OVERVIEW

Objective:

- achieve maximum visibility of the root canals
- determine precise root canal location
- allow for proper cleaning and shaping of the root canal
- remove causes of bacterial infection

The Principles of Endodontic Cavity Preparation are based on the Principles of Cavity Preparation established by G.V. Black in 1936. Black’s Principles are divided into two sections, Coronal Cavity Preparation and Radicular Cavity Preparation.

I. Outline form evolves from internal anatomy of the pulp, as opposed to operative outline form, which is based on external anatomy. The outline form of the endodontic cavity must be correctly shaped and positioned to establish complete access for instrumentation, from the cavity margin to the apical foramen.

Factors include:
- size of pulp chamber
- shape of pulp chamber
- number and curvature of root canals

Younger teeth will exhibit larger pulp chambers, and thus require larger coronal preparation. The size of the pulp chamber varies with shape of crown, age of the tooth, its functional activity and its history.

II. Convenience form involves four objectives:

- gain unobstructed access to the canal orifice
- direct access to apical foramen - freedom within coronal cavity to reach apex in unstrained position
- cavity expansion to accommodate filling
- complete authority over enlarging instrument.

Inadequate convenience form will lead to:

- ledging of root
- instrument breakage
- incorrect shape of completed canal
- improper debridgement

III. Removal of carious dentin and defective restorations:

- eliminates bacteria from interior of tooth
- eliminates discolored tooth structure
- keeps saliva from leaking into prepared access cavity

If too much tooth structure is lost—which prevents placing of rubber dam and sealing against saliva-gingivoplasty or crown lengthening may be necessary. Any restoration should be postponed until radicular preparation has been completed.

IV. Toilet of the cavity involves removal of all caries, debris and necrotic material from the pulp chamber. This is done with a combination of (round burs, spoon excavator) and copious irrigation, and prevents:

- obstruction with debris during canal enlargement
- soft debris from chamber from increasing bacterial population in canal
- coronal debris from staining crowns, especially in anterior teeth.

Following preparation of the coronal portion, radicular cavity preparation is performed, also referred to as cleaning and shaping of the pulp canal, and will be covered explained in depth in a separate demonstration.

Again, it is important to remember that final preparation relates to and reflects internal anatomy of the pulp chamber and canal.
**Coronal Access Preparation: Maxillary Central Incisor**

**ARMAMENTARIUM**

### High-Speed Handpieces

High-speed handpieces should generally be used only for making the initial access outline in the enamel during coronal access preparation. After using the high-speed instrument to break through the roof of the pulp chamber, the slow-speed instrument is then used to continue access preparation and removal of decay. Using a high-speed instrument on the floor of the chamber decreases tactile sense within the canal and can lead to irreparable damage to the canal. The high-speed handpiece is used with either a crosscut fissure bur or a round bur. The low-speed handpiece should be used inside the canal with a long shank round bur.

In the clinic, two types of handpieces may be used for root canal preparation: the latch-type contra-angle handpieces feature a sharp contra-angle and are used with latch-type burs that feature a notched shank, enabling them to engage inside the head of the handpiece. The contra-angle attachment redirects the working tip of the slow speed handpiece to 65 degrees to the horizontal, improving access to many awkward areas of the mouth. Friction grip handpieces may also be used with the appropriate burs. Both types of instruments are used to create post spaces and to open up the orifice of the canal during access preparation, cleaning and shaping.

### Burs

The Gates-Glidden bur is preferred for root canal treatment because it is relatively safe. If the Gates-Glidden bur breaks, it will generally break at the shank and can be easily removed from the canal. Though more efficient, the Peeso reamers often experience breakage in the middle of the working end, making them more difficult to remove from the canal. The Peeso reamers can also create perforations inside the canal. Thus, these burs are more dangerous with regard to endodontic treatment and should not be used.

Once initial access is made and the pulp chamber has been penetrated, long shank round burs should be used to continue with access preparation and removal of decay. # 6 is used to remove tooth decay and to explore the root canal, the # 4 for exploring and the # 2 for going deeper in the root. Using these on the floor of the canal can cause irreparable damage.

### Endodontic Explorer & Stewart Probe

The endodontic explorer is a fine-angled instrument used to explore the individual anatomy of the pulp cavity. Two types of stainless steel endodontic explorers are included in the endodontic kit: DG16 explorer is the one most often used in clinic. The Stewart probe is a bulkier, more rigid instrument that is well suited for use in calcified canals, as it will not snap as easily; in addition, the base is wider and takes more abuse. As a result, the Stewart Probe is often the instrument of choice when one is first learning to perform root canal treatment.

### Portable X-Ray Developing Unit

The x-ray developing unit is used to develop radiographs. The four cups in the unit contain, from left to right: quick fixer, water, quick developer and water. Reversing the order of the cups will result in poorly developed x-rays.

1. To begin, be sure that the translucent red top is properly placed on the unit. The top must not be removed during the developing process.
2. Place the un-opened radiograph and the x-ray clip into the unit through the side openings.
3. Remove the wrapper from the x-ray and, using the clip, dip the x-ray into the developer for two to three seconds.
4. Without removing the x-ray from the unit, take it out of the cup and check that a negative image has formed. If the image has not yet formed, or is very light, place the x-ray into the developer for 1-2 more seconds.
5. Once a clear negative image is appears, dip the x-ray into the water for a few seconds, then place it in the fixer for about 2-3 seconds.
6. When there is no haze or greenish tinge on the image and the image can be seen with the light, wash the x-ray by dipping into the last cup of water, then show it to the instructor.
7. Immediately after fixing, remove the wrapping material from the unit, and use the special receptacle provided to collect the lead; the remainder of the wrapping material can be discarded.

In the event of spills, Fix-off can be used to remove any developer or fixer that may get on clothing. However, Fix-off must be rinsed out of clothing on the same day or it will leave white spots.
PROCEDURE

**Step 1: Starting Radiograph**
Begin with an x-ray of the unprepared tooth. This start x-ray is important in making a diagnosis, as well as in estimating the initial measurement of the canals. Study the radiograph as a blueprint to establish the size, shape and location of the pulp canal(s) and their relative positions.

**Step 2: Pencil Access**
For your first time, outline the coronal access on the tooth in pencil, using the coronal preparation slides as a guide. The access outline for a maxillary canine is similar to an upside-down triangle shape, with the base of the triangle parallel to the incisal edge.

**Step 3: Cut Through Center**
First, remove all caries and fillings that obstruct the view or that can cause leakage. Undermined enamel should also be removed together with any parts of the crown that make accessibility to the canal(s) difficult. Using a high-speed fissure bur or round bur held perpendicular to the lingual surface, cut just through the enamel in the center of the pencil-marked area. A common error is to begin cavity too far gingivally. Do not force the bur.

**Step 4: Extend Access**
Extend the opening laterally to the designated outline by maintaining the point of the bur in the central cavity and rotating the handpiece toward the incisal so that the bur continues to parallel the long axis of the tooth. If there is pulp exposure, it should be widened with the handpiece in order to properly determine the extension of the pulp chamber.

**Step 5: Cut Through Dentin**
With a low-speed long-shank #4 or #6 bur (depending on the size of the pulp chamber), make a cut with the long axis of the tooth and cut directly through the dentin into the large pulp horn, or the largest area of the pulp chamber. The bur should be used with a pull stroke from the chamber and out.

**Step 6: Explore Access**
Use the endodontic explorer to check for the canal. If the explorer meets constant resistance, the pulp chamber has not yet been reached.

**Step 7: Cut into Chamber**
Continue drilling apically through the dentin. You will feel a slight drop as the bur breaks through the roof and drops into the pulp chamber.

**Step 8: Explore Access**
When the pulp chamber has been penetrated, probing with the explorer will often produce a "catch" along the ledges, or overhangs, created by the lingual walls or roof of the pulp chamber.

**Step 9: Remove Undercuts**
Expand the coronal cavity access slightly. Avoid perforating the floor of the pulp chamber. Penetrate the pulp chamber using a slow-speed long-shank round bur (No. 4 or No. 6, depending on size of chamber). Working from inside the chamber to outside in a sweeping motion, remove undercuts, or lingual and labial walls of pulp chamber.
The access on the tooth is extended more toward the cingulum; additional beveling of the incisal wall is also completed by working from inside to outside to remove lingual "shoulder" of the canal, thus allowing for continuous access from the coronal cavity into the canal.

The ideal access consists of smooth walls without ledges. The use of fissure burs very often creates ledges in the floor and walls of the cavity access preparation, which can make canal instrumentation more difficult. Moreover, ledges in the dentin can diminish the tensile strength of the tooth. In general, the No. 2 is used for working within the canals, while Nos. 4 and 6 are for working within the chamber, using a sweeping motion to avoid gouging the floor of the pulp chamber and creating the illusion of a canal which may lead to perforation.

**Step 10:** Remove Debris
Remove debris from the chamber as you proceed, using a No. 2, No. 4 or No. 6 bur to eliminate pulpal horn debris and bacteria. If the canal or chamber is calcified, remove dentin with the slow-speed hand piece and appropriate bur.

**Step 11:** Irrigate
Irrigate periodically to flush out debris. Fill an irrigating syringe with "sodium hypochlorite" [NOTE: use tap water for preclinic exercise] and attach an irrigating needle, the tip of which should be bent at approximately a 45° degree angle to the long axis of the needle. The distance from the bend to the tip of the needle should equal 20 mm.

Using this needle, gently flush fillings and debris from the chamber. The needle should fit in the canal very loosely, and the solution should be introduced very slowly, so that it can run back out of the access opening and is not forced through the apical.

**Step 12:** Straight-Line Access
The resulting cavity should be smooth and continuous, flowing from cavity margin to canal orifice; this is referred to as straight-line access. Verify that you have achieved straight-line access by rotating a file within the canal. The file should have direct and unimpeded access to the canal, achieving 360 degrees of unstrained motion; you should be able to rotate the file 360 degrees about the cavity outline without encountering resistance within the pulp chamber due to ledges or ridges.