BOND STRENGTH EVALUATION OF DIRECT AND INDIRECT COMPOSITE RESTORATIONS

AVALIAÇÃO DA RESISTÊNCIA DE UNIÃO DE RESTAURAÇÕES DE COMPÓSITO CONFECCIONADAS PELA TÉCNICA DIRETA OU INDIRETA

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ABSTRACT

*T*he purpose of this study was to evaluate the bond strength of direct or indirect composite restorations to dentine. Thirty bovine teeth were flattened in order to obtain a plain dentine area. The teeth were divided in 3 groups of 10, according to the restoration fixing method: 1) Direct technique using Single Bond Adhesive System; 2) Indirect technique using Rely-X resin cement; 3) Indirect technique using high viscosity Filtek Flow composite. For group 1, Z-250 composite discs were fixated (6mm diameter by 2 mm height) directly on the treated area. For groups 2 and 3, composite discs were made 24 hours before being cemented, with the same dimensions of group 1, and according to the Rely-X (group 2) and Filtek Flow (group 3) manufacturer's recommendations. After 24h of water storage, the specimens were submitted to a shear bond test on Instron at a speed of 0.5 *mm/min. The data were submitted to ANOVA and Tukey's test (5%). Filtek Flow (6.81MPa) had a significantly lower bond strength mean than Rely-X (10.18MPa) and Single Bond (13.16MPa), which did not differ significantly from each other. The indirect technique showed similar or worse results than the direct restoration technique, which is dependent on the material used for fixation.*

Key words: shear bond strength – flow resin – cement

INTRODUCTION

The need for an alternative to amalgam due to the growing demand for more aesthetic restoration are responsible for the constant and fast development of new composites and adhesive systems. The use of composite restorations for posterior teeth have been increased[1]. However there are some problems commonly encountered in direct posterior composite restorations, such as polymerization shrinkage[2] that result in marginal defects and/or cuspal flexion producing post-operative sensitively[3, 4].

The ideal is a leakage free composite-tooth interface in which the composite do not shrinkage. Unfortunately, until now, this is not possible. Composites shrink due to its own polymerization reaction. In the last ten years many techniques have been developed to reduce the contraction stress in the interface, as multiple increments technique, sandwich technique and ceramic insertion technique[5-7]. However, none

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of them solve the problem completely and all of them are also technique susceptible[5].

The alternative for the composite contraction problem is the use of indirect method, where the restoration is made outside the mouth in a gypsum model. The adhesive-dentine interface stress will be reduced, once the interface will not suffer the stress created by composite contraction. Although the interface will be submitted to the stress generate in the cement polymerization contraction. Improved marginal adaptation and seal on indirect technique have been reported[8, 9]. This technique also facilitates a better sculpture, a more effective contact point and requires less clinical time. In addiction increasing temperature, pressure, light intensity, or a combination of these factors may be used to improve curing[10, 11]. The luting procedure is dependent on the use of resin cement, which is responsible for an effective bond between the substrates. The thickness of the cement may produce a high marginal disadaptation sometimes.

Some professionals use a flow composite instead of dual resin cement to bond the indirect restoration on the prepared tooth. These professional have been used these methods based on the premises the only difference between these materials are the chemical reaction that occurs into the dual resin cement and the flowable composite materials have sufficient light cure activation to set properly. Then, this study intent to get more resources in order to verified the efficiency of the flowable alternative material.

The purpose of this study was to evaluate the bond strength of composite restoration made by direct or indirect technique in dentine. The hypothesis to be tested was that there are no differences between the different luting techniques and among all materials.

MATERIALS AND METHODS

Thirty bovine incisor teeth were used. The roots were removed using a saw (Model 650, South Bay Technology). The vestibular face of the crowns was ground with 180, 400 and 600 grind paper. After a flat area of 7 mm had been obtained, a circular adhesive paper with a 6 mm central hole was placed on the tooth. The specimens were divided into 3 groups according to the restorative method: 1 – Direct technique, using Single Bond Adhesive system; 2 – Indirect technique, using Rely-X adhesive cement with Single Bond Adhesive system; 3 – Indirect technique, using Filtek flow composite with Single Bond Adhesive system. The direct technique required a superficial treatment with 37% phosphoric acid for 20s and Single Bond applied according

to manufacturer's instruction. Z-250 composite was then applied inside a silicon matrix (6mm diameter for 2 mm height) adapted on the delimited area. The composite was activated for 40 seconds with a XL-3000 light cure unit (530 mW/cm^2). For the indirect technique, 20 composite tubules restorations were made in the same way of the direct technique, but on a glass sheet and 24 hours before fixation. Previously to luting, composite discs were sandblasted with 1 µm aluminium oxide The composites discs were cemented to the tooth surface according to the manufactures' instructions of Rely-X (group 2) and Filtek flow (group 3). The specimens had been stored in 37°C distilled water for 24 hours before the bond strength was measured on Instron with speed of 0.5 mm/min. The data were submitted to ANOVA and the means compared by Tukey's test (5%).

RESULTS

Filtek Flow (6.81MPa) had a significantly lower bond strength mean than Rely-X (10.18MPa) and Single Bond (13.16MPa), which did not differ significantly from each other (Table 1).

Table 1. Shear Bond Strength

Technique / Materials	Bond strength (MPa)
Direct – Single Bond	13.16 (2.57) a
Indirect – Rely-X	10.18 (1.93) a
Indirect – Filtek Flow	6.81 (1.13) b

DISCUSSION

Indirect restoration technique has been used to reduce some clinical problem observed during direct restoration technique. The capacity of developing reliable bonds to tooth structure is of paramount importance if some of the purpose advantages of indirect restorations are to be realized[2]. Since the use of a thin layer of adhesive resin cement was as effective in obtaining adhesion as direct polymerization of the material onto the tooth, problems associated with polymerization shrinkage could also be expected to be minimized without adversely affecting restoration retention[2].

The stress in the interface tooth-restorative material created by the composite shrinkage may cause adhesive

or cohesive failures and interfacial gap formation, or if adhesion is maintained, deformation of tooth structure[1]. Beside the initial contraction of the composite, its post-cure polymerization continues to stress the bond during the days following placement[1], which may cause a delay post-operative sensitivity. A reduced post-operative sensitivity has been reported for indirect restoration compared to direct composite fillings, explained by better sealing[12]. According to Jensen and Chan[13] polymerisation shrinkage may compromise the enamel/resin bond strength and increase the potential for microleakage, which appears to be an inevitable phenomenon of restorative and luting materials[14].

During the incremental layering of direct resin composite restorations, the consecutive inserted portions of resin composite copolymerize along the free methacrylate groups available due to oxygen inhibition[15], which did not happen for indirect technique luting step. This may explained why treat the polymerized resin composite surface with aluminium oxide has been shown to be more effective than none or other surface treatments in developing adhesion between the restorative material and the cement[16].

According to Wassel et al.[17] small differences between direct and indirect technique were found, remaining confection time as the mainly disadvantage of indirect technique. Problems related to marginal discoloration, marginal gaps between inlay and cement are also found [8, 17, 18]. However, the indirect technique has the advantage of polymerization shrinkage control, giving reduced marginal discrepancies of fit[19]. It has also been shown that the physical properties of some composite materials, such as diametric tensile strength, hardness, *in vitro* wear and flexural strength can be successfully improved by overcuring the material[20].

The indirect technique with rely-x luting material had no significant difference when compared to the direct technique, showing that both techniques are suitable for clinical practise, when appropriate luting material is used. The choice between them will be dependent on the preference of the clinician.

CONCLUSION

1 - Filtek Flow had a significantly lower bond strength mean than Rely-X and Single Bond, which did not differ significantly from each other.

2 - The indirect technique with rely-x luting material had no significant difference when compared to the direct technique, showing that both techniques are suitable for clinical practise.

3 - Filtek-flow resin is not suitable for luting procedures.

RESUMO

O propósito deste estudo foi avaliar a resistência da união de restaurações de compósito confeccionadas pela técnica direta ou indireta, sobre dentina. Foram utilizados 30 dentes bovinos, os quais foram desgastados até obter-se uma área plana em dentina. As amostras foram divididas em 3 grupos de 10 amostras, de acordo com o método de fixação das restaurações: 1)Técnica direta, utilizando o sistema adesivo Single Bond; 2) Indireta, utilizando o cimento resinoso Rely-X; 3) Indireta, utilizando o compósito de alto escoamento Filtek Flow. Para o grupo 1, confeccionou-se um disco do compósito Z-250 (6mm de diâmetro por 2mm de altura) na área tratada para submeter os corpos-de-prova ao ensaio de cisalhamento. Para os grupos 2 e 3, confeccionou-se previamente os discos de compósito com as mesmas dimensões do grupo 1, esperando 24 h para a cimentação, realizada de acordo com as instruções do fabricante do Rely-X (grupo 2) e Filtek Flow (grupo 3). Após 24 h da fixação, os corpos-de-prova foram levados a uma máquina de ensaio universal Instron, com velocidade de 0,5mm/mim. Os dados foram submetidos à análise de variância e as médias comparadas pelo Teste de Tukey (5%). Verificou-se que a técnica direta (Single Bond) obteve a mais alta média de resistência ao cisalhamento (13,16MPa), porém não diferindo do Rely-X (10,18MPa). O Filtek Flow obteve a menor média de resistência (6,81MPa), diferindo dos demais grupos. Pode-se concluir que a técnica indireta de restauração mostrou resultados similares ou inferiores à técnica direta de restauração, dependendo do material de fixação utilizado.

Key words: *Força de união, resina flow, cimento*

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