Restoration of badly decayed second primary molars

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Abstract: Objective: Evaluation of retentive strength of three different restorative materials used to restore badly decayed pulpotomized second primary molars. **Methods:** Thirty extracted lower second primary molars were selected and randomly divided into three groups of ten restored with group (1): amalgam, group (2): composite and group (3): glass ionomer (Fuji IX). The occlussal part of each tooth was removed with a separating disc leaving about 3mm above the CEJ. After pulpotomy the interance of the orifices were enlarged with large round bur to give space for zinc oxide and eugenol mix and leave enough intra coronal room for the restoration. In order to increase the retention, undercuts were prepared in the cavity walls at the four line angles using a round bur. After restoring teeth, they were subjected to tensile load in a computer controlled materials testing machine. **Results:** Mean and standard deviation of retention forces were; 96.3 ± 2.1 N, 260.8 ± 28.5N and 56.2 ± 4,9N for groups 1, 2 and 3 respectively. There was a statistically significant difference between the three groups. **Conclusion:** Composite material offered the most retentive restoration of badly decayed second primary molars.

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1. Introduction

The preservation of second primary molars has a vital importance especially before the eruption of the first permanent molars. As a natural maintainer of its space, primary molars should be saved by all means. Frequently the invasive decay destroys most of clinical crown leaving a short cervical part with un-resorbed completely formed roots. The pulp condition can easily be delt with (pulpotomized or pulpectomized). Restoration of such tooth thereafter represents a real challenge.[1] The tooth cannot be prepared for steel crown without extensive sub-gingival preparation which can damage the surrounding periodontal tissues. A restoration which preserves the remaining crown should utilize intra coronal retention which is critical to success and longevity of this restoration[2-4]. A restorative material that suits this critical case should be sought to help survival of a damaged, pulpally treated, and valuable tooth[5].

Amalgam has several favorable properties, but lacks the desirable property of bonding to tooth structure[5,6]. Adhesive restorative materials improve the tooth resistance to fracture upon occlusal loading.

The recent advances in adhesive technology and the introduction of stronger adhesive materials created conservative, highly aesthetic restorations [7] that bond to the tooth structure and strengths it.[8]

The introduction of new bonding agents has also led to the possibility of restoring pulpotomized teeth with a bonded restoration instead of crown.[9] The ability to restore pulpotomized primary molars to their original strength and fracture resistance without the placement of crown could provide potential prosthodontic and economic benefits to patients especially when it is difficult to place a crown due to the nature of damage caused by aggressive carious attack.

The aim of this study was to evaluate the retention strength of three different restorative materials used to restore badly decayed pulpotomized second primary molar utilizing a new approach which depends upon intra coronal retention of the restorative material.

2. Materials and Methods:

Thirty extracted lower second primary molars teeth were collected. All the teeth were cleaned from the soft tissue and debris and stored in saline at room temperature. The teeth were randomly divided into three experimental groups each of ten restored with: group (1): amalgam, group (2): composite and group (3): glass ionomer cement (Fuji IX).

The occlusal part of the teeth was removed with a separating disc leaving about 3 mm of the sound tooth structure above the cemento-enamel junction (CEJ) to simulate a badly broken down teeth (Fig. 1). The teeth were subjected to pulpotomy procedure. The interance of the mesial and distal roots canals was prepared with large round bur (no. 4) to accommodate a small plug of fortified zinc oxide and eugenol mix (Dorident, Switzerland) leave enough intra coronal room for the restoration (Fig. 2). A thin mix of zinc phosphate cement base (Harvard, Germany) was applied to cavity floor (Fig. 3). The floor of the cavity was flattened with large inverted cone bur at low speed. Undercuts were prepared in the cavity walls at the four line angles using a round bur (no. 3) at low speed (Fig 3) in order to increase the retention of the restoration. A wire loop

(0.4 stainless steel omega shaped) was placed inside the cavity before placing the restoration. The projected loop was used as an attachment to the retention test machine. In group (1) matrix band retainer (Tofflemire matrix retainer, Teledyne products, Saratoga, USA) was applied and pre-dosed capsule of high copper admixed alloy (amalgam) was triturated and immediately condensed into the tooth (Fig.4). In group (2) the surfaces of the cavities treated with 37% phosphoric acid gel for 30 seconds, then washed with air-water spray for 15 seconds and dried by compressed air. Single bond adhesive (Adper™ single bond, 3M ESPE, USA) was applied according to the manufacturer's instructions and cured for 10 seconds using light cure unite (Demetron LC, sds Kerr, USA) , then the cavities were filled with light curing hybrid composite (Valux plus™, Restorative, 3M, ESPE, USA) incrementally. Every increment was cured for 40 seconds using visible light cure unit (Fig. 5). In group (3) pre-dosed capsule of Fuji (GC Fuji IX ^{GP} Fast, Japan) was activated and immediately mix in an amalgamator, immediately placed into capsule applicator and click trigger until paste is seen through clear nozzle, then extrude into cavity and contoured, apply adhesive bond and light cure (Fig. 6). The restorations were finished and polished and then the restored teeth were stored in distilled water for 24 hours before carrying the retention test. All samples were individually mounted and gripped firmly in the lower fixed compartment of a computer controlled materials testing machine (Model LRX-plus; Lloyd Instruments Ltd., Fareham, UK) with a load cell of 5 kN and data were recorded using computer software (Nexygen-MT 4.5.1; Lloyd Instruments). Each sample was hanged with orthodontic wire attached to the upper movable compartment. Then the samples pulled upward at a crosshead speed of 5 mm/min. The load as a function of vertical deflection was recorded with computer software (Nexygen; Lloyd Instruments Ltd). (Fig. 7). The tensile or retention force was recorded in Newton (N).

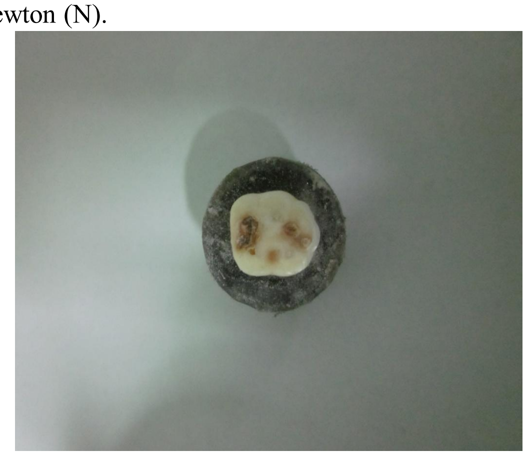

Figure 1: Showing a tooth mounted in the acrylic block

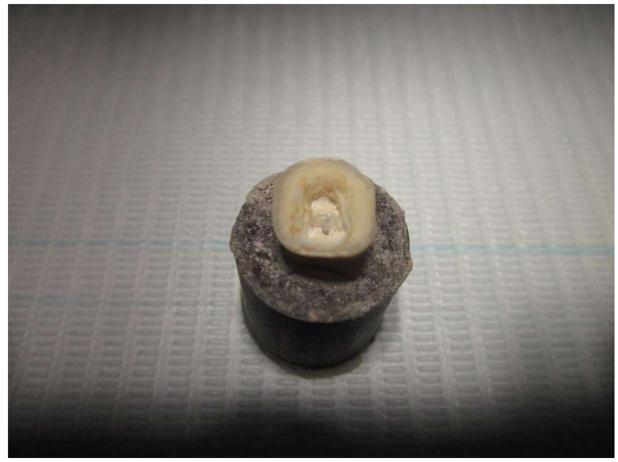

Figure 2: Showing zinc oxide and eugenol capping the orifices of the canal

Figure 3: Showing zinc phosphate cement base and undercuts at the line angles

Figure 4: Showing amalgam restoration and a projected loop

Figure 5: Showing composite restoration and a projected loop

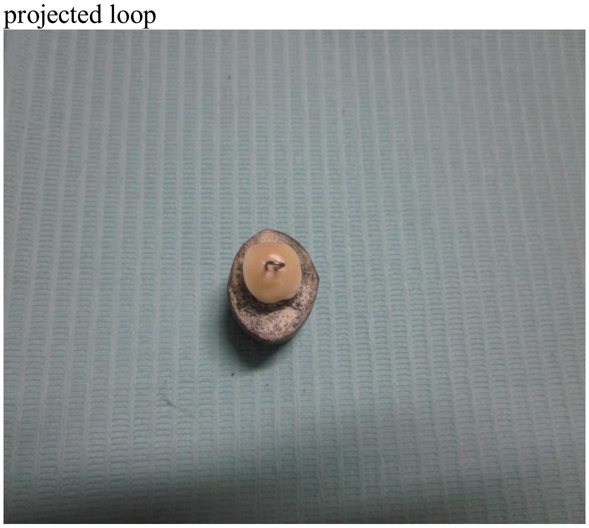

Figure 6: Showing glass ionomer (Fuji IX) restoration and a projected loop

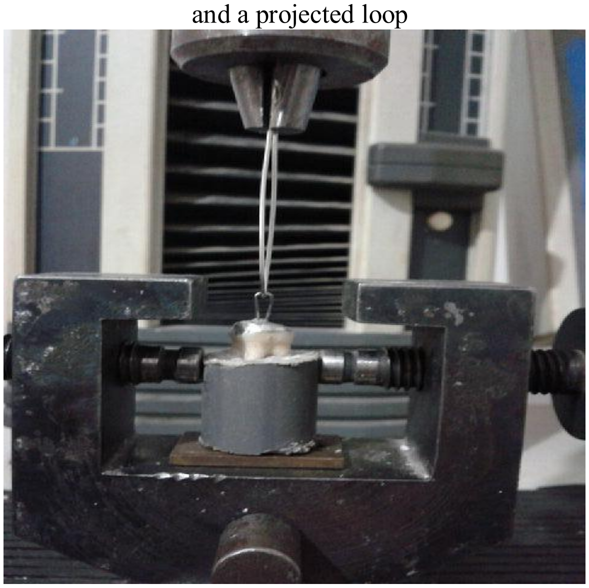

Figure 7: Showing a sample mounted and gripped firmly in a computer testing machine for retention test set up.

Statistical Analysis:

The obtained data was collected; Data were presented as mean and standard deviation (SD) values. One-way Analysis of Variance (ANOVA) was used for comparison between the three materials. Tukey's post-hoc test was used for pair-wise comparison between the materials when ANOVA test is significant.

The significance level was set at $P \leq 0.05$. Statistical analysis was performed with PASW Statistics 18.0 (SPSS: An IBM Company, Chicago, IL, USA; Predictive Analytics SoftWare).

3. Results

The mean and standard deviation values of retention forces were; 96.3 ± 2.1 N, 260.8 ± 28.5 N and 56.2 ± 4.9 N for Amalgam, composite and Fuji IX restoration as in table (1) and (fig.8). One-way ANOVA test results showed that there was a statistically significant difference between the three materials. Pair-wise comparisons between the materials using Tukey's test revealed that Composite had the statistically significantly highest mean retention force. This was followed by Amalgam. Fuji showed the statistically significantly lowest mean retention force.

Table (1): The mean, standard deviation (SD) values and results of comparison between retention values (R.V.) of the three materials

Restorative materials						*P*-value
Amalgam		Composite		Fuji		
Mean (R.V.)	SD	Mean (R.V.)	SD	Mean (R.V.)	SD	
96.3 [b]	2.1	260.8 [a]	28.5	56.2 [c]	4.9	<0.001*

**: Significant at $P \leq 0.05$, Different letters are statistically significantly different*

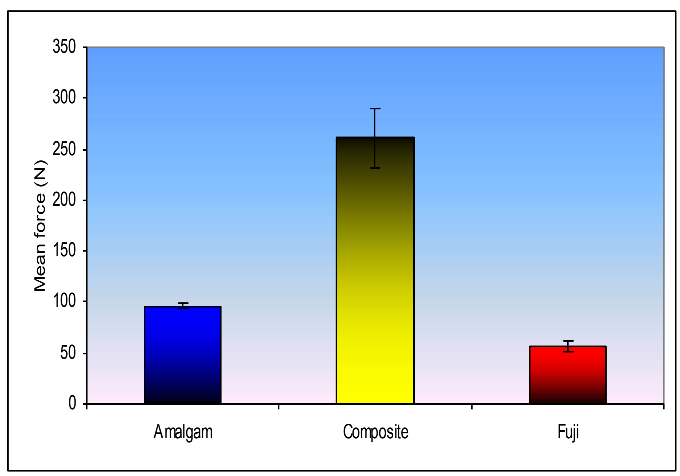

Figure (8): Bar chart representing mean and standard deviation values of retention force of the three materials

4. Discussion:

Preservation of primary teeth is an essential target for the management of the developing dentition and in nurturing a positive attitude in children toward dental health[10,11]. Restoration of extensively decayed second primary molars constitutes a real challenge to dental restorative procedures[1]. Hence the restoration of such defects mainly depends on a cavity design with a maximum mechanical retentive features[12]. In the present study to gain sufficient retention, creation of intracoronal undercuts at four line angles and a small interance of the orifices with a large round bur can improve the retention of the dental restoration.

Bond strength is the force per unit area that is required to break a bonded assembly with failure occurring in or near the adhesive/adherend interface[13-15]. The International Organization for Standardization has produced a document, with the intention of standardizing the different procedures in vogue as far as possible[14]. Tensile test (retention test); it is the test in which the bond is broken by a force working at a 90 º angle (perpendicular) to the tooth surface[13,16,17].

In this study the retention force for amalgam, composite and glass ionomer (Fuji IX) dental materials used to restore the prepared badly damaged second primary molars was assessed. The results of the present study showed a statistically significant difference in the retention of the three restorative materials. The mean retentive force for composite restoration was 260 N which is a highly retentive force. It can be attributed to the use of bonding systems (etching and bond) which create a mechanical interlocking with etched dentine by means of resins tags, adhesive lateral branches and hybrid layer formation[18]. This result is in agreement with **Tay *et al.,* 1994** and **Mason *et al.,* 1998** who suggested the use of bonding system will increase the bond strength values to both enamel and dentine[19,20]. This is followed by the retentive force of amalgam restoration; which recorded 96.3 N. This can be explained by the mechanical retention of the strong projection of the metallic restoration occupying the undercuts and the slightly parallel walls of the cavity.

On the other hand the glass ionomer (Fuji IX) restoration showed the lowest mean retentive force 56.2 N. This may be attributed to the less retention means between the glass ionomer and the tooth structure which depends mainly on the chemical bonding[21,22]. This chemical bond depends on the calcium and mineral content of the tooth[23]. These minerals content decrease in dentine of primary teeth which also has a lower concentration and smaller size of dentinal tubules than the permanent dentine[24,25]. In addition, the weak nature of glass ionomer occupying the undercuts fails to retain the restoration.

The results suggest composite as the most retentive for restoration of badly decayed pulpotomized second primary molars.

Conclusions:

Within the limitations of the results of this in vitro study the following can be final conclusions:

1. There were statistically significant differences in the retentive force of the amalgam, composite and Fuji IX restoration.
2. The presence of the undercuts at the line angles increases the retention force of the amalgam restoration.
3. The composite restoration had the high retentive force due to its inherent bonding characteristics.
4. The glass ionomer restoration (Fuji IX) showed the lowest retentive force and therefore cannot be recommended for the restoration of extensively damaged primary molars.

Clinical significance:

Despite the higher mean values of retentive force of composite restorative material for badly decayed primary molars, it would be better to use the amalgam restoration as an alternative in case of the limitations imposed by the technical manipulative sensitivity of composite.

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References:

1. Bowen RL, Neomoto K, Rapson JE: Adhesive bonding of various materials to hard tooth tissues and forces developing in composite materials during hardening. J AM Dent Res., 1983; 106: 475-77.
2. Ayad MF, Johnston WM, Rosenstiel SF: Influence of tooth preparation taper and cement type on recementation strength of complete metal crowns. J Prosthet Dent., 2009; 102: 354-6.
3. El-Guindy J, Selim M, El-Agroudi M: Alternative pretreatment modalities with a self-adhesive system to promote dentine/alloy shear bond strength. J Prosthodont, 2010; 19: 205-11.
4. Johnson GH, Lepe X, Zhang H, Wataha JC: Retention of metal-ceramic crowns with contemporary dental cements. J AM Dent Assoc., 2009; 140: 1125-36.
5. Prashant M, Vivek S, Sukesh K: Comparison of fracture resistance of endodontically treated teeth using different coronal restorative materials: An in vitro study. J Conserv Dent., 2009; 12(4): 154-9.
6. Soares PV, Santos-Filho PC, Gomide HA, Araujo CA, Martins LR, Soares CJ: Influence of restorative technique on the biomechanical behavior of endodontically treated maxillary

premolars. Part 11: Strain measurement and stress distribution. J Prosthet Dent., 2008; 99: 114-22.

7. Belli S, Erdemir A, Ozcopur M, Eskitascioglu G: The effect of fiber insertion on fracture resistance of root filled molar teeth with MOD preparations restored with composite. Int Endod J., 2005; 38: 73-80.
8. Sagsen B, Aslan B: Effect of bonded restorations on the fracture resistance of endodontically filled teeth. Int Endod J., 2006; 39: 900-4.
9. Hürmüzlü F, Serper A, Siso SH, Er K: *In vitro* fracture resistance of root filled teeth using new generation dentin bonding adhesives. Int Endod J., 2003; 36: 770-3.
10. Mahdi S, Bahman S, Arghavan AB, Fatemeh M: Comparison of shear bond strength of amalgam bonded to primary and permanent dentine. J Indian Soc Pedod Prevent Dent., – June 2008: 71-3.
11. Baghdadi ZD: *In vitro* bonding efficacy of three restorative materials to primary dentine using a one-bottle adhesive system. Gen Dent., 2001; 49: 231-6.
12. Asmussen E, Uno S: Adhesion of restorative resins to dentin – chemical and physical aspects. Oper Dent., Supp 1992; 5: 68-74.
13. Atash R, Abbeele A: Bond strength of eight contemporary adhesives to enamel and dentine: an *in vitro* study on bovine primary teeth. Int J Paediat Dent., 2005; 15: 264-73.
14. ISO/TC 106/Subcommitte 1. CD TR. 11405. Guidance on Testing of Adhesion to Tooth Structure. Geneva: Int Org Stand, 1982.
15. ISO 6345. Adhesion Vocabulary. Geneva: Int Org Stand, 1982.
16. Retief DH, O'Brien JA, Smith LA, Marchman JL: *In vitro* investigation and evaluation of dentin bonding agents. Amer J Dent., 1998; 1:176.
17. Kemper K, Kilian R: New test of tensile bond strength testing. (Abstract 308) J Dent Res., 1976; 55 (Special Issue B): 138.
18. Ferrari M, Goracci G, Garcia-Godoy F: Bonding mechanism of three 'one bottle' systems to conditional and unconditioned enamel and dentin. Amer J Dent., 1997; 10: 224-30.
19. Tay FR, Gwinnett AJ, Wei SHY: Structural evidence of a sealed tissue interface with total etch wet bonding technique *in vivo*. J Dent Res., 1994; 73: 629-36.
20. Mason PN, Caldrese M, Ciraily L: Modified extrusion shear bond strength of the new 3M adhesive. (Abstract 256) J Dent Res., 1998; 77: 1239.
21. Carvalho TS, Amerongen WEV, De Gee A, Bönecker M, Sampaio FC: Shear bond strengths of three glass ionomer cements to enamel and dentine. Med Oral Patol Oral Cir Bucal., 2011 May1; 16(3): e406-10.
22. Lin A, Mclntyre NS, Davidson RD: Studies on the adhesion of glass-ionomer cements to dentin. J Dent Res., 1992; 71: 1836-41.
23. Tesch W, Eidelman N, Roschger P, Goldenberg F, Klaushofer K, Fratzl P: Graded microstructure and mechanical properties of human crown dentin. Calcif Tissue Int., 2001; 69: 147-57.
24. Johenson DC: Comparison of primary and permanent teeth. In: Avery JA, editor. Oral development and histology, Philadelphia: B.C. Decker; 1998. P. 180-90.
25. Koutsi V, Noonan R, Horner J, Simpson M, Mathews W, Puhley D: The effect of dentin depth on permeability and ultra structure of primary molars. Pediatr Dent., 1994; 16:29-35

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