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ORIGINAL ARTICLE

Influence of temporary cement in the tensile strenght of full crowns cemented with resin cement

Influência do cimento temporário na resistência à tração de coroas totais cimentadas com cimento resinoso

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ABSTRACT

Objectives: This study evaluated the influence of residual eugenol on the tensile strength in the ceromer crowns cementation, using resin cement. **Material and Methods:** Thirty-nine third molars were prepared for a full crown. For each prepared tooth one provisional and one ceromer crown were made. The teeth were divided into three groups according the temporary cement (n = 13): [GT] Temp Bond; [GTBNE] Temp Bond NE and [GDY] Dycal. After temporary cementation, the teeth were kept in distilled water for one week and then submitted to traction test in a universal testing machine (EMIC DL 500), using a 200 Kgf load cell at 0.5 mm/min. After the test, the teeth were cleaned and received the final adhesive cementation of ceromer crowns. Next, the specimens were kept in distilled water (37 0C) for a week and then the tensile strength test was performed, also at 0.5 mm/ min. The comparison among groups was carried out by variance analysis (ANOVA) followed by the Tukey test ($p \leq 0.05$). **Results:** The results (Kgf) of provisional cementation for groups GTB, GTBNE and GDY were respectively: 2.75 ± (1.35b), 3.43 ± (1.66ab), and 4.48 ± (1.11a). The results of the adhesive cementation (Kgf) were respectively: 42.71 ± (15.33b), 57.59 ± (15.66a), and 54.75 ± (15.28ab). **Conclusion:** It was concluded that the temporary cement containing eugenol presented negative influence on the removal resistance of crowns cemented with resin cement. Furthermore, dycal presented best result for removal resistance.

KEYWORDS

Zinc oxide-eugenol cement; Cementation; Tensile strength.

RESUMO

Objetivo: Este estudo avaliou a influência do eugenol residual a resistência à tração na cimentação de coroas cerômero, usando cimento resinoso. **Material e Métodos:** Trinta e nove terceiros molares foram preparados para coroa total. Para cada dente preparado uma restauração provisória e uma coroa de cerômero foram feitas. Os dentes foram divididos em três grupos de acordo com o cimento provisório (n = 13): [GTB] Temp de Bond; [GTBNE] Temp NE Bond e [GDY] Dycal. Após a cimentação temporária, os dentes foram mantidos em água destilada por uma semana e, em seguida, submetidos ao teste de tração em uma máquina universal de ensaios (EMIC DL 500), usando uma célula de carga 200 kgf em 0,5 mm/min. Após o teste, os dentes foram limpos e receberam a cimentação adesiva final das coroas de cerômero. Em seguida, as amostras foram mantidas em água destilada (37 ºC) durante uma semana e, em seguida, foi realizado o teste de resistência à tração, também a 0,5 mm/ min. A comparação entre grupos foi realizada por análise de variância (ANOVA) seguida pelo teste de Tukey ($p < 0,05$). **Resultados:** Os resultados (kgf) de cimentação provisória para grupos GTB, GTBNE e GDY foram respectivamente: 2,75 ± (1,35b), 3,43 ± (1,66ab), e 4,48 ± (1,11a). Os resultados da cimentação adesiva (Kgf) eram respectivamente: 42,71 ± (15,33b), 57,59 ± (15,66a), e 54,75 ± (15,28ab). **Conclusão:** Concluiu-se que o cimento temporário, contendo eugenol apresentou influência negativa sobre a resistência à remoção de coroas cimentados com cimento de resinoso. Além disso, o dycal apresentou melhor resistência à remoção.

PALAVRAS-CHAVE

Cimento de oxido de zinco e Eugenol; cimentação; Resistência à tracção.

INTRODUCTION

Temporary cements commonly remain on prepared teeth even when the surface is cleaned with pumice stone, and that situation may be worsened when the eugenol-based cements are used in the adhesive cementation of indirect restoration or dental prosthesis, because this substance can affect the curing of dentin adhesives and resins [1].

Some researchers have suggested that any provisional restoration would have an adverse effect on resin cement bonding due to difficulties in removing all temporary material from teeth [2,3]. Other authors empathized that the eugenol existing in the mixture of eugenol-zinc oxide spreads through dentin and the absorbed amount is sufficient to decrease the effect of the dentin bonding agent and resin cement [4]. However, there are reports that despite eugenol slightly suppresses the polymerization, it may still be considered as an appropriate base material for composite resin, because it avoid shrinkage-induced detachment [5].

There is no consensus in the literature about the influence of temporary cementation on the adhesive cementation. Some studies have shown the bond strength on adhesive cement was affected for the use temporary cement containing eugenol [6-8] while other studies did not found any adverse correlation between the use of materials containing eugenol as temporary cement and resin cement [9-12].

The use of temporary cements is usually necessary and regardless of material, the interference on bond strength may occur by reaction with the permanent material or even by simple obliteration of dentin tubules by its remaining particles. In addition, the full crown retention is dependent of two factors: preparation retention and luting procedure and this relation has not been evaluated on full ceromer crowns in humans' teeth. The aim of this study was assess influence of the temporary cement on tensile strength of ceromer crowns cemented by adhesive technique.

MATERIAL AND METHODS

Experimental design

The present study showed one variation factor: provisional cement in three levels (Tempbond (Kerr, California, USA) [TB]; Tempbond NE (Kerr, California USA) [TBNE]; Dycal (Dentsply, Petropolis, Brasil) [DY]). The quantitative response variable is tensile strength, measured for provisional cement and adhesive cement (Eco-Link (Ivoclar Vivadent, Schaan Liechtenstein) by a testing machine (EMIC DL500, Sao Jose dos Pinhais, Brazil).

Preparation of the specimens

The sample consisted in 39 freshly extracted human third molar and the teeth had crowns with similar dimensions (mesial and distal: 13.5 to 14.5mm/ buccal and palatal 16.5 to 17.5 mm / height 10.5 mm to 11.5 mm), which were checked with a digital caliper (Eletronic Digital Caliper Hardened Stainless, Uyustools, Japan). The teeth were cleaned and the roots were embedded in clear self-curing acrylic resin (JetClassic, Sao Paulo, Brazil), 1 mm above the cement enamel junction.

All the teeth received a full crow preparation with standard 1.5 mm reduction on labial, palatal, mesial and distal surfaces using bur #2135 (Vortex, Sao Paulo, Brazil) with a standardized tipping position of 35º of the tooth long axis. Each diamond bur was replaced after four teeth preparation. The chamfered marginal finish line was kept in enamel. The dimensions of the preparation were also checked with a digital caliper (Hardened Stainless Calipers, Uyustools, Japan). Preparation of retention and luting procedure has not been evaluated on full ceromer crowns.

Provisional crown preparation

The provisional restoration of self-curing acrylic resin (Dencor Classic, Sao Paulo, Brazil)

for each specimen was made using a Teflon matrix (Figure 1). There was a handle on oclusal portion that could be attached and pulled by the upper arm of the testing machine (Figure 2).

Ceromer crown preparation

The impression of the specimens was taken using Speedex (Vigodent, Rio de Janeiro, Brazil) and molds filled with Fujirock EP (GC-Europe, Interleuvenlaan, Greece). Full ceromer crowns shade A2 (Resilab Master E11, Wilcos, Petropolis, Brazil) were made covering the entire preparation. Over the ceromer crowns external retentions were made (Figure 3), so those could be completed with self-curing acrylic resin inside the same matrix used for provisional crowns. The excess of acrylic resin on cervical margin were removed (Figure 4).

Temporary cementation

The specimens were cleaned with pumice and water, the provisional crowns were cemented with their respective cements: [TB] Temp Bond (Keer, California, USA) which contains eugenol in its formulation; [TBE] Temp Bond NE (Kerr, California, USA) eugenol free cement and [DY] Dycal (Dentsply, Petropolis, Brazil) which contains calcium hydroxide (Table 1). The manipulation of all cements was performed according to manufacturer's instructions and the excess of cement was removed.

Temporary cementation testing

After the provisional cementation, the specimens were stored in distilled water for one week followed by tensile strength test in

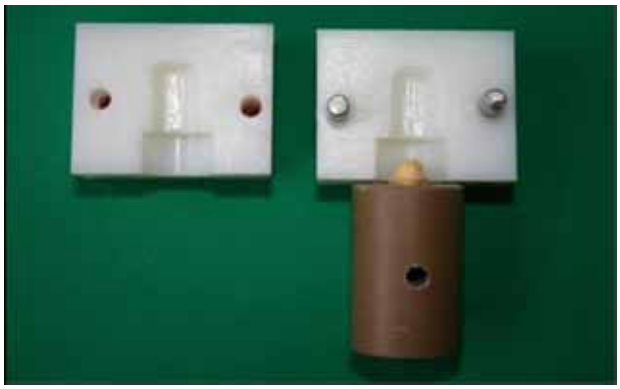

Figure 1 - Matrix used for provisional crowns with projections on occlusal portion.

Figure 2 - Provisional crown ready and positioned inside the open matrix.

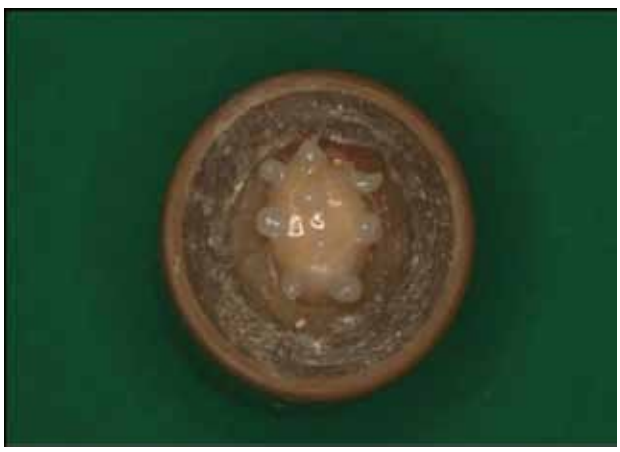

Figure 3 - External retentions over the ceromer crown.

Figure 4 - Ceromer crown with the excess abraded from cervical aspect.

Table 1 - Description and composition of cements used on temporary cementation

	Cement	Manufacturer	Lot	Composition
TB	Temp Bond	Kerr, USA	5-1279	Base: Zinc Oxide 44 g Catalyst: Eugenol 4 g
TBNE	Temp Bond NE	Kerr, USA	mai/42	Base: Zinc Oxide 44 g Catalyst: Polyorganic acids 14 g
DY	Dycal	Dentsply, Brasil	591541	Base: esther glycol salicilate, calcium phosphate, calcium tungstate, zinc oxide and mineral dyes. Catalyst: ethyltoluene sulfoamide, calcium hydroxide, zinc oxide, titanium dioxide, stearate zinc and mineral.

an universal testing machine (EMIC, model DL 2000, 220 volts- EMIC Test equipment and systems, Sao Jose dos Pinhais, Brazil). The acrylic resin handle over provisional crowns was attached to the upper arm of the testing machine, which was attached to a 200 Kgf load cell and was pulled out at 0.5 mm/min.

Adhesive cementation

The residual temporary cement over the specimens was removed with dental explorer and pumice stone/water after the tensile strength tests of provisional crowns. The internal surface of the ceromer crowns was sandblasted with 50 Nm aluminum oxide for 10 s using an air abrasion device (Bio Art Dental Equipment, Sao Carlos, Brazil). Following sandblasting, the ceromer crowns were washed with water-air spray to remove any residual particles that could affect the bonding procedure.

The prepared teeth were etched with 37% phosphoric acid for 15 s followed by water/air spray for 30 s, and dried with absorbent paper. The preparation and inner surface of the restoration were coated with a dual-curing, single-component bonding agent Excite DSC (Ivoclar Vivadent, Schaan, Liectenstein), which was dried after 10 s with gentle air blast, according to manufacturer's instructions.

The base and catalytic paste was dismissal in the ratio 1:1 and mixed. The cement was applied in the inner surfaces of the restoration, placed over the prepared tooth and kept in place with digital pressure.

The excess of cement was removed from each face of the crown and cured for 40 s. The description and composition of the adhesive and the resin cement used on adhesive cementation are shown in table 2.

Table 2 - Description and composition of the bonding agent and resin cement.

	Manufacturer	Lot	Curing mode	Composition
Bonding agent: Excite DSC	Ivoclar Vivadent, Schaan, Liechtenstein	J11002	Dual	Mixture of HEMA (hydroxyethyl methacrylate), dimethacrylates, phosphonic acid acrylate, SiO_2 highly dispersed, initiators and stabilizers in an alcool solution. The brush is coated with initiators.
Resin cement: Eco-Link	Ivoclar Vivadent, Schaan, Liechtenstein	H23217	Dual	The monomer matrix consists of urethane dimethacrylate and decanodiol dimethacrylate. The inorganic particles (about 38% by volume) are silicon dioxide and ytterbium fluoride. Catalysts, stabilizers and pigments are additional components.

Adhesive cementation testing

The teeth were kept for one week in distilled water at 37 ºC, and then subjected to tensile strength test in the same universal testing machine with similar configuration. The values were recorded in a computer attached to the testing machine.

Statistical analysis

The values of tensile strength test was submitted to one-way variance analysis (ANOVA) and Tukey for individual comparisons ($p < 0.05$).

RESULTS

The average ± standard deviation of tensile strength test obtained at provisional crowns cemented temporarily and ceromer crowns cemented with adhesive cement were in the table 3. For provisional cementation, it was found significant difference only between Dycal (4.48 ± 1.11) and Temp Bond (2.75 ± 1.35) cements and for the adhesive cementation, it was found significant difference only for Temp Bond (42.71± 15.33) and Temp Bond NE (57.59 ± 15.66) groups, without significance difference between the other comparisons.

DISCUSSION

The resin cements are being used increasingly due to reported physical and mechanical properties and its optimal marginal seal [2,13]. Certain clinical procedures performed together with the placement of restorations cemented with resin cements involve potential obstacles to achieving maximal advantages of those cements. One is the placement of a provisional restoration. According to the present results, the tensile strength of ceromer crowns with adhesive cement can be negatively influenced by the eugenol of the provisional cement. The only group that showed a significant decrease in tensile values was the eugenol group. Furthermore, the provisional cement and adhesive cement groups showed difference. For provisional cement, it was found significant difference only between Dycal and Temp Bond groups and for the adhesive cement, it was found significant difference only for Temp Bond and Temp Bond NE groups.

Table 3 - Mean ± standard deviation for the tensile strengths of provisional crowns cemented temporarily and ceromer crowns cemented with adhesive cement

Group	GTB – Temp Bond	GTBNE– Temp Bond NE	GDY – Dycal
Provisional cement	2.75 b (± 1.35)	3.43 ab (± 1.66)	4.48 a (± 1.11)
Adhesive cement	42.71 b (±15.33)	57.59 a (± 15.66)	54.75 ab (± 15.28)

*Different letters indicate significant differences between columns ($p < 0.05$).

This also suggests that even the frictional retention was not capable to compensate this interference caused by eugenol. This result can be explain by the chemical reaction that occurs between the remaining eugenol present in the tooth structure and the components of the adhesive system. The hydrogen atom from OH- in eugenol molecule is transferred to bezoiloxyl radical present in methyl methacrylate of resin system, which starts the link of monomer units [14,15]. This radical transformed by eugenol cannot start the polymerization of monomer molecules because it can react with free radicals from developing polymer chains thus decreasing the conversion degree of resin [14]. Furthermore, Takimoto et al. reported that the application the eugenol-containing temporary cement decreased the free surface energy and modified the wettability of dentin [16]. This happens because the temporary cement frequently leave remaining particles in the dentin surface even after the mechanical cleaning methods. These remaining particles can also act as a physical barrier to the diffusion of the components of the adhesive system to dentin and affect the bond strength of the adhesive restoration [17]. Therefore, this inhibitory effect should be considered when perform bonding procedures

following provisional cementation [18-21].In provisional cementation results, the calcium hydroxide cement group presented the higher tensile strength values and this result can be explained due cement's composition [22].

According to Driscoll , the calcium hydroxide products have lower sorption and solubility in simulated dentinal fluid and distilled water than zinc oxide eugenol products and this can influence other physical properties [23]. Furthermore, Ishikiriama et al. stated that effectiveness of eugenol-zinc oxide is questionable, because the eugenol jeopardizes the inner surface of the acrylic resin crowns and margins, thus impairing the seal and retention, which may have occurred in the present study [24]. This behavior could lead to a lower tensile strength of provisional crowns cemented with Temp Bond.

CONCLUSION

Within the limitations of this in vitro study, the eugenol containing provisional cement shows a negative influence on tensile strength of full crowns lutted with resin cement and frictional retention is not able to suppress this interference. Furthermore, Dycal cement presented best result tensile strength.

REFERENCES

1. Bertschinger C, Paul SJ, Luthy H, Scharer P. Dual application of dentin bonding agents: Meet on bond strength. Am J Dent. 1996;9(3):115-9.
2. Akashia AE, Francischone CE, Tokutsune E, da Silva W Jr. Effects of different types of temporary cements on thetensile strength and marginal adaptation of crowns on implants. J Adhes Dent. 2002;4(4):309-15.
3. Fonseca RB, Martins LRM, Quagliatto PS, Soares CJ. Influence of provisional cements on ultimate bond strength of indirect composite restorations to dentin. J Adhes Dent. 2005;7(3):225-30.
4. Hume WR. An analysis of the release and the diffusion through dentin of eugenol from zinc oxide-eugenol mixtures. J Dent Res. 1984;63(6):881-4.
5. He LH, Purton DG, Swain MV. A suitable base material for composite resin restorations: Zinc oxide eugenol. J Dent. 2010;38(4):290-5.
6. Bayindir F, Akyil MS, Bayindir YZ. Effect of eugenol and non-eugenol containing temporary cement on permanent cement retention and microhardness of cured composite resin. Dent Mat J. 2003;22(4):592-9.
7. Latta MA, Kelsey WP, Murdock CM. Effects of adhesive liner and provisional cement on the bond strength of nickel/chrome/beryllium alloy cemented to dentin. Quintessence Int. 2005;36(10):817-23.
8. Koch T, Peutzfeldt A, Malinovskii V, Flury S, Haener R, Lussi A. Temporary zinc oxide-eugenol cement: eugenol quantity in dentin and bond strength of resin composite. Euro J Oral Sci. 2013;121(4):363-9.
9. Schwartz R, Davis R, Hilton TJ. Effect of temporary cements on the bond strength of a resin cement. Am J Dent. 1992;5(3):147-50.
10. Abo-Hamar SE, Federlin M, Hiller KA, Friedl KH, Schmalz G. Effect of temporary cements on the bond strength of ceramic luted to dentin. Dent Mater. 2005;21(9):794-803.
11. Silva JP, Queiroz DM, Azevedo LH, Leal LC, Rodrigues JL, Lima AF, et al. Effect of eugenol exposure time and postremoval delay on the bond strength of a self-etching adhesive to dentin. Oper Dent. 2011;36(1):66-71.
12. Mayer T, Pioch T, Duschner H, Staehle HJ. Dentinal adhesion and histomorphology of two dentinal bonding agents under the influence of eugenol. Quint essence Int. 1997;28(1):57-62.
13. Magne P, So WS, Cascione D. Immediate dentin sealing supports delayed restoration placement. J Prosthet Dent. 2007;98(3):166-74.
14. Hansen EK, Asmussen E. Influence of temporary filling materials on effect of dentin-bonding agents. Scand J Dent Res. 1987;95(6):516-20.
15. Fujisawa S, Kadoma Y. Action of eugenol as a retarder against polymerization of methyl methacrylate by benzoyl peroxide. Biomaterials. 1997;18(9):701-3.
16. Takimoto M, Ishii R, Iino M, Shimizu Y, Tsujimoto A, Takamizawa T, et al. Influence of temporary cement contamination on the surface free energy and dentine bond strength of self-adhesive cements. J Dent. 2012;40(2):131-8.
17. Ribeiro JCV; Silva MM, Fernandes CAO. Influence of temporary cements on the bond strength of resinous materials to the dental substrate. Rev Gauch Odontol. 2012;60(1):91-8.
18. Menezes MS, Queiroz EC, Campos RE, Martins LR, Soares CJ. Influence of endodontic sealer cement on fiberglass post bond strength to root dentine. Int Endod J. 2008;41(6):476-84.
19. Carvalho CN, de Oliveira Bauer JR, Loguercio AD, Reis A. Effect of ZOE temporary restoration on resin-dentin bond strength using different adhesive strategies. J Esthet Restor Dent. 2007;19(3):144-52.
20. Alfredo E, de Souza ES, Marchesan MA, Paulino SM, Gariba-Silva R, Sousa-Neto MD. Effect of eugenol-based endodontic cement on the adhesion of intraradicular posts. Braz Dent J. 2006;17(2):130-3.
21. Erdemir A, Eldeniz AU, Belli S. Effect of temporary filling materials on repair bond strengths of composite resins. J Biomed Mater Res B Appl Biomater. 2008;86(2):303-9.
22. Francisconi LF, de Freitas AP, Scaffa PM, Mondelli RF, Francisconi PA. Water sorption and solubility of different calcium hydroxide cements. J Appl Oral Sci. 2009;17(5):427-31.

23. Driscoll CF, Woolsey GD, Reddy TG, Craig RG. Solubility of zinc oxide eugenol and calcium hydroxide cements in simulated dentinal fluid. J Oral Rehabil. 1989;16(5):451-5.

24. Ishikiriama A, Busato AL, de Lima Navarro MF, Mondelli J. Temporary cementation of acrylic resin and cast complete crowns. J Prosthet Dent. 1984;51(5):637-41.

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