Crown preparation techniques utilising the operating microscope

Author_ Dr Craig Barrington, USA


Fig. 1a

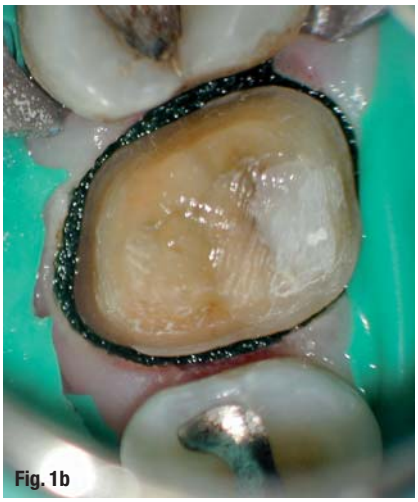
Fig. 1b

Figs. 1–10_Before and after photographs of crown preparations.

_**Successful crown preparations** start at the diagnosis. Early detection of the need for a full-coverage restorative can minimise many difficulties associated with the preparation of a tooth for a crown, obtaining an accurate impression, and the achievement of a precise fitting, long-lasting, aesthetic restoration. Proper diagnosis is the all-important first step.

_The importance of vision

The second most important component is vision. The dental operating microscope (OM) has proven to be valuable in endodontics but it is just as valuable—or more valuable—for restorative efforts. High magnification above 4x is necessary to impose/create good finish lines that are easy to impress and temporise. Magnification of 2 to 24x is available with the OM. Management of gingival health and biological width is important to the overall final look of the crown and the cleanability for the patient. A poor finish line and a poorly positioned finish line not only result in poor impressions and final restoration fit, but also make for poor-fitting provisionals.

If the finish line cannot be found, one cannot properly trim and fit the provisional restoration and remove any temporary cement properly. When patients return, gingival tissues can be irritated, making the placement of the final restoration challenging. If by chance one does achieve a good fit, then, when the soft tissue heals, the junction of the final restoration and the tooth may be visible, ruining the overall aesthetics.


Fig. 2a

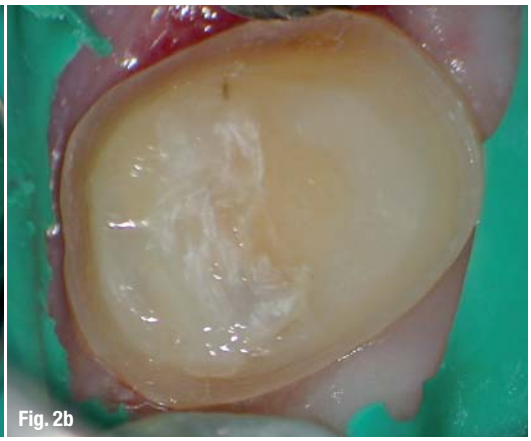
Fig. 2b

_Good patient management

Working at high magnification with the OM requires good patient and procedural management. If the patient moves about or is uncomfortable, the operator cannot concentrate on proper reduction or the task of placing a solid, conservative finish line on the tooth. Therefore, the third most important component in crown preparation success is the dental rubber dam.

For most using a dental dam for a crown preparation is a widely misunderstood concept. Simply put, the rubber dam is the most under-utilised, inexpensive and simple piece of equipment an operator can incorporate into his/her crown preparation protocol. With a little training, dentists and assistants can learn techniques that will benefit all individuals involved in the restoration of a tooth. (Please note that in all of the photographs, a dental dam is in place before and after.)

Tissue management is the fourth concern and it points back to the number one concern of early diagnosis versus waiting until a tooth is severely decayed or broken down. Working deep subgingivally and in irritated tissues exponentially complicates the task of crown preparation. Haemorrhagic areas, or those that are deep subgingivally, can be difficult to visualise and control. Early diagnosis can minimise these tissue complications. Good tissue management protocol is paramount to the success of the final restoration.


Fig. 3a

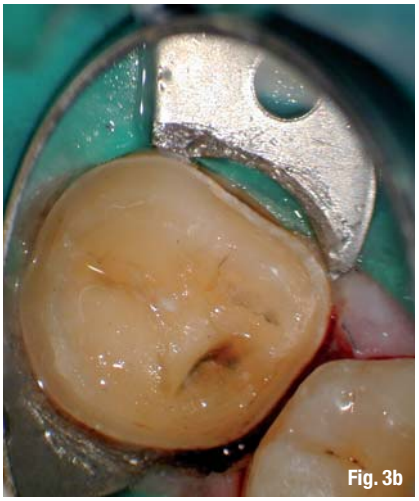
Fig. 3b

_Radiosurgery: A useful instrument

Lasers have been used in dentistry for quite some time but their cost and other fundamental limitations make them difficult to acquire and use. However, radiosurgery has been in use for years and is an affordable and useful instrument that can solve many problems regarding finish-line visualisation, finish-


Fig. 4a


Fig. 4b

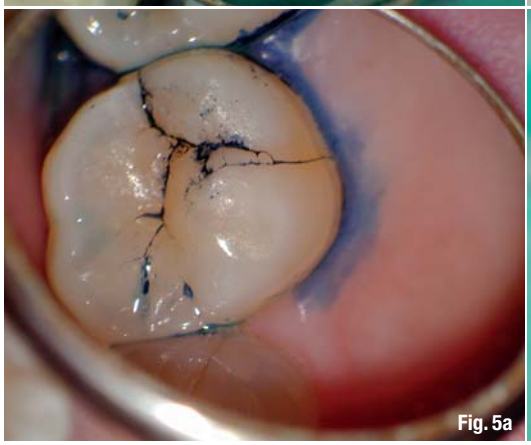
Fig. 5a


Fig. 5b


Fig. 6a


Fig. 6b

line exposure and haemorrhage control. In addition, this simple, conservative instrument can make cord placement quick and simple by preserving the gingival architecture.

The Parkell unit with a #118 tip allows the creation of a very conservative trough or trench around a tooth. In combination with good visualisation using the OM and good patient and procedural management with the rubber dam, we can reliably create a finish line, expose it, place a cord if necessary and impress it.

With a radiosurgical unit, inflamed tissue can be removed such that the healthier tissue is exposed to our haemostatic agents. Healthy haemorrhagic tissue responds better to haemostatic agents than inflamed haemorrhagic tissue does. When inflamed tissue is encountered, use of high magnification and the radiosurgical tip to conservatively contour or remove this nuisance tissue can provide a predictable result. Reducing tissue thickness but not modifying tissue height can leave the gingival tissue in proper position such that we achieve nice aesthetics in our final result.

_Handpiece and bur choices

The final item and of least concern in this protocol are handpiece and bur choices. There is existing debate between electric versus air-driven handpieces and regarding which bur is best for which task. Specifying a particular handpiece or bur would be similar to directing an artist regarding which paintbrush to use. What works in one's hands is the most important factor and that changes from individual to individual and situation to clinical situation. If a practitioner follows the diagnosis, magnification, isolation and tissue management protocol, then bur and handpiece choices will fall into place on their own with time and experience. I typically use an air-driven handpiece and an assortment of Axis turbo diamonds.


Fig. 7a


Fig. 7b


Fig. 8a


Fig. 8b

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Fig. 9a

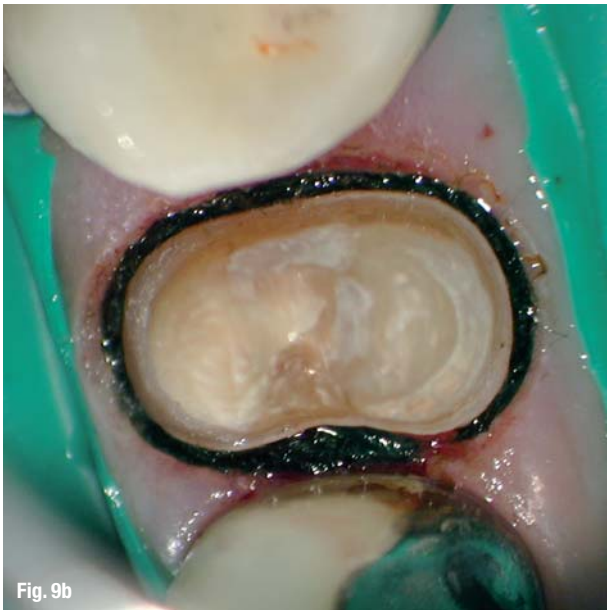
Fig. 9b


Fig. 9c

In a stepwise fashion for an individual crown preparation, the primary concern is achievement of proper anaesthesia such that the patient is comfortable in all capacities. Once this is done, the rubber dam is placed. I use a split- or slit-dam technique. The key to success with this rubber dam technique and crown preparation is the distance at which the holes are placed apart from each other. Generally speaking, holes are punched too close together for this technique. It is best to punch the holes at a distance from each other on the dam that essentially matches the true anatomical distance between the teeth to be isolated.

_Next step: Occlusal reduction

Once the tooth has been isolated and the patient is confirmed to be comfortable, the next step is the occlusal reduction. This makes the tooth shorter and allows better access and visualisation for the axial reduction. If there is an existing restoration in the form of an alloy or composite filling, it is removed and the tooth is reduced to the level of the depth of this restoration. Existing restorations usually provide a good guide to achieving nice occlusal clearance without having to verify prior to the next step. Hopefully, I have not diminished the importance of this step, as I know this can make or literally break a final restoration.

Completing the occlusal reduction first allows me to warm up and work out any kinks in terms of patient issues, patient positioning, handpiece water flow or bur choice etc., before moving to the more complicated axial reduction. On the upper arch, the full-crown preparation is done with a mirror and indirect vision. The OM places us in an ergonomic position for doing this and the rubber dam creates a nice situation for a high volume suction to create an air flow that will keep our mirrors clean(er) of the water spray from the handpiece. On the lower arch, I conduct three-quarters of the procedure with direct vision and then finish certain corners through indirect vision. Indirect vision on the lower arch is not a common technique but with understanding and desire, it is an easy technique to master.

The axial surface reduced first depends on which tooth is being treated. For example, I am right-handed, so on an upper right first molar I reduce the palatal side first and then move to the interproximals. On that same molar, I break contact on the mesial first, moving from the palatal side, breaking the contact towards the buccal side.

This is the easier of the two surfaces to break. First, it is further forward in the mouth and therefore easier to reach; and, second, it is a shorter contact as it is against a premolar. Following the mesial contact break, I continue around the tooth through the mesio-buccal line angle onto the buccal surface. I then break the distal contact, also moving from the palatal side to buccal direction. The most challenging area to prepare on an upper right first molar is the disto-buccal (DB) line angle. Therefore, I prepare the tooth as far as I can through the distal contact and around the DB line angle. I then complete the buccal reduction and connect the buccal finish line at the DB line angle.

Mirror position is critical in achieving a solid finish line on the entire tooth including the DB line


Fig. 10a


Fig. 10b

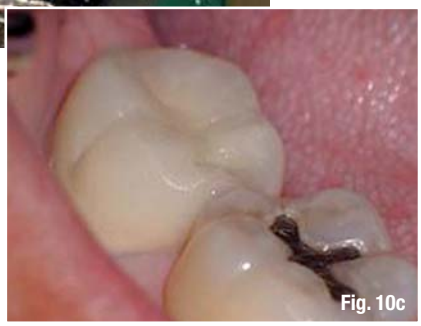
Fig. 10c

angle. These steps, for me, remain true for most upper right teeth, with difficulties being increased as we move more posteriorly and considering patient limitations in anatomy, patient attitude, tooth anatomy and existing restorations or decay.

_Axial reduction

The steps for axial reduction on the upper right arch mirror themselves on the upper left arch. On the upper left arch, I initially reduce the buccal and break contact from the buccal to palatal direction. The difficult area to prepare in an upper left tooth is the disto-palatal/lingual line angle. The difficulty varies according to the tooth being treated and/or the patient's tooth limitations.

The lower arch is different to the upper arch in that direct vision can be utilised for most of the preparation. The buccal reduction is initially done on both lower arches and interproximal contact is broken in a buccal to lingual direction, starting with the mesial contact. Once both mesial and distal contacts have been broken, the lingual reduction has been accomplished. For a lower tooth, the disto-lingual line angle tends to be the most difficult area to visualise, so this is the part that is refined using indirect vision.

_Tissue management and cord placement

Once all occlusal and axial reduction has been accomplished, the next step is tissue management and cord placement. I start with the radiosurgical unit with a #118 tip to create a conservative trough around the tooth, mostly removing tissue thickness and/or reducing any volume of inflamed tissue. This is a very conservative step under the OM. The OM allows precise and accurate tissue removal, and increases tactile sense and the steadiness of our hands.

A size 00 cord is placed in a haemostatic agent to soak at the start of the procedure. Literature supports that a cord soaked for 15 to 20 minutes in a haemostatic agent works better than any other alternative cord/haemostatic agent combination or method.[1] Personal clinical experience and observations find this to be true. With the radiosurgical gingival trough in place, the cord placement is a simple, pressureless and quick, followed by copious air/water syringe rinsing. In the time that it takes to place the cord and rinse most haemorrhage will be controlled, if any.

Now the sharpness and position of the finish line can be re-evaluated and refined. An ultrasonic unit is used, with the irrigation on, to clean the crown preparation of calculus and/or other debris. Occasionally, a BUC-1 endodontic tip (Ultradent), which is about the same size and shape as a 1DT diamond bur, can be used in the ultrasonic unit to refine the crown preparation finish lines. This is done with the irrigation feature turned off on the ultrasonic unit. To sharpen, slightly refine, or minimally move a finish line, I occasionally run the handpiece at a very low speed without water.

_Rinsing and drying

Once all refinements have been accomplished, the preparation is rinsed and dried and for the first time, the entire preparation is evaluated in one view.


Fig. 10d

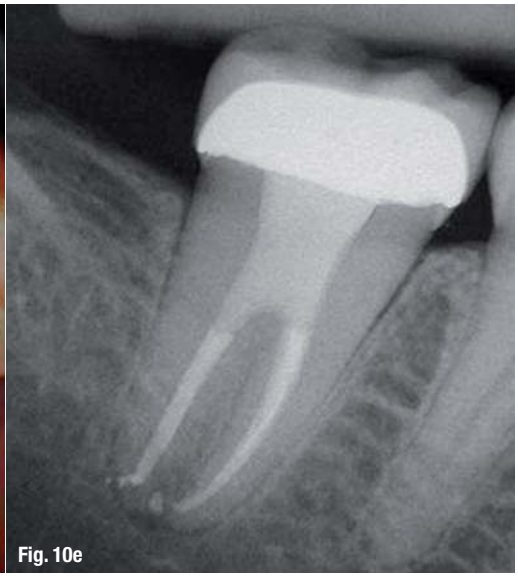
Fig. 10e

The uniformity of the axial reduction and the position of the gums in relation to the cord, and the cord in relation to the finish line are all evaluated.

The axial reduction should have uniform thickness throughout the different positions, as different areas need more reduction, while others need less, based on material and aesthetic demands. There should be no areas where the gingiva is over the cord. If this does occur, that area is refined with the radiosurgical unit to ensure a full view of the cord 360° around the tooth of tooth-tissue-cord.

One of the main reasons we use polyvinyl-siloxane impression materials is because they are repourable. If adequate strength and thickness of this material are not obtained through the proper radiosurgical troughing technique, then the impression may tear upon separation of the model. Having an impression tear after the first pour limits the ability to fabricate a well-fitting restoration.

When a clear tooth-tissue-cord and a visible, sharp finish line are present, the rubber dam is removed and the preparation is evaluated in all dimensions with the naked eye. At times the OM can create a 'cannot-see-the-forest-for-the-trees' type of situation, so it is always valuable to take another look from a different perspective without the OM. This can allow one to identify sharp angles or irregularities in the preparation.

_Full-arch impressions

A full-arch impression is taken with a single tray for the arch that contains the prepared tooth. For the opposing arch, a full-arch alginate impression is taken. With full-arch impressions, a bite registration is usually not required. Most often, one chairside assistant is utilised for the entire procedure, but for difficult and challenging impressions, a second assistant may be utilised for saliva or tongue control.

Once all the impressions have been taken, a provisional is fabricated, refined, polished and cemented. Shades are taken and the patient is released with post-operative instructions._

_Reference

1. Csempesz F, Vág J, Fazekas A. In vitro kinetic study of absorbency of retraction cords. *J Prosthet Dent.* 2003 Jan;89(1):45–9.

_about the author roots

Dr Craig M. Barrington is a 1996 graduate of the University of Texas Health Science Center San Antonio. He practices general dentistry in Waxahachie, Texas, with his wife, and has a particular interest in endodontics and microscope dentistry. Dr Barrington was also part-time clinical Associate Professor in the Advanced Education in General Dentistry Residency Programme at Texas A&M University's Baylor College of Dentistry in Dallas. He has lectured to a variety of dental societies and study clubs. He has also authored and co-authored a number of articles for various dental journals.

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