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Deep Margin Elevation for Indirect Bonded Restorations: A Clinical Report

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Case Report

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Abstract: Localized subgingival margins can complicate the use of indirect bonded restorations (isolation, impression taking, and luting) and subsequently impede their durability and relationship with the periodontal tissues. This article proposes a technique involving placement of a sectional matrix followed by immediate dentin sealing and coronal elevation of the deep margin to a supragingival position using a direct bonded composite resin base. The deep margin elevation technique may be a useful noninvasive alternative to surgical crown lengthening. This technique is a relatively recent technique whose benefits seem recognized.
Keywords: Ceramic inlay-onlay; subgingival margins; deep margin elevation technique.

INTRODUCTION

Subgingival interdental margins may be encountered when replacing large Class II restorations. The use of direct adhesive restorations for large defects does not represent an ideal solution. Because of their size, such defects usually require restoration with inlays/onlays, especially those fabricated using chairside computer-aided design/computer-assisted manufacturing (CAD/CAM) [1]. Such cases generate significant technical and operative challenges during isolation of the operatory field using rubber dam, adhesive procedures, impression taking (traditional or optical), and adhesive luting. When not properly executed, these procedures may affect the longevity of the restoration and its relationship with marginal periodontal tissues. There are various clinical approaches to such challenges [2, 3].

The gingival margins can be surgically exposed by apical displacement of supporting tissues; however, this may lead to attachment loss and anatomical complications such as the proximity of root concavities and furcations.

Another approach, presented by Dietschi and Spreafico in 1998 [2], is to place a base of composite resin to coronally displace proximal margins underneath indirect bonded restorations. This procedure, known as deep margin elevation (DME) or coronal margin relocation is performed under rubber dam isolation following the placement of a matrix. Today, the DME concept can be used in synergy with immediate dentin sealing (IDS) to improve the bond and marginal seal of indirect adhesive restorations [4,5]. In addition to the supragingival elevation of the margin, the adhesive composite resin base is used to seal the dentin, reinforce undermined cusps, fill undercuts, and provide the necessary geometry for inlay/onlay restorations.

CASE REPORT

A 27-year-old female visited the department of Fixed Prosthodontics, Farhat Hached Hospital Sousse-Tunisia complaining about an old amalgam restoration on tooth #16 that she wants to replace it.

Extraoral examination

A review of her medical history revealed no medical disease. She was a nonsmoker and took no medications. She stated that she felt pain on tooth #16.

Intraoral examination

Dental examination

Clinical examination revealed a class II defective amalgam restoration as shown in Fig 1, pain to cold test, no tooth mobility, and probing depths of 2 mm.

After removal of the restoration (Fig.2), intraoral evaluation revealed that the cervical margin of the cavity was juxtagingival and it was assumed that after caries removal it would be located beyond the CEJ.

Radiographic examination

It revealed that there was periapical translucency and that the distance between the cervical margin of the restoration and the alveolar bone crest was about 1.0 mm (Fig.3).

Fig-1a and 1b: Preoperative view of tooth #16

Fig-2: Removal of the restoration

Fig-3: Preoperative x-ray of tooth #16

Aims, Decision and treatment progress

- **Aims**

The treatment aimed to
- relocate proximal margins
- restore the tooth

- **Decision**

With regard to caries extent, the restorative plan in this case included a possible DME to relocate the proximal margins, followed by the adhesively cemented all-ceramic inlay-onlay

- **Treatment progress**

The first step was the removal of caries and endodontic treatment of the tooth #16(Fig 4/Fig 6). The cervical margin of the cavity was intrasulcular beyond the CEJ (Fig 5).

Fig-4: Endodontic treatment

Fig-5: Deep margin with severe undercuts

So we moved to the second step which is the PBE technique. For cavity isolation, rubber dam was placed (Fig.7). A glass-ionomer barrier should be placed to cover the access to the canals (Fig.8).

Due to the subgingival extension of the proximal box floor, isolation with rubber dam did not prevent excessive bleeding. Therefore, a curved matrix with a wooden wedge to ensure tight proximation, were used to achieve isolation for the PBE procedure (Fig.9).

Enamel was selectively etched for 30 seconds, and total etching followed for 10 seconds with a 37% phosphoric acid gel (Total Etch, Ivoclar Vivadent) (Fig.10).

To seal the freshly cut dentin surfaces immediately after tooth preparation an unfilled resin adhesive (Meta P&Bond) was applied and light-cured for 20 seconds (Fig.11).

A base of composite resin (NEXCOMP) to relocate and uplift the cervical margin to a supragingival level was then applied (Fig.12). Flowable composite resin was applied too to block out undercuts (Fig.13).

After light curing for 40 seconds, the matrix was removed and the preparation was finished using diamond burs. Finishing of the elevated proximal margins was accomplished using flexible disks (Sof-Lex, 3M Espe) of decreasing grit and polishing strips.

A bitewing radiograph should be taken to ensure that no excesses or gaps are present before proceeding to final preparation and impressions (Fig.15).

Then, rubber dam was removed and an impression was made. The indirect ceramic restoration was tried-in and finally adhesively luted (Multilink N). (Fig.16-Fig.20)

Fig-6: Occlusal view after removal of caries and endodontic treatment

Fig-7: Rubber dam isolation

Fig-8: Protection of gutta percha with GIC

Fig-9: A curved matrix was placed

Fig-10: Etching of enamel and dentin

Fig-11: Application of adhesive resin

Fig-12: A DME is done

Fig-13: Immediate dentin sealing

Fig-4a and b Preparation of the onlay

Fig-15: Postoperative x-ray of tooth #16

Fig-16: Dental impression

Fig-17: New rubber dam isolation after one week

Fig-18: Luting of the onlay

Fig-19: Final occlusal view

Fig-20: Final buccal view

DISCUSSION

Basically, PBE is not a new treatment regimen, since the principle behind this restorative procedure refers to the open-sandwich technique. Essentially, PBE and open-sandwich technique describe the same procedures. With the conventional open sandwich restoration, a substantial part of the restoration was replaced with a glass-ionomer cement (GIC), the latter covering substantial parts of the exposed dentinal surface of the cavity, and extending to the periphery of the proximal box to form a new cervical seal (being exposed to the oral environment) [6]. However, with the open-sandwich technique using GIC, high clinical failure rates have been reported [7,8], and, thus, modifications using resin- modified GICs, polyacid-modified composite resins, or low viscosity (flowable) composite resins have been introduced later on with acceptable outcomes in the long term [6,9,10].

The main clinical aims behind both the PBE and the open-sandwich technique, are to facilitate adhesive restorations in areas difficult to access, to reduce fracture susceptibility, and to increase the marginal adaption of Class 2 restorations, by applying a (long-lasting) base beneath the restoration which is open to the oral environment.

The clinical application of the PBE technique described in the present case report was performed using a two-step etch-and-rinse adhesive system (Meta

P&Bond) mediating a physically stable bond between dentin and composite resin (Nexcomp). This was followed with an indirect CAD/CAM Lithium Disilicate restoration (Celtra Duo, Dentsply).

The decision to perform a PBE was based on the deep location of the carious defect and the concomitant difficulties achieving an adequate isolation for digital impression and adhesive cementation of the secondary restoration. It is known that using an appropriate pre-conditioning technique will result in reliable bond strengths between composite resin (bases or build-ups) and ceramics [11]. From a clinical perspective, this regimen was justified from several papers confirming the positive prognosis of this kind of treatment [12-15].

Indirect treatment of posterior proximal cavities revealing extensions below the CEJ is clinically ambitious, due to difficulties in achieving an adequate moisture control [13].

When encountering such clinical situations it is a considerable option to relocate the proximal box floor, using a composite resin in order to facilitate rubber dam application and adhesive luting procedures, in particular if several adjacent cavities have to be treated [13]. PBE additionally ensures further requirements like eliminating undercuts and allows proximally undermining caries to be restored minimally invasively to limit the size of the prepared cavities for indirect restorations, thus preventing extensive substance loss [16], improving cuspal reinforcement [17], and compensating for limited polymerization with deep defects. It should be emphasized that composite resin restorations do not serve only for their inherent esthetic qualities; instead, conservative cavity preparations with traditional configurations (as used for amalgam in the past) are not considered mandatory anymore; thus, sound tooth substance can be preserved, and this is an undisputable advantage of direct composite fillings.

Due to the nature of a deep proximal box, air-drying procedures often are not efficient, and pooling of water or adhesive in the cavity corners frequently occurs. Such ineffective drying and pooling effects have been shown to impair adequate removal of solvent and water, subsequently decreasing the strengths of adhesive bonding which is the basis for a successful restoration in the long term [18]. To prevent such pooling effects, PBE seems to be an adequate option, in particular if combined with sophisticated modifications of application techniques (eg, the “snow plough technique”) [19].

A further advantage of the PBE technique is the immediate dentin sealing (IDS) which is performed concomitantly with the PBE procedure. In case a significant area of dentin is exposed during the preparation for an indirect restoration, evidence supports the application of an adhesive resin coating to the freshly cut and conditioned dentin, thus creating a collagen fibril reinforced complex interphase. This procedure includes advantages like increased retention, reduced marginal leakage, improved bond strengths, and decreased postoperative sensitivity [20]. Thus, the sealed dentin is protected from bacterial invasion during the provisional phase, and the luting procedure of any definite porcelain restoration requires less or no anesthetics at all.

An optimal digital impression is fundamental to any CAD/CAM restoration, since image quality, accuracy, and precision of the acquired image is equivalent to the precision of the final outcome. However, digital impressions of deep cavities in the molar region can be challenging due to the limited space available and the restrictions of the used digital system’s scanning depths. By elevating the proximal box, a digital scanner can provide more accurate results if compared to deep cavities. Furthermore, the scanning procedure is much easier to handle and will be accelerated. With an adequate isolation the overall result will be satisfying, since no saliva or blood contamination will impede the outcome of the digital impression.

Since most adhesive cements are photopolymerized, sufficient light-curing through the secondary (indirect) restoration is crucial for clinical success. However, when facing a deep proximal box, sufficient light-curing of luting composites or bonding agents via the secondary restoration might be less efficient. Consequently, sufficient polymerization is impeded when encountering a deep proximal box. With these situations, PBE might be an alternative to solve this complex of problems.

MATERIAL SELECTION

Some of the studies included in the current review did not support the use of certain materials classes (such as [resin-modified] glass ionomers) [13,16].

It is well known that resin-modified GICs or polyacid-modified composite resins (absorbing water/showing hygroscopic expansion) have inferior mechanical properties when compared to composite resins, a comparably rough surface finish, and high solubility rates; similar considerations may be taken into account for flowable composite resins. These materials have been assumed to improve marginal adaptation and seal, and to act as a stress-absorbing layer beneath a filled hybrid composite resin restoration. However, these flowables also have inferior mechanical properties.

However, with a meticulous layering and bonded composite resin, it was concluded that PBE could be an alternative to conventional adhesive luting

to dentin [13], with satisfactory performance in terms of wear of occlusal and proximal contacts [21].

MARGINAL ADAPTATION

The presence of a composite liner underneath ceramic CAD/CAM restorations following different surface treatments did not affect restoration marginal or internal adaptation and appears therefore a suitable alternative to the conventional protocol for indirect class II inlays where the restoration is placed directly over dentin [22].

PBE can be a welcome aid for facilitating adhesive luting of ceramics to deep proximal areas. Three consecutive 1-mm layers as PBE show the best marginal quality to dentin. Self-adhesive resin cements are not recommendable for this indication [13].

It can be concluded that the proximal margin elevation composite technique by placement of a composite filling in the proximal box before insertion of a ceramic inlay results in marginal integrities not different from margins of ceramic inlays placed in dentin. Nevertheless, under clinical conditions with margins located at a subgingival level, this technique might be helpful to facilitate insertion of indirect restorations [12].

FRACTURE STRENGTH

PBE does not negatively influence the marginal integrity or fracture behavior of root canal-treated mandibular molars restored with feldspathic ceramic onlays. In particular, CAD/CAM-fabricated composite onlays without PBE are more favorable in terms of marginal quality and fracture resistance than are ceramic restorations [14].

From a biomechanical point of view, ceramic onlay restorations of teeth with subgingival margins using the deep margin elevation technique seem to be advantageous. This benefit appears to be more evident when the load applied is very high and when it comes to eccentric forces.

SECONDARY CARIES

It has been suggested that such restorations might reduce secondary caries incidence due to good marginal sealing [23]. With timely bonding agents, no clinically considerable complications like discolorations or secondary caries were detected in a previously published prospective clinical trial after 6 years [10], even if the simultaneously performed in vitro study (using water storage and thermomechanical loading) revealed a significant decrease of gap-free dentin margins with Class 2 proximal boxes [24].

PERIODONTAL REACTION

The amount of plaque and the degree of gingivitis adjacent to (polished) composite fillings were not significantly higher than those for the GIC and enamel surfaces [25]. With resin-modified GICs, compomers, and composite resins, this was corroborated; here, the various materials did not result in measurable differences concerning clinical or subclinical signs of gingivitis [26].

Furthermore, the reduced bacterial adhesion of composite resins compared to GICs and flowable composite resins may increase the longevity of dental restorations and could prevent the risk of periodontal disease.

BIOLOGICAL WIDTH

It is generally accepted, that violations of the biologic width will result in gingival inflammation, loss of periodontal attachment, and inflammatory bone resorption. Notwithstanding, minor violations of limited extent and with small but perfectly adjusted composite surface areas have been assumed to be non-detrimental, in particular in cases of maintained oral hygiene measures [19].

From a periodontal point of view, it seems indeed conceivable that in these cases the organism will be able to restore the biologic width (without the need of surgical intervention or orthodontic extrusion), or will adapt to the new one [27].

CONCLUSION

Given an adequate isolation technique, the use of appropriate materials, and careful handling of the latter, PBE is considered a promising restorative completion to facilitate treatment of advanced caries lesions with dentin/cementum margins located beneath the gingival tissues.

It is fundamental to ensure the adaptation and surface condition of the margin as well as to teach the patient oral hygiene instructions to ensure its longevity.

APPROPRIATE FOLLOW-UP MUST BE SET UP

This technique is part of the therapeutic gradient allowing delaying the invasive techniques of several years. PBE is a technique described for only 19 years which makes it a relatively recent technique whose benefits seem recognized. Nevertheless, few in vivo studies are available in the scientific literature to make definitive statements.

In the future, it would also be interesting to ask whether a PBE can be associated with CAD/CAM ceramic crowns.

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