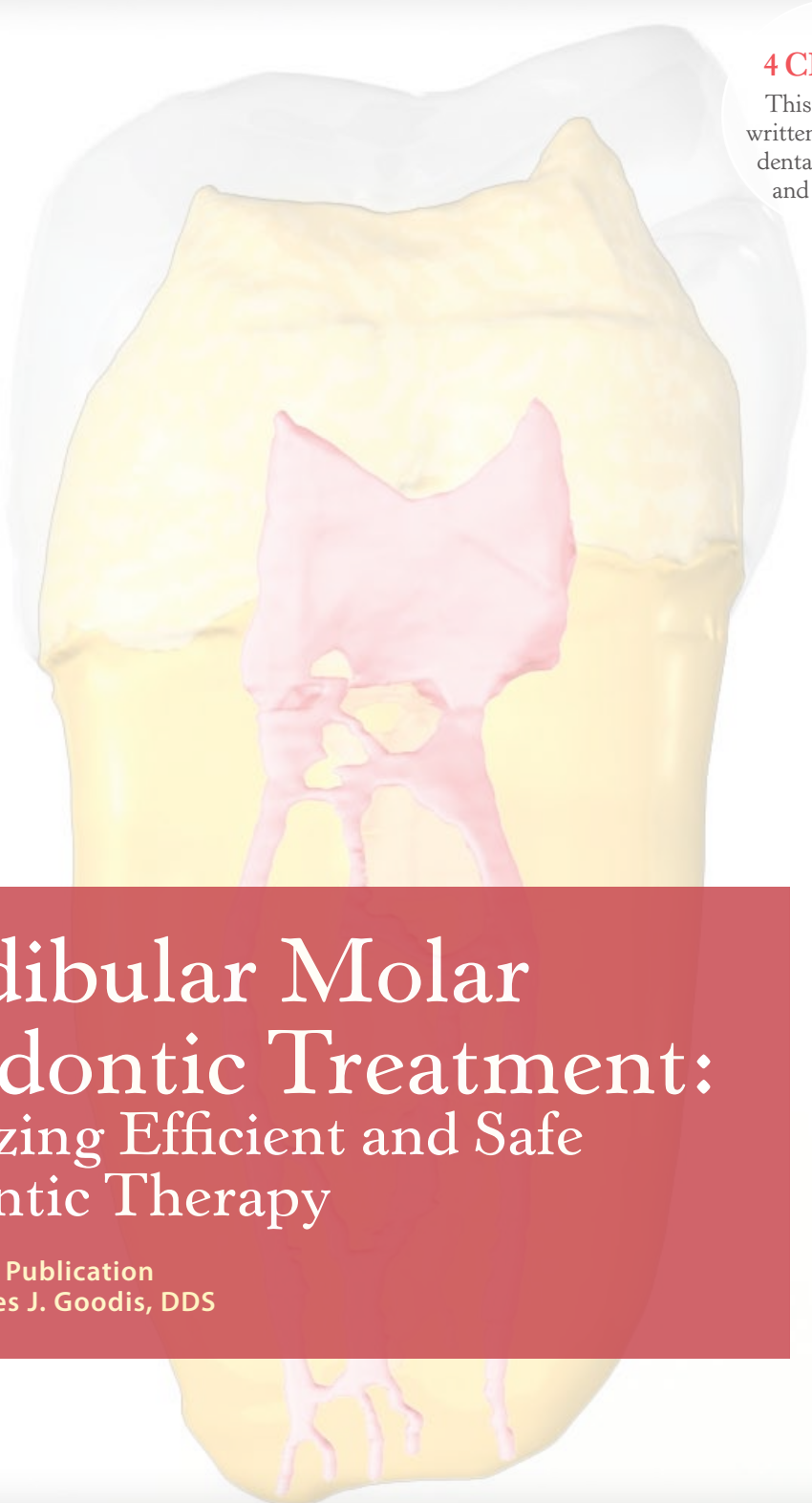


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Mandibular Molar Endodontic Treatment: Maximizing Efficient and Safe Endodontic Therapy

A Peer-Reviewed Publication
Written by Charles J. Goodis, DDS

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Educational Objectives

Upon completion of this course, the clinician will be able to do the following:

1. Understand the key factors in successful endodontic therapy.
2. Know the steps necessary to achieve straight-line access in mandibular molars.
3. Understand the steps in canal access and preparation.
4. Understand how to maximize efficiency and safety using the Integrated Shaping Technique prior to obturation.

Abstract

Endodontic therapy is performed frequently in the United States. Successful therapy relies upon several key factors, including straight-line access and the identification, shaping and debridement and obturation of all canals. Without achievement of all of these, endodontic therapy is compromised. Treatment is more efficient if each instrument helps prepare the canal for the next instrument in the treatment sequence. Use of an instrument system using a specific step-by-step sequence of instruments enables this.

Introduction

Endodontic therapy is a frequently-performed procedure in the United States. Success rates for initial endodontic therapy have been found to range from 74% where teeth presented with peri-apical infection to 98% where there was no evidence pre-treatment of peri-apical infection.^{1,2}

Appropriate access preparation is a key factor in the ability to perform successful endodontic therapy, and straight-line access is required.³ Subsequent key factors include the identification of all canals, followed by shaping and thorough debridement of the canals to remove all pulpal tissue, microbes, and debris. Obturation of all canals and provision of a sound apical and coronal seal is also key. Residual infection is influenced by the adequacy of these procedures (as well as the presence of adjacent peri-apical lesions and periodontal infections, and the types of microorganisms). With respect to this, it should be noted that residual infection has been found in more than half of examined cadaver root-filled teeth.⁴ These findings underscore the importance of thorough access and canal identification, canal preparation and debridement, and obturation. It has been found that the root cause of endodontic failure is almost universally bacterial infection.⁵

The success of endodontic therapy can be predicted by the adequacy of preparation and filling of all root canals.⁶ Anatomical issues include the (variable) number of canals present in individual teeth, their identification and the ability to instrument them.⁷ Multi-rooted and multi-canal teeth typically require a more intricate endodontic procedure than single-rooted and single-canal teeth do. This is reflected in differing healed rates that have been found by comparing single-rooted and multi-rooted teeth four to six years post-treatment.⁸

The introduction of nickel titanium (NiTi) rotary files has resulted in effective endodontic treatment that is more efficient, and offers predictable results with appropriate usage. It was also found, in an in vitro study, that the use of rotary nickel titanium (NiTi) files reduces microleakage from obturated root canals.⁹ Systems have been developed that combine the canal access, glide path, and shaping into a single integrated process prior to obturation. A single integrated process offers the advantages of root canal treatment that can be simpler, more efficient, and safer. This article will review the step-by-step endodontic procedure for a mandibular molar.

Access and Preparation

A thorough radiographic evaluation is required to assess the root configuration and number of root canals prior to starting endodontic treatment. Mandibular first molars are known to have morphological variations that include a second distal root (radix entomolaris) found in up to 4.2% of Caucasians and less than 5% of Asians and Euroasians.¹⁰ The number of canals found in mandibular first molars (as well as other teeth) is variable, with five canals present in mandibular first molars in 1–15% of the population.¹¹ Prior to preparation of the root canals, straight-line access should be obtained for identification of all canals and appropriate instrumentation.

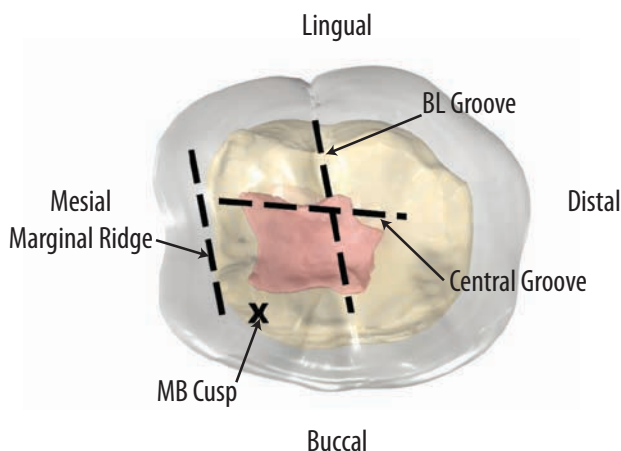
Straight-Line Access

Step 1. Identify Anatomical Landmarks

Access preparation is an essential element of successful endodontics.¹² To prepare the best access, it is important to identify four important landmarks on mandibular molars before starting access preparation. This also applies to any tooth with a crown or large restoration that appears to approximate the natural anatomy of the tooth.

In most cases, the pulp chamber is within and below the 1) mesial marginal ridge, 2) central groove, 3) buccal lingual (BL) groove, and 4) mesial buccal (MB) cusp (Figure 1).

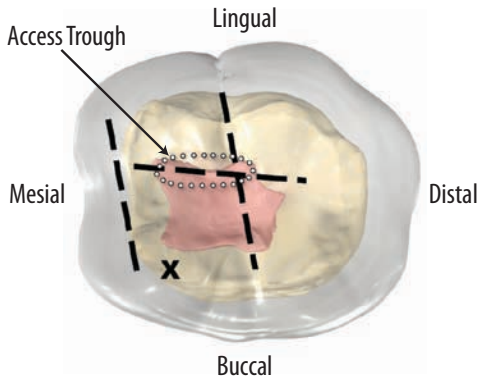
Figure 1. Mandibular Molar, Occlusal View



Step 2. Make an Initial Access Trough

Make an initial access trough into the pulp chamber along the central groove about 1 mm distal to the mesial marginal ridge and 1 mm distal to the buccal lingual groove. (Figure 2) Round-end #2 carbide fissure burs are appropriate for use in enamel and dentin, alloy material, and caries. For porcelain, a #2 round diamond bur can be used, and for cast metal a straight fissure bur.

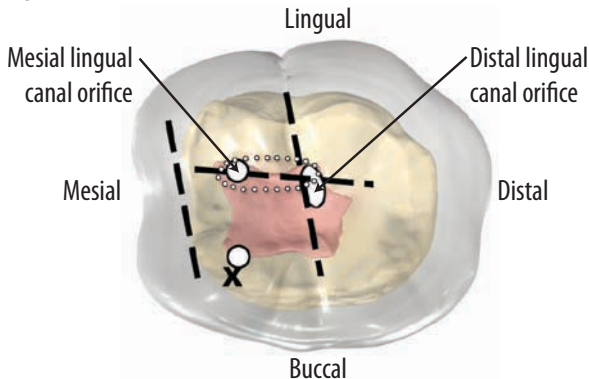
Figure 2.



Step 3. Locate the Mesiolingual and Distal Orifices

After making the access trough into the pulp chamber, use an endodontic explorer to locate the mesiolingual (ML) and distal canal orifices through the access trough. (Figure 3) This will enable proper orientation of the chamber without removing excessive tooth structure. If the canals cannot be located, the prep should be extended slightly until the orifices are found — this is vital for a tooth with a crown or large restoration. Care should be taken to preserve as much tooth substance as possible.

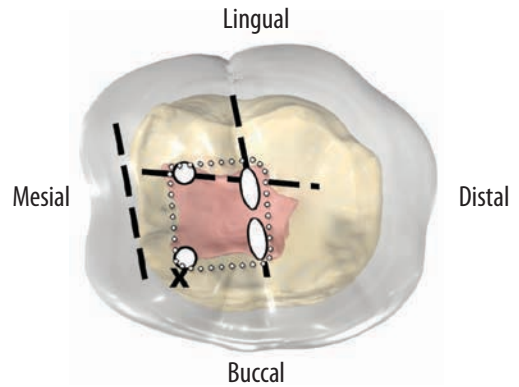
Figure 3.



Step 4. Extend Preparation

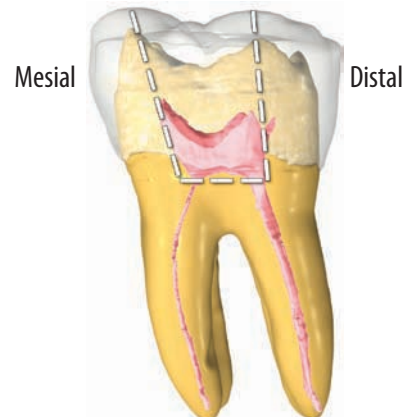
Use a tapered diamond bur to extend the prep into a rectangular shape. (Figure 4) A rectangular shape is better than the traditional triangular shape because it will allow the clinician to find two distal canals, which are present 30% of the time in mandibular first molars.¹³

Figure 4.



It is important to flare the mesial wall to the mesial aspect for straight-line access. Flaring canal orifices prior to canal instrumentation has been shown to facilitate the shaping of root canals during root canal preparation.¹⁴ The distal wall can be undercut slightly, which will still allow straight-line access to the distal canal but create a more conservative preparation for post-endodontic restorative needs. (Figure 5)

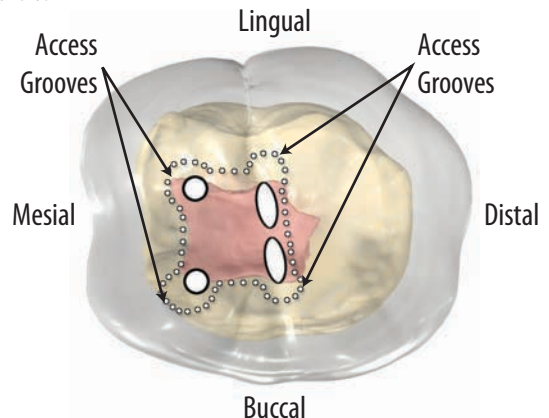
Figure 5. Mandibular Molar, Buccal View



Step 5. Prepare Canal Access Grooves

Use a tapered diamond bur with a non-cutting tip to prepare canal access grooves. (Figure 6) Place the non-cutting tip into the canal orifice and lean the bur toward the outer walls. This will improve the straight-line access of the canal.

Figure 6.



Step 6. Locate the Middle Mesial Canal

Try to locate the middle mesial canal, which is between the MB and ML canals. There is a 1 – 15% chance of a mandibular first molar having a middle mesial canal.¹⁵ (Figures 7, 8) Make a trough 1 mm deep between the MB and ML canals. It is important to remember to go in a slight mesial direction, not straight down or distal, as this would be going toward the furcation. (Figure 9)

Figure 7.

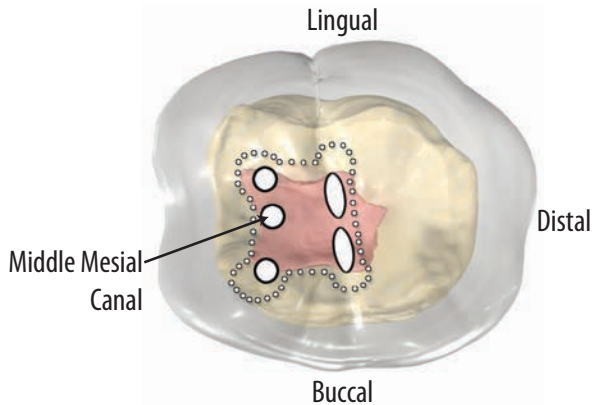


Figure 8. Mandibular Molar, Mesial View

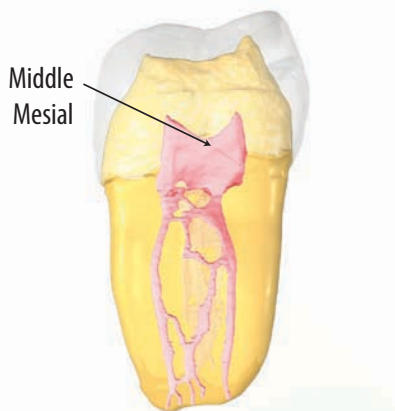
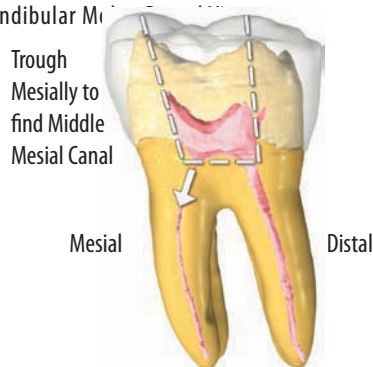


Figure 9. Mandibular Molar



Canal Access and Preparation

Canal access, glide path, and shaping can be combined by having each instrument create better access for the next instrument. This allows root canal treatment to be easy, efficient, and safe and to have a continuously tapered prepara-

tion from the apex to the orifice.¹⁶ It is important to note that shaping and cleaning the root canal is the most important part of endodontic treatment.¹⁷ Also, during the shaping of root canals, no more tooth substance should be removed than is necessary. The residual dentin following treatment is directly correlated to the incidence of root fracture in teeth that previously received endodontic treatment.¹⁸

Since the introduction of rotary NiTi files, endodontic treatment has become more efficient. Endodontic technique systems using rotary NiTi files include the K3 (SybronEndo), Endosequence (Brasseler), ProTaper (Tulsa Dental), and V-Taper (Guidance Endo). Each of these uses a set sequence of NiTi rotary files.

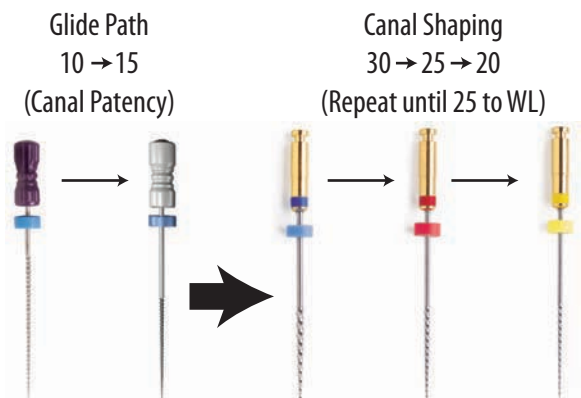
As an example, the recommended sequence for K3 rotary shaping files starts with a size 35 and progresses step-by-step, crown-down, to a size 15 file (35, 30, 25, 20, 15) using 06 tapered instruments. For long, curved, very fine canals, it is recommended that both 04 and 06 tapers be used at each size in this system, first the 06 and then the 04 tapered files. This article will look further at the preparation and obturation of a mandibular molar, using the Integrated Shaping™ technique and the V-Taper Achieve line of instruments.

Integrated Shaping™

The main focus of Integrated Shaping™ is to continually create better access down the canal until the working length is reached and the canals have been shaped in a safe and efficient manner.

This technique can be demonstrated using the V-Taper Achieve System™, which comprises three core rotary files: #30(V10), #25(V08), and #20(V06). (Figure 10) The “V” stands for variable taper, meaning that all instruments have a variable taper along the flutes, from the file tip up toward the shaft, for better access, efficiency, and safety. Also, using a variable taper instrument does not over-prepare the coronal portion of the canal as a constant taper instrument would. Over-instrumenting the coronal portion can result in root fractures.¹⁹ Therefore, avoid constant tapered instruments. In addition, depending on the anatomy, these variable taper files will shape most canals using only two to four rotary files.

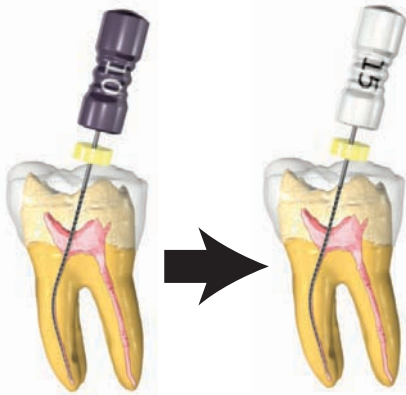
Figure 10. Medium and Small Canal Series



Step 1. Establishing a Glide Path

After straight-line access to the orifice is completed, it is important to establish a glide path (canal patency) by taking 10 → 15 hand files (Figure 11) to the estimated working length.²⁰

Figure 11.



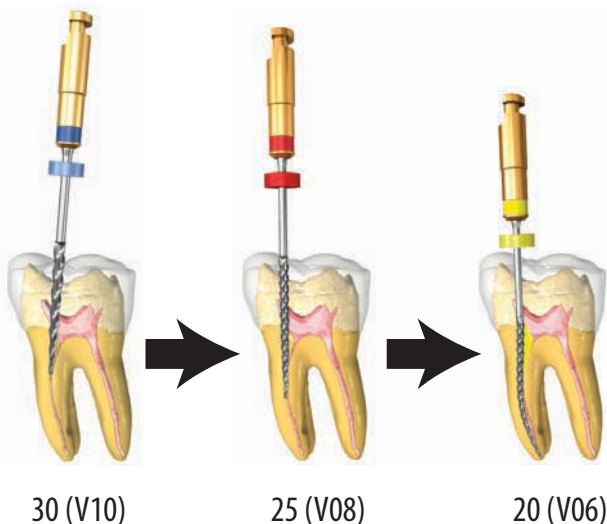
Note: Patency

If the #10 hand file will not go to the working length, use a #6 or #8 hand file to establish canal patency, then use the #10. It may be necessary to take the files 1–2 mm along to establish canal patency.²¹

Step 2. Canal Shaping

Use the 30 → 25 → 20 files (Figure 12) in a crown-down technique²² to shape the canal. Repeat the series until the 25 or 30 are to the working length. In many medium to large canals, only the 30 → 25 or just the 30 will be needed to go to length. Using light apical pressure, take each rotary file to resistance in a slow in-and-out motion three times, then move to the next file. During canal shaping and achievement of working length, it is important to irrigate intermittently to disinfect the canals and to remove debris and the dentin smear layer.

Figure 12.



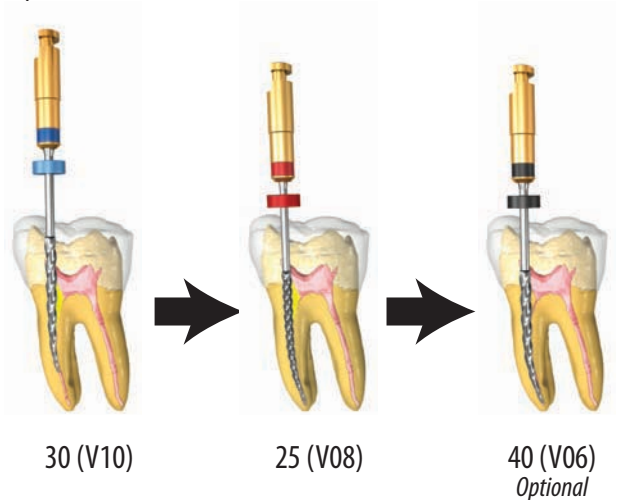
Step 3. Repeat the series as needed, getting the 25(V08) to the working length.

(Figure 13)

Optional: #35, #40, #45, #50 V-Taper™ Rotary Files

Depending on the clinician or the canal size, if the case requires a greater canal shape, after taking the 30 or 25 files to the working length, use one of the larger rotary files, size 35, 40, 45, or 50 (V06).

Figure 13.



Note: Remove Dentinal Triangle

It is important to shape the coronal portion of the canal first.²³ This allows the removal of the dentinal triangle. Therefore, with each rotary file, as you lift out of the canal, use an upward brushing motion on the outer walls to remove the dentinal triangle (in yellow).²⁴ (Figure 14) This upward brushing motion will also eliminate the need for orifice openers or Gates Glidden burs.

Figure 14.



Use of the above technique and files forms deep apical tapers and shapes without over-preparing the coronal area. It is important to remember that over-preparing the coronal area can result in subsequent root fracture. This shaping technique will allow better access for irrigation, cleaning, and 3-D obturation. In addition, this straightforward approach using only two to four V-Taper™ rotary files will increase efficiency and productivity. This will allow root canal treatment to be easy, efficient, and safe for clinicians and patients.

Hand Filing Tips

- Always use a lubricant²⁵
 - NaOCl and RC Prep
- Watch winding motion
 - Rotate file quickly CW and CCW
 - 20–30 degrees
 - Use hand file no more than 5 to 10 seconds, then move to the next file
 - Use light apical pressure
 - Keep a loose, relaxed hand, do not strain
 - The file will advance naturally

Rotary Filing Tips

- Always use a lubricant²⁶
 - NaOCl and RC Prep
- “1–2 second” rule
 - Place rotary file into the canal and cut dentin for only 1–2 seconds
 - Lift upward and brush against the outer wall
 - Repeat twice, then move to the next file
 - Use light, slow, controlled motion
- Merging canals
 - Shape the most patent canal to the working length
 - Shape the other merging canal to the merger point

Obturation

A well-shaped canal facilitates canal obturation.²⁷ Choose the color-coded V-Taper gutta percha that matches the largest file size taken to the working length, then use a vertical, lateral, or single-cone technique to obturate. If your filling technique uses 04 or 06 tapered cones or a thermal carrier, match the tip size of the largest file taken to length to the cone or device and obturate. I recommend the Obtura II™ system from Obtura/Spartan™ to back-fill the canal if you use a warm vertical obturation technique.

It should be ensured that all canals are obturated. (Figures 15, 16) The objectives of obturation are to fill the canals, achieving both an apical and a coronal seal. Inadequate root filling is associated with a lowered success rate, and the overall quality, length, and homogeneity of root fillings are important factors in achieving obturation.^{28,29}

Summary

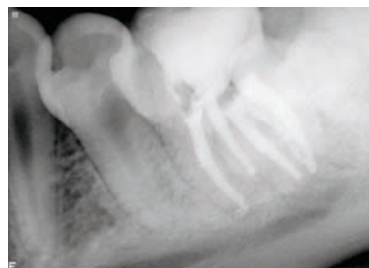
Endodontic therapy is a common procedure. Since the introduction of rotary NiTi files, improved treatment options have become available that have made endodontic treatment increasingly efficient. Straight-line access is essential prior to root canal instrumentation. Systems have been developed using set sequences of NiTi files to increase the efficiency of endodontic instrumentation and to simplify the procedure, including the V-Taper Achieve System using Integrated Shaping™. This provides a straight-forward approach using a minimal two to four rotary files, thereby increasing efficiency and productivity. By combining the canal access,

Figure 15. Obturation showing middle mesial canal (distal angulation)



Case courtesy of Charles J. Goodis, DDS

Figure 16. Obturation showing middle distal canal (severe distal angulation)



Case courtesy of Charles J. Goodis, DDS

glide-path, and shaping, each instrument will create better access for the following instrument. Systematic, sequenced instrumentation and appropriate obturation improve the ease, efficiency, and safety of root canal treatment for clinicians and patients alike.

Acknowledgement

Images provided with permission from the Brown & Herbranson, 3-D Tooth Atlas

Endnotes

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Author Profile

Charles J. Goodis, DDS



Dr. Goodis is a full-time practicing Endodontist in Albuquerque, New Mexico. He received his DDS from the University of Michigan, his GPR Certificate from the University of Minnesota and his Certificate of Endodontics from the University of Connecticut. His major at the University of Michigan was Mechanical Engineering.

It was this background, combined with his experience in Endodontics that led to the development of the Integrated Shaping Technique and the Guidance V-Taper Endodontic System. In addition, Dr Goodis has spoken at numerous state and national meetings.

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Questions

- _____ access is required for endodontic therapy.
 - Vertical
 - Angled
 - Straight-line
 - Any of the above
- In addition to appropriate access, another key factor for successful endodontic treatment is _____.
 - identification of all canals
 - shaping and thorough debridement of all canals
 - obturation of all canals with a sound apical and coronal seal
 - All of the above
- Success rates for endodontic treatment have been found to range from _____.
 - 35% to 45%
 - 52% to 68%
 - 72% to 85%
 - 74% to 98%
- The success of endodontic therapy can be predicted by _____.
 - the adequacy of preparation
 - the time taken for the procedure
 - the adequacy of filling of all root canals
 - a and c
- The residual dentin following endodontic treatment is directly correlated to _____.
 - esthetics
 - the incidence of peri-apical infection
 - the incidence of root fracture
 - None of the above
- The use of rotary NiTi files has been found to reduce microleakage from obturated root canals.
 - True
 - False
- Systems have been developed that combine _____ into a single integrated process.
 - canal access, glide path and shaping
 - canal access, glide path and obturation
 - canal widening and irrigation
 - None of the above
- In mandibular molars, in most cases the _____ is within and below the mesial marginal ridge, central groove, buccal lingual groove and mesial buccal cusp.
 - dentin
 - pulp chamber
 - mesial node
 - None of the above
- An initial access trough is made about _____ to the mesial marginal ridge.
 - 1 mm buccal
 - 1 mm distal
 - 3 mm distal
 - None of the above
- Round-end #2 carbide fissure burs are appropriate for use in _____.
 - enamel and dentin
 - alloy material
 - caries
 - All of the above
- For drilling in cast metal, a _____ can be used.
 - straight fissure bur
 - straight non-cutting end bur
 - #1 slow speed tungsten carbide
 - None of the above
- _____ is used to locate the canal orifices.
 - A periodontal probe
 - An endodontic explorer
 - An irrigation cannula
 - None of the above
- A tapered diamond bur is used to extend the prep into _____.
 - an oval shape
 - a rhomboid shape
 - a circular shape
 - a rectangular shape
- Two distal canals are present in mandibular first molars _____.
 - 10% of the time
 - 20% of the time
 - 30% of the time
 - 40% of the time
- Using the non-cutting tip of a tapered diamond bur in the canal orifice and leaning the bur toward the outer walls will _____.
 - remove too much dentin
 - reduce straight-line access
 - improve straight-line access
 - None of the above
- Shaping and cleaning the root canal is _____.
 - the most important part of endodontic treatment
 - not as important as obturating the canals
 - less important in single-rooted teeth
 - None of the above
- The main focus of Integrated Shaping™ is to _____.
 - speed up the process
 - continually create better access down the canal
 - integrate debridement and obturation
 - b and c
- The “V” in V-Taper refers to _____.
 - variable tip
 - vigorous taper
 - variable taper
 - variable topography
- Use of a constant taper instrument may over-prepare the coronal portion of the root canal.
 - True
 - False
- To _____, #10 to #15 hand files are taken to the estimated working length.
 - establish the working length
 - establish a glide path
 - preserve the crown
 - None of the above
- The V-Taper Achieve System will shape most canals using _____ rotary files.
 - one or two
 - two to four
 - three to five
 - six
- A crown-down procedure starts with larger files and progresses to smaller files in the canal to shape the canal and may repeat the series.
 - True
 - False
- During canal shaping, it is important to irrigate regularly to _____.
 - keep the tooth cooled
 - remove debris and disinfect the canals
 - a and b
 - None of the above.
- Larger rotary file sizes may be required for _____.
 - speed
 - safety
 - a greater canal shape
 - removal of the optimal amount of dentin in all teeth
- Shaping the coronal portion of the canal first _____.
 - enables removal of the pulp chamber contents
 - allows removal of the dentinal triangle
 - enables removal of residual cementum
 - All of the above
- Using an upward brushing motion on the outer walls of the canal while using rotary files will _____.
 - remove the dentinal triangle
 - eliminate the need for Gates Glidden burs
 - eliminate the need for irrigants
 - a and b
- The Integrated Shaping™ technique using V-Taper rotary files forms deep apical tapers and shapes _____.
 - without over-preparing the coronal area
 - without under-preparing the enamel
 - in 50% of canals
 - All of the above
- _____ should always be used with rotary files.
 - A surfactant
 - A lubricant
 - A chelator
 - All of the above
- Rotary files should be used to cut dentin for _____ at a time.
 - only one to two seconds
 - up to five seconds
 - up to fifteen seconds
 - a maximum of forty-five seconds
- Systematic, sequenced instrumentation and appropriate obturation _____.
 - improves the ease of root canal treatment
 - improves the efficiency of root canal treatment
 - improves the safety of root canal treatment
 - All of the above

Mandibular Molar Endodontic Treatment: Maximizing Efficient and Safe Endodontic Therapy

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Educational Objectives

1. Understand the key factors in successful endodontic therapy.
2. Know the steps necessary to achieve straight-line access in mandibular molars.
3. Understand the steps in canal access and preparation.
4. Understand how to maximize efficiency and safety using the Integrated Shaping Technique prior to obturation.

Course Evaluation

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

1. Were the individual course objectives met?	Objective #1: Yes	No	Objective #3: Yes	No		
	Objective #2: Yes	No	Objective #4: Yes	No		
2. To what extent were the course objectives accomplished overall?	5	4	3	2	1	0
3. Please rate your personal mastery of the course objectives.	5	4	3	2	1	0
4. How would you rate the objectives and educational methods?	5	4	3	2	1	0
5. How do you rate the author's grasp of the topic?	5	4	3	2	1	0
6. Please rate the instructor's effectiveness.	5	4	3	2	1	0
7. Was the overall administration of the course effective?	5	4	3	2	1	0
8. Do you feel that the references were adequate?		Yes		No		
9. Would you participate in a similar program on a different topic?		Yes		No		
10. If any of the continuing education questions were unclear or ambiguous, please list them.	_____					

11. Was there any subject matter you found confusing? Please describe.

12. What additional continuing dental education topics would you like to see?

Mail completed answer sheet to

Academy of Dental Therapeutics and Stomatology, A Division of PennWell Corp.

P.O. Box 116, Chesterland, OH 44026
or fax to: (440) 845-3447

For IMMEDIATE results, go to www.ineedce.com and click on the button "Take Tests Online." Answer sheets can be faxed with credit card payment to (440) 845-3447, (216) 398-7922, or (216) 255-6619.

Payment of \$59.00 is enclosed.
(Checks and credit cards are accepted.)

If paying by credit card, please complete the following: MC Visa AmEx Discover

Acct. Number: _____

Exp. Date: _____

Charges on your statement will show up as PennWell

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|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. | (A) | (B) | (C) | (D) | 16. | (A) | (B) | (C) | (D) |
| 2. | (A) | (B) | (C) | (D) | 17. | (A) | (B) | (C) | (D) |
| 3. | (A) | (B) | (C) | (D) | 18. | (A) | (B) | (C) | (D) |
| 4. | (A) | (B) | (C) | (D) | 19. | (A) | (B) | (C) | (D) |
| 5. | (A) | (B) | (C) | (D) | 20. | (A) | (B) | (C) | (D) |
| 6. | (A) | (B) | (C) | (D) | 21. | (A) | (B) | (C) | (D) |
| 7. | (A) | (B) | (C) | (D) | 22. | (A) | (B) | (C) | (D) |
| 8. | (A) | (B) | (C) | (D) | 23. | (A) | (B) | (C) | (D) |
| 9. | (A) | (B) | (C) | (D) | 24. | (A) | (B) | (C) | (D) |
| 10. | (A) | (B) | (C) | (D) | 25. | (A) | (B) | (C) | (D) |
| 11. | (A) | (B) | (C) | (D) | 26. | (A) | (B) | (C) | (D) |
| 12. | (A) | (B) | (C) | (D) | 27. | (A) | (B) | (C) | (D) |
| 13. | (A) | (B) | (C) | (D) | 28. | (A) | (B) | (C) | (D) |
| 14. | (A) | (B) | (C) | (D) | 29. | (A) | (B) | (C) | (D) |
| 15. | (A) | (B) | (C) | (D) | 30. | (A) | (B) | (C) | (D) |

AGD Code 074

PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.

AUTHOR DISCLAIMER

The author of this course has no commercial ties with the sponsors or the providers of the unrestricted educational grant for this course.

SPONSOR/PROVIDER

This course was made possible through an unrestricted educational grant. No manufacturer or third party has had any input into the development of course content. All content has been derived from references listed, and/or the opinions of clinicians. Please direct all questions pertaining to PennWell or the administration of this course to Machele Galloway, 1421 S. Sheridan Rd., Tulsa, OK 74112 or macheleg@pennwell.com.

COURSE EVALUATION and PARTICIPANT FEEDBACK

We encourage participant feedback pertaining to all courses. Please be sure to complete the survey included with the course. Please e-mail all questions to: macheleg@pennwell.com.

INSTRUCTIONS

All questions should have only one answer. Grading of this examination is done manually. Participants will receive confirmation of passing by receipt of a verification form. Verification forms will be mailed within two weeks after taking an examination.

EDUCATIONAL DISCLAIMER

The opinions of efficacy or perceived value of any products or companies mentioned in this course and expressed herein are those of the author(s) of the course and do not necessarily reflect those of PennWell.

Completing a single continuing education course does not provide enough information to give the participant the feeling that s/he is an expert in the field related to the course topic. It is a combination of many educational courses and clinical experience that allows the participant to develop skills and expertise.

COURSE CREDITS/COST

All participants scoring at least 70% (answering 21 or more questions correctly) on the examination will receive a verification form verifying 4 CE credits. The formal continuing education program of this sponsor is accepted by the AGD for Fellowship/Mastership credit. Please contact PennWell for current term of acceptance. Participants are urged to contact their state dental boards for continuing education requirements. PennWell is a California Provider. The California Provider number is 3274. The cost for courses ranges from \$49.00 to \$110.00.

Many PennWell self-study courses have been approved by the Dental Assisting National Board, Inc. (DANB) and can be used by dental assistants who are DANB certified to meet DANB's annual continuing education requirements. To find out if this course or any other PennWell course has been approved by DANB, please contact DANB's Recertification Department at 1-800-FOR-DANB, ext. 445.

RECORD KEEPING

PennWell maintains records of your successful completion of any exam. Please contact our offices for a copy of your continuing education credits report. This report, which will list all credits earned to date, will be generated and mailed to you within five business days of receipt.

CANCELLATION/REFUND POLICY

Any participant who is not 100% satisfied with this course can request a full refund by contacting PennWell in writing.

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