



Treatment options for carious tissue removal

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Received: 19 December 2018 / Accepted: 14 January 2019 / Published online: 24 January 2019
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Quick reference/description

More conservative (selective or stepwise) approaches to carious tissue removal, instead of non-selective removal, reduces tissue loss and pulp exposure risk. In selective removal, carious dentin at the cavity base, close to the pulp, is permanently sealed beneath a restoration, while in stepwise removal, carious dentin is temporarily sealed and then removed in a second step. The hardness of the remaining dentin tissue, judged by tactile feedback during examination, is the main guiding factor for carious tissue removal.

Keywords Caries, Dentine · Excavation · Lesions · Outcomes · Restorations

Overview

Following are the different strategies used for carious tissue removal:

Treatment	Indications	Contraindications	Disadvantages
I. Non-selective removal to hard dentin	None	All lesions	Considered as overtreatment
II. Selective removal to firm dentin	Shallow or moderately deep lesions (permanent and primary teeth)	Deep lesions in teeth with vital pulps	None
III. Selective removal to soft dentin	Deep carious lesions in teeth with vital painless pulps (primary and permanent teeth)	Shallow or moderately deep lesions	Leaving carious tissue restricted to small cavity areas; otherwise impact on bonding and restoration support

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Treatment	Indications	Contraindications	Disadvantages
IV. Stepwise removal	Very deep carious lesions with vital painless pulps (permanent teeth)	Shallow or moderately deep lesions	Additional time and costs; compared with selective removal higher risks of pulp exposure in second step
V. Other strategies			
Sealing			
Occlusal sealants	Intact enamel surfaces (no cavitation) or micro-cavitated (primary and permanent teeth)	Clearly cavitated lesions.	May not be able to withstand masticatory forces
Proximal sealants or resin infiltration	Intact proximal surfaces (no cavitation)	Cavitated lesions.	Applicability not always possible.
Hall technique	Proximal (cavitated or non-cavitated dentinal) carious lesions in primary molars	Permanent teeth. Occlusal lesions unless child unable to tolerate other treatment	Aesthetics Increases occlusal vertical dimension temporarily
Non-restorative Cavity Control (NRCC)	-Non-restorable teeth -Primary teeth or root surface carious lesions which are not manageable using other options or do not need to be restored (cleansable)	Patients (or parents) unable or unwilling to take responsibility for frequent, high quality toothbrushing	Requires patient (or parent) adherence to toothbrushing with fluoridated toothpaste and the skill to brush dentinal lesions

Materials/instruments

- Sharp excavator, stainless steel or self-limiting polymer rosehead burs
- Restoratives, e.g. composites, glass ionomers, resin or glass ionomer fissure sealants, resin infiltration, preformed metal crowns
- Sodium fluoride varnish or silver diamine fluoride

Procedure

Before placing a restoration in a tooth, carious tissue should be removed, with the aim of creating ideal conditions for restoration longevity. Leaving large masses of carious tissue may compromise restoration survival by reducing adhesion area or quality of the base for the restoration. Guiding principles for carious tissue removal are:

- Preservation of non-demineralized and dental hard tissue
- Achieving an adequate seal
- Remove discomfort/pain and dental anxiety

- Maintaining pulpal health
- Maximizing longevity of the restoration

Different criteria are used for assessing the dentin to be removed or retained such as hardness moisture, color, and dye stainability.

The strategies that are used for carious tissue removal include (Fig. 1):

I. Non-Selective Removal to Hard Dentin

In non-selective removal to hard dentin, soft dentin is removed till the hard dentin (similar to healthy dentin) is reached in all areas of the cavity. The entire demineralized dentin is removed. This technique was formerly known as “Complete removal” technique. It is over-treatment and no longer advocated.

II. Selective Removal to Firm Dentin

In selective removal to firm dentin, carious tissue is removed till sound enamel and hard dentin is reached in the periphery, whereas firm dentin is left in the pulpal area of the cavity. This technique is used for shallow or moderately deep lesions. Leaving sound enamel and hard dentin around the periphery ensures good quality bonding, restoration stability, and a peripheral seal.

III. Selective Removal to Soft Dentin

In selective removal to soft dentin, soft carious dentin is left in the pulpal aspect of the cavity. This helps to maintain pulp vitality. At the periphery of the cavity, to achieve a good seal and maximize restoration survival, the peripheral enamel and dentin should be hard (Fig. 2). This technique is used for deep carious lesions in teeth with vital painless pulps. This method reduces the risk of pulpal exposure. It was previously known as partial or incomplete removal.

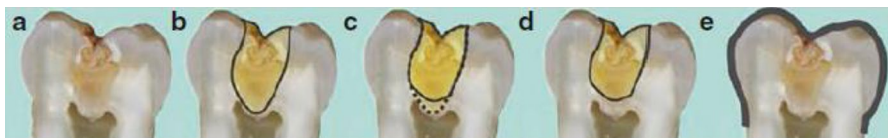


Fig. 1 Removal strategies. **a** Deep carious lesion in a tooth with a vital pulp. **b** Non-selective removal to hard or firm dentin (no longer recommended). **c** Stepwise removal. **d** Selective removal to soft dentin. **e** No removal, involving non-restorative cavity management, fissure sealing, or—as shown—the Hall Technique (Hall Technique restricted to primary teeth; shown here only for demonstrative purposes on a permanent tooth)

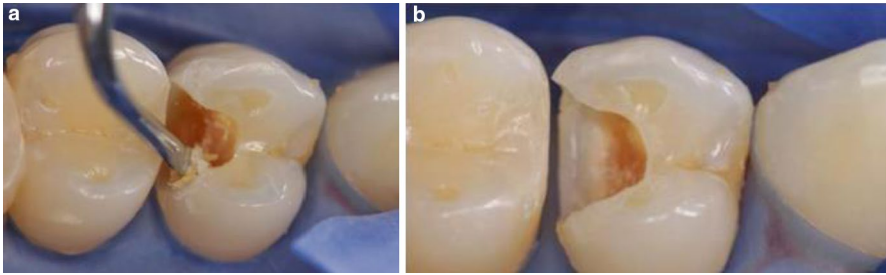


Fig. 2 Selective removal to soft dentin **a** In the periphery, only hard dentin, similar to sound one, and sound enamel is left. In the periphery, very soft dentin is spooned out with a hand excavator; **b** the remaining dentin is leathery, moist and discolored, and sealed under the subsequently placed restoration

IV. Stepwise Removal

In stepwise removal, there is selective removal to soft dentin in the first step and selective removal to firm dentin in the second step (6–12 months later). In between the first and the second step, a temporary restoration that provides a good seal is placed. For the temporary restoration, a restorative material should be chosen that will be durable for at least 12 months or (better) longer, such as glass ionomer cement. A liner, such as calcium hydroxide, may be placed, but is not necessarily required. The temporary restoration is removed after 6–12 months and selective removal to firm dentin carried out till firm dentin remains. Between the two steps, the sealed lesion arrests and remineralizes, bacteria inactivated, and reactionary dentin built up to protect the pulp. This technique was previously known as “two-step excavation.”

V. Other Strategies

More recently developed strategies aim to not remove any carious tissue, but to control the lesion activity instead. They include:

Sealing

In fissure sealing over carious lesions and the Hall Technique for primary molar teeth, no carious lesion is removed at all and the tooth is sealed.

–Occlusal sealants

Sealing lesions using conventional fissure sealants (low filled resins or glass ionomers) is recommended in cases with an intact (non-cavitated) surface; in some instances, micro-cavitated lesions can be sealed, too. Sealing arrests lesions by

starving the sealed bacteria. Sealing lesions using a sealant material can be used for both primary and permanent tooth.

–Proximal sealants and resin infiltration

For proximal lesions with intact surfaces, sealants can as well be used to seal the surface, allowing to impede acid diffusion into the enamel and mineral loss from it. Alternative to sealants, resins can be infiltrated into the porous enamel using infiltrants, i.e. lowly filled resins, making use of capillary forces.

–The Hall Technique

The Hall Technique is a method for managing carious lesions in primary molars by sealing them in under preformed metal crowns (Fig. 3). In the Hall technique, the lesion is assessed clinically and radiographically and no carious tissue is removed if the dental pulp is not irreversibly damaged by the lesion. First, the correct size of the crown is determined, then it is simply pushed over the tooth and cemented using a glass ionomer cement. This seals the lesion and protects the whole coronal tooth structure. The Hall Technique combines the management of the lesion with its restoration, and overcomes a number of issues of conventional plastic restorations in primary teeth.

–Non-restorative Cavity Control (NRCC)

In non-restorative cavity control (NRCC), a decision has been made to arrest the lesion by constant biofilm removal (by the patient) rather than restore the lesion. The carious lesion is made cleansable and then actively arrested (Fig. 4). The



Fig. 3 Three crowns placed, using the Hall Technique, on upper primary molars. The teeth were not prepared and no carious tissue was removed. The correct size of the crowns to fit over the teeth was selected, the crown filled with glass ionomer cement, pushed over the teeth and held, by the child biting until the cement set

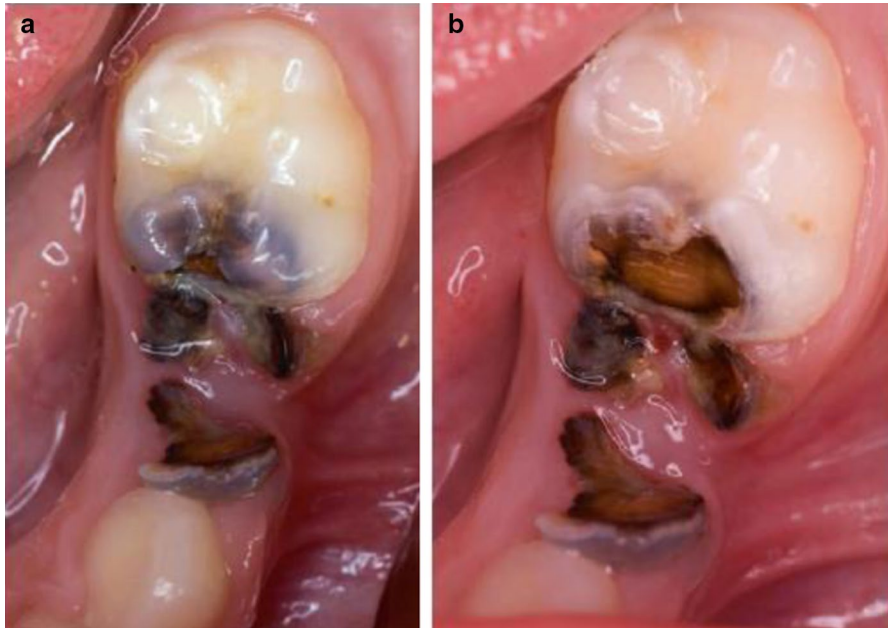


Fig. 4 **a** Lower second primary molar before the lesion is opened up using an air rotor with a diamond bur to remove enamel and some carious dentin. **b** The opened lesion has been transformed from a sheltered cariogenic environment to a cleansable situation and was arrested

cavities are made accessible to a toothbrush or adjunctive cleansing device, for example by rotary instrumentation or hand removal (chiseling) of overhanging enamel. The lesion arrest must be supported by applying sodium fluoride varnish or silver diamine fluoride liquid. Lesions are monitored over time for progression.

Pitfalls and complications

- Non-selective removal to hard dentin is now considered overtreatment. It unnecessarily removes tissue and increases the risk of pulp exposure.
- Stepwise removal involves higher risks of pulp exposure than selective removal, as in the second step, excavation until firm dentin is performed also in proximity to the pulp. Stepwise removal also adds cost, is time consuming, and causes discomfort to the patient.
- Fissure sealant materials do not have the structural strength to withstand masticatory force. Their use is limited to situations where the sealant is largely supported by enamel (non- or micro-cavitated lesions). Restrictions to lesions which are non-cavitated also apply to proximal sealing or resin infiltration.

Further reading

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