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THE USE OF FLOWABLE BULK-FILL RESIN COMPOSITE ENTIRE CAVITY IS A LESS TIME-CONSUMING APPROACH FOR OCCLUSO-PROXIMAL RESTORATIONS IN PRIMARY TEETH

O uso de resina composta fluida bulk-fill como único material restaurador é uma abordagem que consome menos tempo para restaurações ocluso-proximais em dentes decíduos

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ABSTRACT

Aim: To compare the time required to perform occluso-proximal restorations using different flowable resin composites (as an intermediate layer or entire cavity) with conventional resin composite (incremental technique). **Materials and methods:** Two standardized cavities were prepared on occluso-mesial and occluso-distal surfaces of fifty sound primary molars. After application of a universal adhesive system (Scotchbond Universal) in the self-etch mode, the teeth were randomly assigned into five groups (n=10): G1: 2mm of Filtek Bulk Fill Flow + Filtek Z350 XT; G2: 4mm (single increment) of Filtek Bulk Fill Flow; G3: 2mm of Filtek Z350 XT Flow + Filtek Z350 XT; G4: 4mm (two increments) of Filtek Z350 XT Flow, and G5: Filtek Z350 XT. The time required to perform the restorations since the insertion of the first increment of resin composite in the first cavity (occluso-mesial) until the light-curing the last increment in the later cavity (occluso-distal) was measured in minutes using a digital chronometer. Data were submited to one-way ANOVA and Tukey's *post-hoc* tests. **Results:** The ranking of higher to less time was G5 > G1 = G3 > G4 > G2 (p=0.00). **Discussion:** The use of flowable resin composites to fill the whole cavity is attractive in clinical practice, considering the limited functional time of primary teeth and the varying cooperation of the child patient. **Conclusion:** Single use of flowable bulk-fill resin composite and the use of conventional resin composite are the less and more time-consuming approaches for occluso-proximal restorations in primary teeth, respectively.

Keywords: Tooth, deciduous. Composite resins. Dental restoration, permanent.

RESUMO

Objetivo: Comparar o tempo necessário para realizar restaurações ocluso-proximais usando diferentes resinas compostas fluidas (como camada intermediária ou como único material restaurador) com resina composta convencional (técnica incremental). **Materiais e métodos:** Duas cavidades padronizadas foram preparadas nas superfícies ocluso-mesial e ocluso-distal de cinquenta molares decíduos hígidos. Após a aplicação de um sistema adesivo universal (Scotchbond Universal) no modo autocondicionante, os dentes foram divididos aleatoriamente em cinco grupos (n=10): G1: 2mm de Filtek Bulk Fill Flow + Filtek Z350 XT; G2: 4mm (incremento único) de Filtek Bulk Fill Flow; G3: 2mm de Filtek Z350 XT Flow + Filtek Z350 XT; G4: 4mm (dois incrementos) de Filtek Z350 XT Flow e G5: Filtek Z350 XT. O tempo necessário para realizar as restaurações desde a inserção do primeiro incremento de resina composta na primeira cavidade (ocluso-mesial) até a fotopolimerização do último incremento na segunda cavidade (ocluso-distal) foi medido em minutos usando um cronômetro digital. ANOVA e Teste de Tukey foram utilizados. **Resultados:** A classificação do maior para o menor tempo foi G5 > G1 = G3 > G4 > G2 (p=0,00). **Discussão:** O uso de resinas compostas fluidas para preencher toda a cavidade é atraente na prática clínica, considerando o tempo funcional limitado dos dentes decíduos e a cooperação variável do paciente infantil. **Conclusão:** O uso de incremento único de resina composta fluida bulk-fill e o uso de uma resina composta convencional são, respectivamente, as abordagens que necessitam menos e mais tempo para realizar restaurações ocluso-proximais em dentes decíduos.

Palavras-chave: Dente decíduo. Resinas compostas. Restauração dentária permanente.

INTRODUCTION

The greater susceptibility to caries experience of the approximal surface[1] linked to the faster progression rate for enamel to reach the dentin in primary teeth[2] results in a high prevalence of cavitated dentin caries lesions. These lesions need procedures that allow to arrest them and, especially, to reestablish the previous anatomy. Resin composites have become very popular for posterior restorations in primary teeth due to their main advantages as conservative preparations and good clinical performance[3]. Conversely, resin composites are very sensitive and time-consuming technique.

Restoring occlusoproximal cavities in children is a challenging task due broad contact area, difficulty matrix band placement, and less retentive cavity due to reduced enamel dentin thickness[4]. In addition, the polymerization shrinkage stress is reported as the main limitation of monomeric materials like resin composite, due to risk of gap formation, poor marginal adaptation and recurrence caries[5].

It has been suggested the use of an intermediate layer of flowable resin composite placed in the cervical part of the proximal box of class II resin composites. This material presents higher flow, low viscosity, and less filler loading in their formulation[6], which could provide easier insertion into cavity, reducing marginal defects and clinical chair time. Flowable resin composites are available in two groups: inserted in increments of up to 2 mm thickness or bulk-fill (placed into cavities in increments of up to 4-5mm thickness). Usually, flowable resin composites require a final capping layer of a conventional resin composite due to low wear resistance, mainly on stress bearing surfaces. However, good outcomes for Class II restorations using only flowable resin composite in primary molars have been reported[7]. There was no significant difference in the clinical durability at 2 years for flowable resin composite and resin-modified glass ionomer cement restorations[7]. In this sense, the use of a single increment of flowable bulk-fill resin composites are an attractive choice for restoring primary teeth that present lower occlusal load. Considering that the child's behavior is influenced by the length of dental treatment[8] and that a worsening in behavior during the restorative procedure can negatively affect its quality, this study aimed to compare the time required to perform occluso-proximal restorations using different flowable resin composites as an intermediate layer or entire cavity with conventional resin composite (incremental technique).

MATERIALS AND METHODS

This laboratory-based study followed the CRIS Guidelines for in vitro studies[9].

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the Ethics Committee of the Federal University of Rio Grande do Sul, Brazil (4.573.690).

Sample size calculation

The sample size was calculated using www.sealedenvelope.com. According to a previous study[10], the mean working time for performing Class II restoration in primary teeth was 5.07 minutes for bulk-fill resin composite and 7.20 minutes for conventional resin composite. Considering a standard deviation of outcome of 1.65 minutes between the experimental groups, using a significance level of 5%, a power of 80% and a two-sided test, the minimum sample size was 10 teeth per group.

Tooth selection and preparation

Fifty exfoliated or extracted sound primary molars were obtained from a pool after the approval of the study protocol by the local ethics committee. The teeth were disinfected in 0.5% aqueous chloramine, and subsequently, they were individually fixed 1 mm below the the cementoenamel junction in PVC rings embedded with self-curing acrylic resin[11] (JET Clássico, São Paulo, SP, Brazil) to facilitate the restorative procedures.

Cavity preparation

A trained operator performed all cavity preparations. Two cavities were prepared on occluso-mesial and occluso-distal surfaces of each tooth using a #2068 truncated cone diamond bur (Fava, São Paulo, SP, Brazil) at high rotation (KaVo, Joinvile, SC, Brazil) under constant cooling. Each cavity measured 4mm cervical-occlusal height, 4mm buccal-lingual/palatal width and 2mm distal-mesial width. Cavities dimensions were confirmed with a digital pachymeter (Absolute Digimatic, Mitutoyo, Tokyo, Japan).

Randomization and experimental design

The widest buccal-lingual/palatal and distal-mesial dimensions for each tooth were measured using a digital pachymeter (Absolute Digimatic, Mitutoyo, Tokyo, Japan) and recorded. The sum of these two dimensions was used in the distribution of specimens among groups[12] considering five first primary molars and five second primary molars to provide uniformity of tooth size in each group. The randomization was performed by a staff member who was not involved in any of the laboratory study phases. Teeth were assigned into five experimental groups (n = 10) by a programme to generate a random number list (Random.org—Randomness and Integrity Services Ltd., Dublin, Ireland) according to the type of resin composite and number of increments as follow (Figure 1):

Group 1: 2mm of flowable bulk-fill resin composite as an intermediate layer (Filtek Bulk Fill Flow; 3M Oral Care, St. Paul, MN, USA) + conventional resin composite (Filtek Z350 XT; 3M Oral Care, St. Paul, MN, USA) inserted by incremental technique;

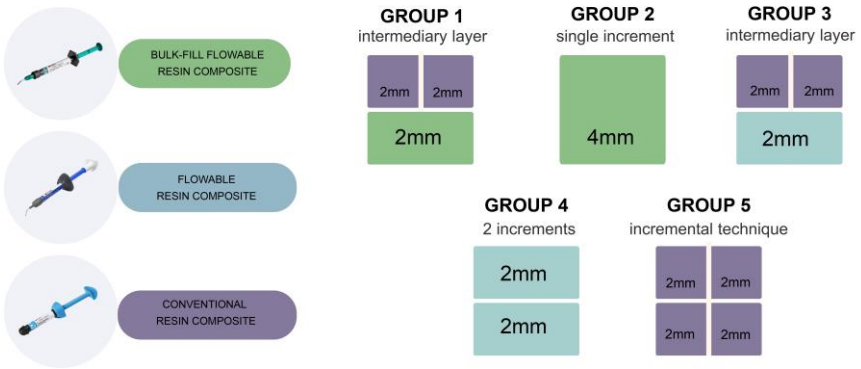
Group 2: 4mm (single increment) of flowable bulk-fill resin composite (Filtek Bulk Fill Flow; 3M Oral Care, St. Paul, MN, USA);

Group 3: 2mm of flowable resin composite as an intermediate layer (Filtek Z350 XT Flow; 3M Oral Care, St. Paul, MN, USA) + conventional resin composite (Filtek Z350 XT; 3M Oral Care, St. Paul, MN, USA) inserted by incremental technique;

Group 4: 4mm (two increments) of flowable resin composite (Filtek Z350 XT Flow; 3M Oral Care, St. Paul, MN, USA);

Group 5: Conventional resin composite (Filtek Z350 XT; 3M Oral Care, St. Paul, MN, USA) inserted by incremental technique.

Figure 1 - Representative experimental groups



Restorative procedures

All restorations were performed by a single and trained operator and the anatomical aspects were reproduzed in all experimental groups. Materials used in this study are described in Table 1. A Tofflemire matrix retainer (TDV, Pomerode, SC, Brazil) and metallic matrix band (Golgran, São Caetano do Sul, SP, Brazil) were adapted on the tooth. The first cavity restored was occluso-mesial followed by occluso-distal. All cavities received the application of a universal adhesive (Scotchbond Universal, 3M Oral Care, St. Paul, MN, USA) in the self-etch mode according to the manufacturer' instructions. Subsequently, the restorative procedures were performed according to allocation group following the manufacturers' instructions. The resin composite increments were measured with a millimeter probe (Golgran, São Caetano, SP, Brazil) and light curing with a light emitting diode curing unit (Radii-cal, SDI, Victoria, AUS) and an irradiance of 1200 mW/cm^2 [13], checked using the light curing unit built-in radiometer. Polishing was performed using rubber points one day after restoration (Astropol, Ivoclar Vivadent, Schaan, Liechtenstein).

Outcome - Restorative time

The time required to perform the restorations was measured in minutes by an assistant using a digital chronometer[14] (Apple, Cupertine, CA, USA) considering since the insertion of the first increment of resin composite in the first cavity (occluso-mesial) until the light-curing the last increment in the later cavity (occluso-distal).

Statistical analysis

The tooth was used as the experimental unit. The time to perform both occluso-mesial and occluso-distal restorations (minutes) was considered for statistical analysis. Thus, the time mean to perform 20 restorations of 10 teeth was considered for each experimental group. Data were submitted to one-way ANOVA and Tukey's *post-hoc* tests. The significance level was set at 5%. Statistical analysis was performed using Minitab18 software (Minitab Inc., State College, USA).

Table 1 - Main composition and manufacturers' recommendations protocol of the materials used.

Material	Manufacturers' recommendations protocol	Batch number	Main composition
Scotchbond Universal adhesive system (3M Oral Care, St. Paul, MN, USA)	Self-etch mode Apply the adhesive for 20 s with vigorous agitation Gentle air thin for 5 s Light cure for 10 s	2210200175	MDP Phosphate Monomer, Dimethacrylate resins, HEMA, Vitrebond Copolymer, Filler, Ethanol, Water, Initiators, Silane
Resin composite Z350 XT, A2B Shade (3M Oral Care, St. Paul, MN, EUA)	Insert the resin composite in 2 mm increments Light cure for 20s each increment	2032400481	Bis-GMA, UDMA, TEGDMA, Bis-EMA, non-agglomerated/non-aggregated 20 nm silica filler, non-agglomerated/non-aggregated 4 to 11 nm zirconia filler, and aggregated zirconia/silica cluster filler Fill content: 78.5% in weight and 63.3% in volume
Flowable resin composite Z350 XT Flow, A2 Shade (3M Oral Care, St. Paul, MN, EUA)	Insert the flowable resin composite in 2 mm increments Light cure for 20s each increment	2207500254	Bis-GMA, TEGDMA, Procrylat resins, non-agglomerated/non-aggregated surface-modified 20 nm silica filler, non-agglomerated/ non-aggregated 75 nm silica filler, and aggregated zirconia/silica cluster filler Fill content: 65% in weight and 46% in volume
Flowable resin composite Filtek Bulk Fill Flow, A2 Shade (3M Oral Care , St. Paul, MN, EUA)	Insert the flowable resin composite in 4 mm increments Light cure for 20s each increment	2201700296	Bis-GMA, UDMA, Bis-EMA, Procrylat resins, 0.1 to 5 μ ytterbium trifluoride filler and 0.01 to 3.5 μ zirconia/silica cluster filler Fill content: 64.5% in weight and 42.5% in volume

MDP: 10-methacryloyloxydecyl-dihydrogen-phosphate; Bis-GMA: bisphenyl-glycidyl methacrylate; HEMA: 2-hydroxyethyl methacrylate; TEGDMA: triethylene glycol dimethacrylate; Bis-EMA: ethoxylated bisphenol-A dimethacrylate; UDMA: urethane dimethacrylate.

RESULTS

The means and standard deviations for all experimental groups are shown in Table 2. The use of a single increment of flowable bulk-fill resin composite resulted in the shorter time. Conversely, the use of conventional resin composite leaded the longer time. The time to perform the restorations using two increments of flowable resin composite was approximately 2 times higher than those obtained with use of flowable bulk-fill resin composite entire the cavity. No statistically significant difference was found when both flowable resin composites were inserted as an intermediate layer followed by conventional resin composite.

Table 2 - The time means required to perform the restorations (minutes) and standard deviations.

Group	Restorative time
1: Flowable bulk-fill resin composite as an intermediate layer	6.29 ± 0.84^{C}
2: Flowable bulk-fill resin composite entire cavity	1.52 ± 0.33^{A}
3: Flowable resin composite as an intermediate layer	6.44 ± 0.61^{C}
4: Flowable resin composite entire cavity	3.26 ± 0.28^{B}
5: Conventional resin composite (incremental technique)	8.16 ± 2.61^{D}

*Different capital superscript letters indicate statistically significance differences between time required to perform the restorations ($p < 0.05$).

DISCUSSION

This is the first study that evaluated the restorative time for filling occluso-proximal cavities in primary teeth using different flowable resin composites as intermediate layer or entire cavity compared to conventional resin composite. The use of conventional resin composite (layering technique) was more-consuming time approach. It is relevant to note that a higher standard deviation was observed in this group, probably due to the sensitivity of the incremental technique even that all restorations were perfomed by same operator.

The reduction in clinical time by the simplified filling technique is one of the most claimed advantages of the bulk-fill composites[15]. Bulk-fill resins contain more reactive photoinitiators, monomers that act as modulator[16] besides have higher translucence to allow greater light transmission through the material,

which makes possible the composite to be placed into cavities in increments of up to 4-5-mm thickness[17]. Bulk-fill resins are available in two groups: low-viscosity or flowable and high-viscosity or full-body bulk-fill resin composites. A recent clinical study[14] showed that full-body bulk-fill resin composite required 30% less time that the convention resin composite to restore occluso-proximal cavities in primary teeth. Flowable materials usually have low filler content, requiring a final capping layer of a conventional resin composite due to low wear resistance. Thus, in our study, a conventional resin composite was used as control instead of a full-body bulk-fill resin composite. However, both flowable resin composites tested have a high filler content (Filtek Z350 XT Flow; 3M Oral Care - 65% in weight and 46% in volume, and Filtek Bulk Fill Flow; 3M Oral Care - 64,5% in weight and 42.5% in volume) and also were tested as an option to fill the entire cavity.

The use of flowable resin composite (bulk-fill or not) as intermediary layer reduced about 20% the time restorative. Both flowable resin composites were compared to Filtek Z350 XT (3M Oral Care) a condensable resin composite, that has hard handling due to high viscosity[18], which could explain this result. A recent systematic review[19] found that flowable bulk-fill showed no significant difference in restorative time compared to conventional layering resin composite for restoring posterior permanent teeth. It is important to highlight that in one study[20] included in the meta-analysis the flowable bulk-fill resin was covered by two increments of a conventional resin composite, but the number of increments used in the control group was not clearly stated. Primary teeth have a limited functional time, and the varying cooperation of the child patient increases the importance of simplified restorative strategy. In this sense, the use of flowable resin composites to fill the whole cavity is attractive in daily clinical practice. In our study, the use of a single increment of flowable bulk-fill resin composite resulted in the shorter time. The time required to perform the restorations with conventional resin composite was 80% higher than those obtained when the flowable bulk-fill resin composite was inserted entire cavity. In addition, as expected, to fill the entire cavity using two increments of flowable resin composite required about 53% more time than restoring the occluso-proximal cavities using a single increment of 4mm of flowable bulk-fill resin composite.

Altough the use of flowable resin composite entire cavity on stress bearing

surfaces is usually not recommended, acceptable clinical results has been reported for occluso-proximal restorations using flowable resin composite in primary teeth[7]. The cumulative failure rate at 2 years was 13.6%, being recurrent caries the main reason for failure. No difference regarding functional failures (marginal adaption and fracture) was reported between flowable resin composite and resin-modified glass ionomer cement restorations[7]. Finally, we should mention the limitations of this *in vitro* study. The restorative procedures were performed in a controlled environment, with the operator having free access to hold the tooth. Thus, the findings cannot be directly extrapoled to clinical practice and are limited to the materials tested. Further studies evaluating the use of flowable bulk-fill resin composite to restore occluso-proximal cavities of primary teeth are necessary considering relevant outcomes such as fracture resistance.

CONCLUSION

The use of flowable resin composite as intermediate layer or entire cavity reduces the time required to perform occluso-proximal restorations in primary teeth in comparison with the utilization of conventional resin composite (layering technique). Single use of flowable bulk-fill resin composite is a less time-consuming approach.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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