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SHEAR BOND STRENGTH OF PULP CAPPING MATERIALS TO DENTIN AFTER ONE DAY: MTA VERSUS BIO-DENTIN

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ABSTRACT

Aim of the study: evaluate and compare shear bond strength of MTA and Bio-Dentin to dentin after one day.

Materials and Methods: Thirty upper premolars were selected and sectioned1 mm above the level of pulp horns to expose much dentin, specimens were randomly assigned into three groups, n=10 each. MTA, Bio-Dentin and calcium hydroxide (control) were mixed then filled in tubes [diameter & height = 3mm] then applied on dentin surfaces. After one day, the shear bond strength was tested using a universal testing device. A Stereo microscope was used to assess failure modes.

Results: After one day, setting of these capping materials, shear bond strength of MTA and Bio-Dentin were significantly different from that of calcium hydroxide. However, shear bond strength of MTA and Bio-Dentin were not significantly different. Calcium hydroxide showed 100% adhesive failure, Bio-Dentin showed 12% mixed failure while MTA showed 15% mixed failure.

Conclusion: After one day setting, MTA and Bio-Dentin showed shear bond strength higher than that of Calcium Hydroxide with some precedence to Bio-Dentin.

KEYWORDS: MTA, Bio-Dentin, Shear Bond Strength, Pulp Capping Materials.

INTRODUCTION

Direct pulp capping is an optional treatment to preserve the pulp vitality. Placement of a capping material directly over an exposed pulp may allow healing and deposition of repetitive dentin [1].

The capping material of choice should be bio-compatible, allowing dentin formation, preventing any bacterial leakage and have the ability to adhere to both dentin structure and the restorative material[2]. For years and years calcium hydroxide was used as a direct pulp capping material with

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considerable success rate[1,2]. Yet, calcium hydroxide has drawbacks like of adhesiveness, higher solubility and defective reparative dentin. Mineral trioxide aggregate (MTA) is a calcium silicate-based material has many uses in endodontics including direct pulp capping with a high success rate [3, 4, 5]. However, MTA possesses some disadvantages like bad handling, tooth discoloration, extended setting time [6], relatively poor adhesion [7] and a protective lining material is needed over MTA to prevent its displacement.

Bio-Dentin is a fast-setting calcium silicate-based cement has been promoted in use for direct pulp capping [8]. Twelve minutes are enough for its initial setting time[9]. The physical properties and dentin adhesion of Bio-Dentin are better than MTA[8, 10].

One of the needed features of direct pulp capping is dentin adhesion [2] so bond to dentin (shear bond) after early setting should be tested. According to, our study aimed to evaluate shear bond strength to dentin of MTA, Bio-Dentin and calcium hydroxide after one day of placement.

MATERIAL AND METHODS

Thirty upper premolars free from caries, restorations or cracks and extracted for orthodontic treatment were gathered and cleaned in ultrasonic cleanser. Each premolar was sectioned horizontally 1mm above the level of the pulp horns (Fig. 1) with a diamond bur (Mani, Japan). The sectioned samples were fixed in a poly vinyl rings by the aid of self-cure acryl (Acrostone, Egypt). The samples were divided into 3 groups (n=10), Bio-Dentin (Septodont, France), MTA (Cerkamed, Poland) and calcium hydroxide (Life, KERR, USA).

According to the manufacturer's instructions, the capping materials were mixed. Each mix was filled in a plastic tube (3x3mm). These tubes were placed on the dentin surfaces. All samples were incubated at 37^{o}C and 100% humidity (Jouan Incubator, UK).

After one day of setting, a universal testing device (EZ-S, Japan) was used to test the shear bond strength. The plunger tip was introduced as close as possible to tube-dentin interface with 0.5 mm/min preadjusting speed until failure (Fig. 1). Software was used to compute the shear bond strength in mega pascals. A stereo microscope at 20% magnification

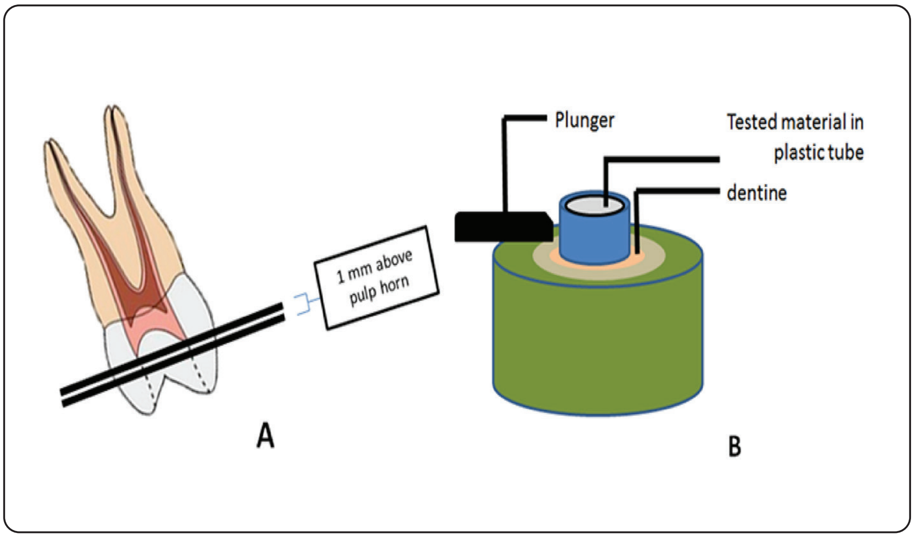

Fig. (1)

was used to assess the failure modes (Motic S-20-10, China).

Price et. Al [11] categorized the failure modes into three categories:

1. Failure at the material-dentin interface greater than or equal 70% of adhesive failures.
2. Failure inside the material greater than or equal 70% of cohesive failures and failure at less than 70% of the de-bonded region accounts for mixed failure.

Kruskal Wallis test was used to statistically analyze. Our data standardized a significant level at P Valve of 0.05.

RESULTS

After one day of placing the capping materials, shear bond strengths of MTA and Bio-Dentin were not significantly different (P > 0.05) (Table 1). Shear bond strengths of MTA and Bio-Dentin were significantly stronger than calcium hydroxide (p<0.05).

	Shear bond strength (After one day of setting)
Calcium hydroxide	0.33 ± 0.09
Bio dentine	1.15 ± 34
MTA	1.06 ± 0.42
p - value	< 0.01

Failure Mode

After one day setting, all calcium hydroxide samples showed adhesive failure, however MTA and Bio-Dentin showed mixed failure (Bio-Dentin 12% - MTA 15%) (Fig. 2)

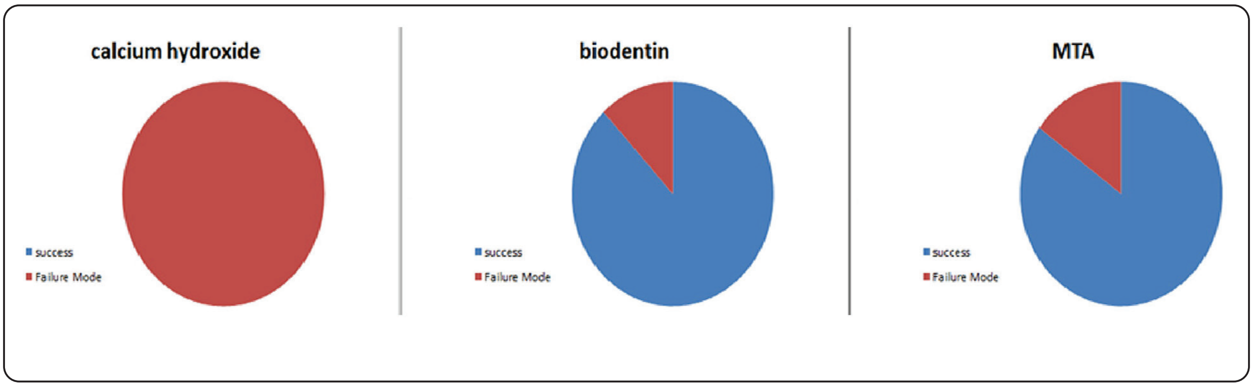

Fig. (2) Modes of Failure

DISCUSSION

After direct pulp capping, the tooth should be restored with a final restoration at once, so adhesion of a capping material to Dentin structure could be investigated as soon as possible. Yet preliminary testing was failed at one, two or three hours. Accordingly, shear bond strength was tested after one day of placement.

Capping materials could be displaced during the final restoration placement so it should be protected with a glass ionomer liner.

According to our results, MTA & Bio-Dentin showed increased shear bond strength after one day setting with some mixed failure. These results are in-accordance with Kaup et. al [7]. They studied the shear bond strength of Bio-Dentin at 2 days, one week and two weeks and concluded that the shear bonds significantly increased by the time. However, this increase was scant and not able to resist forces of restoration [12, 14].

It is possible that adhesion to explain the bond strength of Bio-Dentin and MTA chemical and/or micromechanical adhesion might be produced on calcium silicate cement-dentin [12, 14]. By producing hydroxyapatites, calcium silicate cement may chemically adhere to dentin[12]. Additionally, physical adaption [13] and penetration in dentinal tubules would be predicted to increase calcium silicate's retention to dentin. High PH of hydrated Bio-Dentin may cause dentin to denaturize and become more permeable [14] while calcium silicate's flowable consistency may facilitate its entry into dentinal tubules and cause micromechanical retention [14].

MTA may cling to dentin by a similar chemical reaction and micromechanical retention method.

CONCLUSION

After one day setting, MTA and Bio-Dentin showed shear bond strength higher than that of Calcium Hydroxide with some precedence to Bio-Dentin.

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