SILVER MODIFIED ATRAUMATIC RESTORATIVE TECHNIQUE (SMART): AN ALTERNATIVE CARIES PREVENTION TOOL

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ABSTRACT

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Aim: Introduction of Silver Modified Atraumatic Restorative Technique (SMART) as an alternative caries prevention tool advances the existing dental armamentarium.

Summary: Caries management strategies have advanced far beyond simply "drilling and filling" teeth, which does nothing to halt the underlying causative disease process. Effectively treating the caries disease starts with a careful hard-tissue exam and caries risk assessment (CRA) followed by treatment intervention strategies based on the patient's individual risk status. The latest addition to the caries prevention armamentarium, silver diamine fluoride (SDF), entered the US market in 2015 shortly after it was cleared by the United States Food and Drug Administration (FDA) in 2014 to treat tooth sensitivity. It is being used off-label to treat and prevent caries, using CDT billing code D1354. The case presentation showcases a technique called Silver Modified Atraumatic Restorative Technique (SMART) in which SDF is applied and immediately restored or sealed with conventional GIC. Placement of SDF and GIC on the same appointment is especially useful when, for whatever reason, the patient will not be able to return for subsequent dental treatment and it is deemed advantageous to use a minimally invasive procedure rather than nothing at all.

By placing SMART restorations you kill bacteria and cut off the nutrient source for any remaining bacteria by placing a chemically sealed restoration that will arrest and remineralize the caries lesion, preserving tooth structure and enhancing pulp vitality. The following case study showcases a different approach to using GIC material in combination with SDF.

Keywords: cariology, minimally invasive caries treatment, dental armamentarium, restorative technique.

1. Introduction

Caries management strategies have advanced far beyond simply "drilling and filling" teeth, which does nothing to halt the underlying causative disease process. Effectively treating the caries disease starts with a careful hard-tissue exam and caries risk assessment (CRA) followed by treatment intervention strategies based on the patient's individual risk status[1]. The ADA Caries Classification System (ADA CCS) was published to classify all stages of caries lesions and to help discern when surgical restoration (verses chemical remineralization) is likely needed[2]. The latest addition to the caries prevention armamentarium, silver diamine fluoride (SDF), entered the US market in 2015 shortly after it was cleared by the FDA in 2014 to treat tooth sensitivity. SDF is being used off-label to treat and prevent caries[3], using CDT billing code D1354.

The safety and efficacy of using SDF for caries treatment were reviewed by Horst and others in 2016[3]. Randomized clinical trials evaluated the efficacy of SDF and clearly demonstrate that repeated applications of SDF are required for more predictable caries arrest[4,5]; however, on occasions, there may be a situation where the patient is not likely to return for subsequent treatment or have the ability to receive treatment elsewhere. In this

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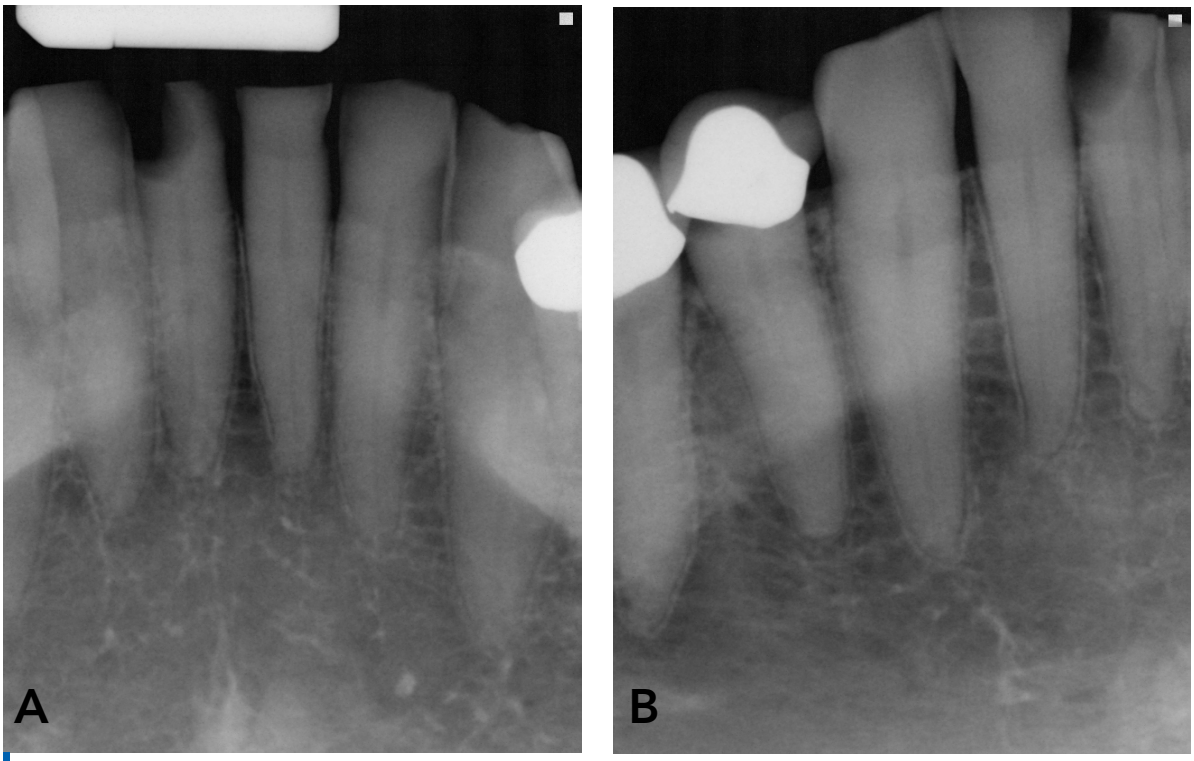


Figures 1A and 1B. Radiograph of distal D3 approximal lesion on tooth #41

case, the healthcare provider has limited options:

1. no SDF placement at all (do nothing),
2. place SDF once knowing success may be limited, or
3. place SDF and a glass ionomer cement (GIC) sealant/restoration during the same appointment to limit access of fermentable carbohydrates and improve chances of SDF caries arrest.

The damage from acids affecting the tooth surfaces through the process of demineralization, as well as the process of remineralization to help replenish the lost substrates from the effects of the acid damage have both been extensively studied[6]. Perhaps what is more exciting are studies demonstrating that conventional GIC produces a sealed chemical bond and remineralized layer at the material-tooth interface[7].

2. Rationale

The case presentation showcases steps when applying a technique called Silver Modified Atraumatic Restorative Technique (SMART)* in which SDF is placed and immediately restored or sealed with conventional GIC. Placement of SDF and GIC on the same appointment is especially useful when, for whatever reason, the patient will not be able to return for subsequent dental treatment and it is deemed advantageous to use a minimally invasive procedure rather than nothing at all. Some examples include, children, humanitarian dentistry in underserved populations, or when there are long wait times for hospital dentistry. The technique presented will combine advantages of three proven principles:

1. the antibacterial and remineralizing effects of SDF causing caries arrest[4,5],
2. partial/incomplete caries removal on deep caries lesions approaching a vital and asymptomatic pulp[8, 9], and
3. proper placement of a chemically sealed and bonded GIC restoration[10].

By placing SMART restorations you kill bacteria and cut off the nutrient source for any remaining bacteria by placing a chemically sealed restoration that will arrest and remineralize the caries lesion, preserving tooth structure and enhancing pulp vitality.

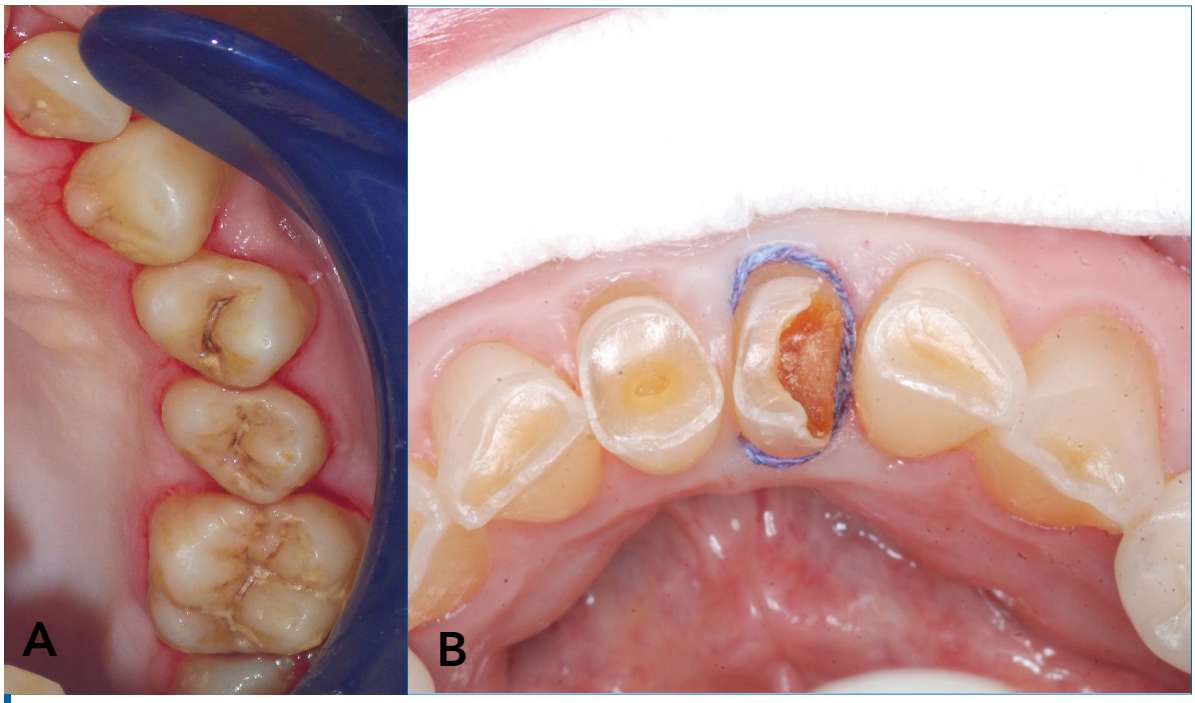
3. Case Study

SDF Placement with Immediate Restoration Using GIC

A 71-year-old female with a medical history significant for hypothyroidism, osteoporosis, gastroesophageal reflux disease, and schizophrenia presented to the practice. She was taking medication for hypothyroidism, osteoporosis. Her chief concern was to address her front teeth and to avoid extraction if possible.

During her clinical exam and CRA, saliva appeared thick and ropey, multiple lesions presented throughout her mouth, and hygiene was relatively fair (moderate plaque, moderate calculus, and multiple areas of bleeding upon probing). The patient was diagnosed with moderate xerostomia, generalized mild chronic periodontal disease and extreme caries risk.

The treatment plan proposed to the patient was limited scaling and root planning to address the periodontal health, and placed on 4 month recall. Upon vitality testing, tooth #41 was diagnosed as vital and a treatment formulated to address the



Figures 2A and 2B. 2B (Pre-Op) Initial ICDAS 2 lesions2 present on teeth #24 and #25. Tooth #41 with an advanced lesion prior to treatment. Retraction cord is optional; cotton roll isolation is recommended

Figure 3. The lesion was desiccated prior to placing SDF

asymptomatic advanced lesion[2] (Figs. 1A and 1B). Due to extreme caries risk from xerostomia and numerous areas throughout her mouth with active carious lesions (approximal and facial-lingual), the patient was placed on high fluoride toothpaste, encouraged to drink water with medication, and to use an anti-cavity mouth rinse. In addition, treatment of GIC sealants immediately after SDF placement was appropriate in order to address the patient's ICDAS 2 lesions on teeth #24 and #25 (Fig. 2A). Prior to beginning treatment, the patient was provided with an informed consent discussing the risks, benefits, and alternatives to agreed upon treatment. This included disclosing that the infected area of the tooth would turn a dark brown to black during the placement of SDF and may show through the restoration especially at the marginal areas. Furthermore, oral hygiene instruction was delivered to the patient to emphasize the importance of better hygiene methods.

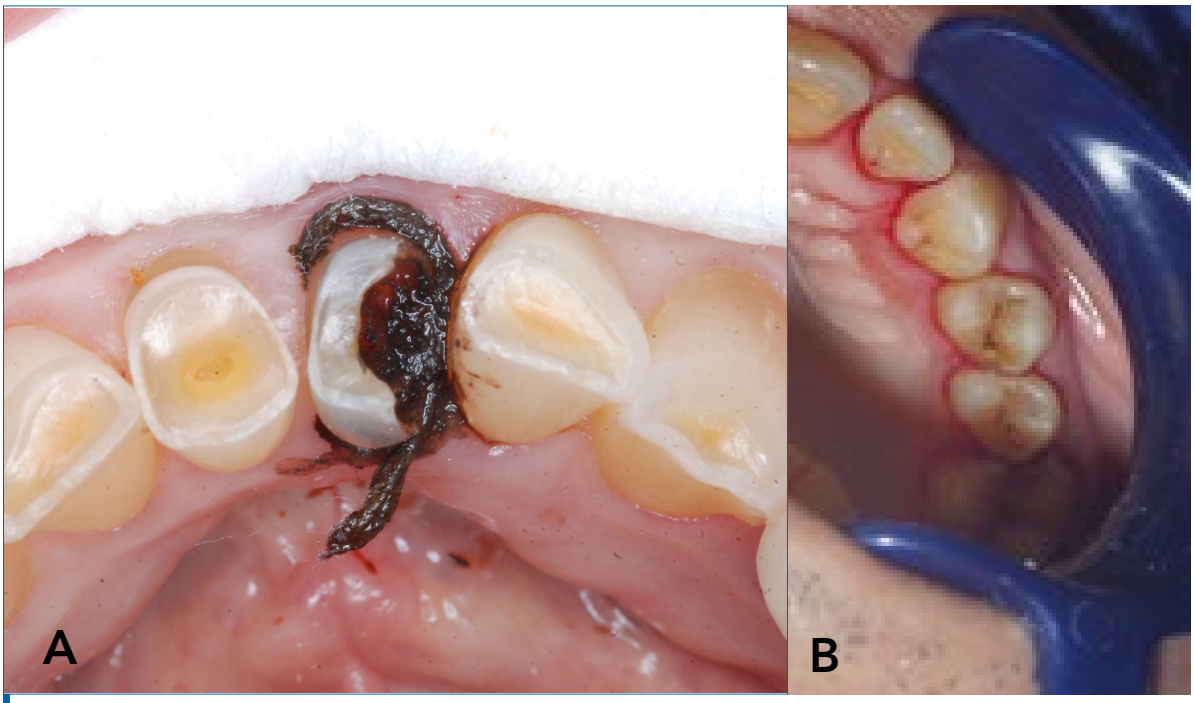
Treatment of the anterior tooth #41, addressed the patient's chief concern of avoiding extraction and applying restoration. After tooth #41 was anesthetized, retraction cord and a cotton roll were placed for isolation (Fig. 2B), followed by desiccation of the lesion (Fig. 3). After transfer of SDF using a microbrush, SDF was left in place for 1 minute (Fig. 4A). It is normal for the area of active disease to remain dark brown to black after application of SDF (Fig. 4B).

The cavosurface margins were prepared using water, a hand piece and a round bur without removing axial decay to avoid pulp exposure (Fig. 5A). In order to achieve an ideal chemical bond with GIC, the tooth structure should be free of debris and decay. Using grey pumice or an air polisher to clean the entire tooth surface will ensure that biofilm or pellicle has been removed (Fig. 5B). A matrix system can be applied to create supportive walls for the GIC restoration.

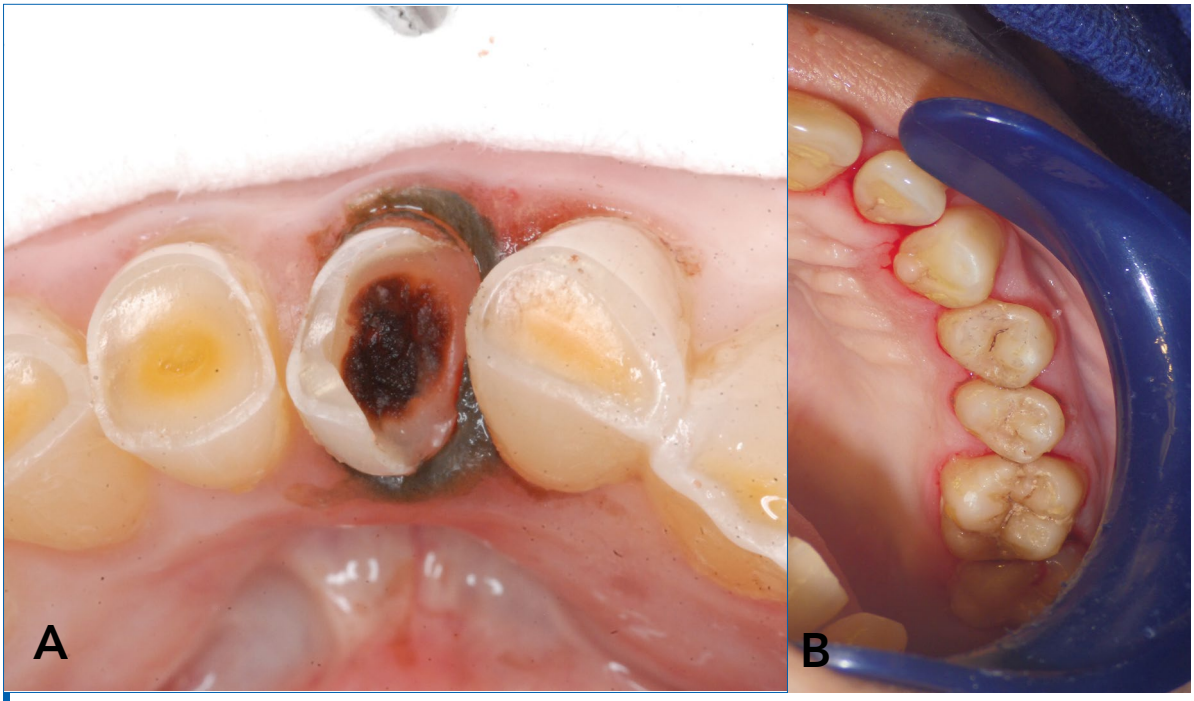
Apply polyacrylic acid to the cavosurface margins or clean the surfaces of teeth for 10 seconds (Fig. 6). Rinse off polyacrylic acid for 10 seconds, and then blot dry. This particular step cleans the smear layer off and provides proper chemical bond with tooth structure.

During rinsing, the assistant can mix the GIC capsule. Prior to placing GIC over the clean moist tooth surface, it is advisable to avoid desiccating the tooth surface.

With the proper amount of moisture, the tooth surface should appear with no pooled water before



Figures 4A and 4B. Using a microbrush, SDF is transferred from a dappen dish to lesions and left for 1 minute



Figures 5A and 5B. Clean perimeter margins in #41 and ICDAS 2 lesions after 10 sec rinse making sure not to desiccate

GIC placement. Keeping the tooth properly moist (careful not to desiccate) GIC can be dispensed over 10 seconds and applied over pits and fissures and preparation. It is essential to not touch or move the GIC after 30 seconds from start of mix.
When working on multiple teeth some use the "finger push" technique. If using a finger press technique, consider changing gloves to avoid potential SDF transfer extraorally (skin, clothes, surfaces) Dispose contaminated items to prevent accidental contact by others.

With a gloved finger slightly lubricated with unfilled resin or manufacturer coat, push the GIC in the pits and fissures and at the same time removing the excess (Fig. 7).
Helpful hint: To avoid adjusting the occlusion you can mark the occlusal contacts (including excursions) prior to GIC placement with articulating paper then avoid applying GIC to those areas.
If you see some GIC in the marked areas you have 10 sec to carve it off and remove any unwanted excess. Excessive GIC can be removed from

Figure 6. Polyacrylic acid over the entire occlusal tooth surface applied with a microbrush

Figure 7. GIC sealants placed on teeth #24 and #25

Figures 8A and 8B. Postoperative photo of tooth #41 after GIC placement. Red articulating paper marks are visible. Note the darkened margin on the facial

unwanted areas using an instrument lubricated with a thin film of unfilled resin. After placement of GIC it is best to allow it set for 2 minutes from the start of the mix before finishing and polishing.

The use of unfilled resin or manufacturer's coat is best to ensure water loss or water gain. Light cure is not needed for this step as the GIC is setting. Light curing will intensify the blackening of the tooth and restoration. As an alternative to using unfilled resin to coat surface, one could simply wet the area with saliva or water when the GIC starts to look "frosty" during the setting process.

Once matrices were removed from preparation, bulk reduction was accomplished with high-speed finishing burs and profuse water spray for anterior tooth, #41.

Contouring was accomplished with light pressure, and polishing cups under water spray to help establish anatomical features (Figs. 8A and 8B). Surface drying is avoided as surface cracking and unesthetic opaqueness can result.

Abrasive use of high speed and burs during contouring can also end in "ditching" the surface of the restoration

4. Clinical Implications

Practitioners and patients benefit from the additional opportunity for a caries prevention

tool and techniques. Although this case study is indicative for this specific patient, the preliminary diagnostic information is essential to collect from all patients prior to the start of treatment.
Furthermore, as SDF and GIC restorations are furthered studied, it is essential for practitioners to present appropriate informed consents and alternatives to treatment to ensure understanding for their patients.

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Questions

Safety and efficacy of silver diamine fluoride (SDF) have been studied and demonstrate:

❑a. Repeated application are required for more predictable caries arrest;
❑b. One application is enough for the patient's lifetime;
❑c. Ineffective and limited in practice;
❑d. Superior method of prevention for adult patients.

Application of glass ionomer cement (GIC) at the same appointment after SDF placement:

❑a. Benefits tooth structure increasing chances of remineralization;
❑b. Kills bacteria and cuts off their nutrient source;
❑c. Benefits populations of various age groups.;
❑d. All of the above.

Best way to address the side effects of SDF can be presented to the patients through:

❑a. Performance of the procedure, then showing patients side effects in the operatory chair;
❑b. Verbal explanation and providing a thorough informed consent;
❑c. Word of mouth referrals;
❑d. Directing patients to online resources.

Once lesion is desiccated, SDF should be transferred and left on lesion for:

❑a. 10 seconds;
❑b. 30 seconds;
❑c. 1 minute;
❑d. 3 minutes.