Cleaning and Shaping the Root Canal System

The aims of root canal preparation are:

• To remove infected debris from the root canal system

• To shape the canal allowing thorough disinfection with irrigants and intracanal medication.

• To provide a space for the placement of a root canal filling.

The removal of vital pulp tissue

In sufficiently wide and straight canals, broaches are recommended to withdraw the pulp tissue all in one piece. The correct technique for the use of the broach (with the rubber dam in place, of course) requires that an adequate access cavity be prepared and irrigated with sodium hypochlorite. Inadequate irrigation or poor control of bleeding may cause discoloration of the tooth within a few hours. First, the correct size must be chosen. It must be wide enough to engage the pulp effectively, but not so wide as to touch the canal walls. The broach is introduced for two-thirds of the length of the root canal. The instrument is rotated at least 180°, and it is then extracted. One may draw three conclusions from the above statements:

– the broach must never be used in narrow or calcified canals

– it must never be introduced into curved canals or into curved portions of straight canals

– it is useless, as well as dangerous, to introduce it to the apex.

It may be used confidently in the upper central incisors, in canines known to have a single canal, in upper second premolars with a single canal, in the palatal roots of the upper molars, and in the distal roots of the lower molars. It is always introduced as far as two thirds of its length.

The removal of necrotic pulp tissue and microorganisms

Pulp tissue that is necrotic or in an advanced state of degeneration cannot be removed with a broach. The removal of this material is achieved by the use of irrigating solutions and the mechanical action of the endodontic instruments.

Coronal Preflaring

The extension of an access cavity into the coronal-most portion of the root canal is called *coronal flaring.* If a canal is constricted, mineralized, or difficult to access, flaring the coronal portion prior to any deep entry into the root canal is beneficial. This canal modification should be preceded by a scouting step, in which a small (e.g., size #10) K-file is passively placed several millimeters into the root canal. Tools for preflaring include Gates Gliddens and dedicated NiTi instruments. More recently, specific orifice shaping rotaries have been developed that are used as a single instrument, rather than a sequence.

Patency File

A *patency file* is a small K-file (usually a size #10 or #15) that is passively extended slightly beyond the apical foramen. The use of a patency file has been suggested for most rotary techniques. This step is thought to remove accumulated debris, to help maintain working length, and to translate into greater clinical success. One concern with the patency file was that instead of having a cleaning effect, the file would push contaminated debris through the foramen. However, an in vitro study suggested that the risk of inoculation was minimal when canals were filled with NaOCl.

Length Estimation

Apex locators, radiographs, tactile sensation, the presence of moisture on paper points, and knowledge of root morphology have been used to determine the length of root canal systems. The length of the root canal is best estimated by using an apex locator and a confirmatory working length radiograph. It is not appropriate to try to estimate the location of the constriction in a root canal by tactile sense alone, as this too often leads to inaccurate measurements. Traditional treatment has held that canal preparation and subsequent obturation should terminate at the *apical constriction*, the narrowest diameter of the canal. This point is thought to coincide with the

cementodentinal junction (CDJ). However, the position and anatomy of the CDJ vary considerably from tooth to tooth, from root to root, and from wall to wall in each canal. Moreover, the CDJ cannot be located precisely on radiographs. For this reason, some have advocated terminating the preparation in necrotic cases at 0.5 to 1 mm short of the radiographic apex and 1 to 2 mm short in cases involving irreversible pulpitis. Although there is no definitive validation for this strategy at present, well-controlled follow-up studies seem to support it. Using an electronic apex locator has helped clinicians identify the position of apical foramina more accurately and allow safe canal shaping as close as 0.5 mm to the canal terminus.

The Apex Locator

The apex locator is an electrical device that allows the operator to estimate the canal length, and with practice can be extremely accurate. Apex locators work by applying an alternating current between two electrodes; one makes contact with the lip or cheek (the ground electrode), the other is attached to a file in the root canal. The impedance at the apical foramen is approximately equal to that between the periodontal ligament and the oral mucosa; this value is used to calibrate the instrument. The apex locator has a display showing the zero reading that indicates when the file tip is at the apical foramen. Some modern apex locators measure the impedance at two or more frequencies to improve the accuracy of the instrument. Some can be used effectively even in the presence of electrolytes such as sodium hypochlorite and blood, although these are best avoided; the pulp floor should always be dry to prevent short circuiting. Apex locators are generally safe to use; however, manufacturers' instructions state that they should not be used on patients with pacemakers without consulting the patient's cardiologist.

***Instrument movements while shaping*(file and reamer)**

Watch winding

The least aggressive instrument action, it is most desirable in early phases of root canal instrumentation. Most clinicians recommend a watch winding movement with rotations of a quarter turn using small (size#08 or #10) K files to reach WL or to explore the canal prior to coronal flaring, or it is can be defined as the reciprocating back and forth (clockwise/ countercl-

ockwise) rotation of the instrument in an arch. Importantly copious irrigation and constant cleansing of the instrument with sterile gauze are necessary to clear the flutes and to prevent packing debris at or through the apical foramen.

Reaming

Reamers are instruments designed to enlarge or taper preexisting spaces. Traditionally, endodontic reamers were thought to cut by being inserted into the canal, twisted clockwise one quarter to one half turn to engage their blades into the dentin, and then with drawn, that is, penetration, rotation, and retraction. The cut is made during retraction. Reaming as a method that produces a round, tapered preparation, and this is only in perfectly straight canals.

Filing

The files achieve its primary cutting action on withdrawal, although it will cut in the push motion as well. The cutting action of the file can be affected in either a filing or a reaming motion. Filing is very efficiently done with headstrom files while K files are the most popular instruments.

Circumferential filing

It is used for canals that are large and/or not round. The file is placed into the canal and withdrawn in a directional manner sequentially against the mesial, distal, buccal, and lingual walls. Because most roots are oval in cross section, and many have a single oval canal, if the dentist attempt to prepare such a canal with reaming action, the result will be a canal with a key hole shape.

Anticurvature Filing

Involves filing preferentially towards the outer curve of the root canal, away from the furcation, to avoid strip perforation. For example the buccal, mesial and lingual walls of the mesial canals of a mandibular molar would be filed more than the distal wall during coronal flaring, with more strokes on each of these walls in a ratio of 3:1.

TECHNIQUES FOR ROOT CANAL PREPARATION:

Standard technique

Standardized files were used sequentially to produce a canal preparation that had the same size and shape (taper) as the last standardized instrument used. The canal could then be obturated with a filling material that has also the same size and shape. Essentially, the canal was made to fit the filling material. At this same time, obturation with silver points having the same shape as the files was an accepted and popular obturation technique. The technique was easy to perform in straight canals of mature teeth exhibiting natural taper but posed problems in small, curved canals. As the instruments got larger, the ability to finesse the stiff instruments to different lengths decreased because of the restoring force of the metal. This often resulted in ledging, apical transportation, and apical perforation, or "zipping".

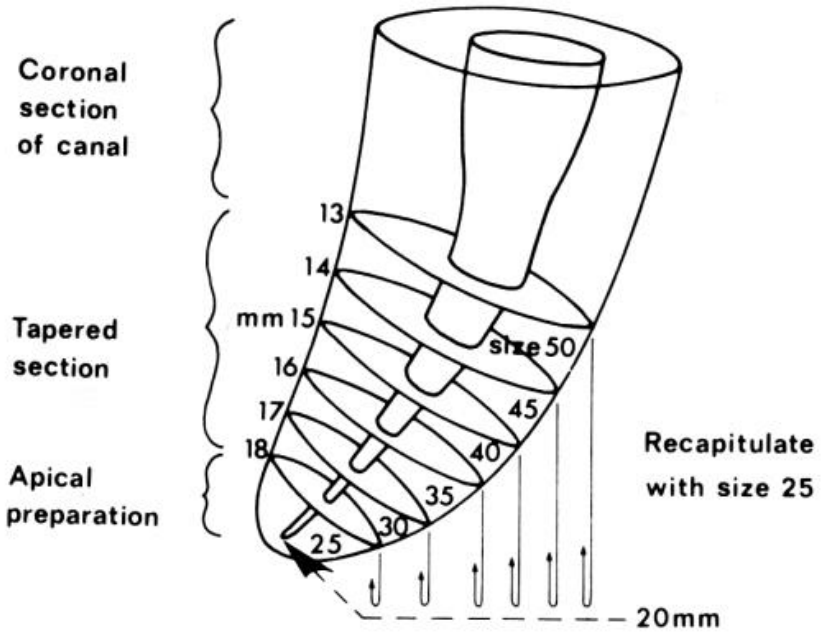
FLARING PREPARATION

This is a tapered preparation, using a step-back or crown-down technique or a combination of the two. The objective is to keep the apical preparation as small as practical (but well debrided) with an increasing taper throughout the canal. Also, the final apical preparation should be at or close to the original canal position.

Step-back technique

In the step-back technique, the apical portion is instrumented first, and then the coronal portion is shaped. After the access opening is made, the working length is determined on a measurement radiograph. The first file that binds in the canal at the working length is considered the initial apical file (IAF). The root canal must then be enlarged by circumferential filing through an additional four instrument sizes. During this initial phase of preparation, no instrument sizes may be skipped or a blockage may be created.

The last file manipulated to the working length should remove only white dentin shavings, and is designated as the apical master file (AMF). Its size determines the size of the gutta-percha master point that will be used later. Next, the coronal portion of the root canal is instrumented in step-back fashion through four additional sizes. Each subsequent larger size K file is set 1mm shorter than the preceding size so that a conical canal configuration with a definite apical stop is formed. Frequent recapitulation with the AMF ensures that the canal remains patent.



Stepdown technique

The principle of these techniques is that the coronal aspect of the root canal is widened and cleaned before the apical part. The obvious advantages of these methods over the stepback are as follows:

It permits straighter access to the apical region of the root canal. It eliminates dentinal interferences found in the coronal two-thirds of the canal, allowing apical instrumentation to be accomplished quickly and efficiently. The bulk of the pulp tissue debris and microorganisms are removed before apical instrumentation is commenced, which greatly reduces the risk of extruding material through the apical foramen and causing periapical inflammation. This should reduce the incidence of after-pain following preparation of the root canal. It allows better penetration of the irrigating solution to the entire root canal system and forms a reservoir of irrigant which is more readily replenished in the canal system. It also reduces the risk of compacting debris apically which may block the canal.

The step-down technique originally advocated for hand file preparation, it also has been incorporated into techniques using nickel-titanium files. With the pulp chamber filled with irrigant or lubricant, the canal is explored with a small instrument to assess the morphology (curvature). The working length can be established at this time. The coronal one third of the canal is then flared with Gates-Glidden drills or NiTi orifice shapers. A large file (e.g., No. 60) is then placed in the canal, and a watch-winding motion is used until resistance is encountered. The process is repeated with sequentially smaller files until the apical portion of the canal is reached. The working length and the initial apical file (the first file that binds at working length) can be determined if this was not accomplished initially. The apical portion of the

canal can now be prepared by enlarging the canal to the master apical file at the working length. Apical taper is accomplished using a step-back technique.

❖ Rotary Instrumentation:

General principles:-

- Nickel-titanium rotary preparation is typically performed in a staged approach using coronal flaring; however, the specific technique is based on the instrument system selected.
- instrument insertions should follow an in-and-out pattern.
- Work instruments to light resistance and never force them.
- Only use instruments in a well irrigated and lubricated canal.
- Clean flutes frequently and check for signs of distortion or wear.
- Frequently NiTi rotaries are combined with hand files or other rotary instruments. One such combination technique uses the following steps:

  1. Canal exploration: After access, the irrigated canal is explored with a No. 10 or No. 15 K-file into the midroot area. Sometimes a canal is already naturally flared and wide (e.g., a maxillary central incisor or canine in a younger patient). In such cases a No. 10 file may immediately be placed to the estimated working length and a working length radiograph can be obtained.

  2. Coronal flaring: For more constricted canals, Gates-Glidden drills or better NiTi orifice shapers can be used to accomplish early coronal flaring. This step facilitates irrigation and removes coronal interferences, which in turn permits easier access to the apical portion of the root canal.

  3. Canal negotiation: In the presence of irrigant or gel-based lubricant, the canal is negotiated to full length with hand files used in a watch-winding

motion. To secure a glide path for subsequent rotary use, the clinician must confirm that a straight No. 15 K-file can reach the corrected working length.

4. Working length determination
5. Initial rotary preparation to working length
6. Master apical file determination
7. Additional apical enlargement

Pro taper universal Technique:

Rules:

• ProTaper® rotary files should be used at a constant speed between 150rpm and 350rpm (recommended: 250 rpm)

• The rotary files should be used in a specific endodontic motor with torque control such as the X-Smart™ Motor

• Always irrigate the canal before engaging a file

• Once working length is confirmed, use each file progressively down to the working length

• Use the shaping files (S1, S2 and SX) with a brushing motion. Brushing motion: Take the file passively to the point of light resistance and 'brush' out of the canal.

• Use the finishing files (F1-F5) in a 'in and out' action (not brushing)

• Withdraw the files once working length is reached

• Clean the files directly after use

For Short canals sequence:

1- Use SX to resistance or no more than three quarter estimated working length.
2- Confirm patency and determine working length.
3- Take SX to working length.
4- Use Fl to working length.
5- Use F2 and F3 if foramen is larger than size 20.

Medium length and long canals sequence:

1- Use SI to resistance or no more than three quarter estimated canal length.
2- Use SX to resistance.
3- Confirm patency and determine working length.
4- Take SI to working length in one or more passes.
5- use S2 to working length.
6- Use Fl to working length.
7- Use F2 and F3 if foramen is larger than size 20.