

KEY WORDS

Hall Technique, primary teeth, caries, restorations, silver diamine fluoride

LEARNING OBJECTIVES

- To explain how to detect, assess and accurately diagnose primary teeth with caries
- To be able to identify cases for which the Hall Technique and silver diamine fluoride may be advantageous
- To find further resources on the Hall Technique and silver diamine fluoride

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WHEN LESS IS MORE: MINIMALLY INVASIVE, EVIDENCE-BASED TREATMENTS FOR DENTINE CARIES IN PRIMARY TEETH – THE HALL TECHNIQUE AND SILVER DIAMINE FLUORIDE

ABSTRACT

Evidence supports minimally invasive dentistry, and we have a better understanding of dental caries as a biofilm-mediated disease. These factors, together with the current need to reduce aerosol generation, make treatment approaches such as the Hall Technique and the use of silver diamine fluoride (SDF) more relevant than ever.

Successful treatment planning depends on carious lesions being detected, their status accurately assessed, and a correct diagnosis made. Choosing the most appropriate treatment options for the tooth and child relies on marrying this with a precise history and an understanding of indications and contraindications for treatments.

This article outlines the optimal use of the Hall Technique and SDF, allowing dental practitioners and therapists to use these modalities as less invasive approaches to provide the highest quality treatment for children with dental caries; less is more.

Introduction

Advancements in techniques and approaches have led to improvements in the management of diseased/carious primary dentition over recent years. The evidence to support these approaches has grown, and they are now considered mainstream options for dentists and dental therapists in their everyday care of children with dental caries in their primary teeth. Two such management options are the Hall Technique and the use of silver diamine fluoride (SDF) which have the advantages of being minimally invasive, child friendly and non-aerosol generating.

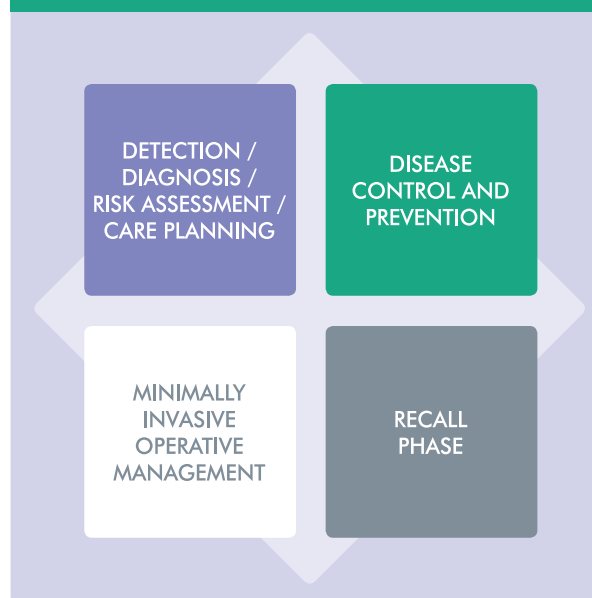
The Hall Technique is most commonly used to restore carious primary molars, but it can also be used for first permanent molars with caries and molar incisor hypomineralisation (MIH). SDF is also often used to manage dental caries in primary molars but can additionally be used in the prevention and management of caries in patients with high caries rates and needs, but low access to care or limited ability to cope with more invasive treatments (such as the very elderly and those with learning disabilities). This paper focuses on managing dental caries in primary teeth where the carious lesion has extended into the dentine but has not reached the dental pulp and there is no pain or peri-radicular infection. It is assumed that practitioners are experienced with assessing children, their families' preferences, and managing children's behaviour so the aspects concentrated on here relate to the carious lesion and the tooth status.

Developments in the use of SDF now see it often being used before a restorative material being placed or prior to the Hall Technique. These combined treatments take advantage of the bactericidal properties of SDF and promote the arrest and remineralisation of carious lesions. They are known as Silver Modified Atraumatic Restorative Treatment (SMART) restorations and the Silver Modified Hall Technique (SMART Hall Technique).

In previous times, it was traditional for procedural steps and pictures to be listed in journals. Here we are going to focus on key points, indications/contraindications and selected cases,

FIGURE 1

MINIMUM INTERVENTION DENTISTRY: THE FOUR OVERLAPPING AND INTERLINKED PHASES²



and allow the clinician to make use of some of the high-quality online teaching resources, such as videos (see page 39 for examples). This also allows the most up-to-date material to be accessed.

Minimally Invasive Dentistry

Minimally Invasive Dentistry has been defined as "maximal preservation of healthy dental structures."¹ It plays a part in the overall modern concept of Minimum Intervention in Dentistry (see Figure 1), where:

*"The patient (and profession) must understand that dental caries is a lifestyle-related non-communicable disease which is ultimately the patients' own responsibility to control and prevent, aided and abetted to a varying extent, by the full oral healthcare team."*²

This conveys the underpinning concept that patients with dental caries require preventive intervention that is likely to involve behaviour change. Two reputable sources of guidance on prevention in the child patient are published by the Scottish Dental Clinical Effectiveness Programme (SDCEP) (*Prevention and Management of Dental Caries in Children*),³ and Public Health England (PHE) (*Delivering better oral health*).⁴

Child-friendly treatment approaches

The Hall Technique and SDF are just two of the treatments that can be described under the umbrella term 'child-friendly' (others would include Atraumatic Restorative Treatment [ART], selective caries removal, and fissure sealants that can be placed over non-cavitated lesions). These approaches aim to control caries progression through the tooth with minimal discomfort to the child, reducing the need for local anaesthesia (LA), air rotors and lengthy procedures, all of which require cooperation from the child. This helps nurture a positive attitude towards dentistry that will hopefully sustain into adulthood.

The rationale behind minimally invasive approaches is based on our current understanding of the carious lesion progression process; it happens slowly and is a dynamic process reliant on the conditions the plaque biofilm finds itself challenged by, rather than a linear and unstoppable process. Hence, biological interventions to hinder the cariogenic bacteria from thriving tip the balance back in favour of remineralisation or away from favouring demineralisation. This allows the lesion to become arrested without the need to undertake extensive invasive procedures

that involve completely cutting out the lesion and surrounding tissue, and which require LA and air rotors. More invasive procedures are likely to be associated with a higher chance of failure.⁵

Non-aerosol generating procedures (non-AGPs)

The additional advantage of the Hall Technique and SDF are that neither treatment involves the use of rotary handpiece instruments (slow speed or air-rotor driven) and therefore can be used without the need for a triple syringe to wash or dry. This means that they can both be considered non-aerosol generating procedures (non-AGPs).

Characterising the lesion to decide which treatment for which tooth

Often the terms 'detection', 'assessment' and 'diagnosis' of carious lesions are used interchangeably. They are, however, separate stages within the examination and diagnosis process for caries.

Detection of dentinal carious lesions

Caries detection is about finding the disease and, for each tooth surface, answering a dichotomous question: is there an alteration of any form within the tooth structure, such as colour, texture, form or radiopacity/radiolucency that could be due to dental caries?

There are two factors that make dental caries particularly difficult to detect prior to cavitation:

1. The initial demineralisation of enamel is difficult to detect visually: it is still white, like enamel, it is often covered in plaque and its refractive index, when the tooth is wet, is very similar to water/saliva so is difficult for the eye to pick up.
2. It tends to occur in a 'sheltered' area because this is where the cariogenic biofilm can thrive and mature and become acidogenic and demineralising.

To avoid missing or underdiagnosing lesions, it is helpful to go back to the core 'rules' for caries detection, taught in all dental schools: the teeth must be clean, dry, viewed under good lighting and, ideally, with the aid of

magnification. However, in routine practice when a child patient is being seen for a dental examination, this is not necessarily a straightforward process. The teeth being examined may not even be clean, for example, but there are practical options to deal with this:

- Consider carrying out toothbrushing instruction to promote skills development prior to an examination. (This may seem unusual to the parent/carer so needs to be explained. It may not be feasible to carry out this toothbrushing instruction before any intra-oral examination, in which case the examination would need to be staged to allow accurate detection of all carious lesions.)
- Alternatively, carry out an oral prophylaxis after the initial dental examination and then re-examine the clean teeth closely.

Detecting non-cavitated carious lesions that have extended into the dentine can be difficult for the occlusal and the proximal surfaces of the tooth. To improve detection rates, multiple investigative methods can be used, and the results combined. Although there are many different tools to detect caries, in the UK, only visual and radiographic means are commonly used. While radiographs can be helpful for detection, there is good evidence that dentinal caries should be detectable visually, without the need for radiographs, when the teeth are cleaned and dried prior to the examination.

The ideal time to treat carious lesions that have progressed into dentine, is prior to frank cavitation. At this stage, for proximal lesions, the treatment of choice with the most predictable and best outcome is the Hall Technique. The preformed metal crowns are easiest to fit before significant enamel breakdown and while there is still an intact marginal ridge. Unless the dentition is spaced, the most challenging areas to fit a crown are the proximal surfaces of primary molars. This is because of the wide contact areas found in primary teeth (see Figures 2a and 2b) and often the only way to detect these lesions is through careful visual inspection, looking for proximal demineralisation shining through the occlusal surface as a grey shadow (see Figures 2c and 2d).

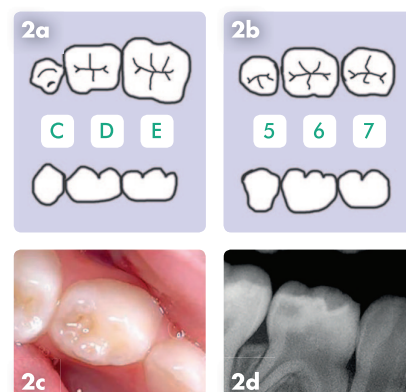


Figure 2: Proximal surface caries develop just below where the adjacent teeth touch. (a) Broad contact areas of primary molars and (b) contact points of permanent molars: the larger contact areas on primary molars make it more difficult to detect the early stages of proximal caries development prior to gross enamel breakdown, by direct visualisation; (c) Indistinct grey shadowing of the mandibular right first primary molar (visible even when wet but would be clearer when dry) is indicative of caries extending into dentine; (d) Radiograph of the same tooth showing the extent of the lesion

Assessment of dentine caries

This step informs the diagnosis, but also allows the lesion to be monitored over time. There are several factors to consider in assessing the lesion.

Cavitation

If the lesion can be seen visually to be cavitated, then the dentine is involved and probably also visible. This directly affects the treatment options available.

Extent and depth

In addition to being useful for detecting carious lesions, radiographs can help assess the extent and depth of such lesions. Deeper lesions may need different treatment choices to promote a long-lasting restoration. If the carious lesion appears visually to have reached the pulp (i.e., the pulp can be seen) or radiographically (i.e., there is no clear band of dentine visible between the lesion and pulp) then the only treatment options are likely to be pulp therapy or extraction. However, if there is doubt as to whether a clear band of dentine can be seen and the tooth has been asymptomatic or showing signs of mild reversible pulpitis, the option of using

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SDF to try to arrest the caries and make the biofilm less virulent followed by a Hall Technique crown should be considered and discussed with the parent/carer and child. If the lesion progresses, then the treatment options are the same: pulp therapy (although access will have to be through the crown with a resin composite to restore the access cavity) or extraction.

Activity

It is useful to know whether a dental lesion is active for two reasons. Firstly, it allows the correct treatment to be chosen – an inactive lesion might need no clinical treatment, only maintenance of active prevention. Secondly, continuing activity of lesions that are being managed with SDF means the treatment is not working. This could be because the prevention is not being carried out adequately or the diet has not changed to a less cariogenic one, for example.

The most reliable way of determining whether a lesion is active or has been arrested is to monitor it over time. However, this is clearly not useful clinically since active lesions need an intervention to stop them progressing. Unnecessary treatment should always

be avoided but to wait for evidence that the lesions are active, through continued tooth destruction, would be clinically detrimental. We must therefore rely on other signs, such as texture and moisture that reflect the loss of mineral content of the tooth structure and the state of the plaque biofilm. Whether a dentine lesion is active or arrested is determined through assessing its softness/wetness (active) and hardness/dryness (inactive), however colour is not a good indicator. The texture of the carious lesion should be assessed using a ball-ended probe.⁶ An explorer must not be used to detect caries or assess its activity as this will cause iatrogenic damage, breaking enamel and resulting in cavitation and damaging dentine.¹ Inactive dentine caries feel hard and dry, while the active lesions tend to be wet and leathery during the initial stages, becoming softer in more advanced stages.^{7,8}

Diagnosis

Diagnosing the state of each tooth leads to the level of intervention that is likely to be needed. Generally, only active caries require treatment. Table 1 shows the indications and contraindications for the use of the Hall Technique and SDF.

The SDCEP's guidance on the *Prevention and Management of Dental Caries in Children*³ details how and when to carry out the Hall Technique and can easily be used on a phone or tablet through the Dental Companion app⁹. The app allows the clinician to discuss diagnosis and treatment options.

The Hall Technique

This is a method for sealing caries under a preformed metal crown (also known as stainless steel crowns) to stop the lesion's microbiome from accessing nutrients (notably carbohydrates) from the mouth/diet and preventing the lesion from progressing. The lesion arrests under the crown. The Hall Technique has been used for over 20 years and is taught as a standard treatment at all UK dental schools. At present, there are more than ten randomised control trials that demonstrate the Hall Technique to be more effective than most other treatments, apart from conventionally placed crowns, where it performs equally as well.

Patient and tooth level indications and contraindications for the Hall Technique are shown in Table 1.

TABLE 1

THE INDICATIONS AND CONTRAINDICATIONS OF THE HALL TECHNIQUE AND SDF TREATMENT APPROACHES FOR PRIMARY MOLARS IN CHILDREN

		How to assess?		Hall Technique	SDF	Notes
Tooth level	Tooth condition	Clinically Radiograph	Unrestorable	✗	✓	
			Hypomineralised	✓	✓	
			Atypical shape	✓	✓	
	Signs and symptoms	Clinically Radiograph	Asymptomatic	✓	✓	
			Reversible pulpitis	✓	✓	More invasive treatment may be needed if pulp is too damaged for the reversible inflammation to settle with removal of the ongoing stimulus of an active carious lesion.
			Signs/symptoms of irreversible pulpitis, or abscess/sinus	✗	✗	

(continued)

TABLE 1 (CONTINUED)

		How to assess?		Hall Technique	SDF	Notes
Lesion level	Activity	Clinically (tactile)	Active	✓	✓	
			Inactive	✓	✓	- Hall Technique probably not required unless rest of mouth is high caries risk. - SDF may be useful if there is hypersensitivity.
	Cavitation	Clinically (visual)	Cavitated	✓	✓	Check radiograph for extent of lesion.
			Non-cavitated	✓	✗	Might be the treatment of choice if there are reasons why other treatments (such as sealants) are not suitable.
	Accessible to cleaning	Clinically (tactile or visual)	Accessible	✓	✓	
			Inaccessible (sheltered)	✓	✗	SDF arrests caries by direct contact with the lesion. Consider making the lesion more accessible by removing unsupported enamel.
	Lesion depth on radiograph	Radiograph	Outer half of dentine	✓	✓	
			Inner half of dentine	✓	✓	
			Pulp involvement/No clear band of dentine (bitewings)	✗	✗	
	Patient level	Caries risk assessment	History and examination	Increased risk	✓	✓
Standard risk				✓	✓	
Coping abilities		History and examination	Uncooperative	✗	✗	
			Limited cooperation for non-invasive treatments (i.e., can't tolerate LA or rotary instruments)	✓	✓	
			Cooperative/willing to cooperate	✓	✓	
Medical conditions		Medical history	Allergy to the material	✗	✗	
			Immunocompromised or high risk of endocarditis	✓	✓	Previously the Hall Technique was avoided in these situations, but success rates are high enough for it to be a viable option

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Figure 3: A clinical case where the Hall Technique was the treatment of choice for the multiple carious lesions in primary molars; (a) maxillary arch prior to treatment; (b) mandibular arch prior to treatment, except for tooth 75, which has been fitted with a crown using the Hall Technique and a separator placed between 84 and 85; (c) 1.5 years follow up after crowns have been fitted to all mandibular primary molars and maxillary first primary molars, showing the resolution of the occlusion. The crowns were fitted at several appointments with time between to allow the occlusion to be re-established (see SDCEP manual). Atraumatic Restorative Treatment with high viscosity glass ionomer was used to restore the upper second primary molars

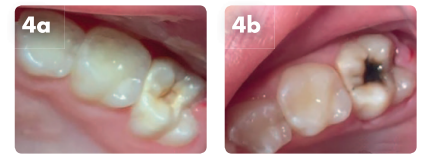


Figure 4: An example of using SDF; (a) Maxillary left first permanent molar with an occlusal cavitated carious lesion; (b) the same tooth after SDF application and the demineralised areas are darkly stained

There are many step-by-step guides to the Hall Technique, and videos with patient or model demonstrations that give excellent guidance on how to carry out the technique (see Table 2 for useful resources and Figure 3 for images of a clinical case).

An overview of the steps involved in carrying out the Hall Technique are outlined below:

1. Assess the lesion's extent using clinical and radiographic diagnosis, as appropriate.
2. Discuss the technique with the child and parents/carers, explaining that the crown will seal in the decay and that administering LA or removing decay with a handpiece will not be required. Show them a crown or a photograph of it to ensure that they are aware of its appearance.
3. Prepare materials. These include orthodontic separates (if indicated), pliers or floss for placement of the separators, gauze square, glass ionomer luting cement, cotton wool rolls, knotted floss and the preformed metal crown.
4. Assess the tooth's morphology, contact areas and occlusion. A further visit is required if orthodontic separators are needed to open proximal contact points. Choose the smallest size of crown that covers the occlusal surface and will fit over the tooth. Try it up to the contact points but do not pass it through them at try-in stage.
5. Fill the crown with glass ionomer luting cement.
6. Fit and seat the crown.

7. Ask the child to open their mouth, remove excess glass ionomer cement (GIC), check the crown has fully seated squarely on the tooth and not at an angle.
8. Before the cement has set, put pressure back on it through the child biting or by pushing it down and maintain pressure until the cement sets.
9. Clear away remaining extruded cement and check occlusion.

Silver diamine fluoride (SDF)

This is a clear odourless liquid that comprises ions of silver, fluoride and ammonium as a stabilising agent. SDF is made by different manufacturers and has recently become available in most countries worldwide. A recent paper discussing the global policies and guidelines on the use of SDF for managing carious lesions, shows that it has already been adopted in many different community-based dental programmes.¹⁰ There are numerous randomised control trials and systematic reviews supporting its use for managing carious lesions.¹¹ In the UK, the only available product is Riva Star (SDI, Bayswater, Australia), where SDF is packaged together with potassium iodide, in two individual containers, in two forms: capsules and bottles.¹²

SDF is mainly used to arrest active carious lesions (enamel and dentine), but it has the disadvantage of causing any demineralised areas that it touches to turn black (Figure 4). Therefore, it is more commonly used on posterior teeth than anterior teeth, even though

potassium iodide (KI) is claimed to mitigate the black staining.

SDF may not arrest carious lesions, and it may not remove the need for an alternative approach if the carious lesion does not arrest and continues to progress.

The best source of resources, such as patient information leaflets, SDF application protocol and consent form, can be found on the British Society of Paediatric Dentistry's (BSPD) website (see Table 2).

Overview of the steps in placing SDF

1. Obtain valid informed consent from the patient and/or the parent/carer where necessary.
2. Ensure that the dental team involved, and patient are wearing personal protective equipment, as appropriate.
3. The cavity should be cleaned from any gross debris so SDF reaches the carious lesion.
4. Apply petroleum jelly to the lips and the gingiva if close to the lesion to avoid inadvertent staining.
5. Isolate the area with cotton wool rolls and dry the carious lesion.
6. Apply SDF with a micro-brush directly onto the lesion.
7. Optional: If using KI, apply it with a different, clean micro-brush immediately after SDF application. Apply one to three times until no more white precipitate forms.
8. Leave SDF to be absorbed for at least one minute. Try to keep isolated for up to three minutes and then blot the excess solution.
9. Follow-up 2–4 weeks after the first application to check the activity of the carious lesion. Consider reapplying SDF, if the carious lesion is still active.

TABLE 2

EXAMPLES OF ONLINE RESOURCES SHOWING HOW TO CONDUCT THE HALL CROWN AND SDF TECHNIQUES (AND THEIR MODIFICATION) ON A CHILD PATIENT

Intervention	Resource	Description
Prevention and management of caries	https://www.sdcep.org.uk/published-guidance/caries-in-children/	The SDCEP guideline for preventing and managing caries in primary and permanent teeth in children. Section 10 also provides a guide on how to carry out most of the procedures covered here.
Hall Technique	https://en.wikipedia.org/wiki/Hall_Technique	Wikipedia guide with a downloadable pdf manual on how to carry out the technique.
	https://www.youtube.com/watch?v=GtZh5tD1sls	A five-minute teaching video showing the fitting of a Hall Technique crown on a model, by Dundee Dental School, UK.
	https://www.youtube.com/watch?v=JpNxTu5ljLg https://www.youtube.com/watch?v=0CFKbkW1Wxl	A two-part (seven- and three-minute) video with two Hall Technique crowns being fitted in the surgery with a child, by Dundee Dental School, UK.
SDF	https://www.bspd.co.uk/Professionals/Resources	The following can be found on the British Society of Paediatric Dentistry's Resources page: <ul style="list-style-type: none"> - An SDF video made by and for children - Patient information leaflet (PIL) on SDF for printing - Standard Operating Procedure for SDF - An SDF background PowerPoint A short SDF demonstration video on a model
	https://www.nature.com/articles/s41415-020-1203-9	An article in the <i>British Dental Journal</i> about the use of SDF in practice.
SMART and SMART Hall	https://www.youtube.com/watch?v=XT3doMnS050	An eight-minute video showing the application of SDF followed by the application of GIC, by Dr Jeanette MacLean.
	https://youtu.be/ndxQEDwOrAM	A video showing use of the Hall Technique in children after having applied SDF, by Dr Jeanette MacLean.
	https://www.youtube.com/watch?v=zMWaWfl1G_Y	A nine-minute video of SMART Hall Crown Technique in the knee-to-knee position with parent, on a 2-year-old child.
Different interventions	https://www.youtube.com/c/DundeeDentalSchool/videos	Video tutorials showing a range of techniques available through the University of Dundee, School of Dentistry's YouTube channel, including: <ul style="list-style-type: none"> - 'how to' for selective caries removal - ART - the Hall Technique techniques for placing GIC fissure sealants.

10. Bi-annual SDF re-applications demonstrate a better arrest rate than a one-time application.

Non-restorative cavity control and SDF

SDF could also be useful where it is not possible to manage carious lesions by selective caries removal and restoration. For example, where there is minimal

tooth structure remaining and hence, restorative solutions cannot be offered due to lack of retentive means, or where the patient cannot cooperate with traditional treatment without resorting to general anaesthesia or sedation.

SDF also attempts to 'buy time' by slowing or stopping the carious lesion progression allowing uncooperative

children to acclimatise to the dental environment and become more cooperative with traditional treatment options.

This method of non-restorative management, also relies strongly on behaviour change techniques to support the parents/carers to change diet and oral hygiene behaviour, to

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allow the disease progression to be halted.

However, the biggest challenge of using this technique is that it relies on the clinician being able to change the behaviour of the patient and the parent/carer away from that which caused the disease in the first place. The difficulty of this, whether it is promoting toothbrushing with fluoridated toothpaste or reducing the cariogenicity of the diet, should never be underestimated.

SDF combined with restorative approaches

There have been reports of the use of SDF with both ART and the Hall Technique. The rationale for this approach is to maximise the chances of arresting the lesions by uniting the antibacterial effect of SDF and the sealing abilities that can be provided by placing a Hall crown or GIC. From a pragmatic point of view, SMART approaches would seem to be promising treatment strategies, especially when children cannot be brought back to the clinic to receive further treatment. However, there are currently no randomised control trials investigating the effectiveness of these approaches compared to other restorative options.

Silver Modified ART (SMART)

By removing enough of the lesion to allow a restoration to be placed which has adequate depth to give the material strength and which is adherent around the periphery of the lesion to seal it off, we can avoid damaging the dental pulp or removing excessive tooth tissue resulting in weakening the tooth. This is known as 'selective caries removal'. It can be carried out using ART with hand instruments.

The chances of arresting the lesion can be improved by using SDF prior to placing the restoration. In addition, there is a balance to be struck between removing as little carious dentine from the base of a cavity as possible (to preserve tooth structure and avoid exposing the pulp) and achieving optimal restoration bonding (bonding to soft, carious dentine compromises the bond). Therefore, another approach to avoid having to selectively remove carious lesions until 'hard' dentine is reached has been advocated: this is by using SDF to arrest



Figure 5: An example of using SMART technique to treat dentinal carious lesions in primary teeth; (a) Maxillary primary central incisors with proximal carious lesions; (b) Same lesions after SDF application and GIC dressing

the lesion, occlude the dentinal tubules and improve the quality of the seal.

When there is removal of only soft dentine or undermined enamel, there is usually no need for local anaesthetic because no 'live dentine' is being removed. In addition, the use of ART with hand instruments avoids the need for pressure, noise and all the associations of rotary instruments which can provoke anxiety. It also avoids generating aerosol and critically, allows delicate and precise removal of carious tooth with tactile feedback, allowing soft dentine to be left on the base of the cavity but hard dentine on the periphery of the cavity to allow good adhesion of the restorative material.

Following selective caries removal, SDF is applied onto the carious lesion. The GIC can be applied immediately following placement of SDF or after waiting for a few days or weeks until the carious lesions have arrested (see Figure 5). There are several factors that will influence this decision; the child may have had enough treatment and be unable or unlikely to continue happily with treatment or the clinician may prefer to place a further application of SDF onto the tooth to help with the arresting process. There is no evidence yet to support one approach over the other.

SDF Modified Hall Technique (SMART Hall Technique)

When applying SDF prior to placing a crown using the Hall Technique, carious tissue does not need to be removed. The SDF is applied directly onto the carious lesion and then the crown can be placed, or, like the SMART procedure, there can be a delay of 1–2 weeks where the child returns, and the lesion reassessed to see if it has been arrested. A decision can then be made to possibly

re-apply the SDF and then place the crown. Similar to the SMART technique, applying SDF before placing a crown using the Hall Technique aims to make the environment for cariogenic bacteria and the plaque biofilm unfavourable and increases the chances of success with sealing the carious lesion (Figure 5).

Assessing treatment success

The final stage of carrying out any treatment is assessing whether the outcome has been successful. Caries is a dynamic process and by tipping the balance back in favour of remineralisation, or at least away from favouring demineralisation, the lesion can be arrested. The Hall Technique, SDF and combining SDF with restorations share the common goal of trying to stop the carious lesion from reaching the dental pulp, causing pain and/or pulpal infection before the tooth exfoliates. Treatment success can ultimately be measured by the tooth exfoliating naturally without pain or infection. However, success can be assessed before the tooth is due to exfoliate by evaluating some interim measures (see Table 3). If it looks like the treatment is unsuccessful, then the approach may need to be changed.

Conclusion

With high-quality research and the availability of state-of-the-art dental materials, providing dental care for children has moved beyond the traditional 'drill and fill' approach to managing dental caries with minimally invasive, more child-friendly methods, such as the Hall Technique and SDF. These treatments have proven repeatedly, that by doing *less* 'drill and fill' in children, *more* can be achieved in terms of both treatment success and a reduction in discomfort to the child patient. The two approaches have the additional

TABLE 3**POTENTIAL SIGNS AND SYMPTOMS OF UNSUCCESSFUL TREATMENT, THEIR ASSESSMENT METHODS, AND FURTHER MANAGEMENT OPTIONS**

	Signs and symptoms indicating treatment is failing		How to assess	Treatment options
The Hall Technique	Minor failures	Loss of crown	Clinically	Replace crown or place restoration
		Perforated crown	Clinically	Consider repairing crown with composite or GIC
		Caries around margin of crown (if any tooth exposed)	Clinically	Caries may need to be removed (hand instruments or slow speed handpiece) and restored or apply SDF
		Impacted first permanent molar	Radiograph	Place separator, if possible, remove crown or extract tooth if first permanent molar severely impacted. Consider orthodontic opinion as possible crowded dentition
	Major failures	Irreversible pulpitis, abscess, sinus	History Clinically Radiograph	Pulp therapy through crown or extract tooth
SDF	Dentinal carious lesions not arresting: new lesions developing on teeth, more teeth becoming carious, caries becoming more extensive		Compare with previous clinical photographs or records. Check for presence of plaque biofilm and soft, moist (active) carious dentine	Re-apply SDF and re-assess after 1 to 2 weeks if possibility of arresting. Increase prevention and consider changing treatment plan to incorporate a restorative solution
		Pulpitis	History	Assess whether irreversible and, if tooth is restorable, try to restore and consider using SDF then a crown if possible or GIC if anterior teeth. If unrestorable, extract

advantage of being non-aerosol generating, which is highly relevant in the current climate. However, for the techniques to be successful, accurate detection, assessment, and diagnosis of the status of the dental caries and the tooth is a prerequisite. Combinations of these approaches are now increasingly and effectively being used to manage caries in primary teeth, although there is very limited data on whether this strategy increases the success rates. As with any treatment, plans need to be assessed for their success and, because children are being treated, the clinician must be

flexible and discuss modifications with the parent/carer as needed.

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AUTHORS' CONTRIBUTIONS

NI and WA conceived the paper. All authors discussed the paper and contributed to, read and approved to the final manuscript.

DECLARATION OF CONFLICTING INTEREST

The authors declare that they have no conflicts of interest.

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