Description and characterization of an alternative technique for temporary crown cementation with calcium hydroxide cement

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ABSTRACT

The purpose of this study was to describe and characterize (using the tensile test) an alternative handling technique for calcium hydroxide cement in temporary crown cementation. In the group treated with the conventional technique (n=10), the base and catalyst pastes of a calcium hydroxide cement (Dycal) were dispensed at a 1:1 ratio and mixed. The cement was then applied to the internal cervical surfaces of the provisional restoration, and the restoration was placed on the prepared tooth and kept in place with digital pressure. In the group treated with the alternative technique (n=10), the base paste of the calcium hydroxide cement (Dycal) was placed on the tooth and the catalyst paste was inserted into the temporary crown. The provisional prosthesis was placed on the tooth and kept in place with digital pressure. Tensile values were evaluated and compared between groups using Student's t test with a 5% level of significance ($\alpha = 0.05$). Use of this alternative technique resulted in significantly lower tensile strength compared to the conventional technique (0.58 ± 0.12 vs. 1.08 ± 0.13 MPa; $p < 0.001$). The technique presented here (alternative) could avoid the undesired removal of cemented cast posts or cores at the time of provisional prosthesis removal and ensures the cementation of extensive provisional prostheses with calcium hydroxide cement.

Key words: *Calcium hydroxide, dental cements, tensile strength.*

Descrição e caracterização de uma técnica alternativa para a cementação de coroa temporária com cimento de hidróxido de cálcio

RESUMO

O objetivo deste estudo foi descrever e caracterizar (utilizando o ensaio de tração) uma técnica alternativa de manuseio para o cimento de hidróxido de cálcio na cimentação de coroa temporária. No grupo tratado com a técnica convencional (n=10), as pastas base e catalisadora de um cimento de hidróxido de cálcio (Dycal) foram dispensadas na proporção de 1:1 e misturadas. O cimento foi então aplicado às superfícies cervicais internas da restauração provisória, e a restauração foi colocada sobre o dente preparado e mantido no local com pressão digital. No grupo tratado com a técnica alternativa (n=10), a pasta base do cimento de hidróxido de cálcio (Dycal) foi colocada no dente e a pasta catalítica foi inserida na coroa provisória. A prótese provisória foi colocada sobre o dente e mantida no local com pressão digital. Os valores de tração foram avaliados comparados entre os grupos pelo teste t de Student, com nível de significância de 5% ($\alpha = 0,05$). O uso desta técnica alternativa resultou em resistência à tração significativamente menor em comparação com a técnica convencional ($0,58 \pm 0,12$ vs. $1,08 \pm 0,13$ MPa; $p < 0,001$). A técnica aqui apresentada (alternativa) poderia evitar a remoção indesejada de pinos ou núcleos fundidos no momento da remoção da prótese provisória e garantir a cimentação de próteses provisórias extensas com cimento de hidróxido de cálcio.

Palavras chave: *Hidróxido de Cálcio. Cimentos Dentários. Resistência à Tração.*

INTRODUCTION

The use of provisional prostheses with temporary cements is necessary to meet the requirements of pulp protection, periodontal protection, aesthetics, and occlusion prior to cementation of the final prosthesis[1]. The operator's familiarity with the prosthesis and cement materials optimizes the results of provisional treatment. The cementing technique and the type of cement used play important roles. The retentive properties of a

temporary cement should be sufficient to prevent premature loss of the prosthesis, but should not hamper its removal when desired[2].

The choice of a cementing agent should be guided by consideration of several factors, such as the degree of tooth retention, duration of provisional prosthesis use, prosthesis fabrication technique, and tooth vitality status[3]. Temporary cementing agents should be biocompatible, have low mechanical strength, and be easy to handle; however, no single material meets all these requirements fully.

Although calcium hydroxide cements were developed for pulp capping, they are also suitable for temporary cementation. They are among the most commonly used materials for the cementation of provisional prostheses[4], but the time between the manipulation of the two pastes and insertion in the prosthesis is critical, and their mechanical resistance can be high. The aim of this study was to describe and characterize (using the tensile test) an alternative handling technique for calcium hydroxide cement in temporary crown cementation.

MATERIALS AND METHODS

An intact bovine incisor from which all debris had been removed was used in this study. The tooth was embedded in self-curing acrylic resin[5], (Jet; Artigos Odontológicos Clássico Ltd., São Paulo, SP, Brazil) in a polyethylene tube (Reforplás Indústria e Comércio Ltd., São Paulo, SP, Brazil), with the cementoenamel junction projecting 5 mm above the resin and the buccal surface oriented perpendicular to the tube. The tooth surfaces were cleaned for 10 s with a rubber cup and non-fluoridated pumice– water slurry (S.S. White, Petrópolis, RJ, Brazil), rinsed with air–water spray for 10 s, and air dried for 10 s.

A mold of the tooth was made with polydimethylsiloxane impression material (Zetaplus/catalyst; Zhermack, Badia Polesine, RO, Italy), rinsed with 150 mL distilled water, and dried. The tooth surfaces were cleaned again as described previously. A polydimethylsiloxane index (Zetaplus/catalyst; Zhermack) and a scaled periodontal probe (S.S. White) were used to control tooth reduction. A 1.2-mm-diameter diamond bur (No. 3216; KG Sorensen, Barueri, SP, Brazil) was used to achieve a 6° convergence angle and a circumferential chamfer margin of 1.2 mm at the cementoenamel junction. The incisal edge was reduced by 2 mm, and the axiogingival and axioincisal angles were rounded and finished with a multilaminated tungsten carbide bur (CF 375 R; Orthometric, Marília, SP, Brazil). After tooth reduction, self-curing acrylic resin (Dencor; Artigos Odontológicos Clássico Ltd.) was inserted into the mold. The provisional restoration was made with an L-shaped handle in the incisal for tensile testing. The provisional restoration was finished and polished. From this restoration, 20 specimens were made of self-curing acrylic resin by duplication in polydimethylsiloxane (Zetaplus/catalyst; Zhermack). The specimens were divided randomly into two groups (n=10) according to handling technique. In the group treated with the conventional technique, the base and catalyst pastes of a calcium hydroxide cement (Dycal; Dentsply, Petrópolis, RJ, Brazil) were dispensed at a 1:1 ratio (Fig. 1) and mixed (Fig. 2). The cement was then applied to the internal cervical surfaces of the provisional restoration

Fig. 1: The base and catalyst pastes of a calcium hydroxide cement were dispensed at a 1:1 ratio (conventional technique).

Fig. 2: The base and catalyst pastes of a calcium hydroxide cement were mixed (conventional technique).

(Fig. 3), and the restoration was placed on the prepared tooth and kept in place with digital pressure (Fig. 4). In the group treated with the alternative technique, the base paste of the calcium hydroxide cement (Dycal; Dentsply) was placed on the tooth (Fig. 5) and the catalyst paste was inserted into the temporary crown (Fig. 6). The provisional prosthesis was placed on the tooth and kept in place with digital pressure (Fig. 7). A single operator performed all procedures, with the order of specimens cemented by the two techniques randomized.

After curing, excess cement was removed from all surfaces of the provisional crown and the tooth surfaces were cleaned again as described previously. After 10 min temporary cementation, the tensile test was performed with a universal testing machine (EMIC DL2000; Instron Brasil Equipamentos Científicos Ltda., São José dos Pinhais, PR, Brazil). The acrylic resin handle of each provisional crown was attached to the upper arm of the testing machine, which was attached to a 1000 N load cell operated at 0.5 mm/min. Thus, the results were obtained in N and divided by the area (200 mm^2) to obtain tensile strength values in MPa.

Fig. 3: The cement was applied to the internal cervical surfaces of the provisional restoration (conventional technique).

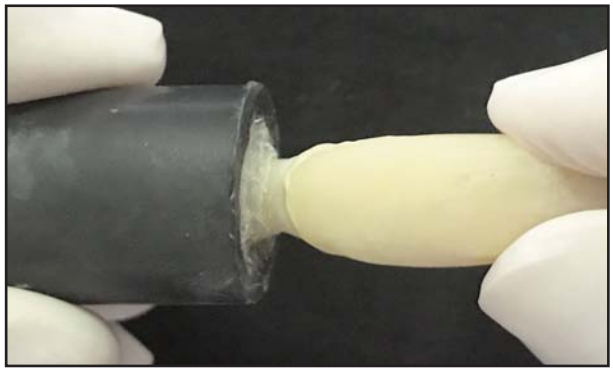

Fig. 4: The provisional restoration was placed on the prepared tooth and kept in place with digital pressure (conventional technique).

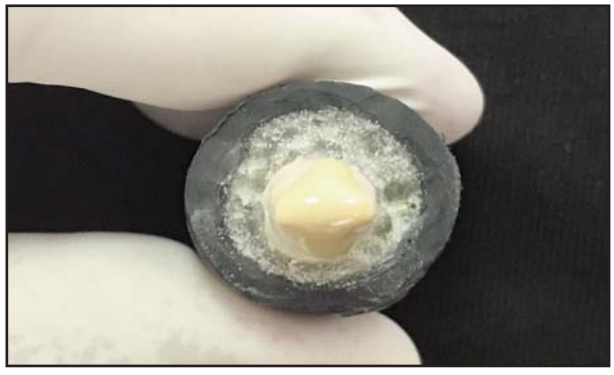

Fig. 5: The base paste of the calcium hydroxide cement was placed on the tooth (alternative technique).

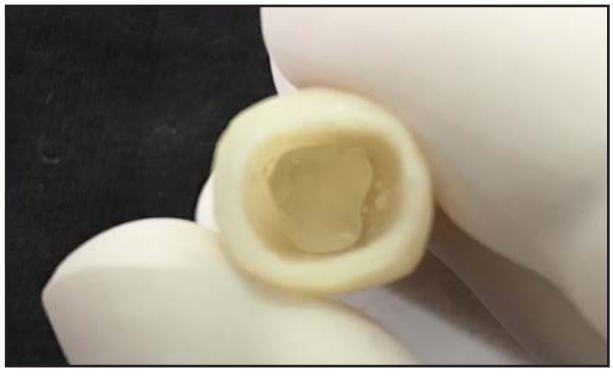

Fig. 6: The catalyst paste was inserted into the temporary crown (alternative technique).

Fig. 7: The provisional prosthesis was placed on the tooth and kept in place with digital pressure (alternative technique).

Statistical analyses were performed using Minitab 16 for Windows 8 (Minitab, State College, PA, USA). The normality of data distribution was investigated with the Shapiro–Wilk test, followed by parametric testing. Tensile values were compared between groups using Student's t test with a 5% level of significance ($\alpha = 0.05$).

Table 1: Tensile strength means (MPa) for different techniques

Technique	Tensile Strength
Conventional	1.08 (0.13)
Alternative	0.58 (0.12)

The difference between means is statistically significant ($p<0.001$). Standard deviations in parentheses.

RESULTS

None of the specimens presented cracks or fractures caused by the tensile test; therefore, none was discarded. The mean (± standard deviation) tensile values, in MPa, of the different techniques are shown in Table 1. The alternative technique showed significantly lower tensile strength compared to the conventional technique (0.58 ± 0.12 vs. 1.08 ± 0.13 MPa; $p<0.001$).

DISCUSSION

A satisfactory temporary restoration must protect the pulp from external stimuli, maintain tooth position and correct occlusion, and allow easy cleaning by the patient[6]. In addition to these basic requirements, the restoration must remain stable in the mouth during the period required for fabrication of the final restoration, with no dislodgment, which could damage the restoration and cause issues such as pulpal and periodontal alteration, modification of tooth positioning, caries development, and the patient's social constraint. Thus, an adequate temporary cement must be used for provisional restoration[7]. Calcium hydroxide cement possesses most of the required characteristics, but it has high mechanical strength and sets rapidly. Thus, an alternative handling technique for this cement was tested in the current study. Use of this technique resulted in significantly lower tensile strength compared to the conventional technique.

Good retention and strength are required for a temporary restoration to meet functional and aesthetic requirements; the cementing technique and type of cement used play major roles. The retentive properties of a temporary cement should be sufficient to avoid premature loss of the restoration, but should not complicate its removal when desired[2,7]. Some calcium hydroxide–based cements have greater mechanical retention than temporary cements[8,9], which could lead to the undesired removal of cemented cast posts or cores at the time of provisional prosthesis removal. At minimum, this issue entails the need to spend additional time re-cementing the cast posts or cores; it may also lead to damage such as cracking or fracture of the tooth involved. Thus, a technique that reduces the mechanical strength of calcium hydroxide cement is needed. The alternative technique described in the present study reduced mechanical strength by 47%. This percentage is consistent with the mechanical strength of other zinc oxide-based non-eugenol cements[8].

When used according to the manufacturer's instructions (conventional technique), the base and catalyst pastes of calcium hydroxide cement are mixed for 30 s; the setting time is 2 min and the working time is 1 min[10,11]. As this cement sets very rapidly, it is not normally used for temporary cementation of extensive provisional prostheses with several tooth elements. The alternative technique described in the present study would be of great value in such clinical situations and its use with cemented cast posts or cores and for extensive provisional prostheses is feasible. Moreover, this technique has been used clinically to cement provisional prostheses for three years at the University of North Parana, with excellent results. However, further studies are needed to evaluate properties other than the reduction in retention of provisional prostheses.

CONCLUSIONS

Based on the methodology and materials used and the results obtained in this study, the following conclusion can be drawn:

The technique presented here (alternative) could avoid the undesired removal of cemented cast posts or cores at the time of provisional prosthesis removal and it ensures the cementation of extensive provisional prostheses with calcium hydroxide cement.

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