Periodontal health evaluation for deep margin elevation using bioactive composite versus bulk fill composite. A case report

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Abstract
Elevation of deep subgingival proximal cavity margins with resin composites under direct or indirect restorations was reported to be promising in terms of esthetic and mechanical points of view. A relatively new category of restorative materials called bioactive composites was released, until now, their periodontal response when used for elevating of deep subgingival margins have not been yet investigated. Thus, the aim of this report was to compare the periodontal conditions and radiographic marginal quality of two molars having their proximal dentin/cementum margins elevated with either bioactive composite or bulk fill composite. The patient had two proximal cavities with gingival margins below cemento-enamel junction in 26 and 27. 26 was vital and its proximal gingival margin was elevated using bioactive composite while 27 was non-vital and its proximal gingival margin was elevated using flowable bulk fill composite before completing the endodontic treatment. The rest of the cavities of both teeth were completed with the same type of regular bulk fill composite. Four periodontal measurements, in addition to a radiographic evaluation for the gingival margins were recorded immediately after completing the restorative work and compared to the same measurements after 6 months. It could be concluded that, regardless of the poor radio opacity of the used bioactive composite, its use for elevation of dentin/cementum margin had a better periodontal response than using flowable bulk fill.

Keywords: Bioactive composite, bulk fill composite, deep margin elevation, proximal dentin/cementum margin

Introduction
The increasing use of non-amalgam restorations has resulted in a rise in complicated clinical problems. One of these is proximal caries extending below cemento enamel junction (CEJ), considering impeded proper moisture control in these areas and challenges in bonding with dentin/cementum margins.\(^1\) Elevation of proximal dentin/cementum margins under either direct or indirect restorations has been investigated using either glass ionomer-based or resin-based materials.\(^2,3\) A lot of studies advocated the use of resin composites for bonding with such margins,\(^4,5\) especially with the current modifications in resins, like bulk fill category that can be placed in layers up to 4-mm in thickness and cured in one single step, thus, they can be quickly applied and save chair time, especially when used for deep and large cavities.\(^5\) Nevertheless, some recent literature argue that glass ionomer-based materials with its hydrophilic nature, flexibility, chemical bonding could be a more suitable option for bonding to deep moist dentin/cementum margins.\(^6\) Bioactive restorative materials are a relatively new category which react to pH changes in the mouth by uptaking calcium, phosphate, and fluoride ions to maintain the chemical integrity of the tooth structure. Activa bioactive restorative is one of this category and could be more accurately considered as altered resin modified glass ionomer.\(^7\) Benetti and Michou\(^8\) stated that this material has a promising mechanical behavior as it showed comparable flexural strength and fracture toughness to flowable and bulk fill resin composites. On the other hand, the material’s compromised hardness suggests the importance of using an abrasive-resistant resin composite as a coverage.\(^9\) Although the treatment plan in such clinical
situations usually requires indirect adhesive restoration, the direct restorative options cannot be neglected, especially with the advances in adhesive technology and the development of modern materials, in addition, direct options are simple and cost-effective solutions. The clinical success in restorative dentistry can be based on different technical parameters, such as esthetics, marginal quality, proper function on occlusion, and preservation of vitality of restored teeth. Nevertheless, healthy periodontal tissues are mandatory for success of any restoration.

To the authors’ knowledge, until now, no laboratory or clinical study has evaluated the performance of bioactive composite as a base for proximal dentin/cementum margin elevation. Based on the previous data, this case report intended to compare the periodontal conditions and radiographic marginal quality of two upper molars having their proximal dentin/cementum margins elevated with two different base materials while the rest of the cavities were restored with the same type of resin composite.

Clinical Protocol

A 38-year-old man presented to the department clinic, the chief complaint was food impaction in the upper left side with repeated bleeding with brushing on the same side. Medical history was free. Extraoral examination revealed no swelling or asymmetries in the head and neck regions. After careful intraoral examination, proximal carious lesions in both 26 and 27 were found [Figure 1a and b], 26 had positive response to vitality tests, on the other hand, 27 was not responsive to vitality tests. A periapical pre-operative radiograph showed deep cavitated carious lesions in both distal surface of 26 and mesial surface of 27, reaching beyond CEJ in both teeth [Figure 1c]. A periapical radiolucency related to the roots of 27 was evident on the radiograph. After history taking, extra and intraoral examination and radiographic assessment, the final diagnosis was: Reversible pulpitis due to caries in 26 (ICDAS 5), pulpal necrosis in 27. The patient had received a visit for scaling and polishing a week before the start of the restorative treatment. Patient was asked to write a consent to the trial before starting the treatment. The treatment plan involved the following steps:

1. Control phase: Scaling and prophylaxis
2. Lag phase: Lasted 1 week after scaling session, the patient was given oral hygiene instructions to follow
3. Definitive phase: Included two sessions, restorative treatment for 26 and endodontic and restorative treatment for 27
4. Maintenance: After 6 months, the patient was recalled for periodontal and radiographic evaluation.

The restorative plan in this case involved elevation of proximal dentin/cementum margins of both teeth using either bioactive composite (ACTIVA BIOACTIVE RESTORATIVE, Pulpdent, Watertown, Massachusetts, USA) or flowable bulk fill composite (Tetric N flow bulk fill, Ivoclar Vivadent, NY, USA) followed by completing the cavities with direct regular bulk fill composite (Tetric N- Ceram bulk fill, Ivoclar Vivadent, NY, USA). The direct protocol was chosen in this case due to the financial limitation of the patient that excluded the indirect option.

Cavity preparation and caries removal

Each molar was treated separately in one visit; the period between the two visits was 1 week. After local anesthesia, the preparation was performed using conventional diamond burs (öko DENT, Germany) in a high-speed hand piece (W&H, RC-90RM, Austria) under copious coolant, the margins were not beveled with slightly rounded line angles. The preparation design was dictated by the extent of decay and the preparation guidelines defined by the manufacturer of the restorative materials. A gingivectomy was performed by a thermal-cut bur (Dentsply Sirona Inc, Konstanz, Germany) without coolant to remove gingival overgrowth; this is followed by final finishing for the cavity margins. Multiple isolation using rubber dam was performed before removal of the remaining infected soft dentin in 26 treatment visit using round bur (öko DENT, Germany) in a low speed hand piece (Strong 204, Daegu, South Korea) with coolant [Figure 1d], the removal of infected dentin on the axial wall of 26 was guided using caries indicator (Ultradent Products Inc, South Jordan, UT, USA). The same steps were repeated in 27 visit, followed by opening of an access cavity after the rubber dam application [Figure 1g], followed by placement of a Teflon piece in this access to prevent the base material going to be used for margin elevation to close this access [Figure 1h].

Restoration steps

For 26, a selective etching (N-Etch, Ivoclar Vivadent, NY, USA) for enamel was performed (15 s), followed by washing and dryness. Large-sized saddle contoured metal matrix band (Tor VM, Moscow, Russia) with enlarged sub-gingival ledge with Small Spring clip was applied around the cavity while making sure that the end of the band was beyond the gingival margin of the cavity. A universal adhesive (Tetric N-Bond Universal, Ivoclar Vivadent, NY, USA) was applied before base placement on all cavity surfaces, air thinned and light cured as recommended by the manufacturers’ instructions with a LED curing light (Elipar Deep Cure, 3M ESPE, St. Paul, MN, USA) operating at 1000 mW/cm². The gingival margin of 26 was elevated until just below the proximal contact using bioactive composite that was applied and cured according to manufacturers’ instructions. The rest of the cavity was filled with regular bulk fill composite. Excess composite and high points were evaluated using articulating paper and removed with diamond finishing stone (öko DENT, Germany) in a high-speed hand piece. Final polishing of occlusal surfaces were performed with rubber points and cups (KENDA AG Dental Polishers, Vaduz, Liechtenstein) using low speed handpiece under water cooling [Figure 1e and f]. In the visit of 27 treatment, the same steps were repeated except that the base material used for elevation was flowable bulk fill, in addition, after margin elevation, the saddle matrix was changed to a contoured sectional matrix (Tor VM, Moscow, Russia), a
suitable sized wooden wedge and separation ring (Garrison Dental Solution, Spring Lake, MI, USA) that were used to build the final proximal contour of 27 and creating adequate contact [Figure 1i]. The proximal surface elevation provided adequate isolation for completing the endodontic treatment of 27 that was followed by covering the canals access by a thin layer of flowable bulk fill then completing the cavity as mentioned in 26 [Figure 1j and k]. Dental floss (Oral B, Procter & Gamble, Iowa City, IA, USA) was used to check the tightness of the proximal contact. All procedures were performed by a single operator (first author) with the help of magnification (4x loupes, Amtech, Wenzhou, China).

**Periodontal and radiographic evaluation**

After completing the restorative work, four periodontal measurements were registered by the second author, who was blind during the restorative procedures:

1. Probing depth at six different sites with a periodontal probe (Zoll Dental, Niles, IL, USA)
2. Plaque index using plaque disclosing liquid (Plaque test, Ivoclar Vivadent, NY, USA), it was recorded as the percentage of total surfaces (six aspects per tooth) displaying the presence of plaque
3. Gingival index (GI), the scores of the four areas of the tooth was summed and divided by four to give the GI for the tooth
4. Papillary bleeding index, a periodontal probe was inserted into the gingival sulcus at the base of the papilla on the mesial aspect, and then moved coronally to the papilla tip. This was repeated on the distal aspect of the papilla.

A baseline periapical radiograph was taken to ensure intimate adaptation of each base material and dentin/cementum margin [Figure 1l]. The length of the base/tooth margin was divided into four parts, each was scored as continuous (score 1) or discontinues (score 0), this followed by summing these 4 scores

**Figure 1:** Composed figure showing: (a) Pre-operative occlusal view for 26, (b) pre-operative occlusal view for 26, (c) pre-operative radiograph, (d) cavity preparation for 26, (e) occlusal view for 26 immediately after restoration, (f) baseline post-operative radiograph for 26, (g) access cavity for 27, (h) covering the access with Teflon before starting proximal building, (i) occlusal view after rebuilding for 27 mesial wall, (j) occlusal view for 26 and 27 immediately after restoration for 27, (k) Buccal view for 26 and 27 immediately after restoration for 27, (l) baseline post-operative radiograph for 27, (m) occlusal view for 26 and 27 after 6 months, (n) buccal view for 26 and 27 after 6 months, (o) 6 months radiograph
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per each base/tooth margin, consequently, at baseline, each tooth was radiographically scored from 0 to 4. After ending the treatment and baseline evaluation, oral hygiene instructions were given to the patients. Patients were recalled 2 weeks later and then 3 months for oral hygiene measures reinforcement. After 6 months, the periodontal and radiographic evaluations were repeated [Figure 1m-o].

Results

There was a noticeable improvement in periodontal indices scores in both teeth after 6 months. The periodontal condition for 26 returned almost back to a healthy normal state; however, there were still several isolated bleeding points on probing of 27. The radiographic evaluation for the used bioactive composite was challenging due to their radio opacity similarity to dentin, limiting the accuracy of assessment for the actual restoration/tooth margin, on the other hand, the used flowable bulk fill radio opacity was enough to accurately detect the margin. All baseline and 6 months follow-up scores for both teeth are illustrated in Table 1.

Conclusion

Within the limitation of the short follow-up period, the following conclusions could be drawn:

1. The periodontal condition of tooth elevated with bioactive composite was better than tooth elevated with flowable bulk fill.
2. The radiographic assessment of the used bioactive composite was challenging compared to flowable bulk fill.

Clinical significance

Periodontal response for deep margin elevation with bioactive composite could be promising. Further clinical trials are needed.

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