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Shear-Bond Strength of Theracal LC, Dycal and Biodentin Liners to Resin Composite

Ula A Fathi*, Eman Adil Abdul Qadir, Jumana Abdulbari Abduljawad

Department of Conservative Dentistry, College of Dentistry, University of Mosul, Mosul, Iraq

ABSTRACT

Aim: Assessment of shear bond strength of different pulp capping materials (chemical and light cured Dycal, Biodentine and TheraCal LC) to composite resin restoration.

Materials and Methods: 40 acrylic blocks with cylinder holes measuring 5×2 mm3 each were prepared. The holes were filled with pulp capping materials, on each pulp capping material composite resin restoration was applied. Then shear bond strength was evaluated by the universal testing device. Analysis of data was done by one way "ANOVA" and "post hoc Tukey's test". Results: shear bond strengths of different pulp capping materials were significantly different (P<0.05). The lowest bond strength was revealed by chemical cured dycal while the highest bond strength was revealed by light cured dycal.

Conclusion: Type of pulp capping materials plays an important role in achieving proper bond to composite resin restoration.

Key words: Theracal LC, Biodentine, Calcium hydroxide, Shear bond strength

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Corresponding author: Ula A Fathi

e-mail: ulaa.fathi@uomosul.edu.iq

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INTRODUCTION

Deep cavities are treated with protective dental liners to keep the pulp from external stimulant and promote growth of reparative dentin. These substances have ability to block dentinal tubules and guard the pulp against microbial attacks, Thermomechanical stimuli, therapeutic effects, and irritants [1]. In dentistry, vital pulp therapy is referred to as a process intended to keep the tissue of the pulp that has been affected but not damaged by bacteria and different external factors. Previously, calcium hydroxide was used to administer this therapy [2]. calcium hydroxide (dycal) is a common pulp capping material. Unfortunately, it has high solubility and pH which forms a necrotic area at the liner–cavity interface. As bioactive tricalcium silicate cements such as Biodentine and TheraCal LC have a potential for remineralization, better mechanical properties, shorter setting time and easy application, it makes them suitable for capping of the pulp and as a cavity base/liner [3]. Bioactive liners under composite would be therapeutically more favorable than glass ionomer liners, comparatively; bioactive liners were more remineralizing and physiologically well-tolerated by the pulp tissue [4]. TheraCal LC is a newly developed resin modified calcium silicate that can be utilized as a liner under different restorations and cements as well as a pulp capping agent. In comparison to calcium hydroxide-based materials, it exhibits a physiochemical bond to dentin and apatite formation that is faster with respectable compressive strength [5]. Recently, biodentine has been employed as a dentine substitute material under composite restorations. Major components of Biodentine are zirconia carbonate and tricalcium silicate. After setting, it produces calcium hydroxide and has the ability to induce mineralization. Therefore, using Biodentine as a base or liner instead of glass ionomer cement may be advantageous. Compared to fluoride ions, silica is a more potent inducer of dentine matrix remineralization [6]. The goal of the current study is to assess the shear bond strengths of Biodentine, Light-cured Dycal, Chemical-cured Dycal, and Theracal LC when they are adhered to resin composites using a universal adhesive.

MATERIALS AND METHODS

40 blocks made from fast setting acrylic was prepared

(N=40) in the center of each acrylic block there is a cylindrical hole of (2 mm height and 5 mm diameter) were prepared by using stainless steel mold [7]. The samples then divided into four subgroups 10 samples for each according to the type of liner material used to fill the holes on the acrylic blocks surface as following:

Group I: Theracal LC resin modified calcium silicate pulp capping (BISCO, USA).

Group II: Visible light-cured calcium hydroxide dycal liner (Cal CLTM PREVEST, DenPro, India)

Group III: Chemical cured calcium hydroxide dycal liner (DENTSPLY, Canada)

Group IV: biodentine (Septodont, France)

For group I and II we put TheraCal LC and light-cured calcium hydroxide liner in 2 increments of 1 mm thick each into the acrylic blocks then curing each layer as the manufacturer stated time utilizing a LED light-curing unit (woodpecker, china). While in-group III we put the chemical-cured (CC) calcium hydroxide after mixed according to manufacture instruction by mixed equal amount of both base and catalyst on the paper pad and mix thoroughly to achieved uniform color. While in-group IV we put the Biodentine after mixed the capsule in the amalgamator for 30 seconds then inserted into the acrylic blocks cylindrical holes and let them set.

Restorative material placement

The surface of the liner was etching with phosphoric acid gel"37%" (DLine, EU) for 15 seconds. Then bonding (One Coat Bond SL, COLTENE) was added to the etched surface and cured for 20 seconds. After bonding a cylindrical shape tube with a dimension of (4 x 4 mm) fixed on center of the bonded liner surface by orthodontic wax. Then composite restorative material (PESIDENT DENTAL GmbH, Germany) was packed in to the molds in two increments and light cured for 30 seconds with tip of the light cure unit was placed in contact with the surface of the plastic molds to ensure standard curing distance. After the polymerization, the polyethylene tubes detached carefully with sharp knife and the samples were incubated for 24 h at 37^{o}C. For standardization, a single investigator prepared all the samples.

Shear bond strength test

Each specimen was attached to the universal testing device (GESTER, total testing solution, China). A chisel with knife-edge was fixed onto the movable head of the universal testing device, knife-edge pointed at liner base/ adhesive line and vertical force was applied at a cross-head speed of 1.0 mm/min till failure of the bond occurred. The failure force was noted in N/mm2 and then altered to MPa.

The force needed to separate composite restorative material was measured in Newton's (N) and the shear bond strength was recorded in MPa by dividing the greatest amount of force throughout the samples surface area (π r2) [8]. "One-way ANOVA" and "post hoc Tukey's test" were used to statistically analyze the result.

RESULTS

The shear bond strength data showed normality, the (one-way ANOVA test) displayed statistical difference ($p<.05$) between groups and the Tukey's test displayed that there is a significant difference for each pulp capping material with all the other pulp capping materials. The light cured dycal had the highest shear bond strength followed by Theracal LC then biodentine while chemical cured dycal had the lowest shear bond strength (Table 1).

DISCUSSION

Many restorative materials have excellent properties, but they may not protect the pulp from external effects. The bonding of the composite restoration with the enamel, dentin, and underlying base/liner is essential for the creation of an effective marginal seal and for its long-term retention. Liners are pulp capping materials that are placed between dentin and the restorative material to provide pulp protection [9]. The application of a liner with a sealing ability that inhibits entry of microorganisms at the cavity-restoration interface is important factor for successful pulp capping therapy [10].

There are many calcium silica-based pulp capping materials have been developed. Among the new pulp capping materials that have appeared recently, Biodentine is advertised as 'bioactive dentine substitute'. It has the ability to induce the pulp progenitor cells to differentiate into odontoblasts resulting in the formation of mineralized layer similar to the molecules of dentin [11]. Another calcium silica-based pulp capping material is TheraCal LC, which is a light activated material [12]. Hydration causes TheraCal LC to set. It affected by water absorption from the dentin and how much is diffused inside the substance. The bonding could be affected by this. In contrast to our findings, a study by Cantekin, et al. found that TheraCal LC had a greater bond strength when compared to silorane-based composites [13].

Table 1: Means, (SD) and Tukey's analysis of different pulp capping materials.

Group	the shear bond strength (MPa)			
	Mean (SD)	F, (P value)	minimum	Maximum
Theracal LC	24.3490 (.36068)a	335.714 (.000)	23.87	24.82
Light cured calcium hydroxide	34.4901 (4.74169)b		29.83	39.14
Chemical cured calcium hydroxide	3.8312 (.43500)c		3.26	4.38
biodentine	10.1010 (.20798)d		9.79	10.42
In each column mean values with different superscript letters are significantly different ((P<0.05)				

With regard to pulp capping treatment process, dycal has long been regarded as the standard cavity lining material because of its potent antibacterial characteristics, and bioactivity in the creation of the hard tissue barrier [14]. But over time, calcium hydroxide's employment as a liner decreased due to its undesirable characteristics, including its brittleness and tendency to fracture, high solubility, and gradual dissolving [15]. To solve these problems Lining materials with better physical characteristics and reduced solubility in acids and water were created, using light-activated calcium hydroxide [16,17]. In vitro examination of bond strength can aid in predicting the clinical effectiveness of new materials in a short period of time, even if clinical trials are the most conclusive method of evaluating adhesion quality and efficacy. The shear bond strength test is a dependable and popular method for assessing the adhesive qualities of different dental materials in a laboratory environment [18].

In their investigation, Boby, et al. compared the bond strengths of Theracal LC and light-cured dycal to Nano composite resins and discovered that light-cured dycal had a higher bond strength than Theracal [19] this founding is in an agreement with the founding of our study. The light curable dycal is anticipated to provide better adhesive properties in addition to the therapeutic advantages of calcium in pulpal healing, which is believed to increase the success of vital pulp therapy [20]. Contrary to Theracal LC, chemical-cured dycal lacks resin in its composition; as a result, its bond to resin composite is entirely micromechanical [21]. In this study, TheraCal LC with composite presented high shear bond strength value. The results were similar to a study done by Velagala Deepa, et al. This can be due to the presence of dimethacrylate monomer, which has known to promote a chemical adhesion between TheraCal LC and bonding adhesive [22]. In this research, Biodentine presented more bond strength than chemical cured dycal, and less bond strength than Theracal LC and light cured dycal.

Hashem et al. listed that Biodentine should be permitted to mature for 2 weeks before testing the shear bond strength to withstand the contraction forces of the composite resin [23]. In our study the shear bond strength was tested after 24 hours to simulate clinical conditions.

As a result, the bond strength between Biodentine and restorations may be impacted by the setting reaction of Biodentine. While Biodentine takes up to 14 days to reach the necessary bulk strength to survive the stresses of polymerization, Thus, in our study, applying composite before Biodentine' s mechanical bond had fully formed and matured (after 24 hours), may have led to lower shear bond strength results [24]. The findings of our investigation show that chemically cured dycal to adhesive systems have a much lower bond strength value than all others. Dycal, MTA Plus, Biodentine, and Theracal LC were tested for their ability to adhere to composite resins by Raina, et al. They found that chemically cured Dycal had the lowest bond strength value [25].

CONCLUSION

The composite resin and pulp capping agent must successfully bond in order for the final restoration to be durable and long-lasting. Light cure calcium hydroxide (dycal) has a high bond strength capability and is easy to apply, supporting its use as the preferred material in critical pulp therapy.

REFERENCES

1. Tohidkhah S, Ahmadi E, Abbasi M, et al. Effect of Bioinductive cavity liners on shear bond strength of dental composite to dentin. BioMed Res Int 2022; 2022.
2. Manoj A, Kavitha R, Karuveettil V, et al. Comparative evaluation of shear bond strength of calcium silicate-based liners to resin-modified glass ionomer cement in resin composite restorations-A systematic review and meta-analysis. Evid Based Dent 2022; 1.
3. Jain B, Tiku A. A comparative evaluation of shear bond strength of three different restorative materials to biodentine and TheraCal LC: an in-vitro study. Int J Appl Dent Sci 2019; 5:426-429.
4. Mehra S, Gupta AK, Singh BP, et al. To evaluate shear bond strength of resin composite to Theracal Lc, Biodentine, and resin–modified glass ionomer cement and mode of fracture: An in vitro study. Dent J Adv Studies 2020; 8:49-54.
5. Fathi U. Strength evaluation of different dental pulp capping materials. J Global Scientific Res 2022; 7:2464-2467.
6. Mustafa RM, Al-Nasrawi SJ, Aljdaimi AI. The effect of biodentine maturation time on resin bond strength when aged in artificial saliva. Int J Dent 2020; 2020.
7. Korkmaz Y, Gurgan SE, Firat E, et al. Shear bond strength of three different nano-restorative materials to dentin. Oper Dent 2010; 35:50-57.
8. Thepveera W, Potiprapanpong W, Toneluck A, et al. Rheological properties, surface microhardness, and dentin shear bond strength of resin-modified glass ionomer cements containing methacrylate-functionalized polyacids and spherical pre-reacted glass fillers. J Functional Biomater 2021; 12:42.
9. Roberson T, Heymann HO, Swift Jr EJ. Sturdevant's art and science of operative dentistry. Elsevier Health Sciences 2006.
10. Morotomi T, Washio A, Kitamura C. Current and future options for dental pulp therapy. Jpn Dent Sci Rev 2019; 55:5–11.
11. Singh H, Kaur M, Markan S, et al. Biodentine: A promising dentin substitute. J Interdiscipl Med Dent Sci 2014; 2:140.
12. About I. Biodentine: From biochemical and bioactive properties to clinical applications. Giornale Italiano di Endodonzia 2016; 30:81-88.
13. Cantekin K. Bond strength of different restorative materials to light-curable mineral trioxide aggregate. J

Clin Pediatr Dent 2015; 39:143-148.

14. Ansari SN, Ganguly KK. The stipulation of dental cavity lining under composite resin restoration: A myth or reality?. J Bahrain Med Soc 2020; 32:26-33.
15. Reddy SP, Prasad MG, Radhakrishna AN, et al. Clinical comparison of eggshell derived calcium hydroxyapatite with dycal® as indirect pulp capping agents in primary molars. Pesquisa Brasileira Odont Clín Integrada 2020; 20.
16. Poorzandpoush K, Omrani LR, Jafarnia SH, et al. Effect of addition of nano hydroxyapatite particles on wear of resin modified glass ionomer by tooth brushing simulation. J Clin Exp Dent 2017; 9:e372.
17. Caneppele TM, Bresciani E, Da Silva Ávila DM, et al. Effect of lining materials on shear bond strength for composite restorations *In vitro*. Int J Periodont Restorative Dent 2017; 37.
18. Pranav DP. Comparative evaluation of effect of two different bonding systems on shear bond strength of composite and compomer to mineral trioxide aggregate: An in vitro study. J Int Oral Health 2015; 7:93-95.
19. Boby A, Pai D, Ginjupalli K, et al. Comparison of shear bond strength of light cure mineral trioxide aggregate and light cure calcium hydroxide with nanofilled composite: A stereomicroscopic and scanning electron microscope analysis. J Indian Soc Pedod Prev Dent 2020; 38:56–63.
20. Yalcin M, Barutcigil C, Sisman R, et al. Evaluation of sealing ability of pulp capping agents against leakage on direct pulp capping with a computerized fluid filtration meter. J Restorative Dent 2014; 2:46-50.
21. Sultana N, Nawal R, Chaudhry S, et al. Effect of acid etching on the micro-shear bond strength of resin composite–calcium silicate interface evaluated over different time intervals of bond aging. J Conserv Dent 2018; 21:194.
22. Deepa VL, Dhamaraju B, Bollu IP, et al. Shear bond strength evaluation of resin composite bonded to three different liners: TheraCal LC, Biodentine, and resin-modified glass ionomer cement using universal adhesive: An in vitro study. J Conserv Dent 2016; 19:166.
23. Hashem DF, Foxton R, Manoharan A, et al. The physical characteristics of resin composite-calcium silicate interface as part of a layered/laminate adhesive restoration. Dent Mater 2014; 30:343-349.
24. Banomyong D, Ritsayam S, Jantarat J, et al. Early and 24-hour shear bond strength to dentine of three calcium silicate based pulp capping materials. Mahidol Dent J 2018; 38:177–183.
25. Raina A, Sawhny A, Paul S, et al. Comparative evaluation of the bond strength of self-adhering and bulk-fill flowable composites to MTA Plus, Dycal, Biodentine, andTheraCal: An in vitro study. Restor Dent Endod 2020; 45.