Hi-Ho, Silver!

When SDF makes sense in treating adult patients

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Although not new in its use in medicine, silver is experiencing a bit of a renaissance in the dental industry in the form of SDF. Silver diamine fluoride (SDF) has been used as a therapeutic agent for arresting caries in teeth since the 1970s.[1,2] SDF was developed by Reichi Yamaga, Misuho Nishino, et al. when ammonia was added to silver nitrate to make it stable for use as an antibacterial agent to prevent and treat dental caries.[2]

The U.S. Food and Drug Administration (FDA) approved the use of SDF as a desensitizing agent in 2014.[3] The use of SDF off-label as an interim caries arresting medicament has been popular around the world because of its economic benefits and ease of use for children, elderly population and disadvantaged communities with difficult access to dental care.[4,5] Today, SDF should be considered an integral part of the of the restorative treatment regime for patients of all ages, not just children or the elderly.

SDF at work

The antibacterial effect is one of the key modes of action of silver diamine fluoride.[1,3,4] The interim arrest of caries occurs partly because of SDF's ability to interrupt the caries process. The caries process begins with demineralization of enamel from acids released by the bacteria that cause tooth decay. In vitro studies have supported the clinical efficacy of the fluoride ions in SDF in reducing the solubility of tooth tissue against chemical acid challenge. Research shows that the antibacterial action of the silver ions acted specifically against cariogenic strains of *S. mutans* (MIC, 0.12 mmol/mL).[6,7]

SDF affects the caries process as well as the tooth structure. The effect on enamel is primarily caused by fluoride, while the effect on dentin is predominantly because of silver.[10,11] Along with reducing the chemical acid effect, the fluoride ions facilitate enamel remineralization.[8,9] In turn, silver ions act like rebar to occlude the dentin tubules and reduce sensitivity.

SDF was primarily introduced for use in pediatric patients because of its quick and simple application, but it is often avoided in adults because of its tendency to stain infected tooth structure. Staining, the most reported side effect of silver diamine fluoride, occurs from the reduction of silver ions to metallic silver and silver oxide. Ionic silver absorbs onto any protein surface, but is especially bound to denatured proteins. This accounts for the specificity to carious collagen over healthy collagen.

Staining, however, is not the same for every individual case. The amount of caries, the concentration of the SDF and the frequency with which the SDF if applied, as well as the specific product used, can all affect the level of the staining.

Indications for use on adults

Just like every product in dentistry, SDF works best when used in the right situation. In our opinion, there are three general case types where we have found SDF acceptable as an adjunct or interim treatment in the adult patient.

1. Cases in which the stain is acceptable (hard to see or hard to treat).

Distal buccal caries on the last lower molar can always be difficult to access and seal properly; sometimes in attempts to do so, we destroy more healthy tooth structure than we save. If we can arrest the caries without destroying form and function in the process, it may present a better treatment alternative.

If the patient's pretreatment caries is difficult to access and visualize without cheek retractors and a hygiene mirror, the treatment itself may remain similarly unnoticeable even if it stains or darkens the teeth (Figs. 1 and 2). These "acceptable" cases can also be a case of the patient choosing the resulting staining over outcomes of alternative treatment plans. If we can use SDF to arrest decay on a tooth that could otherwise have the potential to be extracted, the patient may find that an acceptable alternative.

Fig. 1: #18 before treatment.

Fig. 2: #18 after SDF.

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2. Cases in which the stain is reduced.

Certain SDF products on the market have introduced potassium iodide (KI) as a second step that helps reduce staining during the interim treatment until a final restoration can be placed. These products are also great for areas of root exposure, where a patient may have dentinal hypersensitivity but no true lesion or plaque retentive area that requires a final restoration.

If a patient presents with noncarious cervical lesions with sensitivity and no need for preps, but can see their symptoms alleviated with little to no staining, they may jump at the treatment plan that doesn't include "the drill."

When silver diamine fluoride is used in these first two case examples, it has to be confirmed that the site is not plaque-retentive or a food trap. SDF works at halting decay but it will lose the battle if the patient has poor home care or debris constantly accumulates.

3. Cases in which the stain is covered up. (Most adult patients will need a final restoration.)

With the adult patients who normally visit a dental office, carious lesions are more likely to require a restoration to restore full form and function and eliminate food traps. This is also an ideal opportunity to cover SDF staining with an opaque restoration (Figs. 3 and 4).

Fig. 3: #15 treated with SDF after patient presented with fractured cusp. Tooth is asymptomatic and tests vital. Patient does not have funds for final crown and often fails appointments.

Fig. 4: #15 after glass ionomer restoration was placed during the same visit.

The SMART (silver modified atraumatic restorative treatment) restoration is a technique to halt decay and seal teeth using SDF and glass ionomer cement (GIC) or or resin-modified glass ionomer. SDF is applied as usual in two appointments to arrest decay. With this technique, the second application is followed by the placement of GIC or other restorative material over the arrested decay, which seals out the nutrients carious bacteria feed on and restores some form and function, leaving a non-plaque-retentive surface for the patient to keep clean. Although other treatments may be used, this is a helpful technique for any patient you may see with limited access to care or difficulty making or keeping multiple appointments.

This technique can be tapered to your patients. If patients are unlikely to return or access to care is limited, Silver diamine fluoride can be applied and immediately sealed with GI in the same day. If the patient is likely to return, SDF is an ideal interim step to arrest the decay; then, even if the patient is delayed in returning, there is no progression and the lesion can be restored with your preferred restorative material.

Possible additional uses

In more complex cases with significant decay throughout the oral cavity, treatment planning may take several visits. Silver diamine fluoride can be used to halt decay while complex diagnosis and planning is completed; this allows for comprehensive treatment while not allowing lesions to progress. Once a comprehensive plan has been decided, final restorations can be placed over the SDF to restore form and function, eliminate food traps and mask the potential staining resulting from the caries arrest.

Unfortunately, we have also seen situation where finances can limit treatment options. There are cases where the patient needs time to save for a new crown, or insurance will not cover a new crown just yet because of time restrictions. For these patients, SDF can be used along the margin to arrest decay until finances or insurance coverage can be obtained. When the time comes to replace the crown, the crown is removed, recurrent decay under the crown is excavated and the margin is dropped to eliminate any trace of the potential staining from SDF (barring any other potential complications that may exist under the crown that you have already discussed with the patient at the start of treatment).

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These cases are a small sample of the benefits of using SDF in a general practice. SDF is quick, simple to use, can be applied by a hygienist and, because of its minimal side effect, it is a safe adjunct for treatment in adults as well as children. A few cases have reported a mild gingival irritation on the mucosa adjacent to the area treated after SDF application,[12] which can be prevented by applying a thin layer of petroleum jelly to the adjacent gingiva before applying SDF.[13]

As far as placing restorations after silver diamine fluoride, it has been reported that SDF does not affect the bond strength of composite resin to noncarious dentin, but may reduce bond strength to caries-affected dentin. SDF is compatible with glass-ionomer cements and may increase resistance of GICs and composite restorations to secondary caries.[14] In other words, clinicians can use their full arsenal of restorative care, while SDF provides an added margin of safety for the patient. **DT**

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