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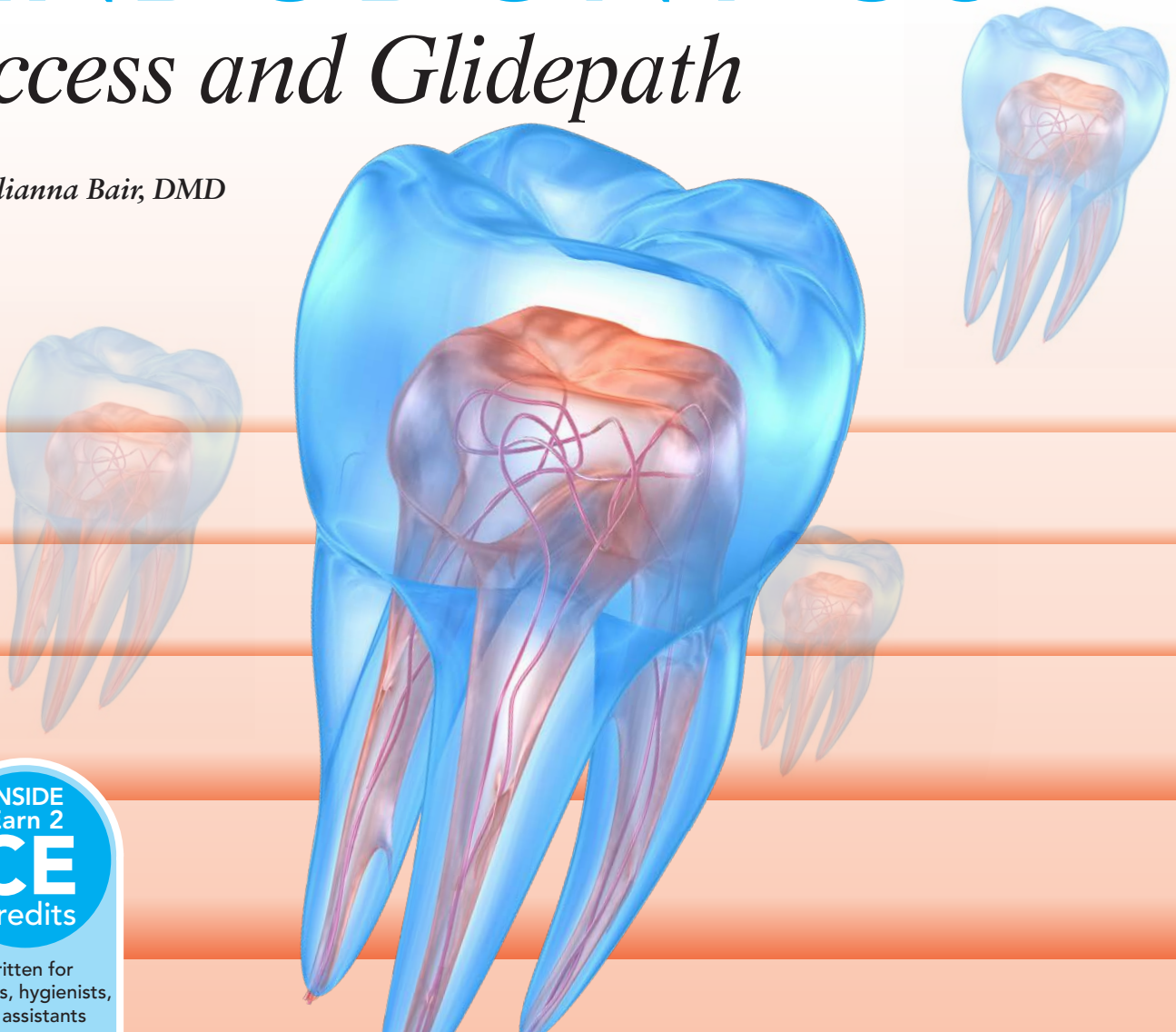
Knowledge for Clinical Practice



ENDODONTICS

Access and Glidepath

By Julianna Bair, DMD



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ABSTRACT

Access cavity preparation and glidepath are the critical first steps in root canal treatment. There have been many changes from traditional access preparation to current access trends, due to improvements in available instruments, dental operating microscopes, and cone beam computed tomography (CBCT). The access preparations have been trending toward being more minimally invasive and to conserve dentin. However, this puts more strain on the instruments and may make subsequent cleaning, shaping, and obturation more difficult. Securing the glidepath is a very delicate procedure and must be performed with mindfulness and patience. The proper sequence of instruments should be followed, as well as care taken to irrigate between instruments.

EDUCATIONAL OBJECTIVES

At the conclusion of this course, participants will be able to:

1. Understand the trend to be more minimally invasive in access preparation.
2. Comprehend why preservation of critical dentin is important.
3. Identify new instruments and tools allowed for this trend.
4. Learn to recognize cases to tackle and cases to refer, and where challenges may be.
5. Explain why securing a smooth glidepath is critical for rotary instrumentation and important for the cleaning and shaping to follow.

ABOUT THE AUTHOR



JULIANNA BAIR, DMD

Dr. Julianna Bair is a Board-certified pediatric dentist. As a pediatric dentist, she noticed that many endodontists preferred not to see children and many pediatric dentists did not have a good understanding of endodontists. She decided to further her education and complete an endodontic residency at Einstein Medical Center in Philadelphia, PA. She is currently practicing as a dual specialist—endodontist and pediatric dentist—in New York City.

Introduction

The first step in nonsurgical root canal treatment is access cavity preparation. A precise access is critical, as all subsequent steps of the root canal treatment build off of the access cavity. Goals of the access include: 1) locate the root canal system; 2) allow proper cleaning and shaping, disinfection; and 3) facilitate the obturation of the root canal system.¹ Traditional and current access trends are discussed here. Available instruments and potential challenges that may be encountered will be reviewed as well.

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Typically, the first step should be to remove any caries and defective restorative material so as to evaluate the restorative prognosis of the tooth early on. If the tooth is nonrestorable at this point, it can be referred for an extraction without putting the patient and clinician through a laborious and expensive procedure. Complete caries excavation and removal of defective restorations allow better visualization and detection of any fractures. Furthermore, removing defective restorations early on prevents any debris from inadvertently dropping in and irreversibly blocking the canals from instrumentation. These initial steps are important to prevent further bacterial contamination of the root canal system.

Endodontic access cannot be mentioned without discussing Krasner and Rankow's work that established guidelines regarding the pulp chamber anatomy. The study examined 500 extracted permanent, human teeth, and established laws for finding pulp chambers and root-canal orifices. Important rules to keep in mind while accessing and searching for orifices: 1) the pulp chamber is always in the center of the tooth at the level of the cementoenamel junction (CEJ); 2) the floor of the pulp chamber is always a darker color than the surrounding dentinal walls; and 3) the orifices of the root canals are located at the junction where the walls meet the floor.²

Current trends of minimally invasive dentistry have challenged the ways teeth have been traditionally accessed. There is an appreciation to maximize the preservation of natural tooth structure, especially in the critical per-cervical region. Pericervical or cervical dentin is defined as the 4 mm of dentin coronal to the crestal bone.^{3,1} The amount of remaining dentin in this region provides strength to the tooth and retention for the restorative materials; it should be preserved as much as possible. Improved materials and technology allow for this conservative access preparation and the proper disinfection that follows. In the following section, the traditional access will be juxtaposed with current access trends. Practitioners should use their clinical judgement to design the access for a particular case. Some

cases may allow a conservative access; whereas others may have a more complicated root canal anatomy such as a deep split or severe curvature and more access room would facilitate subsequent instrumentation.

Anterior Tooth Access

Traditionally, the access is initiated in the center of the anatomic crown on the lingual surface (see Figure 1). The initial penetration through enamel is completed while holding the bur perpendicular to the lingual surface. This angulation is redirected to become parallel to the long axis of the tooth when entering the pulp chamber. Removal of the pulp horns dictates a triangular access form. In this traditional access, the lingual shoulder — defined in Cohen's Pathways of the Pulp as the “shelf of dentin that extends from the cingulum to a point approximately 2 mm apical to the orifice” — is to be removed to gain straight-line access to facilitate instrumentation for effective debridement.⁴

Probably the biggest change in endodontic access, the anterior tooth access is now moved more toward the incisal aspect. This incisally positioned access eliminates the need to remove the lingual shoulder for straight-line access, sparing the critical per-cervical dentin around the cingulum area of the tooth that gives it strength. Furthermore, this type of access prevents gouging or perforating buccally. In mandibular incisors, this allows access toward the lingual, to search for the second lingual canal that is often missed in the two-canal configuration type.



Figure 1. Traditional anterior tooth access is at the center of the anatomic crown on the lingual surface.



Figure 2. The current trends in anterior tooth access have been moved more toward the incisal aspect of the tooth.

Canine access is in many ways similar to incisor preparations. The differences are that canines are wider labiolingually than mesiodistally and there are no pulp horns. Usually one root canal configuration is present, although two have been seen. These anatomical differences render the canine access preparation to be more oval, and again current trends have moved the access more toward the incisal aspect, which not only spares the critical dentin, but works with how the canine canal typically projects toward the facial and the incisal aspects (Figure 2).^{5,1}

Premolar Access

Access initiation is in the central fossa between the buccal and lingual cusp tips, and slowly widened in a buccolingual direction towards the cusp tips. The orifices will be beneath the cusp tips. Clinicians must keep in mind the lingual tilt of the crown of mandibular premolars when accessing. Clinicians also must be aware of possible anatomical variations of premolars. Some premolars may present with three canals (MB, DB, and P) “mini-molar.”⁶ In this case, access is further extended mesiodistally at the buccal aspect of the tooth (Figure 3A and 3B).

Current trends for premolar access have not changed much from classic access techniques, other than keeping the

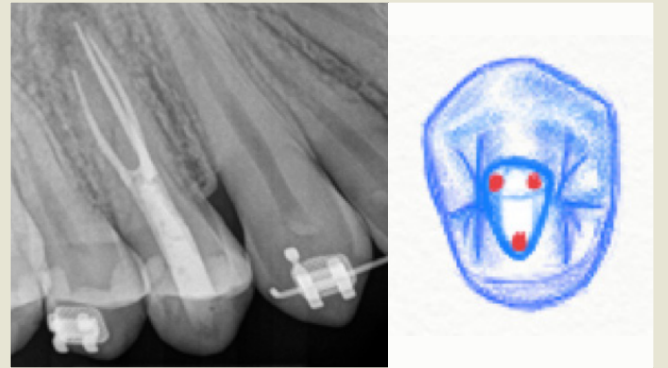


Figure 3A and 3B. A three-canaled premolar, or “mini-molar.” Access design is modified to facilitate the cleaning and shaping of this unique anatomy.



Figure 4. Premolar access oval.

access oval more conservative (Figure 4). There is no longer a need to extend the access preparation from cusp tip to cusp tip. Clinicians should access enough for current flexible instruments to be introduced into the orifice and properly debride and disinfect the root canal system.

Maxillary Molar Access

Traditional access initiation is on the central groove within the boundaries: mesially, a line connecting the MB and ML cusp tips and distally, the oblique ridge. The classic design is typically triangular and more mesially placed. As the access is deepened, the angle of the bur should be changed to penetrate the pulp chamber toward the largest canal, which would be

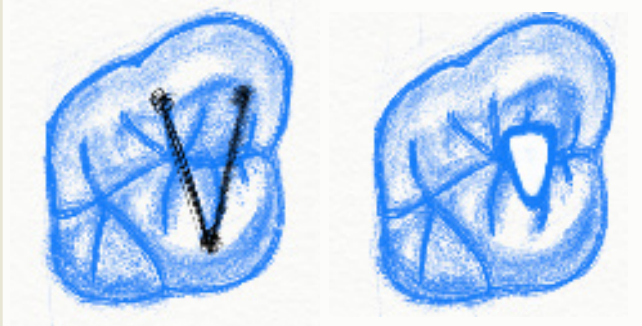


Figure 5A and 5B. Traditional maxillary molar access is within the boundaries of the MB and ML cusps and the oblique ridge. The access is typically triangular in shape.

the palatal in maxillary molars (Figure 5A and 5B).

Current access trends for maxillary molars take a more centered approach to preserve tooth structure and prevent gouging the mesial dentin shelf (Figure 6). The access preparation is more of a long oval.

Mandibular Molar Access

Classic access initiation is on the central groove within the boundaries: mesially, a line connecting the MB and ML cusp tips and distally, a line connecting the buccal and lingual grooves. The access is triangular for a three-canal configuration or trapezoidal for a four-canal configuration

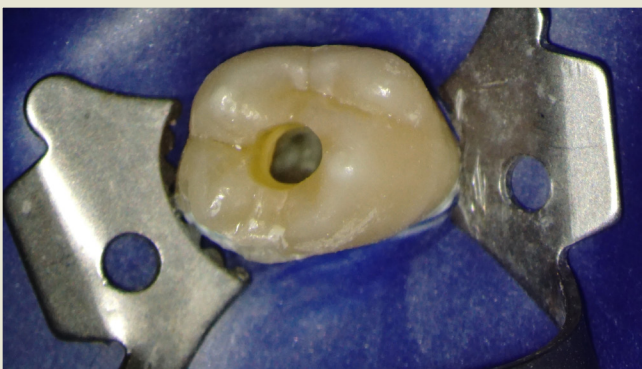


Figure 6. Orifice-directed access of a maxillary molar that is minimally invasive.

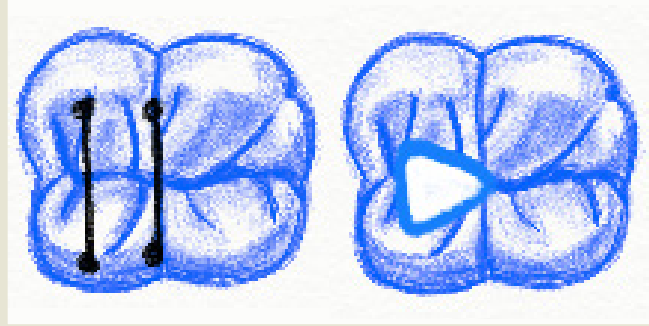


Figure 7A and 7B. Traditional mandibular molar access is within the boundaries of the MB and ML cusps.

(Figure 7A and 7B). As the access is deepened, the angle of the bur is directed toward the distal canal to penetrate the pulp chamber. Traditionally, it is advocated for all orifices to be visualized from the occlusal surface for straight-line access to the root canal system. Previously, the instruments dictated the access preparation, but now with improved technology and better instruments, access preparation can be more conservative to preserve tooth structure.

Current mandibular molar endodontic preparations are access in a conservative square or round shape and kept centered to avoid removing more dentin on the mesial aspect of the tooth (Figure 8). No longer is it necessary to visualize all

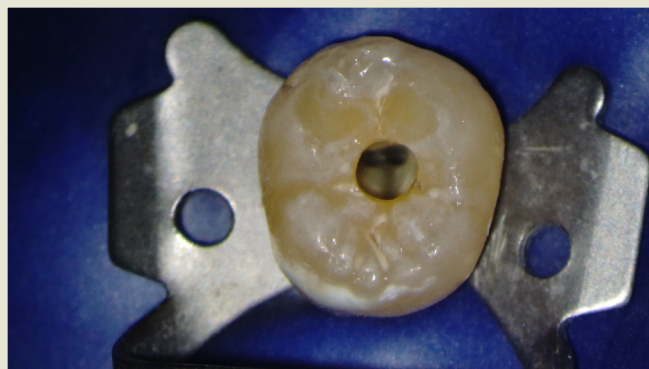


Figure 8. Current minimally invasive access style of a mandibular molar.

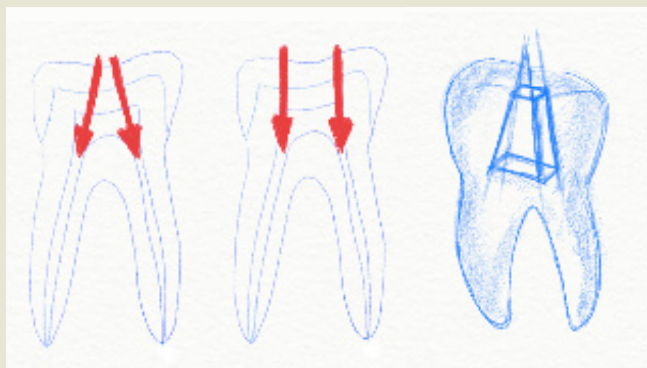


Figure 9A and 9B. A diagram of an orifice-directed access.

orifices from the occlusal surface, rather the goal is an orifice-directed access, in which the hand-held mirror may have to be angled in multiple directions to visualize different parts of the root canal system (Figure 9A and 9B).

Some experts in the field argue that the pulp horns need not be removed in these conservative accesses, or the access can be so precise, directed, and conservative that the orifices are individually accessed, leaving a truss.¹ However, such skilled clinical practice requires high magnification under a dental operating microscope and instruments such as ultrasonics with bendable tips to reach and properly debride and disinfect the isolated areas.

The caries/restorative/anatomy-leveraged access are nontraditional access cavities that maximize tooth structure preservation. For example, through class V cervical abrasions. Or through the area of caries excavation, known as a caries-directed access.

However, with more minimal accesses, the clinician must be aware of the increased stress and strain on the instruments, and furthermore the increased risk of breakage. Also, keeping the access too small may compromise thorough debridement and complicate the obturation. There must be a balance between conservation of tooth structure and root canal treatment.

These techniques discussed should be performed with

the proper tools. Most importantly, the use of a dental operating microscope is a must for proper visualization. Instruments such as ultrasonics, and specific burs that will be subsequently reviewed allow for the precision that is required to create these conservative accesses.

Armementarium

Dental operative microscopes (DOM). DOMs have been required in postgraduate endodontic programs by the Commission on Dental Accreditation (CODA) since 1998. It is an integral part of performing quality root canal treatment. The DOMs have many advantages over loupes, the most important of which is that the DOM provides 4x–25x magnification and most loupes provide 2.5x–6x.

Radiographic images. The peri-apical radiograph provides a wealth of information. Are the canals straight or curved? Are there calcifications of the pulp chamber or canals? At what angle should the access be made? Cone beam computed tomography (CBCT) provides precise information regarding the orientation, angulation, and morphology of the root canal system and surrounding anatomical structures. The CBCT is an indispensable tool in modern day endodontic treatment. It can be used to plan an access, with the precise measuring tool.

Burs. Traditionally, the round bur has been taught to penetrate the pulp chamber roof with a “drop-in” feeling. The round bur can also be used to remove the chamber roof and any pulp horns with a withdrawal stroke. Small round burs (1/2 round, 1/4 round), preferably on the slow-speed handpiece, sometimes can be used to gently trough along developmental grooves in search of additional anatomy such as MB2, DB2, midmesials, second palatal canal, etc. The Munce Discovery Burs (CJM Engineering) serve a similar purpose. Tapered diamond burs create the desired funnel shape of an access and it can also serve to refine the access cavity. Diamond burs are used for access through porcelain or zirconia material. Any metal, such as the metal layer of the porcelain fused to metal crown,

or amalgam restoration can be accessed with a transmetal carbide bur. However, take care that the carbide bur does not touch the porcelain, as microcracks can be created and propagated and the restorative material may shatter. Burs with safety tips such as Endo-Z burs (Dentsply Sirona) prevent drilling on the pulpal floor that may lead to perforations. The length of the bur tip can be used as a rough estimate to measure depth of penetration. Remember, at any point in which there is uncertainty there is always the option to take a check radiograph.

The ultrasonics are important instruments in the field of endodontics. It has been shown that the use of hand, rotary, and ultrasonic instrumentation was more effective at removing necrotic biofilm and debris versus hand and rotary instrumentation alone.⁷ Ultrasonics instruments also facilitate the removal of pulp stones and the troughing process in search of canals. Using the ultrasonics in the deeper parts of the access or the refinement of the access allow better visualization of the canal system over the traditional handpiece. Modified ultrasonic tips that are angled are useful to get the hard-to-reach places such as beneath pulp horns or trusses.

Access Challenges

Calcifications can be a complication encountered during access (Figure 10A and 10B). The pulp chamber and/or canal orifices may be calcified and/or occupied with pulp stones.

Heavily restored teeth present challenges in that the orientation of the restoration may be different from the natural axis of the tooth and there may be an increased risk of perforation on access. It is advised to study the pre-op radiographs prior to beginning the access. Removing any old, defective restorative material when possible may be helpful, as well as being mindful of the color map inside the tooth.

Teeth without crowns are extremely difficult to access, due to the lack of orientation. Some tips that may help include: accessing without a rubber dam, using adjacent teeth as guidance, and palpating the buccal root anatomy



Figure 10A. Calcifications of the pulp chamber and canal system



Figure 10B. The completion of the case previously shown.

to determine the root angulation. The rubber dam is then placed to complete the root canal once the initial access has been made and orifice(s) identified.

Clinicians should refer cases that are beyond their comfort to treat or require additional tools beyond the ones they have at hand.

Common Errors

If there is poor access placement, the orientation may be thrown off. The clinician may not be searching in the right area for the orifices, resulting in a perforation, for example. Forgetting to extend the access until the darker floor meets the peripheral, ivory walls may result in missed



canals and anatomy. An example of inadequate extension is seen in mandibular incisors, in which a lingual canal is left unexposed. The opposite — overextension — weakens the tooth. In such situations, the walls do not guide the files, and possibly make it difficult to place instruments in the canals.

Sometimes, clinicians may fail to unroof the pulp chamber. They simply are not deep enough. The pulpal floor is a darker, gray color that is distinct from the whiter walls. Leaving pulp horns can cause discoloration, which can be esthetically displeasing especially in teeth of the anterior esthetic zone.

Perforations are also a common error during access. The anterior tooth is most often perforated through the buccal, as the bur was improperly angulated and the clinician failed to recognize the inclination of the tooth. Furcation perforation results when the clinician is drilling on the pulpal floor, as he or she failed to measure or forgot to keep in mind the depth of the pulp chamber. A mesial/distal/buccal/lingual surface perforation results from a failure to recognize the angulation of the tooth. Perforations often progress to periodontal problems later as these areas are difficult to maintain. Early repair results in better outcomes when treating perforations. Fuss and Trope reported that size, location, and time of repair significantly impact the prognosis.⁸ They reported that small, infrabony perforations that are repaired immediately have a generally positive prognosis.

Again, proper lighting and magnification help avoid these errors. A check radiograph may be taken at any point. The tooth can be medicated and temporized and a CBCT taken. A specialist should be consulted or referrals should be made in a timely manner, if there are any issues or restrictions in delivery of quality care.

Glidepath

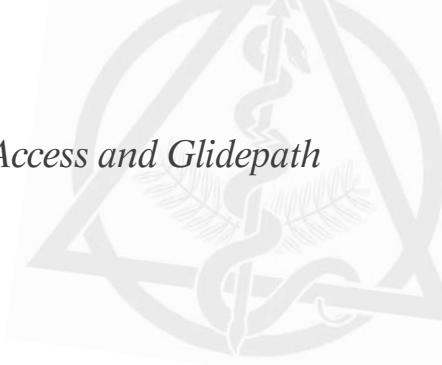
The endodontic glidepath is a “reproducible smooth tunnel from endodontic access orifice to the physiologic terminus” (Dr. John West).^{9,10} Establishment and maintenance of a glidepath allow for proper disinfection of the root canal

system. The steps of preparing a glidepath will be reviewed, and possible challenges and instruments to use in preparing the glidepath are discussed.

Again, as with access cavity preparation, the radiograph should be studied in detail. Are the canals relatively straight? Or takes a severe curve? Some multiplanar curves are not visible from a 2D radiograph. Perhaps the canals may be wide or have immature root apices, such as those in younger patients. Or the opposite, the canals may be calcified, such as those in the older population or in teeth that have sustained trauma. Learn to recognize challenges and be able to distinguish which can be handled and which cases should be referred.

It is safest to establish a glidepath with hand files prior to introducing rotary instrumentation. One of the easiest ways to break a rotary file is by pushing it repeatedly in a dry and previously unnegotiated canal. The glidepath is easily and irreversibly lost if one is not mindful in this part of instrumentation. A glidepath achieved with at least a No. 10 hand file is critical prior to any mechanical instrumentation. It is advised to work the No. 10 file until it is very loose. Make short vertical strokes initially, then increase stroke amplitude, making longer and longer smoothing strokes until the stroke amplitude is halfway up and down the canal. Some instructors advocate to follow with a No. 15 file in the same manner, and possibly a No. 20 file. The larger the hand file, the less strain and less risk of rotary instrument breakage. However, larger hand files can also easily ledge or block due to the abrupt increase in instrument diameter. After a smooth glidepath is secured with hand files, rotary instrumentation can be used.

There may be a number of reasons why a file stops short of being patent, unable to advance further. One, the canal may be clogged with dentin mud, necrotic debris, or may be blocked by dense collagen. The solution would be to irrigate copiously with sodium hypochlorite. Then, it is advised to take a small hand file (No. 6 or No. 8) with a small apical pre-bend to touch the blockage, remove, irrigate,



re-bend the file and repeat the steps, with the goal of slowly advancing this file deeper into the canal.

Two, the instrument may be too wide for the canal. Maybe there is significant calcification. So, the solution would be to use a smaller file instead. Try to picture where in the canal the instrument is meeting resistance. Perhaps it may be in the coronal region, in which case coronal flaring with an instrument such as the 17 mm .25/.08 Traverse Orifice File (KaVo Kerr) may be helpful. Keeping this short file in the straight coronal portion prevents any ledges or irreversible blockages. After the coronal widening, small hand files should advance further, and will give a better tactile sensation to negotiate apically.

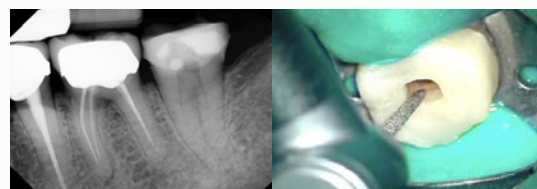
Sometimes the No. 10 file may be loose, but a No. 15 file is frustratingly unable to follow. Keep in mind that the file tip of a No. 15 file is 50% wider in diameter than a No. 10 file. This abrupt increase in tip diameter is too great for the No. 15 file to follow easily after a No. 10 file, and perhaps using a No. 12.5 file between will allow for a smoother transition. This is explained by Dr. Buchanan as the fundamental difference in cross-sectional shape of the files.¹⁰ He asks the question why a No. 15 file stops short and forms a deadly blockage, while a rotary file with the same tip diameter will advance smoothly following the No. 10 file? He points out that the cross-sectional shape of the K-file is square-shaped and the rotary file is triangular-shaped. Being triangular, the rotary files have 57% more free space to collect debris than the square K-file. The square file, with less chip space, often gets debris pushed ahead of the file tip. Therefore, less resistance is met while using rotary instrumentation after a glidepath is established with a No. 10 file. However, be mindful that this puts more strain on the rotaries and they are at higher risk for breakage. Rotary instruments should never be pushed. Let the handpiece be naturally guided down the canal with no more pressure than that put pressing on, but not breaking, a mechanical lead pencil.

There is a new instrument designed to help create this glidepath. With a small tip size of .13 and .18, this can be the

intermediary file between No. 10 to 15 or No. 15 to 20. The flexibility of the heat-treated NiTi material and the variable flute angles along the file allows this to be the ideal rotary negotiation file. The tighter flutes near the tip give it strength and also flexibility to maneuver around curves. And the more open flute angles near the shank allow for more chip space, therefore maximizing debris removal and efficiency of the file. The maximum flute diameter is 1.0 mm, preventing coronal overenlargement that may weaken the critical pericervical dentin and minimizing risks of strip perforations.

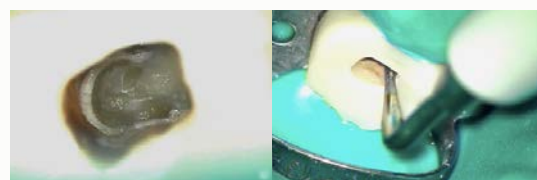
Three, the file may not be advancing because the canal may have a significant curvature that was not visualized. The solution is to make sure that a reproducible glidepath with smaller files is secured prior to advancing to the next instrument. A small pre-bend is placed, and in an envelope of motion, the file is advanced further to length with watchwinding and subsequently push-pull motions. Rushing this step leads to ledges and perforations that may take more work and time to overcome or bypass. A check film may be taken at any point the file is not advancing to evaluate the progress.

Four, the impediment encountered may be a ledge, or an apical delta, apical blockage with dentinal shavings, pulp stone, restorative material dropped in, etc. Small hand files may be taken down in attempt to bypass these impediments. The coronal aspect of the canal can be flared from 1 mm to a few mm short of the impediment, allowing more room and better tactile sensation for the small hand file to try to advance past the blockage. The small hand file may be negotiated to length, but the rotary instrument may not follow the path. A solution is to keep the hand file to length or beyond and bring in an oscillating handpiece that performs the watchwinding movements mechanically, and attach it to the hand file. The instrument can be gently activated and over some time slow vertical strokes can be made so as to smooth out the ledge or impediment. Another solution, as suggested by Dr. Buchanan, is to take a pre-bent .13/.06 Traverse file, which will nicely hold the apical bent tip due to being heat treated, finesse it past the impediment, attach the handpiece to

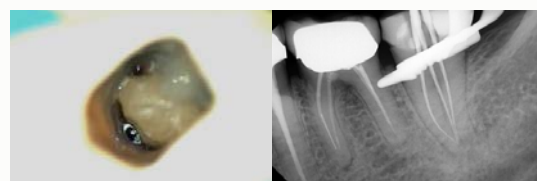


#18 C-shaped canal

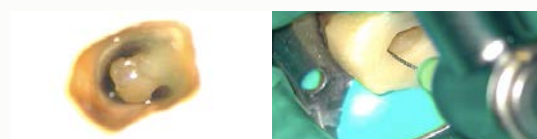
Access prep with a LA access bur



Modification of the access prep with a mini-ultrasonic tip



Crown-down preparation with Traverse Orifice Opener. Traverse 13/.06 files x 3 canals for working length determination



Cleaning of isthmus of the C-shape canal with #10 k-file with M4 handpiece. Calcium hydroxide placed

Figure 11. Tooth #18 C-shaped canal case highlights the importance of a conservative access preparation and securing the glidepath. (Courtesy of Dr. Ko.)

the latch of the Traverse file, and take the file to length and once beyond, nothing more to prevent transportation.¹¹

Conclusions

In summary, the access cavity preparation is the first critical step in endodontic treatment. It is important to understand the root canal anatomy so as to design an access that will allow adequate biomechanical instrumentation of the root canal system, yet maximize the preservation of tooth structure (Figure 11).

Preparing the glidepath takes time and discipline. Many teeth may have naturally wide and easy glidepaths that do

not require much work to instrument. However, in cases with calcified canals, or sharp curvatures, patience is the key. The glidepath can be easily lost or irreversible damages made, such as blockages, ledges, perforations, and transportations. If a file does not advance, it is advised to remove the file, place a gentle pre-bend, and dance it around in an envelope of motion to find that path. Use copious irrigation and lubricant. Work smaller files until they are loose before moving on to the next instrument. Always confirm with the apex locator or radiographic image. It takes patience and discipline to slow down, but this will improve the quality of the endodontic treatment delivered and ultimately be rewarding.

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CEQuiz

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1. Krasner and Rankow (2003) found that the pulp chamber floor was always ___ than the dentin walls.
 - a. lighter
 - b. darker
 - c. clearer
 - d. variable
2. The first step of access is to find the pulp chamber.
 - a. True
 - b. False
3. Peri-cervical or cervical dentin is defined as the ___ of dentin coronal to the crestal bone.
 - a. 2 mm
 - b. 3 mm
 - c. 4 mm
 - d. 5 mm
4. The traditional anterior access is on the lingual aspect, center of the tooth, ___ in shape.
 - a. square
 - b. circle
 - c. trapezoidal
 - d. triangular
5. Anterior access has now been moved more towards the ___ aspect.
 - a. buccal
 - b. lingual
 - c. incisal
 - d. apical
6. Current premolar access trends have not changed much from traditional access styles.
 - a. True
 - b. False
7. Premolar access starts in the central fossa and widened in the ___ direction.
 - a. buccolingual
 - b. mesiodistal
 - c. circumferential
 - d. Figure 8 configuration
8. Dental operating microscope provides ___ times the magnification.
 - a. 2.5x–6x
 - b. 4x–6x
 - c. 6x–10x
 - d. 4x–25x
9. Current maxillary and mandibular molar access trends tend to be more ___ and ___ in shape.
 - a. mesial/circular
 - b. mesial/triangular
 - c. center/circular
 - d. center/triangular
10. Minimally invasive access, such as through the excavated carious site, is termed:
 - a. caries centered access
 - b. caries directed access
 - c. caries focused access
 - d. caries enhanced access
11. The CBCT provides a multitude of information regarding the root canal system typically including all except:
 - a. orientation
 - b. angulation
 - c. morphology
 - d. fractures
12. Which bur must be kept from touching porcelain to prevent fracturing the material?
 - a. Fine diamond
 - b. Coarse diamond
 - c. Carbide
 - d. Finishing
13. In mandibular incisors, it is often the ___ canal that is left unexposed.
 - a. buccal
 - b. lingual
 - c. mesial
 - d. distal
14. The primary goal of an orifice-directed access is to ___.
 - a. preserve structural dentin
 - b. locate root canal anatomy
 - c. clean and shape
 - d. facilitate the endodontic procedure
15. There is an increased risk of instrument separation with conservative access preparations.
 - a. True
 - b. False



16. Krasner and Rankow (2003) found that the orifices of the root canals are located _____.
a. at the center of the tooth due to the rule of centrality
b. at the junction where the walls meet the floor
c. near the mesial aspect
d. near the distal aspect
17. Perforations of the anterior tooth often happens through the ____ aspect of the root.
a. buccal
b. lingual
c. mesial
d. distal
18. Fuss and Trope reported what significantly impacted the prognosis of perforations?
a. Size
b. Location
c. Time of repair
d. All of the above
19. The endodontic glidepath should be _____.
a. kept minimal
b. reproducible
c. as tight as possible
d. as loose as possible
20. The first instrument introduced in a root canal system should be the _____.
a. small hand file
b. small rotary instrument
c. orifice opener
d. glide path files
21. Which of these may be a reason the file does not advance?
a. Blockage
b. Ledge
c. Canal is too tight for the instrument
d. All of the above
22. The file tip of a No. 15 file is __ wider in diameter than a No. 10 file.
a. 20%
b. 30%
c. 40%
d. 50%
23. Rotary files have a __ cross-sectional shape. K-files have a __ cross-sectional shape.
a. triangular/square
b. triangular/circle
c. square/triangular
d. circle/triangular
24. Most rotary files should not be used for more than a few seconds in each canal and canals should be kept well lubricated.
a. True
b. False
25. Which is a solution if the file is not advancing?
a. Take a small file and place a pre-bend at the tip and try to negotiate past the impediment
b. Coronally flare short of impediment
c. Use lubricant
d. All of the above
26. What are benefits of Ni-Ti rotary instruments that are available on the market?
a. Noncutting tips
b. Flexible
c. Stiff
d. a and b
27. The significance of a secure glidepath is _____.
a. safety for rotary instrumentation
b. safety for irrigation
c. safety for access
d. safety for working length
28. Rotary files have __ more cross-sectional space than hand files.
a. 47%
b. 57%
c. 67%
d. 77%
29. The best rotary instruments have adequate apical taper and __ coronal taper.
a. maximal
b. minimal
c. variable
d. adequate
30. The endodontic glidepath is a _____.
a. reproducible smooth tunnel from orifice to the terminus
b. reproducible smooth tunnel from access to the orifice
c. reproducible smooth tunnel from orifice to patency
d. reproducible smooth tunnel from access to patency

