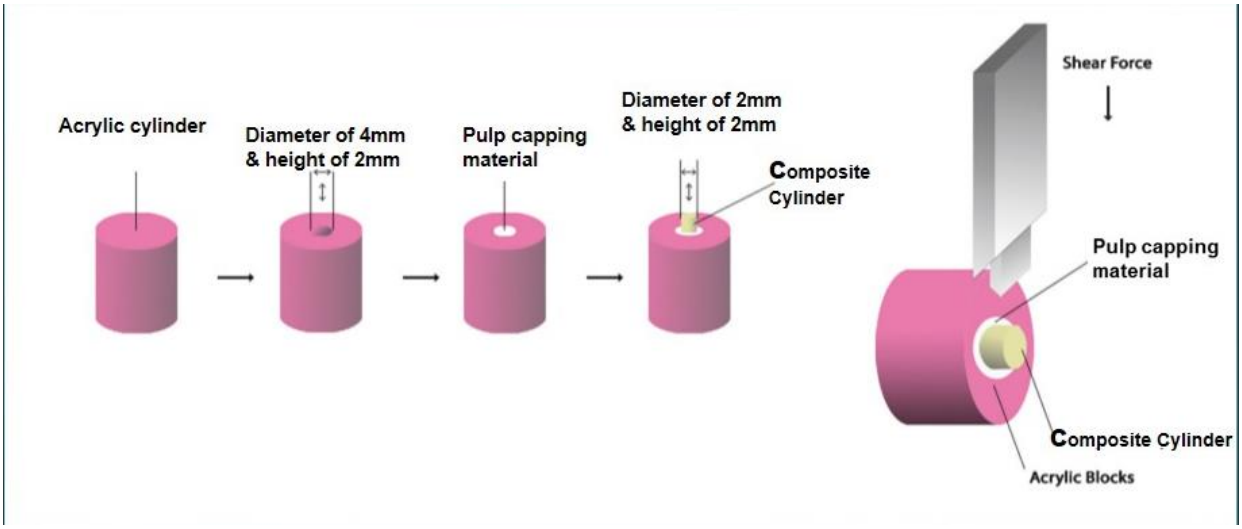

Fig 1.Diagramatic representation of specimen fabrication

Shear Bond Strength Test.

The polymerized samples were put away in 100% relative humidity at 37°C for 24hours. For shear bond quality testing, the samples were made sure about in a holder put on the platen of the testing machine and afterward sheared with a blade edge cutting edge on an all inclusive testing machine ACME Engineers, India.Model No. UNITEST-10. Accuracy of the machine: ±1%,At Cross head speed: 1 mm/minute. Shear bond strength in MPa was calculated by dividing the peak load at failure with the specimen surface area.

Fracture Analysis.

Fractured test samples were analyzed under a stereomicroscope at an magnification of ×25 (Stemi 2000C: Carl Zeiss, Gottingen, Germany). Fractured samples were delegated as follows: cohesive failure completely within pulp capping agent, cohesive failure entirely within composite resin material, adhesive failure that happened at the pulp capping and restorative material interface, or mixed failure when 2 modes of failure occurred simultaneously. Fracture analysis was achieved by a single observer who was completely uninformed about the experimental groups. Fracture analysis was performed by a solitary observer who was totally uninformed about the trial gatherings

Statistical Analysis.

One-way analysis of variance was utilized to identify contrasts in bond quality among the test samples. Post hoc comparison were performed utilizing the the Scheff´e test.

III. RESULTS

The mean values and standard deviations of shear bond strengths are given in Table 2.

When shear bond strengths of adhesive systems were compared, no significant differences were found between both control groups. ($P > .05$).the bond strength of group 2A presented significantly higher bond strength values (48.15 MPa) than group 1A (28.51Mpa) ($P < .05$).

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Table 3 shows the fracture modes of the experimental groups Most of the observed modes of failure were cohesive than that of adhesive in both group 1A and 2A. Comparatively Cohesive fractures were more seen in Biodentin than that of MTA.Group 1B and group 2B(control groups) showed more adhesive failure compare to cohesive and mixed.

III.DISSCUSSION

Mineral trioxide aggregate (MTA) is a mineral powder. It consists of fine hydrophilic particles that set in the presence of moisture [15]. The different employments of MTA in an assortment of surgical and non-surgical endodontic applications have been broadly revealed (15,16,17,18,19,20) . This is chiefly because of its array of beneficial features: (1) able to stimulate cytokine release from bone cells, thereby inducing hard tissue formation; (2) have a dentinogenic effect on the pulp; (3) possess antimicrobial properties; and (4) able to maintain pulp integrity after pulp capping and pulpotomy without cytotoxic effects [15,17,19.21-26] An especially valuable clinical application is that rasin based helpful materials can be applied legitimately on set MTA(15).

Table 2. Mean shear bond strength values of adhesives (MPa) to WMTA and Biodentine

Groups	N	Mean ± SD
GROUP 1 A (MTA) **GROUP 1 B** (C)	20 20	6.16 ± 2.49 **0.22 ± 0.18**
GROUP 2 A (BIODENTINE) GROUP 4 B (C)	20 20	**14.93 ± 7.70** 0.40 ± 0.65

This is particularly significant in pediatric dentistry and where isolation is troublesome due to diminished clinical advances and application of time. Be that as it may, data is rare on the adhesion of resin based materials to MTA. As of late, Biodentine (Septodont, Saint-Maur-des-Foss'es, France) is another tricalcium silicate-based therapeutic material has been presented. The fundamental part of Biodentine powder is tricalcium silicate,with the expansion of calcium carbonate and zirconium oxide. The fluid is an answer of calcium chloride with a water-reducing agent. Inclusion of calcium chloride brings about shorter setting time, as it likewise quickens the pace of early quality advancement. In this manner, the main points of interest of Biodentine over MTA are its more noteworthy i.e thickness and its shorter setting time (12 min around). It has been shown that Biodentine initiated a viable dentinal bonding when applied legitimately to precisely uncovered mechanically exposed pulps (27). Since Biodentine is suggested for use as a dentine substitute under rebuilding efforts, the bond quality between restorative materials and Biodentine is significant for the nature of filling. On the nature of fillings, the bond quality between two restorative materials is of foremost significance. It has been evaluated that a bond quality extending from 17 to 20 MPa might be required to oppose contraction powers adequately to deliver gap free restoration edges (28,29).

Table 3. Failure modes of the specimens after shear bond test bond.

GROUPS	ADHESIVE	COHESIVE	MIXED	N
GROUP 1A GROUP 1B (C)	07 18	10 02	03 00	20 20
GROUP 2A GROUP 2B (C)	02 16	**14** 03	04 01	20 20

In the context of the present study, only the shear bond strength result attained with seventh generation bonding system exceeded this value range. In other words, this study showed that the shear bond strengths of seventh generation adhesives capable of producing gap-free restoration margins. . In this study, the bond strength of a resin composite when bonded with seventh generation bonding agent values ranged from 16.21 to 21.53 MPa with MTA and Biodentine showed 15.33 to 31.15 MPa fracture analysis indicated adhesive, cohesive, and/or mixed fracture, contingent upon the cement tried. Right now, general pattern was watched; samples that gave lower bond quality flopped more at composite resin and pulp capping material interface (adhesive). Then again, samples with higher bond quality failed all the more durably in pulp capping material.

It is suggested that at least 72 hours are necessary to achieve the desirable seal ability of MTA.[15] Odabas et al evaluated the SBS of composite to Biodentine after 2 time intervals (ie, 12 minutes and 24 hours and obtained an increased SBS value for the 24-hour period[30]. Hence to achieve proper strength in present study MTA and Biodentine specimens were stored for 72 hours at 100% humidity to allow complete hardening of the materials.

The large disparity in bonding performance among the adhesives can in part be ascribed to the influence of the pH value, the influence of the solvent, and the influence of filled/unfilled adhesives. 3M ESPE Single Bond Universal Adhesive classified as strong self-etch adhesives with <1 ph. It has water and ethanol as a solvent and it is unfiled adhesive system. Bond strengths of filled adhesive to WMTA is better than the unfilled adhesive system. As for means to improve bonding between unfilled adhesives and the rigid tooth substrate, Pashley *et al*. [31] suggested applying a second layer of the unfilled adhesive after light curing the first layer.

IV. CONCLUSION

This in vitro study found significant differences between shear bond strength of seventh generation adhesive system with MTA and Biodentine. However, Biodentine has shorter setting time than MTA (12 min); the highest bond strength value was obtained Biodentine with seventh generation adhesive. Then again, in view of the varieties in the structure of various resin composites and adhesive system, various outcomes could be accomplished. The adhesive system didn't influence the bond quality of Biodentine. Further examinations are required for better comprehension of the adhesion mechanism of adhesive system to Biodentine

V. FUTURE SCOPE

Enhanced Properties of Pulp Capping agents such as MTA and Biodentine along with suitable resin based restoration with adhesive system which shows better adhesion and high sheer strength will provide promisable success in VPT's.

Conflict of Interest: No conflict of interest

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