Therapeutic seal of approximal incipient noncavitated carious lesions: Technique and case reports

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Sealing of incipient carious lesions in occlusal surfaces has been shown to arrest the progression of the lesions. In this report, we describe for approximal surfaces with noncavitated incipient lesions the clinical procedures for sealant application illustrating this minimally invasive method with 3 clinical cases and scanning electron microscopic images.
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Key words: approximal carious lesions, case reports, minimally invasive method, pit and fissure sealant

National surveys conducted during past decades have shown a large decrease in dental caries prevalence among children and adolescents in most industrial countries.[1–4] Despite significant improvements in dental caries health, the majority of children have manifest caries when they reach adulthood.[5–7] Furthermore, as initial caries lesions are not included in these surveys, the true prevalence of dental caries is almost certainly underestimated.[8] For approximal surfaces, initial lesions constitute the majority of surfaces with carious lesions in teenagers in many countries.[5] A recent study showed that at the age of 21 years, 29% of approximal surfaces showed enamel caries, 14% showed dentin caries, and another 5% were restored.[6] Thus, dental caries continues to be a major problem, especially in the teenage years, and the presence of initial caries and its significance for further caries development underline the need for exploring new strategies for prevention and therapy.[9]

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From a clinical point of view, it is important to decrease the potential risk that initial carious lesions develop into deeper manifest lesions requiring restorative treatment. For approximal tooth surfaces so far, intensive and frequent treatment with high concentrations of fluoride has been used for remineralizing and retarding the progression of noncavitated initial lesions.[10–12] This exposure has not, however, been completely successful in the long-term perspective.[6,13]

Another approach is to seal the carious lesion with adhesive resin-based materials. For occlusal tooth surfaces, dental sealants are highly effective in preventing pit and fissure caries.[14–16]

Long-term studies have shown that as long as the sealants remained intact, caries left underneath were arrested for up to 10 years.[17] Some studies have suggested the possibility of sealing approximal noncavitated enamel carious lesions on premolar and molar surfaces as well.[18–22] In spite of the clinical usefulness of this method for occlusal surfaces, few clinical reports have evaluated the potential of this method for treating approximal tooth surfaces with initial caries in vivo.[23] The purpose of this report is to describe the procedures related to the placement of dental sealants over noncavitated approximal initial caries lesions and to illustrate the method with some case reports.

CLINICAL PROCEDURE

Permanent premolars or molars with approximal incipient carious lesions, which can be seen radiographically in the enamel up to the enamel-dentin junction (score 1 and 2 according to Mejáre et al[6]), are selected (Fig 1a). To get access to the approximal space, a temporary tooth separation was performed.[18,20,24]

An orthodontic elastic separator (Masel Orthodontics) is placed around the approximal contact area involving the affected tooth (Fig 1b). A plier is used to stretch the separator and snap it in between the two teeth. The patient is seen about 1 week later, and the separator is removed. In most cases, the space obtained after tooth separation is between 0.8 and 1 mm (Fig 1c). When the space is less than 0.8 mm, double orthodontic wires (0.5-mm diameter; Brass-wire soft; Dentaurum) can be placed between the teeth by the fourth day for better separation.

After careful visual and tactile examination of the approximal surface and confirmation of a noncavitated carious lesion (Fig 1d), the surface is gently cleaned with pumice, water, and a sharp, soft hand brush (Interprox-micro; Dentaid) (Fig 1e). After washing and drying with contaminant-free compressed air, cotton rolls or a rubber dam are applied. The adjacent approximal surface is protected with a nylon adhesive strip (Dispens-O-Mat; Polydent). The carious tooth area and about 1 mm of sound enamel surrounding the lesion are etched for 20 seconds with a 35% phosphoric acid gel (Scotchbond Etchant; 3M Espe) using a bent, fine marten-hair brush (no. 00; Ocean). The etchant is thoroughly washed away with water followed by air drying. When the approximal surface is completely dried, a light-cured, low-viscosity, fluoride-releasing pit and fissure sealant (Clinpro Sealant; 3M Espe) is carefully applied in a minimal amount with a very thin layer onto the etched area with a marten-hair brush (Fig 1f). After waiting for 30 seconds, the sealant is cured with a visible dental curing light. During the procedure, a dental floss without wax is placed in the interdental space to avoid sealant flow to the cervical zone.

After polymerization, the sealant is inspected for complete coverage. Excess sealant is removed with an explorer, and the margins are slightly polished. Finally, a neutral sodium fluoride varnish (Duraphat; Colgate Oral Pharmaceuticals) is applied for protecting etched areas that have eventually not been sealed.

The patient is clinically examined 6 months later and then once a year. Standardized bitewing radiographs are taken to control the lesion.

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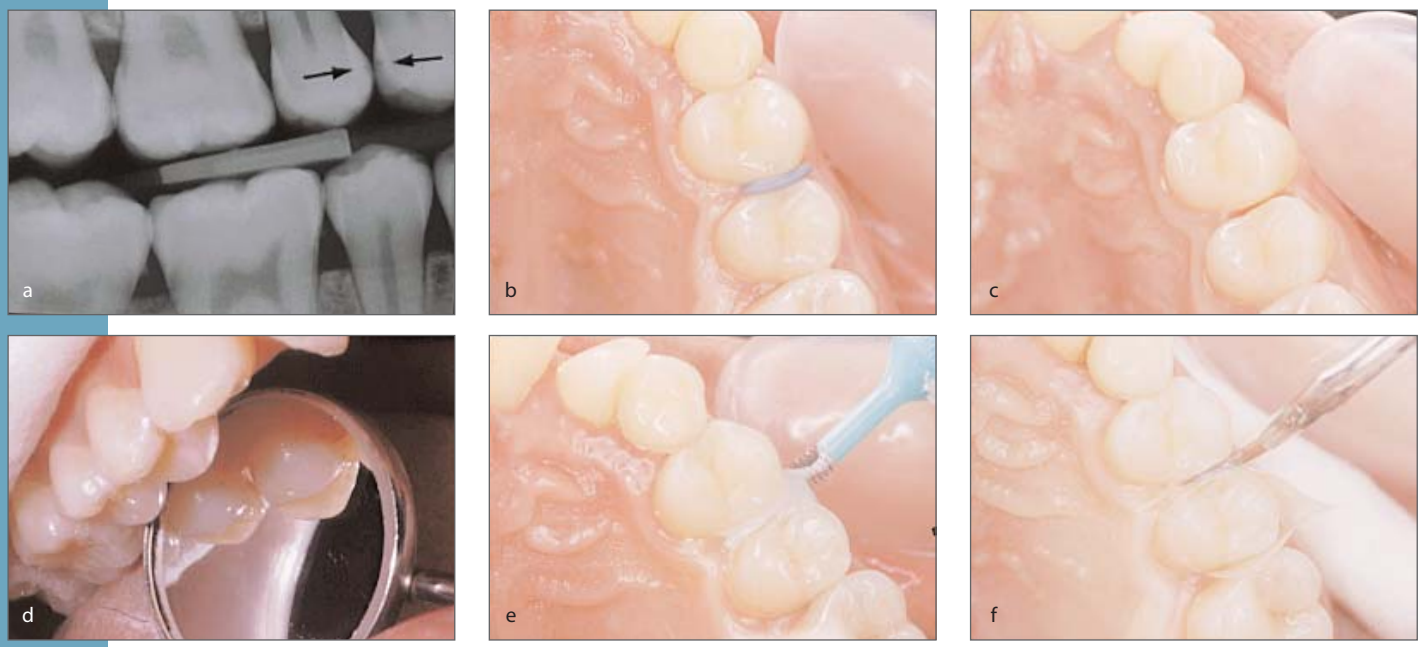

Fig 1 The clinical procedures. *(a)* Standardized bitewing radiograph showing approximal incipient noncavitated carious lesions *(arrows)*. *(b)* An orthodontic elastic separator is placed around the approximal contact area involving the affected teeth. *(c)* After a week, the separator is removed, and a space between 0.8 and 1 mm is obtained. *(d)* Visual examination of the approximal surface. *(e)* The approximal space is gently cleaned with pumice, water, and a soft hand brush. *(f)* The sealant is applied with a brush.

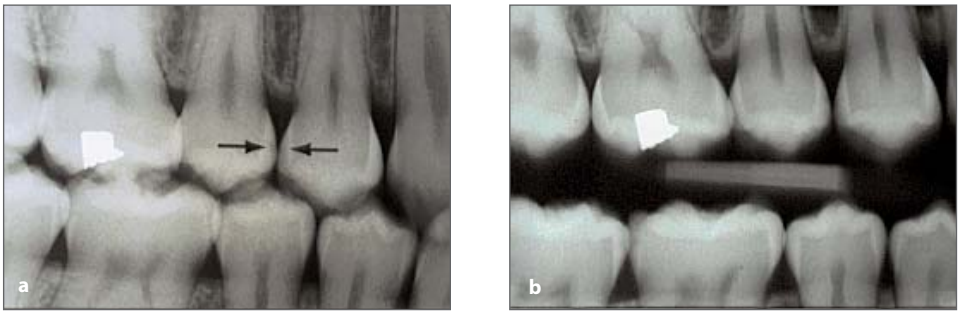

Fig 2 Case 1: A 19-year old patient. *(a)* Baseline bitewing radiograph showing 2 initial carious lesions in the maxillary right first and second premolars *(arrows)*. *(b)* After 3 years, no progression of the lesions could be observed.

CASE REPORTS

The following 3 cases are representative of the indications for sealing incipient noncavitated approximal carious lesions.

Case 1

A bitewing radiograph revealed in a 19-year-old patient 2 initial carious lesions in the enamel of the distal and mesial approximal surfaces of the maxillary right first and second premolars, respectively (14d and 15m). The lesions were classified as score 1 (Fig 2a, black arrows). Tooth separation was made, providing a sufficient visual access to confirm that the lesions were noncavitated. After treatment with sealants, instructions on how to clean the sealed approximal surfaces with toothbrushing and flossing were given to the patient. After 3 years, the control examination showed no progression of the lesions (Fig 2b).

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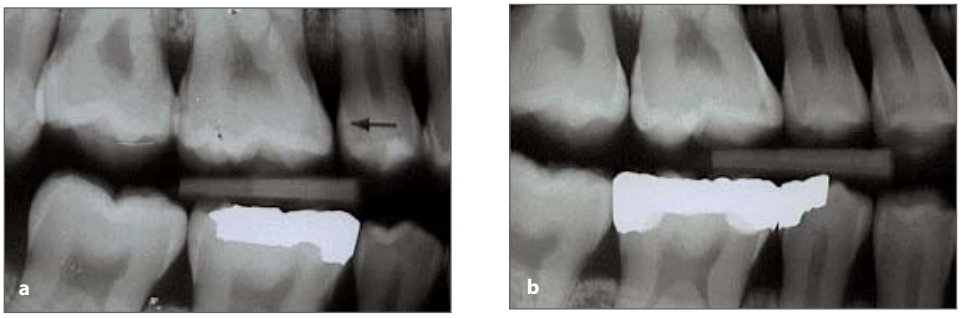

Fig 3 Case 2: A 25-year-old patient. *(a)* A distal initial lesion in 15d was classified as score 2 *(arrow)*. *(b)* After 3 years, the sealed distal lesion in tooth 15 was still completely arrested. Note that teeth 46 and 45 had received occlusodistal amalgam fillings by another clinician.

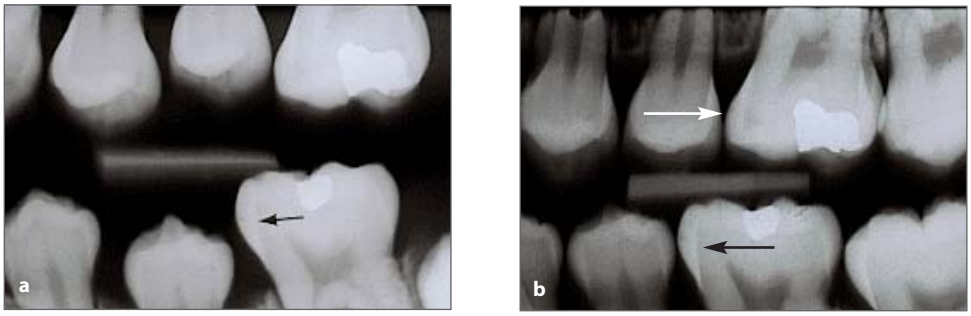

Fig 4 Case 3: An 11-year-old child. A mesial incipient noncavitated caries lesion (score 1) on tooth 36 *(a, black arrow)* and the lesion after 3 years *(b, black arrow)*. Note that a new incipient lesion had developed on the mesial surface of tooth 26 *(b, white arrow)*.

Case 2

A 25-year-old patient living in a low-fluoridated area (0.1 ppm F) and with a high cariogenic activity presented at baseline many lesions in the mandibular and maxillary teeth. The distal initial lesion in the maxillary right first premolar (15d), classified as score 2, was selected for sealant treatment (Fig 3a). After 3 years, the control examination showed that the sealed distal lesion in tooth 15 was still completely arrested (Fig 3b). It is interesting to note that during the first year, both tooth 46 and tooth 45 had received occlusodistal amalgams by another clinician (Fig 3b).

Case 3

An 11-year-old child had recently moved to Valparaiso (fluoridated area: 0.6 ppm F). He showed a high caries risk mainly due to past caries activity in the primary teeth (dft = 3) and permanent molars (dft = 4), deficient oral hygiene, and a high frequency intake of sugar. Bitewing radiographs showed incipient noncavitated caries lesions (score 1) on the mesial surface of the mandibular left molar (36, Fig 4a). In this patient, tooth 75 was exfoliated, and tooth separation was not necessary. The good clinical access to the mesial surface of tooth 36 made it easier for the proper placement of the therapeutic sealant. After treatment, the patient received advice about his cariogenic diet and deficient oral hygiene. The use of a fluoridated dentifrice was also recommended. New bitewing radiographs after 3 years (Fig 4b, black arrow) confirmed the complete arrestment of the lesion. Examination of the bite-wing radiographs taken after the third year revealed a new incipient lesion on the mesial surface of the maxillary left first molar (Fig 4b, arrow). Treatment with a therapeutic sealant was performed.

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DISCUSSION

Use of dental sealants has become an established clinical procedure for the prevention of pit and fissure caries.[25] This concept has also been suggested for treatment of approximal noncavitated enamel carious lesions on premolar and molar surfaces, as adhesive resins have been found to infiltrate artificially created caries-like lesions and to increase the protection against further acid demineralization.[21] The described clinical technique in the present report shows the usefulness and potential of this treatment strategy for early enamel lesions on approximal posterior tooth surfaces in some clinical cases.

The trend today—and an important principle of minimally invasive dentistry—is to delay the restorative intervention as long as possible. Once a filling is placed, the tooth enters a repeat restorative cycle that can be illustrated by studies showing that replacement of restorations makes up 50% to 70% of all operative treatment on adult patients.[26] Therefore, a shift toward a more tissue-preserving approach has emerged when restoring teeth. The concept of minimally invasive dentistry has evolved and puts a focus on maximum conservation of demineralized noncavitated enamel and dentin.[27] The therapeutic approach using a sealant on noncavitated demineralized approximal surfaces can be regarded as a refined model of care in accordance with this new concept.

Accurate diagnosis of the lesion is essential in minimally invasive dentistry and should give information about both the activity and status of the lesion and the presence or absence of cavitation. The ability to visualize the approximal surfaces allows inspection of surface reflection and texture for lesion activity. It has recently been shown that active noncavitated lesions with a chalky and rough surface had greater risk of progressing to a cavity than inactive shiny and hard lesions.[8] In cases where remineralization with fluoride is not a viable approach, therapeutic sealants could be an additional option.

To gain access to the approximal space, it is necessary to place a rubber spacing ring for 3 to 5 days for temporary tooth separation, a step that can be regarded as somewhat inconvenient and that requires more operative time when performing the sealing process. However, this step, which opens up an interproximal space varying between 0.8 and 1.0 mm, allows direct inspection of the lesion and application of the fluoride-containing sealant. Because of the transparency of the very thin layer of sealant, overextension to the buccal and lingual area helps in visualizing it and getting clinical control of the sealant area. Excess sealant is removed with an explorer and the margin slightly polished. A very fine polish strip can be used approximally to avoid a rough cervical sealant margin. It is important that the sealant completely covers the lesion together with a rim of sound etched enamel around the periphery of the lesion; if not, the lesion can progress.

In the early stages of the caries lesion, there will be a subsurface demineralization resulting in microporosities within the tissue. Studies have shown that the surface zone of artificial lesions of enamel can be occluded following infiltration with polymer materials.[21] Gomez et al[22] reported that application of a pit and fissure sealant on extracted human teeth with proximal noncavitated enamel lesions infiltrated the superficial porous caries lesion and produced resin tags of up to 6 microns in length forming a physical barrier. Scanning electron microscopic images[22] from sealed lesion areas showed that tags had an irregular distribution pattern with a complex morphology, varying in thickness and extension (Figs 5a and 5b) and not corresponding to the typical acid etching pattern seen in the sound enamel around the lesion (Figs 5c and 5d).

The present clinical cases showed no lesion progression after 2 to 3 years, and this observation indicates that the development of the disease had been intercepted at an early stage and that the progression was inhibited beneath the sealant before it had produced a recognizable cavity. As the sealant contained fluoride, a possible contributing factor for the arrest of the lesion progression in the clinical cases could have been fluoride leakage affecting cariogenic organisms beneath the sealant and within the biofilm outside the sealant. Earlier studies

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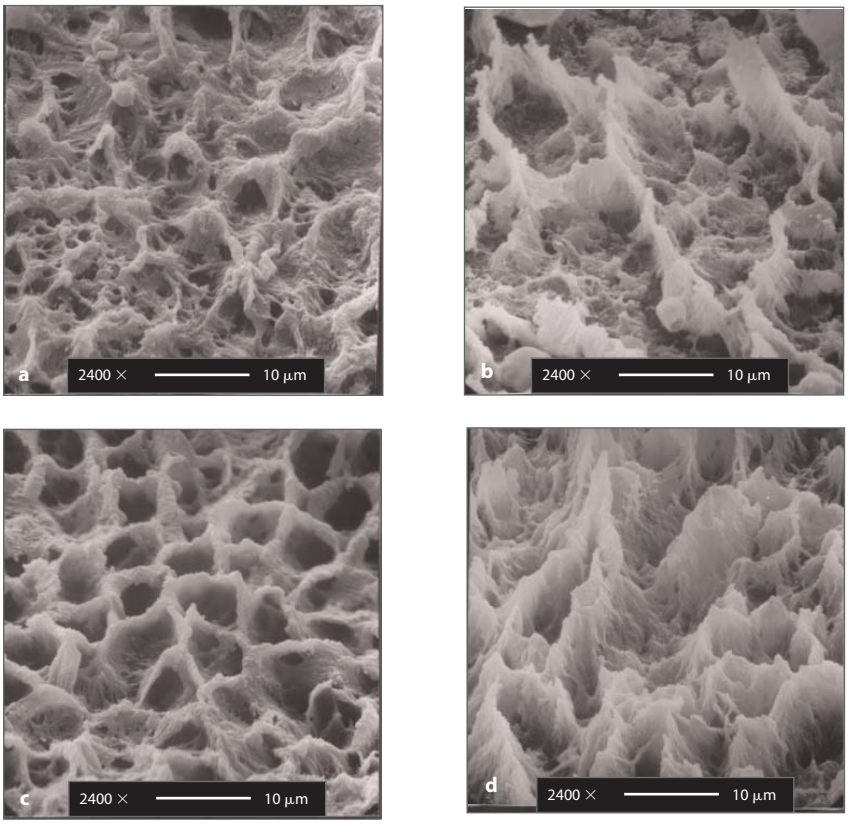

Fig 5 Resin tag patterns in sealed lesion areas *(a and b)* and in sound enamel *(c and d)*.

have shown incorporation of fluoride in the enamel after experimental application of fluoride-releasing sealant.[28]

The caries-preventing effect of sealants may also be due to the fact that pit and fissure sealants applied to incipient occlusal lesions result in a long-term reduction of the number of viable bacteria under the sealant.[29] Remaining cariogenic bacteria in the lesion are cut off from a nutritional supply of fermentable carbohydrate for producing acid, resulting in prevention of further progress of the carious process and in an inactive lesion. To ensure an effective seal, a careful technique for applying the sealant is needed.

An important aspect is that the arrest of the lesion progression into a cavity implies that a cavity preparation for a restoration can be avoided. This also implies that iatrogenic damage of the adjacent tooth can be avoided with the present therapeutic sealant method. Studies have shown that in 70% of approximal Class II cavity preparations, the adjacent tooth is damaged and will develop caries more frequently compared to a non-damaged surface.[30] Further advantages with the method are that sealants are esthetically appropriate, are relatively inexpensive, and can be reapplied at any time without removing tooth structure.

CONCLUSION

Application of a pit and fissure sealant over natural noncavitated approximal lesions has been described. The method seems to be effective and represents a promising alternative to traditional preventive treatments. Long-term clinical studies in a large group of high-caries-risk patients are required to further evaluate the potential of the sealant method.

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