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

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Received: August 17, 2016
Accepted: August 18, 2016
Available online: August 21, 2016

Cite this article:
Alvear Fa B, Jew JA, Wong A, Young D. Silver Modified Atraumatic Restorative Technique (SMART): an alternative caries prevention tool. StomaEduJ. 2016;3(2):

ABSTRACT

Aim
Introduction of Silver Modified Atraumatic Restorative Technique 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. Aim

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.

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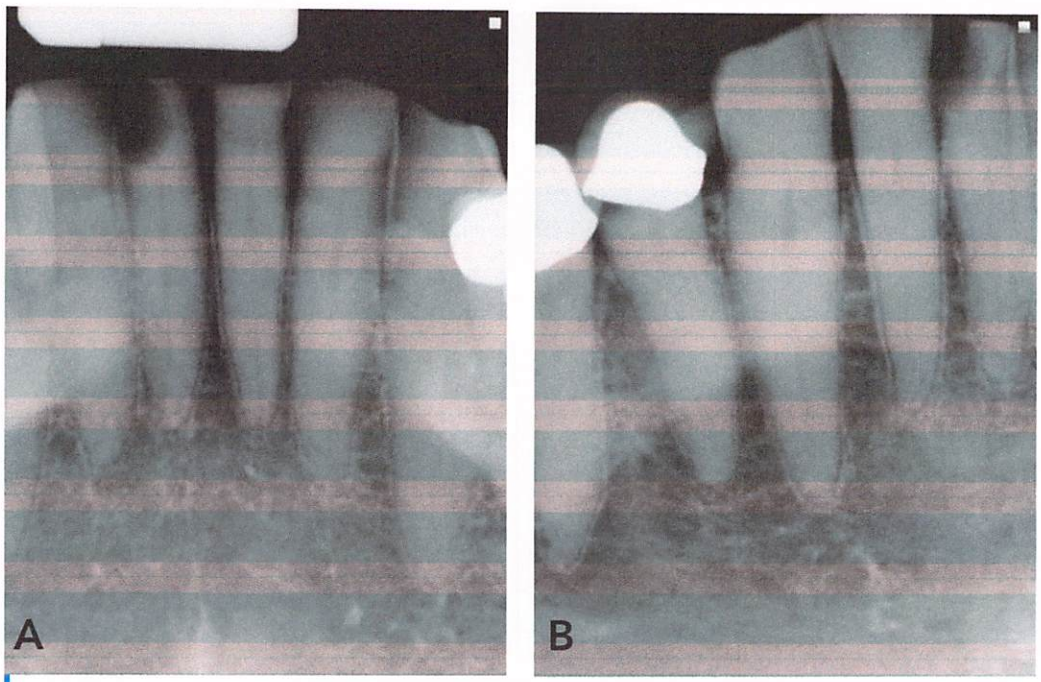


Figures 1A and 1B. Radiograph of distal D3 approximal lesion on tooth #25

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 arrest4,5; 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 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 more exciting are studies demonstrating that conventional GIC produces a sealed chemical bond and remineralized layer at the material-tooth interface.7

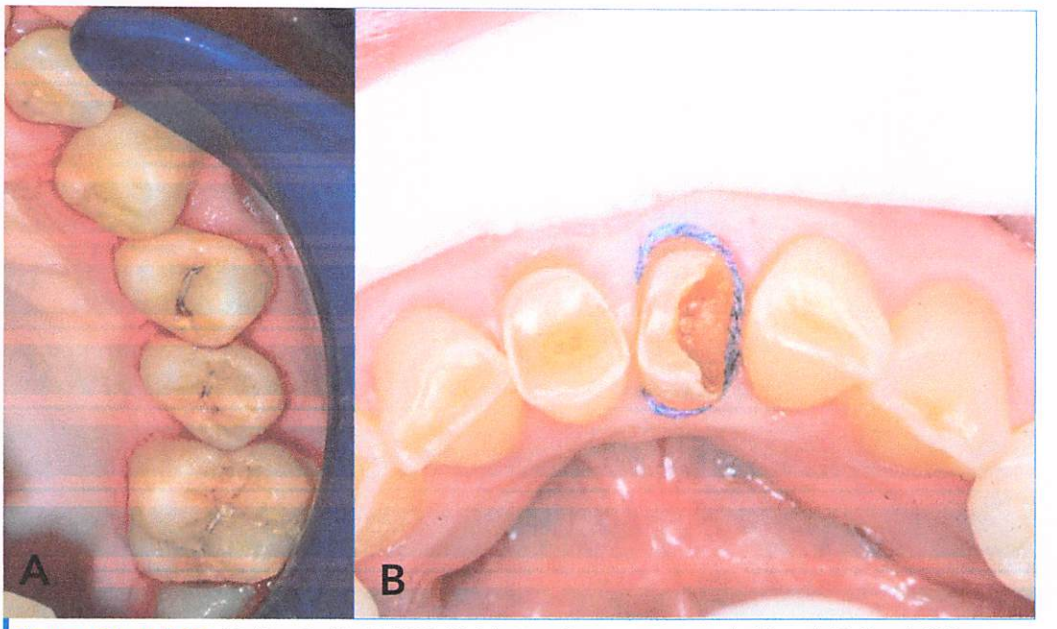
2. Summary

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 pulp8, 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.

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 mouth, and hygiene was relatively fair (moderate plaque, moderate calculus, and multiple areas of bleeding upon probing). Patient was diagnosed with moderate xerostomia, generalized mild chronic periodontal disease and extreme caries risk.



Figures 2A and 2B. 2B (Pre-Op) Initial ICDAS 2 lesions2 present on teeth 12 and 13. Tooth #25 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

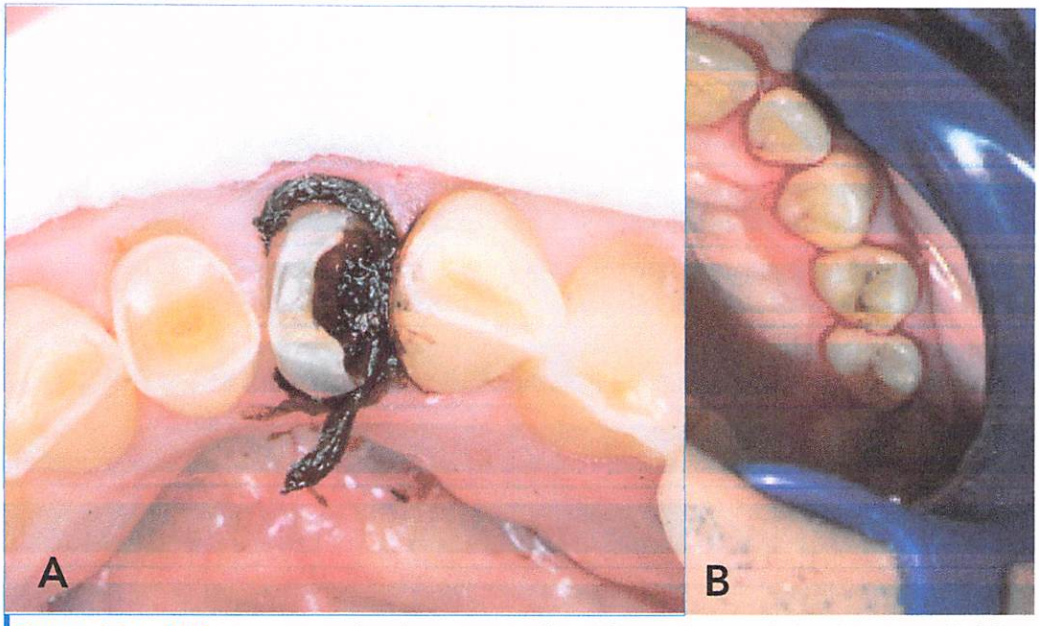
The treatment plan proposed to the patient was limited scaling and root planning to address the periodontal health, and placed on 4 month recall. Upon vitality testing, tooth #25 was diagnosed as vital and a treatment formulated to address the asymptomatic advanced lesion2 (Figures 1A and 1B). Due to extreme caries risk from xerostomia and numerous areas throughout her mouth with active carious lesions (approximal and facial-lingual), 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 #s 12 and 13 (Figure 2A). Prior to beginning treatment, the patient was provided informed consent discussing the risks, benefits, and alternatives to agreed upon treatment. This included disclosing that the infected area of 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 importance of better hygiene methods.

Treatment of the anterior tooth #25, addressed patient's chief concern of avoiding extraction and applying restoration. After tooth 25 was anesthetized, retraction cord and a cotton roll were placed for isolation (Figure 2B), followed by desiccation of the lesion (Figure 3). After transfer of SDF using a microbrush, SDF was left in place for 1 minute (Figure 4A). It is normal for the area of active disease to remain dark brown to black after application of SDF (Figure 4B).

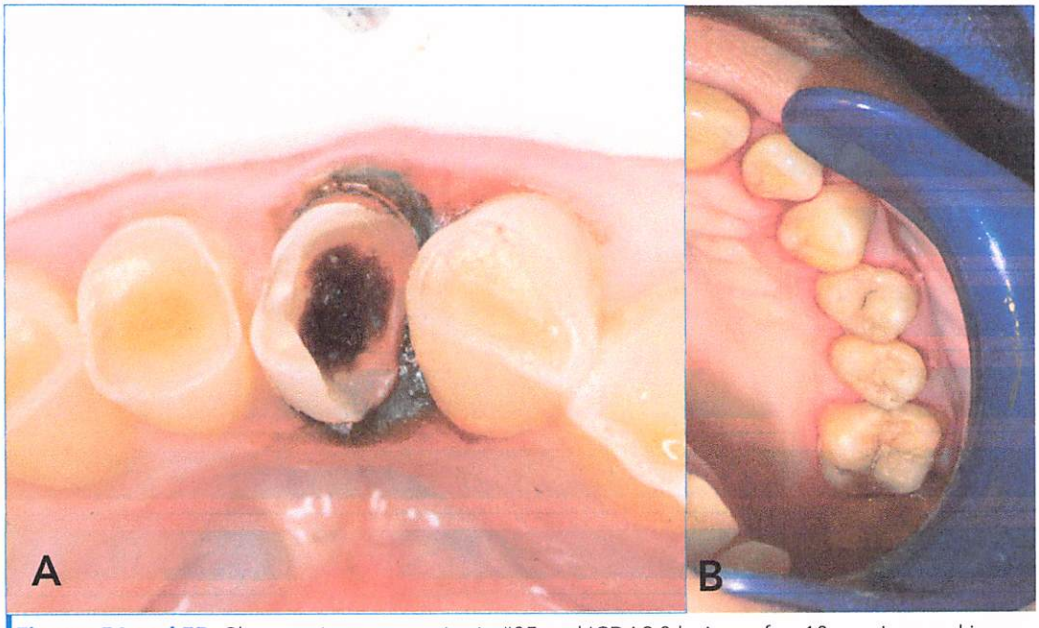
Cavosurface margins were prepared using water, and a hand piece and round bur without removing axial decay to avoid pulp (Figure 5A). In order to achieve an ideal chemical bond with GIC, tooth structure should be to be free of debris and decay. Using grey pumice or an air polisher to clean the entire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

Apply polyacrylic acid to cavosurface margins or clean surfaces of teeth for 10 seconds (Figure 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



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 #25 and ICDAS 2 lesions after 10 sec rinse making sure not to desiccate

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 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 manufacturers coat, push the GIC in the pits and fissures and at the same time removing the excess (Figure 7).

Helpful hint: To avoid adjusting the occlusion you can mark the occlusal contacts (including excursions) prior to GIC placement with articulating pa-

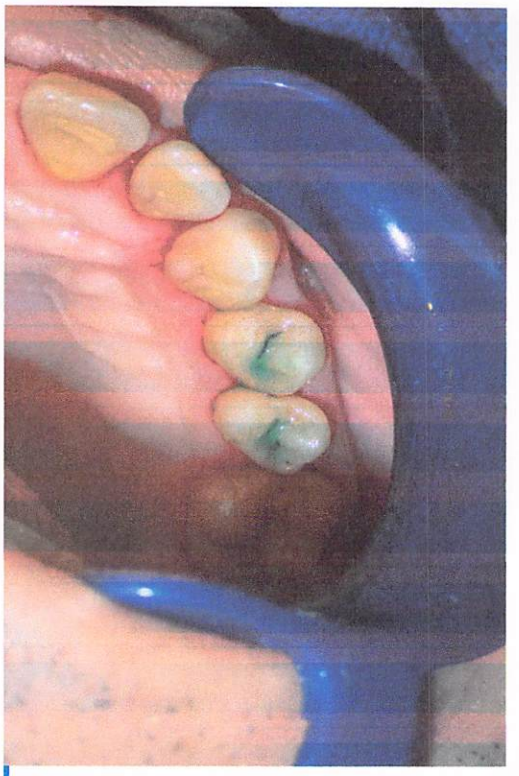


Figure 6. Polyacrylic acid over the entire occlusal tooth surface applied with a microbrush

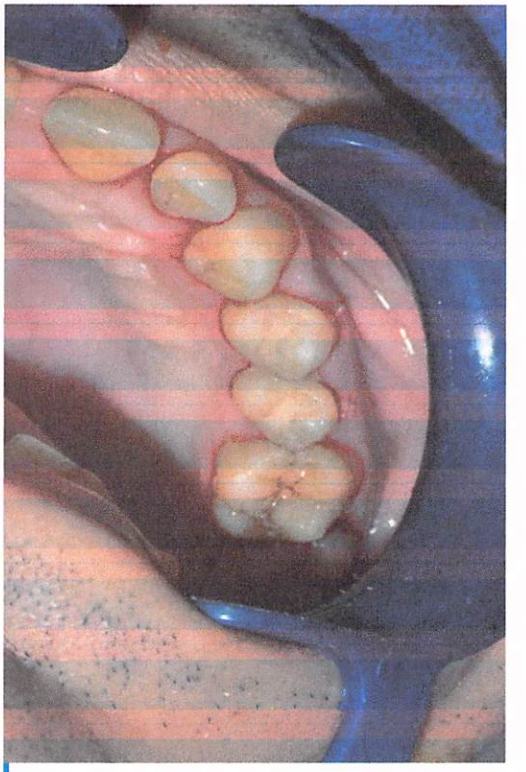


Figure 7. GIC sealants placed on teeth 12 and 13

Figures 8A and 8B. Postoperative photo of tooth 25 after GIC placement. Red articulating paper marks are visible. Note the darkened margin on the facial

per 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 unwanted areas using an instrument lubricated with a thin film of unfilled resin. After placement of GIC best to allow set for 2 minutes from start of 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. 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, #25.
Contouring was accomplished with light pressure, and polishing cups under water spray to help establish anatomical features (Figure 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

3. 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.

Acknowledgements

The authors would like to acknowledge Drs. Steven Duffin, John Frachella, Jason Hirsch, Jeremy Horst, Martin Macintyre, Cate Quas, and Douglas Young for the term "Silver Modified Atraumatic Restorative Treatment (SMART)" as pioneers for this technique. SMART has several possible variations one of which is presented here.

The authors would also like to thank Drs. Vu Le and Allen Wong for contribution of the figures provided in this case study.

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Don't Know, Can't Do, Wont Change; Barriers to Moving Knowledge to Action in Managing the Carious Lesion

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In this special issue of Advances in Dental Research we present the International Caries Consensus Collaboration (ICCC) recommendations for carious lesion management (Schwendicke et al. 2016) and related terminology (Innes et al. 2016), developed from evidence-led consensus. During a lecture 130 years ago, GV Black stated that "*The day is surely coming and perhaps within the lifetime of you young men before me when we will be engaged in practicing preventive rather than reparative dentistry*" (Joseph 2005). This aspiration has been reinforced by consistent and growing evidence supporting less invasive management strategies. However, creating evidence is only the beginning of the story; the next challenge is to translate that evidence into clinical practice (Elouafkaoui et al. 2015). One clear example of our failure to meet this challenge can be seen in the treatment patterns for carious lesions confined to enamel. The invasive (operative) management of enamel lesions is not supported by evidence (Ricketts et al. 2013; Schwendicke et al. 2013a; Schwendicke et al. 2014; Dorri et al, 2015). It is considered too invasive and is no longer recommended (Kidd and Fejerskov 2013; Tyas et al. 2000). Despite this, 40 to 80% of dentists worldwide would still chose to lift a rotary instrument, remove tooth tissue and restore these lesions instead of managing them preventively or micro-invasively (Barbara et al. 2010; Domejean et al. 2015, Gordan et al. 2009, Kakudate et al. 2014). A similar story can be told for the management of cavitated carious lesions. Although there is increasing evidence supporting less invasive carious tissue removal strategies, especially in deep carious lesions, (Ricketts et al. 2013, Schwendicke et al. 2013a), they are still treated over invasively, with complete removal of carious tissue compromising tooth structure and the health of the dental pulp (Oen et al. 2007, Schwendicke et al. 2013b, Weber et al. 2011). This failure to follow new evidence is not limited to dentists who are "out of touch", do not undertake continuing professional development or who have been practicing for many years; in some countries and some schools, new dentists are still taught to remove all infected carious tissue and it is actually not possible to pass professional exams without demonstrating this. The reasons underlying this failure to translate evidence into clinical practice are many, and complex.

It cannot be assumed that newly generated evidence, however compelling, will immediately produce a significant change in clinical practice. The transition of new, evidence-based treatments from the scientific literature into general clinical practice can be slow, and sporadic (Schwendicke et al. 2015). Translational research has shown that this process is complex, with the majority of problems falling into one or more of three areas, loosely summarized as; Don't Know, Can't Do, or Wont Change. These individual areas are also, in turn multifaceted (Grol and Grimshaw 2003), involving a complex interplay of human-, organizational- and policy/system-level influencing factors. Our two consensus documents aim to reduce the "Don't knows". The "Don't know", could be due to general ignorance (perhaps remedied with an appropriate educational intervention), or the more problematic willful ignorance, where the subject chooses not to learn more about a topic (perhaps because it challenges their current beliefs). So, although changing clinicians' behaviors is not a straightforward process, it is accepted that an essential starting point of managing the problem of "Don't know", is the availability of high quality, evidence-based guidance on best clinical practice. The guidance should synthesize the best evidence from the literature into clear, unambiguous recommendations (Schünemann et al. 2014). It is essential that these recommendations use a clear and widely agreed terminology to allow transparent discussion and debate without breakdown due to misunderstanding.

Can such recommendations around less invasive and more contemporaneous management of carious lesions be drawn up, and could these be applicable to all types of patients, countries, healthcare remuneration settings, dental care professionals, and dental education systems? We think yes; and the ICCC's recommendations and terminology publications in the special issue of Advances in Dental Research (Innes et al. 2016 and Schwendicke et al. 2016) address the lack of international guidance on caries lesion management. This was the first goal of the group. The consensus achieved has been built on a foundation of evidence assimilation. However, it only acts as a starting point for accessible, formal evidence to recommendation production. Beyond "Don't know", further barriers to implementing that knowledge base ("Can't Do", or "Wont Change"), will be addressed as part of the next steps.

Acknowledgments

The authors received no financial support and declare no potential conflicts of interest with respect to the authorship and/or publication of this article.

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