

stepwise caries excavation

a viable clinical option

The thought of leaving heavily infected dentine in a cavity for 6 to 12 months would have been a short cut to failure at many dental schools in the not-too-distant past. However, well conducted trials in Scandinavia have shown just how powerful the defence mechanisms of the dentine and pulp can be, if given a chance to operate.¹⁻⁵

What is stepwise caries excavation?

Stepwise caries excavation is the removal of caries in a deep lesion in stages. Each stage is separated by an interval of 6-12 months.

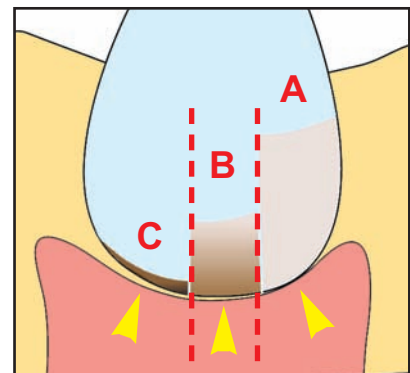
The technique

The procedure is used on vital, asymptomatic, teeth with deep dentinal lesions. In particular, it is for situations where the removal of all caries in one visit is likely to result in a pulp exposure.

At the first appointment:

1. Access is gained to the caries.
2. Using a slowly rotating round bur and/or a spoon excavator just enough soft caries is removed to allow room for a calcium hydroxide -containing base.
3. The periphery of the cavity is made completely

Soft, wet, carious dentine and the risk of a pulp exposure. Stepwise caries excavation can provide the solution.....



Removal of all caries at a single visit carries the risk of a pulp exposure if the lesion is close to the pulp (A).

The stepwise excavation technique (A,B,C) enables the healing mechanisms in the dentine and pulp to operate and produce an effective calcified barrier at the base of the lesion (C).

stepwise caries excavation (cont)

caries free and the base placed.*

4. The cavity is restored with a suitable material such as glass ionomer cement.

At a follow-up visit 6-12 months later:

1. The interim restoration and base are removed.
2. Further dentine excavation is carried out. Clinical judgement is used to assess whether another interim base and restoration are required or whether all the remaining caries is removed at that visit.

Final restoration:

Once the stepwise excavation is completed the cavity is restored.

Clinical Findings

The viability of the procedure has been demonstrated in clinical trials.

In a practice-based study, operators chose large carious lesions whose removal in one sitting was expected to result in a pulp exposure.¹ Lesion depth was assessed from the relevant radiographs.

The stepwise cavity excavation procedure was used. After intervals ranging from 2 to 19 months the final excavation was made.

This last step resulted in only 5.3 percent of the teeth having a pulp exposure. This contrasts markedly with the original assessment by the operators of the likelihood of a pulp exposure in each case.

Two earlier studies in which there were generally shorter intervals between the excavations also gave encouraging findings.^{2, 3}

In one study on young permanent teeth significantly fewer (17.5 percent) had exposed pulps than those in which the caries was removed in one step (40 percent).²

With primary teeth immediate caries removal resulted in 53 percent of the teeth having

pulp exposures. In contrast where the stepwise caries excavation technique was used the corresponding figure was only 15 percent.³

How It Works

Removing some of the caries and sealing off the remainder from the oral environment makes the caries left behind less active.^{4, 5}

The seal provided by the interim restoration (i) prevents more oral bacteria reaching the lesion; and (ii) deprives the remaining bacteria of an outside source of foodstuff.

This allows time for the repair mechanisms of the dentine and pulp to operate:

1. Minerals dissolved from the carious dentine become deposited in the underlying dentinal tubules.
2. Odontoblasts within these dentinal tubules may start laying down more peritubular (intratubular) dentine.

The above two processes may occur separately or together.⁶⁻⁸

At the pulpal end of the tubules reparative dentine can form. Its nature depends on the severity of the caries attack.

With time there is a reduction in the number of bacteria surviving in the remaining caries.

Changes in the Carious Dentine

Traditionally light-coloured, moist, caries is associated with a fast progressing lesion whereas the darker, more leathery, variety is indicative of a slowly progressing lesion.

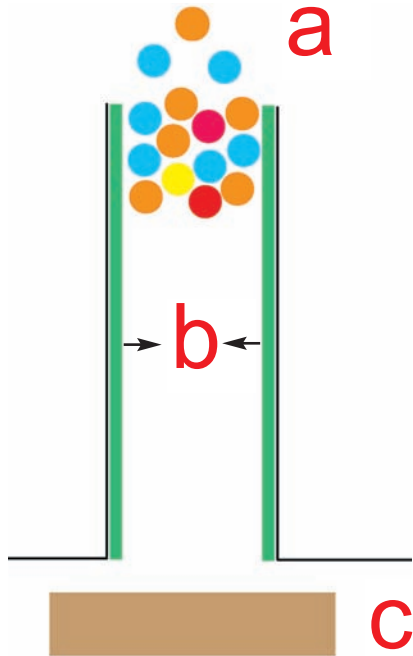
After the interim restoration is placed the remaining caries becomes, harder, drier and darker.^{1, 4, 5}

If all has been successful, at the end of the procedure, the cavity floor is medium hard to hard. Its colour can range from light yellow to black.^{1, 4, 5}

[more >](#)

* The placement of a Ca(OH)₂ base may prove to be unnecessary if GIC is used as the restoration (see page 40).

Nature's Tubule Seal



Tubule narrowing

Odontoblasts can deposit more dentine inside the highly mineralised sheath that exists around each dentinal tubule *.

This causes a narrowing and, sometimes, a complete blocking of the tubule.

* Peritubular (intratubular) dentine.

Processes **a** and **b** can occur separately or together to produce a zone of transparent (sclerotic) dentine.

a

Mineral deposits

Mineral salts dissolved from the overlying carious dentine start to become deposited in the tubules.

Once the interim restoration is placed the bacterial activity in the remaining caries is reduced and the pH rises.

This allows more dissolved minerals to be deposited in the dentinal tubules and block them further.

c

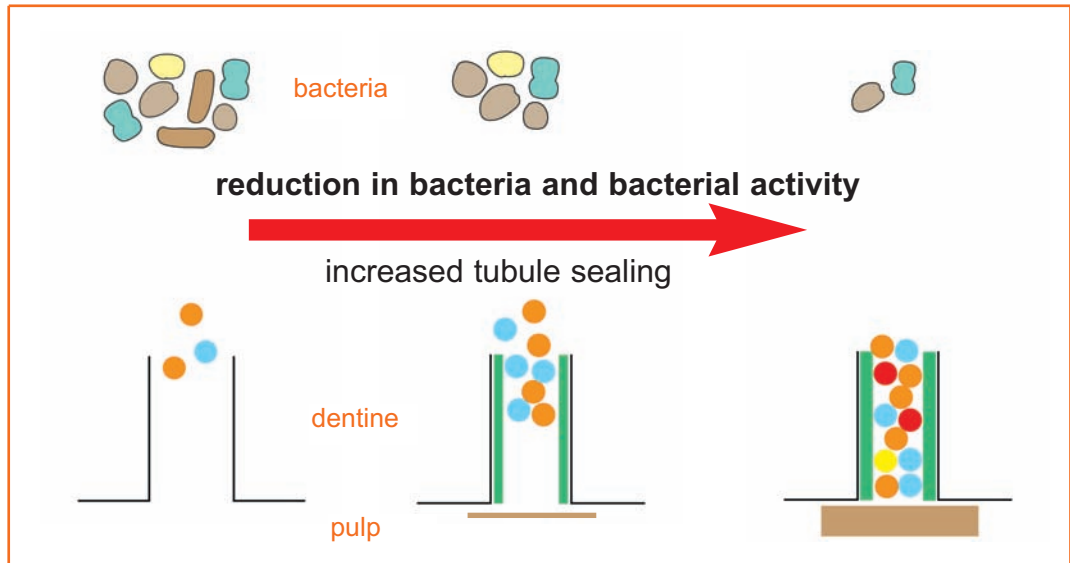
Reparative dentine

The ends of the tubules can be capped with reparative dentine. This may be produced by the existing odontoblasts or by new odontoblasts created in the adjoining pulpal tissue.

The type of reparative dentine formed depends on the nature of the stimulus. One type has fine tortuous tubules (tubular) and the other no tubules at all (atubular).

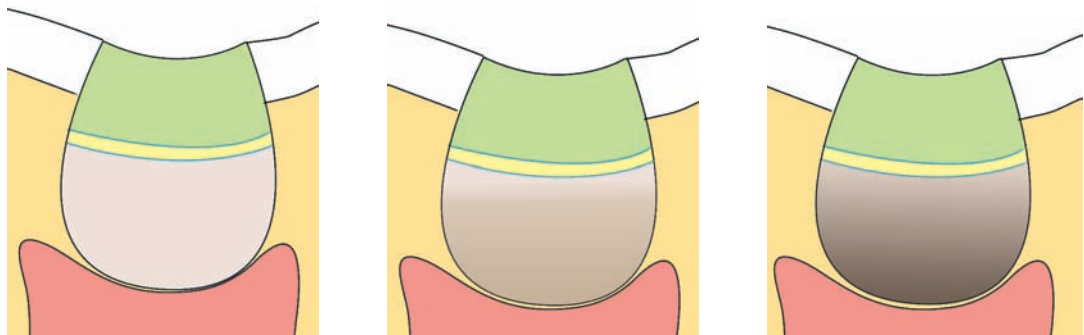
References are 6, 7 and 8 on page 35.
The various zones in carious dentine are shown on page 40.

After an Interim Restoration is Placed



After an interim restoration is placed:

- There is a reduction in the number of bacteria found in the remaining decay and the underlying tubules become more sealed (above).
- The remaining carious dentine hardens, dries out and becomes darker (below).



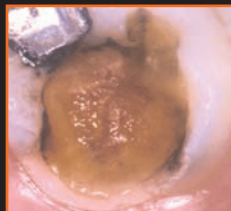
decay becomes harder, drier and darker



time

Dentine Colour

The colour of the remaining dentine is invariably some degrees darker than the peripheral dentine.....



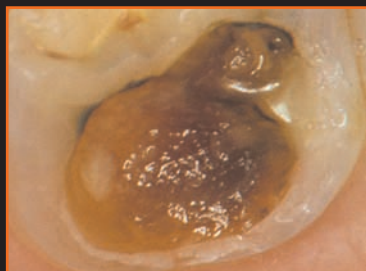
Top: Example of the soft, moist, carious dentine commonly seen at the start of treatment.

Right: Example of remaining dentine after caries arrestment. It is firm and the yellow-light brown colour shown is quite typical.^{1,4}

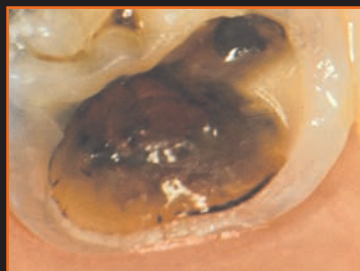
At times, the remaining dentine can be quite pigmented, especially if a metal fluoride, such as silver fluoride, has been used as a part of treatment (below).

Below left: Active, moist, caries before treatment. In this case no caries was removed.

Below right: Appearance of lesion 29 months later. The dentine is hard and dark.



Before

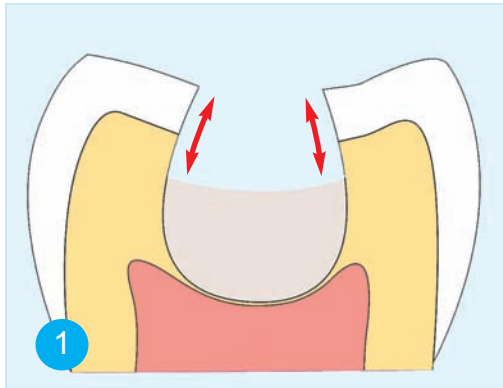


After (29 months)

1. Bjorndal L, Thylstrup A. A practice-based study on stepwise excavation of deep carious lesions in permanent teeth: a 1-year follow-up study. *Community Dent Oral Epidemiol* 1998; 26: 122-128.
2. Leksell E, Ridell K, Cvek M, Mejare I. Pulp exposure after stepwise versus direct complete excavation of deep carious lesions in young posterior permanent teeth. *Endod Dent Traumatol* 1996; 12: 192-196.
3. Magnusson BO, Sundell SO. Stepwise excavation of deep carious lesions in primary molars. *J Int Ass Dent Child* 1977; 8: 36-40.
4. Bjorndal L, Larsen T, Thylstrup A. A clinical and microbiological study of deep carious lesions during stepwise excavation using long treatment intervals. *Caries Res* 1997; 31: 411-417.
5. Bjorndal L, Larsen T. Changes in the cultivable flora in deep carious lesions following a stepwise excavation procedure. *Caries Res* 2000; 34: 502-508.
6. Linde A, Goldberg M. Dentinogenesis. *Critical Reviews in Oral Biology and Medicine* 1993; 4: 679-728.
7. Ten Cate AR. *Oral Histology*. 5th Edition pp155, 158, 161. St.Louis. Mosby Year Book; 1998.
8. Daculsi G, LeGros RZ, Jean A, Kerebel B. Possible physico-chemical processes in human dentin caries. *J Dent Res* 1987; 66: 1356-1359.

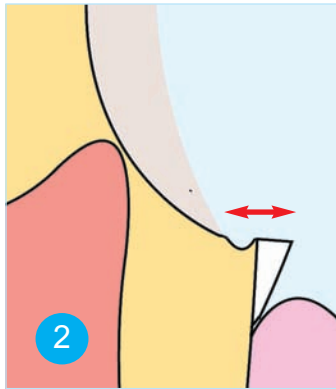
PROCEDURE:

placement of interim restoration

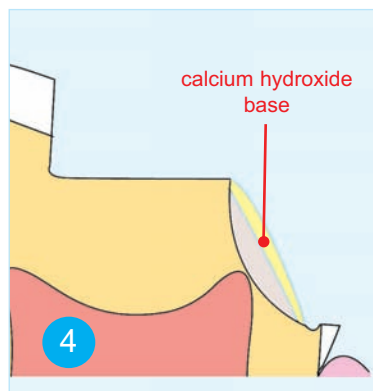
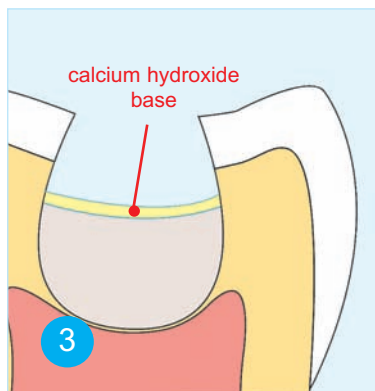


Remove the superficial soft caries. The depth should be enough for the interim restoration and a calcium hydroxide base.

Extend the preparation into sound enamel at the periphery of the lesion and into sound dentine for about 2 mm below the dentino-enamel junction*.



If the lesion extends onto a smooth surface ensure that there is a lip of sound dentine just inside the dentino-enamel junction on the gingival floor.



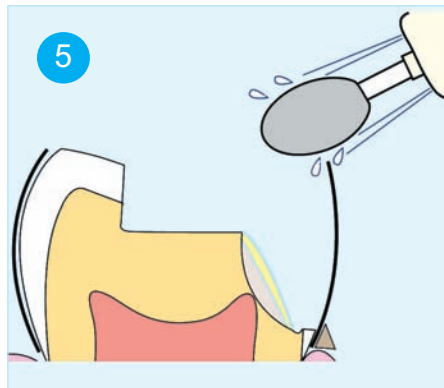
Cover the remaining caries with a hard-setting calcium hydroxide base such as *VLC Dycal* (Caulk) or *Kerr Life* (Kerr Corp).

(The placement of this base may prove unnecessary if GIC is used as the restoration- see page 40)

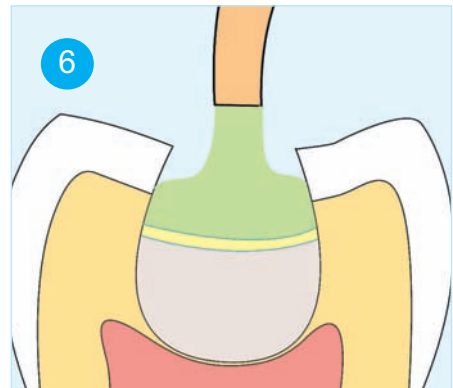
* Do not use a caries-detector dye for determining the presence of caries at the dentino-enamel junction. These dyes are unreliable because they can stain quite sound dentine found in this region.

PROCEDURE:

placement of interim restoration (cont)

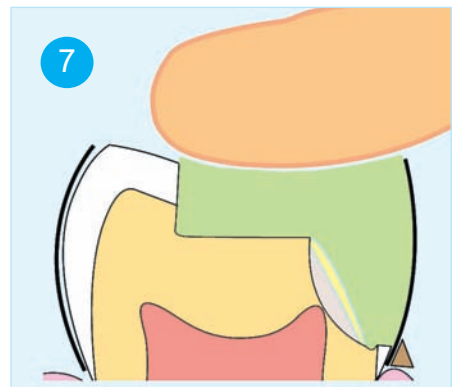


Place and wedge a metal matrix band, such as a *Tofflemire*. Any minor reductions in band height can be done with a oval-shaped diamond bur in a high speed handpiece.



Apply the manufacturer's recommended conditioner then wash and gently dry. Insert glass ionomer cement such as *Fuji IX GP* (GC Corp) or *Ketac Molar* (3M Espe).

After filling the cavity wait until the GIC just starts to get its initial set, then apply firm finger pressure (see page 39).



Keep the restoration dry for another 3-4 minutes then remove matrix band and trim restoration with diamond burs under an air-water spray. Tapering diamond burs are useful for proximal surfaces whilst an oval shaped diamond is effective for shaping occlusal surfaces.

Apply a suitable bonding resin and light cure.

Leave for 6-12 months (12 months preferable) then re-enter and remove more carious dentine.

more >



placement of a GIC interim restoration

further practical aspects

Dr Hill works for the NSW Corrections Health Service and is required to place many interim restorations as part of his primary care duties.

The following technique has evolved over the past 5 years and has resulted in the saving of numerous teeth that otherwise would have been extracted.

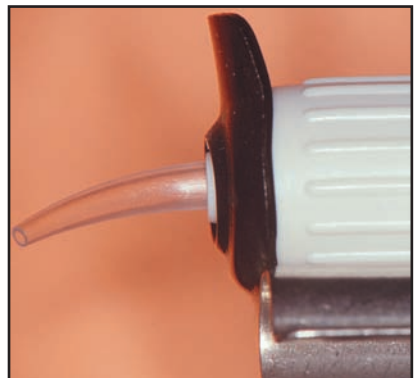
technique of Dr Peter Hill

A heavily-filled, autocured glass ionomer cement such as *Fuji IX GP* (GC Corp) is used. The fast setting version is preferable.

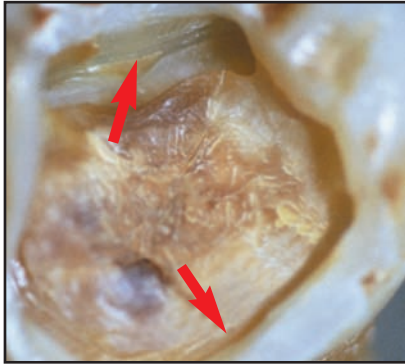


Above: A *Tofflemire* matrix band in a *Tofflemire* retainer is quite suitable for the majority of cases. A standard wedging procedure is used.

Right: For large cavities have the second capsule ready to be mixed as soon as the first comes off the amalgamator. With the fast-setting material speed is important.

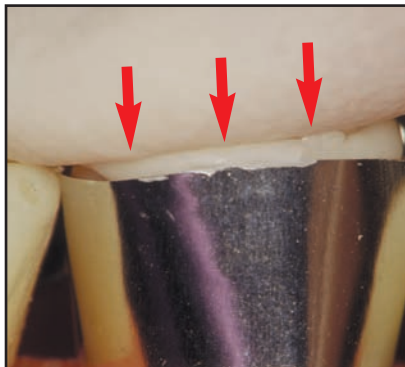


placement of a GIC interim restoration (cont)



Ideally the periphery of the cavity should finish in sound enamel and dentine. As shown here there is a lip of sound dentine extending around the entire carious mass.

(Modified from original photograph provided courtesy of Dr Graham Mount)



One of the secrets in obtaining good adaptation and a satisfactory proximal contact is to apply firm pressure with a finger just at the point where the material starts to set. With experience this stage becomes easy to identify.



Examples of interim *Fuji IX* restorations after 20 months.

TIP:

interim restorations in general practice

1. Inform patient of the purpose of the interim restoration.
 - a. It allows nature's defence mechanisms to work and build up a barrier under the decay.
 - b. In the longer term it can save time and money by preventing the need for root canal treatment.
2. Charge the full restoration fee. No 'fund fee' only.

Done properly an interim restoration requires care and time. Charging the full fee places a worth on the procedure in the patient's (and operator's) mind. If a subsequent interim restoration is required make any fee adjustments, if necessary, at that stage.

ADDITIONAL NOTES

Is a Calcium Hydroxide Base Required under Interim GIC Restorations?

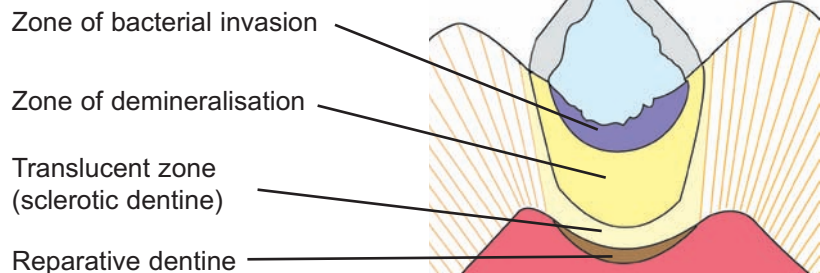
Glass ionomer cement releases a number of ions under neutral and acidic conditions. Work undertaken at the University of Adelaide by Drs Ngo and Mount (as yet unpublished) indicates that a number of different ions released by glass ionomer cement restorations can be deposited in subjacent demineralised or carious dentine. This process may be sufficiently beneficial that a base, such as calcium hydroxide mentioned on pages 31-32 and 36-37, is not required.

The Layers in Carious Dentine

Illustration of the various zones that are present in carious dentine.

Reference:

Axelsson, P. *Diagnosis and risk prediction of dental caries. Vol 2.* pp 199, 224. Chicago. Quintessence Publishing Co. 2000.



TIP:

removing carious dentine - do it slowly

With an interim restoration it is important that all caries be removed from the periphery of the lesion. In dentine this removal should extend approximately 2 mm below the dentino-enamel junction. The procedure can be done with very sharp excavators or round burs.

Round burs are very efficient. However, with the majority of slow-speed handpieces supplied with current operatory units, the cut-in rotation speed is too high.

A round bur rotating too quickly produces too much vibration and can be uncomfortable for the patient.

Using reduced speed (100 -200 rpm) and round tungsten carbide burs, dentine caries can be removed efficiently, cleanly and without discomfort.

Example Products

Ultra-low-speed handpieces:

W&H - Model WA-86LT. 10:1 reduction in shank. Uses standard head. (Distributor: Adec Australia)

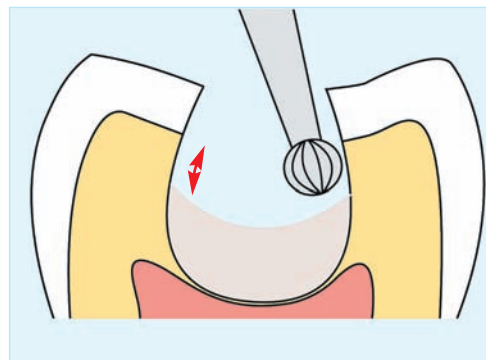
Kavo - Model 29 CH - Intra reducing shank. 7.4:1 reduction. Can use a standard head or obtain even further reduction using a Kavo 67 LH 2:1 reducing head. (Distributor: Ivoclar Vivadent)

Micro Mega
- Model 10 XE. 5:1 reduction. (Distributor: JB Wisbey, Sydney)

Tungsten carbide burs:

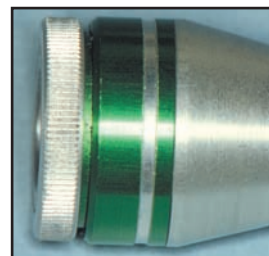
Komet - Round
(Distributor: Halas Dental)

-technique developed by Drs GG Craig and KR Powell



The preparation should finish in sound dentine to a depth of approximately 2 mm below the dentino-enamel junction.

Several manufacturers produce handpieces suitable for ultra-low-speed cutting. The reduction gears are in the shank of the handpiece. These handpieces may be identified by two green bands, or one large green band, near the base.



Round tungsten carbide burs cut very efficiently and are available in a range of sizes. When using them ensure that they are running in the correct direction (clockwise when pointed downwards).



Children and the elderly, especially, may be apprehensive about ultra-low-speed cutting. If this is the case, a simple trick is to first run the bur on the patient's index finger or thumb as an introduction to the procedure.

