Extended sealing of interproximal caries lesions

Stefano Ardu, Dr med dent[1]/Reymond Perroud, Dr med dent[2]/
Ivo Krejci, Dr med dent[3]

In recent years the concept of minimally invasive dentistry has offered a more conservative approach to restoration of teeth with caries lesions. Several techniques have been suggested for treatment of proximal lesions, but their results have been less than ideal. The aim of this article is to present a new technique for ultraconservative restoration of small interproximal caries lesions that avoids the disadvantages of both the tunnel and the proximal slot restorative techniques. Two cases, of patients with high and low caries risk, are presented to illustrate the technique. The proposed technique can be considered the most conservative alternative to conventional Class 2 or slot-cavity treatment approaches.
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Key words: caries lesion, caries risk, fluoride, minimally invasive dentistry, proximal lesion, resin composite

Modern dentistry has dramatically changed since G. V. Black's 1891[1] idea of extension for prevention, making room for a more conservative philosophical approach called *minimally invasive dentistry*.

Black's approach was to treat interproximal caries lesions by a surgical approach requiring the removal of infected dentin and the extension to areas that were presumed to be caries free to ensure better retention and easy cleaning of all restorative margins. This approach was based on a lack of understanding of caries processes and the poor physical properties of the restorative materials available in that period. An attempt toward a more conservative approach for proximal lesions has been the tunnel technique,[2,3] whereby the interproximal ridge is preserved. Although different interventions' modalities have been suggested,[4] poor clinical trial results have been reported. Originally, the restorative material of choice was glass-ionomer cement, which, most probably because of its poor mechanical properties and lack of strong adhesion, did not have great success.[5,6] Another approach was to modify conventional Class 2 cavities into interproximal minibox or slot cavities,[7,8] in an attempt to be less invasive of surrounding sound tooth structures. However, as soon as the interproximal ridge is destroyed, general tooth strength is affected,[9] and no attempt to restore the tooth with amalgam,[7] ceramic inserts,[10] or direct stratification of hybrid or packable[11] resin composite is able to fully reestablish original tooth stiffness.

The aim of this article, based on case reports (Figs 1a to 1h and 2a to 2n), is to present a new technique for ultraconservative restoration of small interproximal caries lesions that avoids the disadvantages of both the tunnel and the proximal slot restorative techniques.

[1]Assistant researcher, Division of Cariology and Endodont-ology, Dental School, University of Geneva, Geneva, Switzerland.

[2]Senior Lecturer, Division of Cariology and Endodontology, Dental School, University of Geneva, Geneva, Switzerland.

[3]Professor and Chairman, Division of Cariology and Endodontology, Dental School, University of Geneva, Geneva, Switzerland.

Reprint requests: Dr Stefano Ardu, Ecole de Médecine Dentaire, Université de Genève, Rue Barthélemy-Menn 19, CH-1205 Genève, Switzerland. E-mail: stefano.ardu@medecine.unige.ch

TECHNIQUE

When an interproximal dentin lesion is confirmed by radiographic (Figs 1a, 1b, 2a, and 2b) and eventually optic or laser light (Diagnodent, Kavo) examination, local anesthesia is induced, followed by rubber dam placement (Figs 1c and 2c). The caries lesion is approached through the occlusal surface using a diamond-coated 80-μm bur in a red contra-angle handpiece (Figs 1d and 2d). Progressing deeper into the dentin, being parallel to the marginal ridge, the caries lesion is evidenced as a darkened area, which is debrided by a tungsten or steel bur (Figs 1e and 2e).

As in most instances, the caries lesion is wider than expected by only radiographic examination, and mantle dentin is affected circumferentially around the enamel caries lesion. Surprisingly, in small- to medium-sized interproximal defects, the proximal enamel wall is often demineralized but still intact (Figs 1f and 2g). This is why no attempt is made to open the lesion into the interproximal area.

After the application of an adhesive system, a 2-layer resin composite stratification is made using a darker dentin shade followed by less-saturated enamel shade. Eventually, dark-brown color effects can be added in pits and fissures to better characterize and mimic surrounding stains.

In patients with low to medium caries risk, the demineralized outer interproximal enamel surface is remineralized by periodic fluoride gel applications (Binaca gel or Elmex Gel, Gaba) (Fig 1h) or fluoride-containing varnishes (Fluor Protector, Ivoclar Vivadent).

In patients with elevated caries risk, the outer proximal demineralized surface is sealed by a filled bonding agent eventually applied in 2 layers. In this case, a wooden wedge is inserted to gain better access to the lesion, and the proximal surface of the neighboring tooth is protected by a metal matrix (Fig 2h). An abrasive metallic strip is used to remove the interproximal superficial hypermineralized enamel layer, then 35% H_3PO_4 gel is used as an etching agent for at least 60 seconds, rinsed off with a generous water spray, and well dried with compressed air. The demineralized enamel surface is then coated with a thick layer of a filled bonding agent (Optibond FL, Kerr), which is applied with a microbrush onto the proximal surface (Fig 2i and 2l), light cured for 5 seconds, followed by application of glycerin gel and light polymerization through the glycerin gel for another 40 seconds from oral and from vestibular directions. Eventual excess of bonding agent is removed with a common plastic abrasive strip, and the occlusion is checked. The entire restoration is then reevaluated and eventually repolished at a following dental appointment.

DISCUSSION

The interproximal lesion in posterior teeth usually has its origin just below the contact area because in this zone, plaque has the opportunity to accumulate and mature easily. Often the demineralized enamel remains intact until the dentin lesion is quite advanced.[12] It will take up stain and become disfigured, but in the presence of fluorides, it may remineralize forming a superficial layer of fluoroapatite. This "therapeutic" approach aims to repair initial enamel lesions and allows the tooth to become even more resistant to further cariogenic attack because fluoroapatite starts to demineralize at a pH of 4.5, rather than at 5.5 as does hydroxyapatite.[10]

Nowadays no atraumatic treatment is available to heal carious dentin; thus the surgical approach from the occlusal surface to eliminate the affected dentin is mandatory. Infected dentin is replaced with resin composite, which is a material with similar mechanical properties, and the interproximal enamel ridge is preserved. The use of a surgical microscope or other optical magnification devices is recommended to better control the clinical procedure. Two approaches are proposed depending on the patient's caries risk. A minimally invasive method can be suggested for patients with low caries risk in which the proximal enamel lesion is remineralized by periodic fluoride gel or fluoride varnish application (ie, Elmex Gel, Gaba, or Fluor Protector, IvoclarVivodent). Initial

Case 1 *Treatment of a lesion in a patient with low caries risk.*

Fig 1a *(left)* Initial bitewing revealing a proximal caries lesion in the maxillary first and second premolars.
Fig 1b *(center)* Preoperative view.
Fig 1c *(right)* Rubber dam placement.

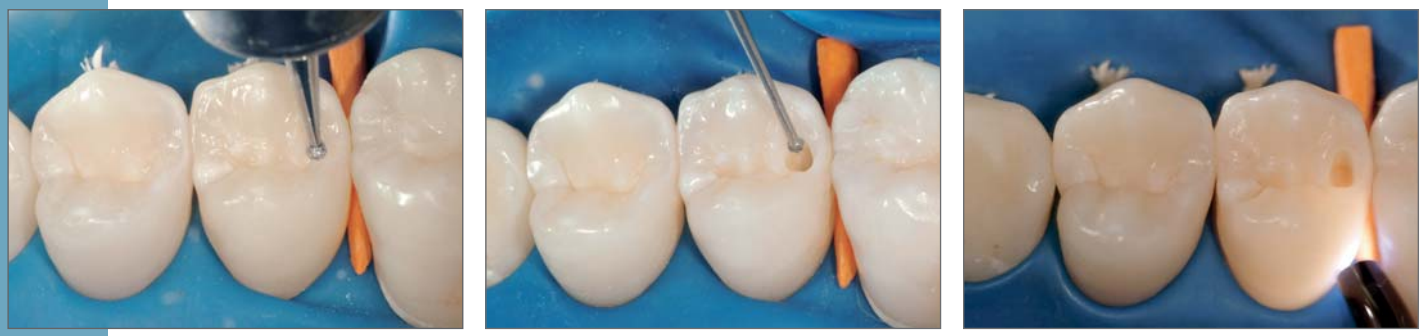

Fig 1d *(left)* An 40-µm diamond bur is used to open the lesion from the occlusal surface.
Fig 1e *(center)* A tungsten bur is used for caries removal.
Fig 1f *(right)* View of the caries-free cavity through transillumination.

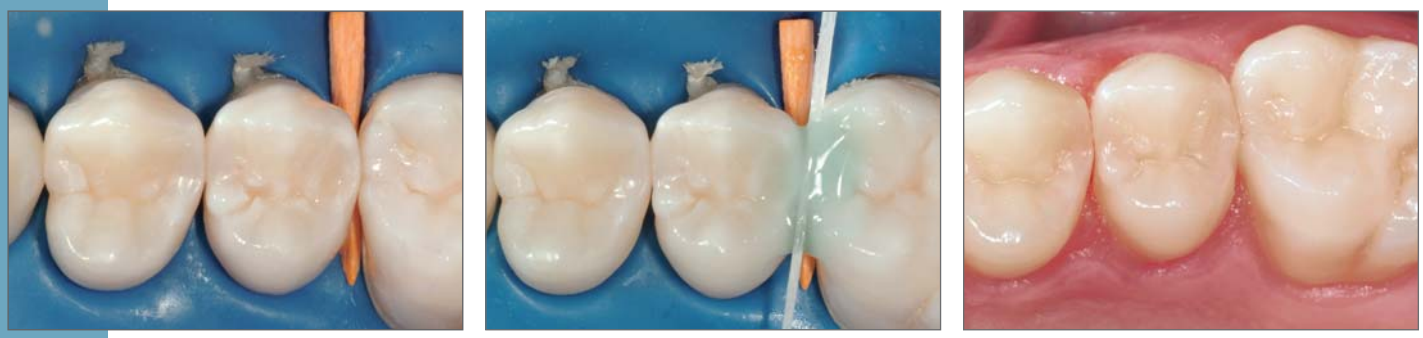

Fig 1g *(left)* Final view of the occlusal resin composite restoration.
Fig 1h *(center)* Fluoride application to promote remineralization of the interproximal lesion.
Fig 1i *(right)* Clinical view after 1.5 years.

cavitations in patients with higher caries risk, on the other hand, should be sealed on the affected proximal surface. This treatment, realized with a filled bonding layer, aims to provide a smooth surface, avoiding plaque accumulation and helping common oral hygiene procedures.

The traditional approach is more damaging to teeth, causing excessive sound tooth loss even for relatively small lesions. None of the currently available restorative materials is capable of replacing natural tooth structure esthetically for the long term, so it is logical to attempt to retain the original tooth structure as long as possible. Restoration replacement, in fact, always causes larger cavity design and tooth substance damage, progressing toward the vicious cycle of tooth loss.

Case 2 *Treatment of a lesion in a patient with high caries risk.*

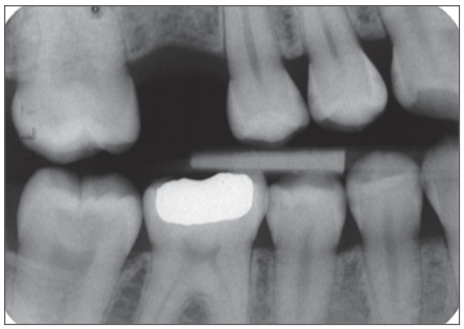

Fig 2a *(left)* Initial bitewing where several lesions are detected. The mandibular first premolar has an initial caries lesion.
Fig 2b *(center)* Preoperative view.
Fig 2c *(right)* Rubber dam placement.



Fig 2d *(left)* An 80-µm diamond bur is used to open the lesion from the occlusal surface.
Fig 2e *(center)* A tungsten bur is used for caries removal.
Fig 2f *(right)* A 40-µm diamond bur is used to perform a peripheral bevel of the occlusal cavity.



Fig 2g *(left)* View of the caries-free cavity.
Fig 2h *(center)* Etching of the interproximal demineralized surface under the protection of the neighboring tooth with a metal matrix.
Fig 2i *(right)* Interproximal bonding application.

CONCLUSIONS

With the advent of adhesive dentistry a large step forward has been made to preserve sound tooth structure. By using bonding procedures, no additional macromechanical retention is needed, and cavity design is dictated only by the extent of the dentin lesion and minimal enamel loss to reach the infected dentin. The proposed technique extends this minimally invasive philosophy into the proximal region of posterior teeth and can be considered the most conservative alternative to conventional Class 2 or slot-cavity treatment approaches.


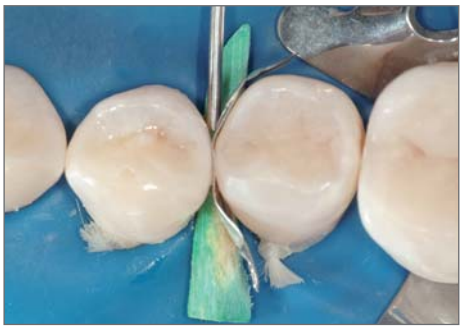


Fig 2j *(left)* Flossing tape is used to better reach the contact surface.
Fig 2k *(center)* A gentle air spray allows removal of the excess bonding material.
Fig 2l *(right)* Polymerization of the interproximal bonding layer.


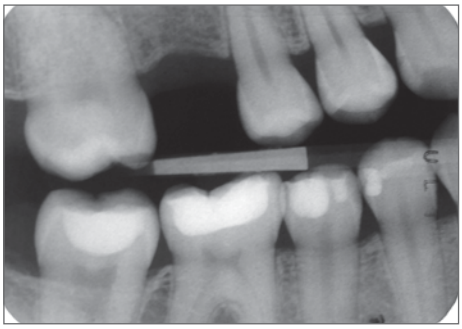

Fig 2m *(left)* Fluoride application to remineralize the etched enamel that was eventually not covered by a bonding layer.
Fig 2n *(right)* Posttreatment bitewing radiograph.

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