BULK-FILL RESINS IN PEDIATRIC DENTISTRY: CASE REPORTS WITH SIX-MONTH FOLLOW-UP

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Palavras-chave: Odontopediatria. Primeiro molar permanente. Resina *bulk-fill*.

RESUMO

Introdução: A evolução dos procedimentos operatórios minimamente invasivos possibilitou a recuperação da função e estética com praticidade, proporcionando tratamentos de excelência. Resinas *bulk-fill* apresentam vantagens: inserção em incrementos únicos de até quatro milímetros, menor contração de polimerização e redução do tempo clínico, mantendo propriedades estéticas semelhantes às resinas compostas convencionais. **Objetivo**: Relatar dois casos clínicos de restaurações classe I em lesão cariosa em dentina não cavitada (ICDAS 4), em molares permanentes, com resina *bulk-fill* utilizando a técnica da réplica oclusal. Adicionalmente, foi realizado o acompanhamento dos casos após seis meses, avaliando-se de acordo com os critérios *World Dental Federation* (FDI) e *Public Health Service* (USPHS). **Relato**: As restaurações foram realizadas utilizando-se os materiais: Caso 1: resina Filtek *bulk-fill flow* (3M ESPE) associada à resina de cobertura Filtek Z350 XT (3M ESPE); Caso 2: resina Filtek *bulk-fill* condensável (3M ESPE). Avaliações foram conduzidas por três avaliadores cegos em relação aos materiais e técnicas. **Resultados**: Caso 1 apresentou menores pontuações nos critérios FDI e USPHS, com melhores propriedades estéticas, funcionais e biológicas, comparado ao Caso 2. **Conclusão**: Ambos os tratamentos apresentaram resultados clínicos satisfatórios após 6 meses de avaliação. Resinas *bulk-fill* possibilitam um tratamento rápido, eficaz e de qualidade.

Keywords: Pediatric dentistry. First permanent molar. Bulk-fill resin.

ABSTRACT

Introduction: Minimally invasive dental procedures are aimed at recovering function and aesthetics in a practical manner, providing excellent treatment options. Bulk-fill composites offer some benefits, such as placement in single increments up to 4-mm thickness, decreased polymerization shrinkage, and general reduction in clinical time, while keeping aesthetic properties similar to those of conventional composite resins. **Objective:** To report two clinical cases of class I restorations in permanent molars with dentin carious lesions (ICDAS 4) treated with bulk-fill composites using the occlusal stamp technique. Cases were followed up for 6 months and the restorations were evaluated according to the World Dental Federation (FDI) and Public Health Service (USPHS) criteria. **Case report:** Restorations were performed using the following materials: Case 1 - Filtek™ bulk-fill flowable resin (3M ESPE) associated with Filtek Z350 XT resin (3M ESPE); Case 2 - Filtek bulk-fill packable resin (3M ESPE). Three blinded evaluators assessed the materials and techniques in the follow-up period. **Results:** Case 1 achieved the lowest scores by the FDI and USPHS criteria, presenting better aesthetic, functional, and biological properties. **Conclusion:** Both treatments were clinically satisfactory after 6 months. Bulk-fill composites are good materials, allowing for a fast, effective, and quality treatment for the pediatric patient.

Submitted: April 5, 2018
Modification: May 7, 2018
Accepted: May 7, 2018

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INTRODUCTION

Among all dental surgical procedures, composite restorations are one of the most frequent ones in daily clinical practice.[1] Composite resins are widely used for restorations of posterior permanent teeth because of their inherent properties, such as aesthetics similar to the tooth structure, translucency, wear characteristics, and biocompatibility.[2]

In order to simplify and speed up dental procedures, recently developed bulk-fill composites can be applied in large increments of up to 4-mm thickness[1,3] at one time. The main difference between bulk-fill and conventional composite resins is in the low polymerization shrinkage of the former but, in spite of that, aesthetics and function are not compromised.

The reduction in composite increments is closely associated with a shorter clinical chair time and with fewer manipulation errors.[3] The overall decrease in the patient's treatment time obtained with these composites makes them a great alternative in pediatric dentistry, as quicker clinical procedures are essential when dealing with young patients.

The aim of this study was to report two cases of class I restorations performed with bulk-fill composites in non-cavitated dentin carious lesions using the occlusal stamp technique. In addition, longitudinal follow-up of the restorations was performed after 6 months according to the World Dental Federation (FDI)[4] and the Public Health Service (USPHS) criteria.[5] These case reports are described in compliance with the Case Report Guidelines (CARE).[6]

CASE REPORTS

CASE 1: BULK-FILL FLOWABLE RESIN

A 13-year-old female patient was brought in by her mother to the Pediatric Dental Clinic of the Federal University of Rio de Janeiro for a dental checkup, without any specific dental complaints. There was no report of any relevant systemic conditions in the patient's medical history taking. The informed consent form was signed by the patient's mother.

During dental examination, a dark shade in the underlying dentin was noted on the occlusal surface of the right mandibular first permanent molar (46) (Figure 1A). This lesion was classified as ICDAS 4 according to the International Caries Detection and Assessment System (ICDAS)[7,8] (Figure 1B).

For a more accurate diagnosis, transillumination (Figure 1C) and interproximal radiographs (Figure 1D) were performed. As the occlusal surface was intact, the use of the occlusal stamp technique was planned with bulk-fill flowable composite (3M ESPE, Campinas, Brazil) and a cover layer of Filtek™ Z350 XT (3M ESPE, Campinas, Brazil) as restorative materials.

Initially, the stamp was fabricated using a self-curing acrylic resin. Powder was added to the liquid, petroleum jelly was spread over the occlusal surface (Figure 2A), and the resin was adapted to the tooth to fabricate the occlusal stamp (Figure 2B).

After anesthesia and rubber dam isolation, the overlying enamel was removed with a high-speed spherical drill (1012-KG Sorensen, São Paulo, Brazil) (Figure 2C). Selective removal of dentin carious tissue was then performed with a low-speed spherical bur (#2 FG, Microdont, São Paulo, Brazil) and with a manual excavator (Figure 2D). Selective etching was performed with 37% phosphoric acid for 15 seconds in enamel and, after that, acid was also applied to the dentin for another 15 seconds (Figure 2E). After washing and drying, Adper Single Bond Universal adhesive (3M ESPE, Campinas, Brazil) was applied in the prepared cavity and cured for 20 seconds.

Cavity depth was checked with a calibrated probe (with millimeter markings), since the use of a bulk-fill flowable composite as restorative material requires that each increment should not exceed 4 mm (Figure 2F). The composite was dispensed in a single 4-mm increment with the disposable tip into the cavity and cured for 40 seconds (Figure 2G). Subsequently, the nanoparticulate Filtek Z350 XT composite (3M ESPE, Campinas, Brazil) was placed over the flowable increment (Figure 2H) and the occlusal stamp was positioned over the latter composite layer, followed by a final light curing (Figure 2I).

After removing the occlusal stamp, the appearance of the restoration was immediately assessed (Figure 2J). Rubber dam isolation was then removed and the occlusal contact points were checked. Polishing was then performed (Figure 2K) and the patient returned for follow-up after 6 months (Figure 2L).

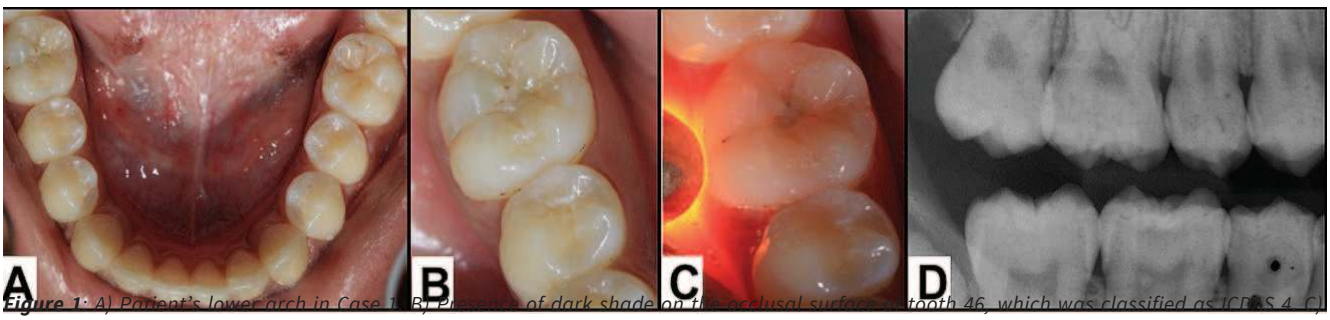


Figure 1: A) Patient's lower arch in Case 1. B) Presence of dark shade on the occlusal surface of tooth 46, which was classified as ICDAS 4. C) Transillumination of tooth 46, confirming dentin involvement in the carious lesion. D) Bitewing radiography of the region, evidencing carious lesion in tooth 46.

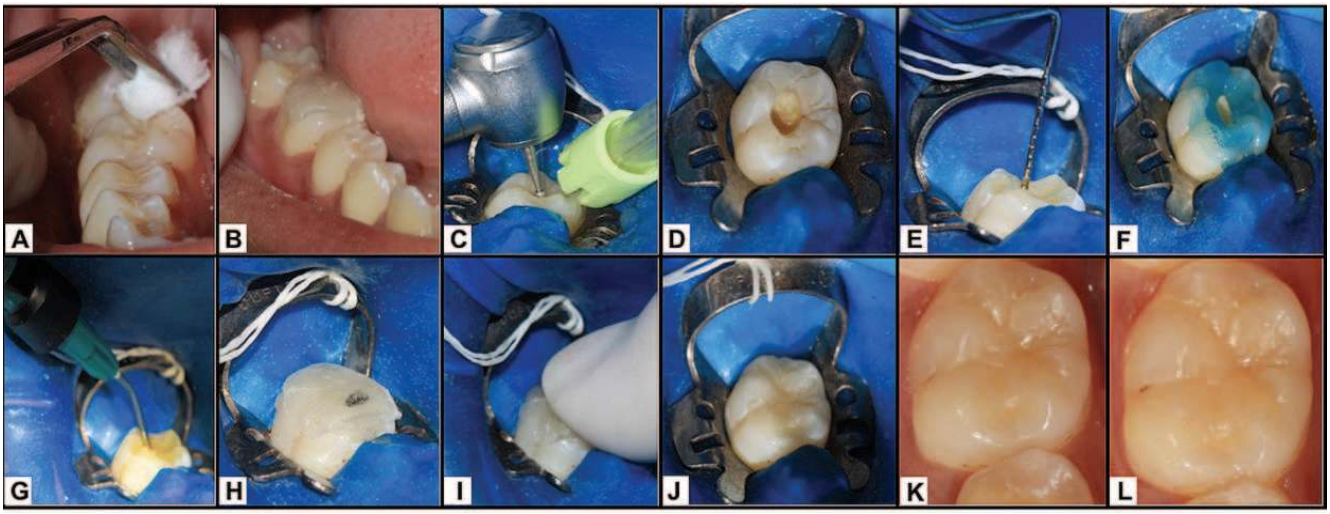


***Figure 2**: Case 1. A) Petroleum jelly application on the tooth. B) Acrylic resin placed on tooth 46 to produce the stamp. C) After rubber dam isolation, caries removal was initiated. D) Tooth 46 after caries removal. E) Measurement of cavity depth with a millimeter probe. F) Selective enamel etching procedures. Adhesive was then applied and cured. G) Placement of bulk-fill flowable composite. H) After curing, a nanoparticulate composite resin was applied as a cover layer and stamp was placed immediately thereafter. I) Digital pressure was applied. Photopolymerization was performed over the placed stamp J). Immediate final aspect. K) Clinical aspect after polishing. L) Clinical follow-up after 6 months.*

CASE 2: BULK-FILL PACKABLE RESIN

An 11-year-old male patient was brought in by his mother to the Pediatric Dental Clinic of the Federal University of Rio de Janeiro for routine examinations. Before the evaluation, the informed consent form was signed by the patient's mother. No relevant systemic alterations were noted during history taking. Dental examination revealed stained pits and fissures in the mandibular first permanent molars (Figure 3A and 3B). Interproximal radiographs were taken (Figure 3C) and the presence of a dentin carious lesion under the "intact" occlusal fissure was observed in the left mandibular first permanent molar (36). As the patient presented negative (-) behavior towards dental treatment, the stamp technique was chosen as restorative option, aiming for quality and efficiency, using bulk-fill packable resin (Filtek™ Bulk Fill - 3M ESPE, Campinas, Brazil).

The occlusal stamp was fabricated as previously described (Figure 4A and 4B), followed by anesthesia and rubber dam isolation of the tooth (Figure 4C). High- and low-speed spherical drills and manual excavators were used for selective removal of the carious tissue (Figure 4D). The cavity was measured with a calibrated probe (with millimeter markings) at a depth of less than 5 mm (Figure 4E). Acid etching was performed with 37% phosphoric acid as described in Case 1 and Adper Single Bond Universal adhesive (3M ESPE, Campinas, Brazil) was applied in the cavity and light-cured for 20 seconds (Figure 4F). The Bulk-Fill Packable composite (3M ESPE, Campinas, Brazil) was then placed in a single increment into the cavity (Figure 4G) and the occlusal stamp was pressed over the composite (Figure 4H). Light curing was performed for 40 seconds (Figure 4I) and the stamp was removed, revealing the appearance of the final restoration (Figure 4J). The rubber dam was removed and the occlusion was checked with carbon paper (Figure 4K). The restoration was polished and the patient returned for follow-up after 6 months (Figure 4L).

FOLLOW-UP AFTER 6 MONTHS

Two criteria were used to assess the quality of dental restorations during the follow-up visits: 1) the modified Public Health Service (USPHS) criteria,[5] which analyze anatomical shape, marginal adaptation, color, marginal discoloration, surface roughness, and caries presence; 2) the World Dental Federation (FDI) criterion,[4] which analyzes aesthetic (surface brightness, color, and anatomical shape), functional (retention and fracture of the material, adaptation, marginal contour, and wear), and biological properties (dental integrity, periodontium, adjacent mucosa, and general oral health).

Three experienced pediatric dentists blinded to the materials and techniques used on each patient conducted the longitudinal evaluations. All clinical examinations were performed in the dental setting, under ideal lighting, with the aid of a dental mirror and explorer.

Patient 1, treated with Filtek™ Bulk-Fill Flowable (3M ESPE) with a cover layer of Filtek Z350 XT (3M ESPE), had lower USPHS (Table 1) and FDI scores (Table 2) than Patient 2, treated with Filtek™ Bulk-Fill (3M ESPE) (Tables 3 and 4). The combination of Bulk-Fill Flow and Filtek Z350 XT resulted in better aesthetic, functional, and biological properties.

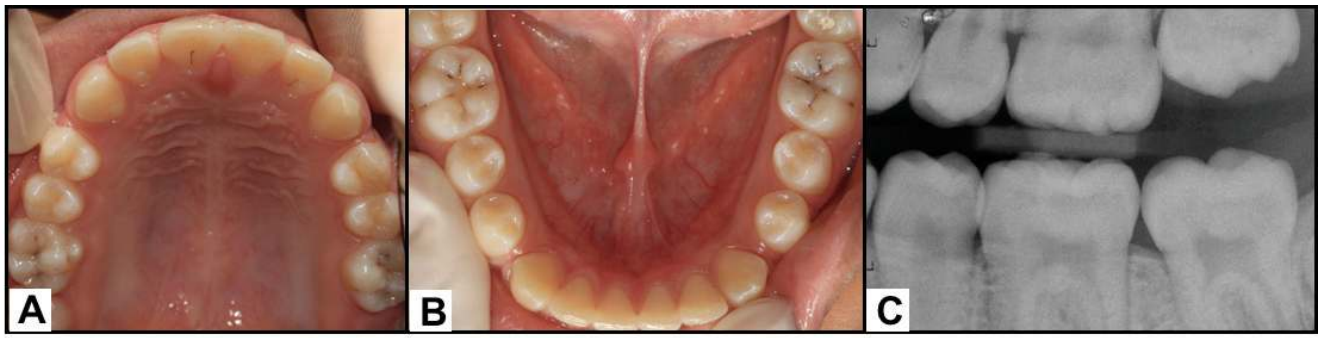


***Figure 3**: Case 2. A) Patient's upper arch. B) Patient's lower arch. C) Left-side interproximal radiograph showing a non-cavitated dentin carious lesion in tooth 36.*

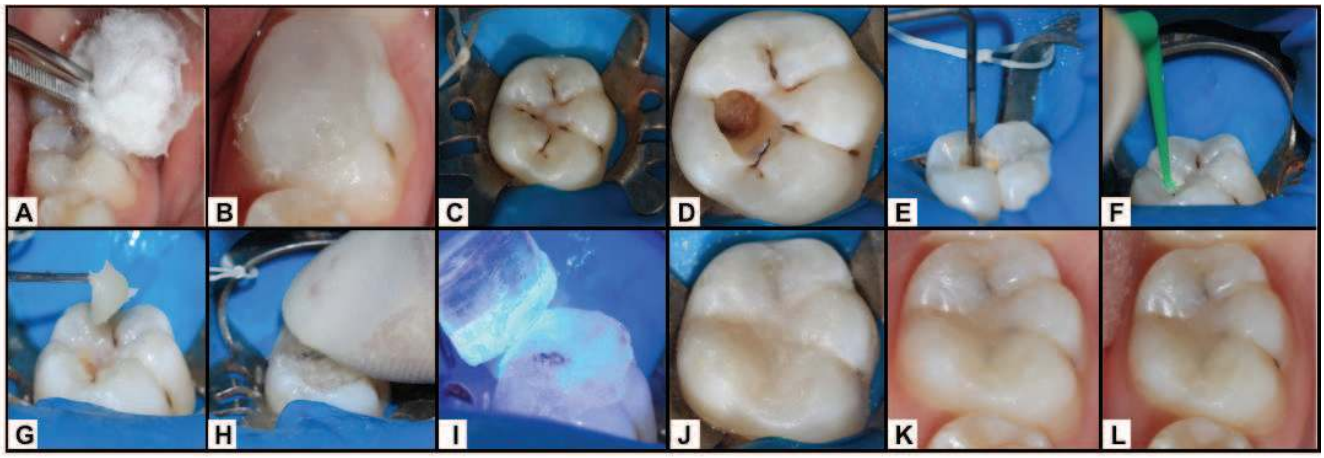


***Figure 4**: Case 2. A) Petroleum jelly application on tooth 36. B) Fabrication of the stamp in acrylic resin. C) Tooth after rubber dam isolation. D) Occlusal aspect after caries removal. E) Measurement of cavity depth with a millimeter probe. F) Application of bonding agent after acid etching, washing, and drying. G) After adhesive curing, placement of the bulk-fill packable resin; H) placement of the occlusal stamp and digital pressure; I) Photopolymerization. J) Immediate final appearance. K) Clinical aspect after polishing. L) Clinical follow-up after 6 months.*

***Table 1**: Evaluation of patient 1 (restoration with bulk-fill flowable resin) after 6 months, according to the modified Public Health Service (USPHS) criteria.*

Criterion	Examiner 1	Examiner 2	Examiner 3
Anatomic shape	0	0	0
Marginal adaptation	0	0	1
Color	0	0	0
Marginal discoloration	0	0	0
Surface roughness	0	1	1
Caries presence	0	0	0

***Table 2**: Evaluation of patient 2 (restoration with bulk-fill packable resin) after 6 months, according to the modified Public Health Service (USPHS) criteria.*

Criterion	Examiner 1	Examiner 2	Examiner 3
Anatomic shape	0	0	0
Marginal adaptation	0	0	1
Color	1	0	0
Marginal discoloration	0	1	0
Surface roughness	0	0	1
Caries presence	0	0	0

DISCUSSION

With the improvement of restorative dental materials, it is now possible to combine function, aesthetics, and practicality into minimally invasive treatments. As restorative dental materials evolve, changes in the polymer matrix seek to reduce the polymerization shrinkage stress.[9] Improvement in bulk-fill resins allows a great depth of cure as well as a low polymerization shrinkage.[10] This occurs because of the incorporation of more reactive photoinitiators, which act as polymerization reaction modulators.[10] In fact, the bulk-fill restorative composite allows the placement of large increments with good aesthetic results,[2] keeping the functions of a conventional composite resin. Both tested materials yielded acceptable results, with easy handling, restoring aesthetics and function with less in-office time, which is fundamental in pediatric dentistry.[11]

Although the incremental technique with layers of up to 2 mm is the conventional method of composite resin restoration, there is no consensus in the literature regarding

the benefits of this procedure for the final quality of the restoration.[12] With the reduction in the number of clinical steps, technical simplification, and possibility of placement of up to 4-mm layers, bulk-fill composites have been strongly recommended,[13] especially for posterior teeth.[14] Although the introduction of bulk-fill composites has sparked off an intense debate, restoration of the entire cavity in a single placement procedure is not recent in the scientific literature.[3]

Commercially available bulk-fill composites come in flowable (used as a base material and associated with a cover layer of conventional resin) and paste or packable (for restoration in one single increment) forms.[13] In this study, the bulk-fill flowable and packable composites were from the same manufacturer and were placed with the same technique. However, treatment outcomes were different. As the follow-up evaluation was performed blindly, results can be considered consistent and reliable. In this case, patient 1 had lower scores both in modified USPHS and FDI criteria.

A clinical study on the clinical performance of class II restorations in bulk-fill and conventional composites found that bulk-fill restorations resulted in less marginal discoloration and misadaptation.[14] The present follow-up evaluation, however, showed differences between materials for marginal discoloration according to the USPHS criteria, with bulk-fill packable resin presenting a slight color change (which, according to one of the evaluators, could be polished). This probably occurred because nanoparticulate coating was used in Case 1, which is indeed indicated for aesthetic procedures, allowing adequate finishing and polishing. On the other hand, in Case 2, only the bulk-fill packable composite was used, resulting in differences in aesthetic and functional properties. On the other hand, a clinical study comparing high-viscosity bulk-fill resins and nanohybrid composite resins showed great performance of both materials.[15] This could demonstrate that both dental materials can be clinically effective despite the differences found in the present case report. Finishing and polishing procedures are essential for obtaining better aesthetic outcomes and increasing the longevity of direct composite restorations,[16] reducing roughness and making the tooth surface smoother and glossier. Magdy et al.[16] observed that bulk-fill and nanohybrid composites presented smoother surfaces after finishing and polishing compared to nanoceramic composites. By evaluating the different types of polishing systems, Rigo et al.[17] demonstrated that surface roughness is mostly related to the material composition than to the used polishing system.[17] Thus, despite the slight difference in the results of the present study, the aesthetic properties of the bulk-fill packable composite can be improved with finishing and polishing, since the success of restorations does not depend exclusively on their mechanical properties, but also on aesthetic satisfaction.[18]

Table 3: *Evaluation of patient 1(restoration with bulk-fill flowable resin), according to FDI World Dental Federation criteria (HICKEL et al, 2010).*

	Examiner 1	Examiner 2	Examiner 3
Surface brightness	Good	Very Good	Very Good
Color – surface and marginal	Very Good	Very Good	Very Good
Color and translucency	Very Good	Very Good	Good
Anatomic shape	Very Good	Very Good	Good
Material fracture and retention	Very Good	Very Good	Very Good
Marginal adaptation	Very Good	Very Good	Very Good
Occlusal contour and wear	Very Good	Very Good	Very Good
Proximal anatomic shape	Very Good	Very Good	Very Good
Radiographic assessment	Very Good	Very Good	Very Good
Patient satisfaction	Very Good	Very Good	Very Good
Postoperative sensitivity and dental vitality	Very Good	Very Good	Very Good
Secondary caries, erosion, abfraction	Very Good	Very Good	Very Good
Dental integrity	Very Good	Very Good	Very Good
Periodontal response	Very Good	Very Good	Very Good
Adjacent mucosa	Very Good	Very Good	Very Good
Oral and general health	Very Good	Very Good	Very Good

***Table 4**: Evaluation of patient 1(restoration with bulk-fill flowable resin), according to FDI World Dental Federation criteria (HICKEL et al, 2010).*

	Examiner 1	Examiner 2	Examiner 3
Surface brightness	Satisfactory	Satisfactory	Satisfactory
Color – surface and marginal	Very Good	Good	Good
Color and translucency	Good	Very Good	Very Good
Anatomic shape	Very Good	Very Good	Very Good
Material fracture and retention	Very Good	Good	Good
Marginal adaptation	Very Good	Very Good	Very Good
Occlusal contour and wear	Very Good	Good	Good
Proximal anatomic shape	Very Good	Very Good	Very Good
Radiographic assessment	Very Good	Very Good	Very Good
Patient satisfaction	Very Good	Very Good	Very Good
Postoperative sensitivity and dental vitality	Very Good	Very Good	Very Good
Secondary caries, erosion, abfraction	Very Good	Very Good	Very Good
Dental integrity	Very Good	Very Good	Very Good
Periodontal response	Very Good	Very Good	Very Good
Adjacent mucosa	Very Good	Very Good	Very Good
Oral and general health	Very Good	Very Good	Very Good

CONCLUSION

In both cases reported herein, the use of Filtek™ bulk-fill flowable (3M ESPE) and Filtek™ bulk-fill (3M ESPE) resins for restoration of occlusal carious lesions by means of the stamp technique yielded satisfactory clinical outcomes, which makes bulk-fill composite resins an excellent choice for restorations in pediatric dentistry. However, Case 1, treated with Z350 XT (3M ESPE) composite coating after placement of Filtek bulk-fill flowable resin produced better results because of the nanoparticulate nature of the material, achieving great aesthetic and functional outcomes after finishing and polishing.

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