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CLINICAL CASES SERIES

Clinical Cases in
Endodontics

Takashi Komabayashi
University of New England

WILEY Blackwell

This edition first published 2018

Registered Office
John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA

Editorial Office
111 River Street, Hoboken, NJ 07030, USA

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Library of Congress Cataloging-in-Publication Data

Names: Komabayashi, Takashi, 1973- editor.
Title: Clinical cases in endodontics / edited by Takashi Komabayashi.
Description: Hoboken, NJ : Wiley, 2017. | Series: Clinical cases series | Includes bibliographical references and index. |
Identifiers: LCCN 2017020926 (print) | LCCN 2017021343 (ebook) | ISBN 9781119147114 (pdf) | ISBN 9781119147060 (epub) | ISBN 9781119147046 (pbk.)
Subjects: | MESH: Root Canal Therapy–methods | Endodontics–methods | Case Reports
Classification: LCC RK351 (ebook) | LCC RK351 (print) | NLM WU 230 | DDC 617.6/342–dc23
LC record available at https://lccn.loc.gov/2017020926

Cover Design: Wiley
Cover Images: (Column 1) Courtesy of Howard Foo;(Column 2) Courtesy of Qiang Zhu and Keivan Zoufan;(Column 3) Courtesy of Nathaniel Nicholson

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ACKNOWLEDGEMENTS

The editor and contributors would like to acknowledge the great help they have received from colleagues and students.

Special support came from:

Elizabeth J. Dyer, MLIS, AHIP (Associate Dean of Library Services, Research & Teaching Librarian, University of New England); **Miki Furusho** PhD (Image analysis consultant, University of Connecticut); **Kathy Hooke**, MAT, JD (English language consultant); **Christine Lin** (Assistant); **Oran Suta** (Medical/Dental illustration, University of New England College of Osteopathic Medicine).

The following students at the University of New England College of Dental Medicine reviewed and provided invaluable feedback on this textbook:

Brittney Bell, Aparna Bhat, Dorothy Cataldo, Hannah Chung, Lindsey Cunningham, Sarah Georgeson, Andy Greenslade, Keith Hau, Anna Ivanova, Alex Katanov, Jonathan Nutt, Tara Prasad, Rishi Phakey, Christine Roenitz, Tarandeep Sidiura, Arina Sorokina, Shadbeh Taghizadeh, Eleanor Threet, Jackson Threet, Anh Tran, Robert Walsh, Minjin Yoo, Kenneth Yuth.

Professional clinical input and critical reviews were generously provided by the following valued colleagues (endodontists, endo residents and periodontists):

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1

Introduction

Takashi Komabayashi

LEARNING OBJECTIVES

- To understand the purpose, special features, and benefits of this book.
- To understand the scope and approach of each chapter.
- To understand the terminology and common frames of reference used.

Copiously illustrated in full color, *Clinical Cases in Endodontics* brings together actual endodontic clinical cases chosen by national and international master clinicians and leading academics, building from the simple to the complex and from the common to the rare. Part of the Wiley-Blackwell Clinical Cases series, and with cases ranging from nonsurgical root canal treatment to complicated therapy, this book presents practical, everyday applications accompanied by rigorously supported academic commentary in a unique approach that questions and educates readers about essential topics in clinical endodontics. The format of *Clinical Cases in Endodontics* fosters case-based, problem-based and evidence-based independent learning and prepares readers for case-based examinations. It is, therefore, useful as a textbook from which predoctoral dental students and postgraduate residents may learn about the challenging and absorbing nature of endodontic treatment. However, the book's range and depth of detail will also make it an excellent reference tool for practitioners whenever perplexing cases arise in the dental office.

Each chapter provides a brief recap of key theoretical concepts, situates cases within the framework of standard protocols, and considers the advantages and disadvantages of the clinical regimen. This approach enables student readers to build their skills, aiding their ability to think critically and independently. However, by simulating a step-by-step visual presentation, this book also facilitates development and refinement of technique regardless of one's years of experience in endodontic treatment. *Clinical Cases in Endodontics* will make all readers more confident in their understanding of endodontic treatment.

Composition of each Chapter (Chapters 2 to 25)

Clinical Cases in Endodontics adheres to the same four-part structure for each chapter.

1. Learning Objectives

Each chapter opens with a statement of learning objectives for that chapter, a format familiar from course syllabi at many dental schools or dental continuing education courses.

2. Clinical Case (With Radiographs and Pictures)

The focus of each chapter is a single case, presented in the case-based format of the American Board of Endodontics (ABE) Case History Exam. Since this book is intended for dental students and general dentists, as well as endodontic residents and endodontic specialists, the level of case difficulty may not be the same as that reflected in the ABE Case History Exam. All cases are real cases, however, chosen by master

Clinical Cases in Endodontics, First Edition. Edited by Takashi Komabayashi.

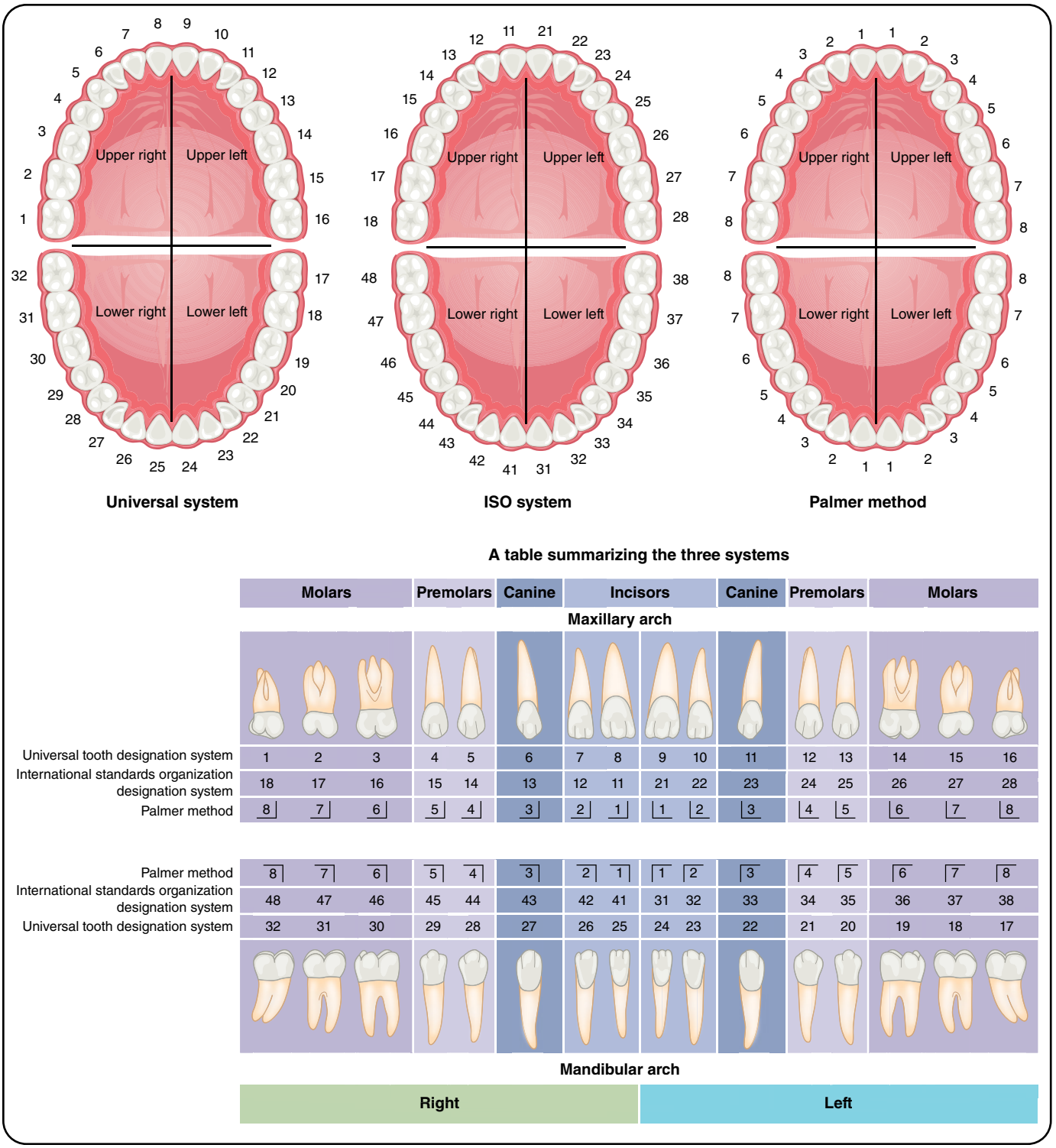


Figure 1.1 Tooth designation: three system summary.

with best-evidence outcomes or other professional standards;

- encourages active learning methods, such as case analysis and discussion, critical appraisal of scientific evidence in combination with clinical application and patient factors; and structured sessions in which students/ residents/ dentists reason aloud about patient care.

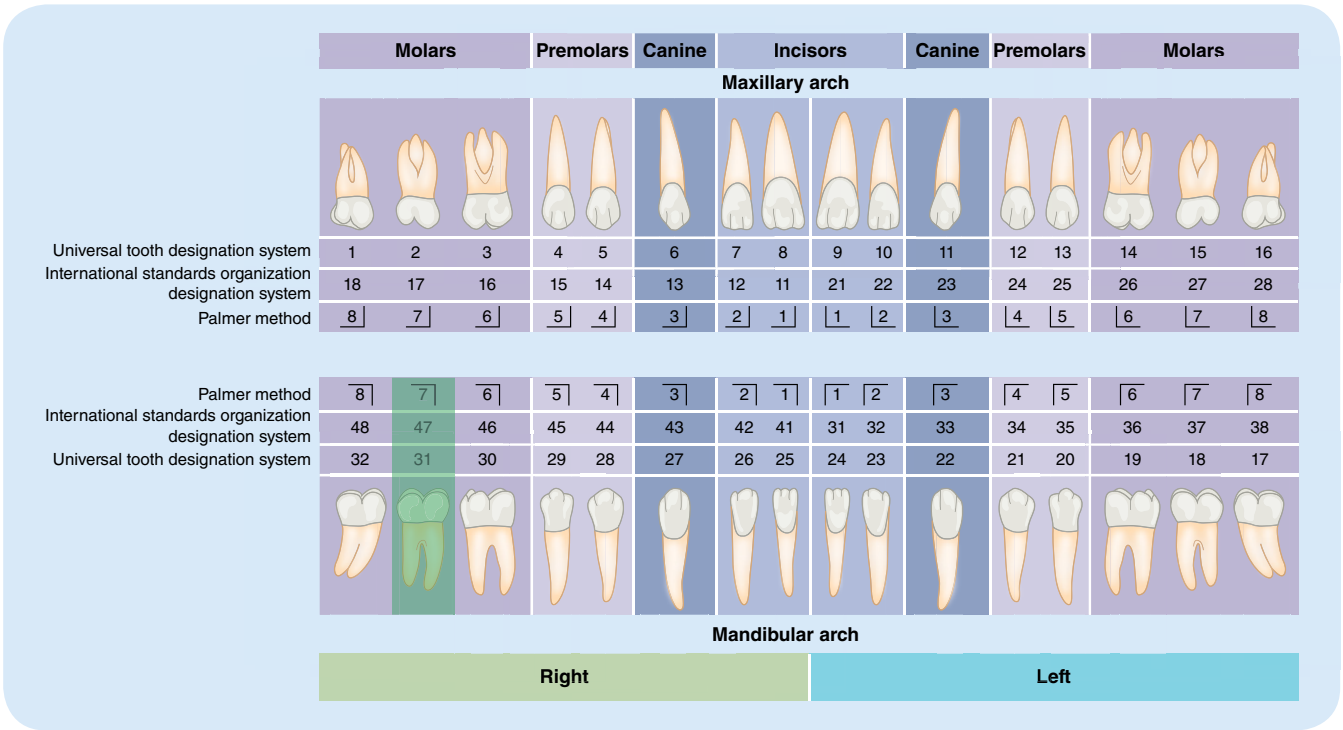
2

Diagnostic Case I: Tooth Fracture: Unrestorable

Suanhow Howard Foo

LEARNING OBJECTIVES

- To apply knowledge of dental anatomy to clinical procedures involving a cracked tooth.
- To be able to interpret radiographs used in endodontic diagnosis.
- To formulate a correct endodontic diagnosis and treatment plan based on a variety of clinical testing procedures, taking into account factors such as loss of tooth structure, bruxism, age, and gender.
- To understand the prognosis and incidence rates of the various types of root fractures.



Clinical Cases in Endodontics, First Edition. Edited by Takashi Komabayashi.

Prognosis

Favorable	Questionable	Unfavorable
		X

Clinical Procedures: Treatment Record

First visit (Day 1): Exam: Pt was referred for an evaluation of tooth #31. Medical history (Hx) and vital signs were taken. Three periapical (PA) radiographs were prescribed in order to evaluate the PA area for possible infection and to determine the extent of the crack. The radiographs showed PA rarefactions (Figures 2.1 and 2.2) at root tips and bone loss in D root area. Clinical tests and exams were performed. Tooth #31 had an M to D crack that was verified with methylene blue (Figure 2.3) and a fiber optic light (Figures 2.4 and 2.5). The tooth could be separated in a buccal–lingual (B–L) manner with light touch. The defect could be seen extending to the pulpal floor. Pt was informed that the prognosis of the tooth was unfavorable and that extraction was needed to alleviate his pain and for healing to occur. The Pt accepted treatment (Tx) of extraction of Tooth #31. The extracted tooth was photographed and confirmed the initial diagnosis of a root fracture and split tooth (Figure 2.6).

Post-Treatment Evaluation

Second visit (1-week follow-up): Pt returned for a post-operative (PO) follow-up. The area around the extraction site of tooth #31 was neither inflamed nor swollen. Gingival tissue had already begun to fill in the socket. The Pt was able to eat and brush his teeth in the lower right quadrant.

Figure 2.3 Mesial to distal crack of tooth #31, stained with methylene blue to better visualize the extent of the crack.

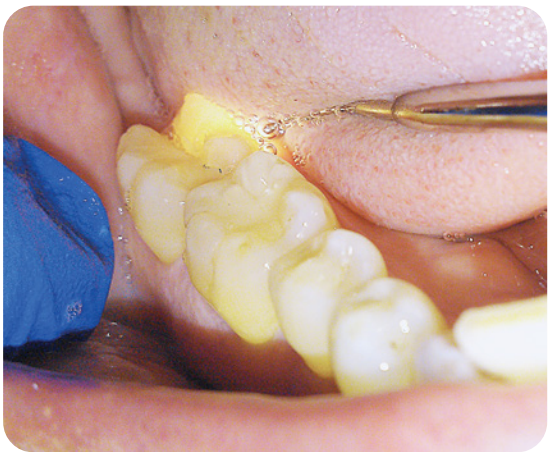


Figure 2.4 Fiber optic light illumination of tooth #31 shows that the crack goes below the CEJ. The light does not pass through from lingual to buccal.

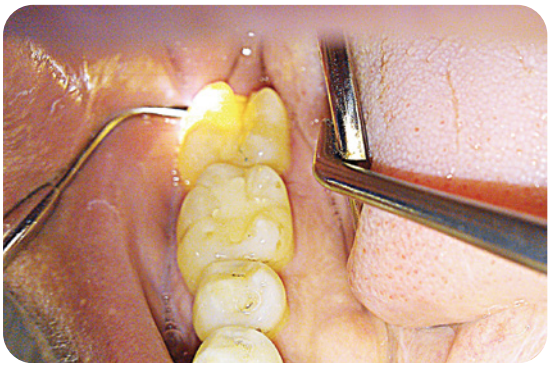


Figure 2.5 Fiber optic light was used on the buccal surface to confirm the crack.

Figure 2.6 Diagnosis of a split tooth is confirmed after the extraction of tooth #31.

Diagnosis (Post-Treatment)

The cystic lesion was most likely a lateral periodontal cyst considering the cyst was located in the lateral periodontium of tooth #8, and the tooth was vital with normal apex.

Post-Treatment Evaluations

Third visit (1-year follow-up): Pt failed the six-month recall appointment. RMHX. Tooth #8 was asymptomatic and restored with composite core (Filtek™ Supreme Ultra A2B, 3M ESPE, Two Harbors, MN, USA) by her general dentist. The tooth was non-tender to percussion and palpation. A follow-up radiograph was made and it revealed healing of the bony defect (Figure 3.12). The general dentist had performed a RCT on tooth #9 and restored with composite core build-up. Gingiva was normal. Probing depth was <3 mm and mobility was normal. A full-coverage restoration was recommended on teeth #7, #8 and #9. A follow-up appointment was scheduled.

Fourth visit (3-year follow-up): RMHX. Tooth #8 was asymptomatic and non-tender to percussion and palpation. Mobility was normal. Gingiva shape and texture looked normal (Figure 3.13). Probing depth was <3 mm and no bleeding upon probing was noted (Figure 3.14). Apex appeared normal in the periapical (PA) radiograph (Figure 3.15). The Pt was urged to pursue full coverage restoration as soon as possible. Prognosis was favorable.

Figure 3.12 One-year follow-up radiograph reveals healing of the lateral lesion on the distal side of tooth #8.

Figure 3.13 Three-year follow-up clinical photograph. Gingiva looks normal.

Figure 3.14 Three-year follow-up clinical photograph. No bleeding upon probing.

Figure 3.15 Three-year follow-up radiograph shows normal apex of teeth #7 and #8 and healing of the lateral lesion on the distal side of tooth #8.

Chief Complaint

"My tooth started hurting really bad yesterday. Today I woke up swollen. I can't even touch the tooth with my tongue; the pain is excruciating."

Medical History

The patient (Pt) was a 42-year-old male who had hypertension and was at the time on Hydrochlorothiazide/Valsartan 160 mg/12 mg per os per day. No known drug allergies (NKDA) were reported. Previous physical examination had been within the preceding six months.

The Pt was American Society of Anesthesiologists Physical Status Scale (ASA) Class II.

Dental History

The Pt reported that tooth #19 had received a porcelain-fused-to-metal (PFM) crown approximately two years previously. Pt started experiencing pain the previous day, and the pain rapidly intensified overnight. Pt noted extra-oral swelling on his lower left (LL) quadrant on the morning of his visit to this office (Figure 5.1). The pain was severe, constant and throbbing in nature; spontaneous and aggravated by mastication and pressure; and was intensified with supination. The pain localized to tooth #19 (The Pt pointed to offending tooth). The Pt had also been experiencing referred pain to his left ear. The Pt had not been able to get relief after four tablets of Ibuprofen 200 mg.

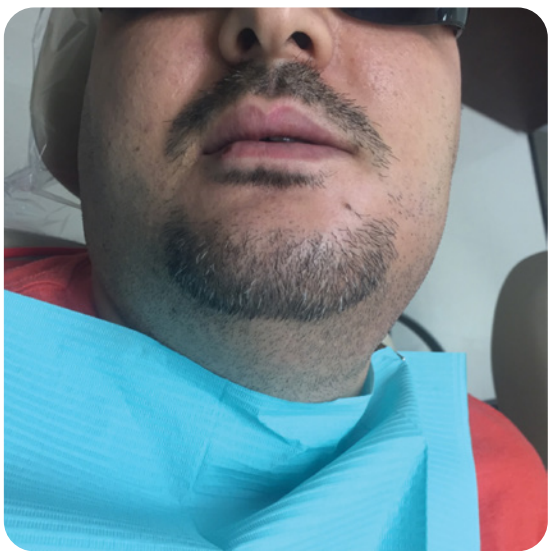


Figure 5.1 Pt presents with extra-oral swelling on LL quadrant and facial asymmetry.

Figure 5.2 Extra-oral swelling on LL with asymmetry.

Clinical Evaluation

Examinations

Extra-oral Examination (EOE)

There was facial swelling in the LL quadrant (Figure 5.2); The temporomandibular joint (TMJ) showed no popping, clicking or deviation on opening; lymph nodes were not swollen.

Intra-oral Examination (IOE)

Soft tissue was erythematous (Figure 5.3); with swelling. There was no sinus tract and oral hygiene was fair. The Pt had a PFM crown on tooth #19.

Figure 5.3 Intra-oral swelling on buccal area of tooth #19. Gingival tissues are erythematous.

Treatment Plan

Recommended

Emergency: Pulp debridement with calcium hydroxide ($Ca(OH)_2$)

Definitive: Non-surgical root canal treatment (NSRCT)

Alternative

No treatment, extraction

Restorative

Composite core build-up

Prognosis

Favorable	Questionable	Unfavorable
X		

Clinical Procedures: Treatment Record

First visit (Day 1): BP was 94/60 mmHg LAS, pulse was 92 BPM. After clinical and radiographic examination, diagnosis, and treatment (Tx) planning, the risks and benefits of Tx were discussed with the Pt and his parents. Informed consent for endodontic Tx was obtained from Pt's parents. Anesthesia was achieved by topical 20% benzocaine followed by administration of mental nerve block, B and lingual (L) infiltration with 36 mg lidocaine (lido) with 0.018 mg epinephrine (epi). Rubber dam isolation (RDI) was achieved with Ivory® 9 clamp (Heraeus Kulzer, Wehrheim, Germany) placed apically to the orthodontic bracket and wire on tooth #25. The coronal surface was wiped with a cotton pellet soaked in 3% sodium hypochlorite (NaOCl). The access cavity was prepared with #2 surgical length round bur and fissure bur on a high speed handpiece. The outline of the endodontic access was shaped as an oval with the incisal edge slightly flared to aid in visualization of the canal orifice (Figure 8.3). The area of the cingulum was extended towards the L to aid in the detection of a possible L canal. After the B canal was identified, the L canal was detected by angling the tip of the size #10 K-file by 30° and running the tip of the file along the L surface of the B canal. Working lengths (WL) were determined with radiographs and the use of an electronic apex locator Root ZX® II (J. Morita, Kyoto, Japan)using a size #10 K-file (Figure 8.4). The two canals were found to be confluent in the apical third (Vertucci type II configuration). The canals were instrumented manually with K-type and Hedstrom files in the apical third to a size #20 Hedstrom file and with Gates Glidden burs #2, #3, and #4 in the coronal two-thirds of each canal. Irrigating solution was 1% NaOCl. The canals were dried with sterile paper points. $Ca(OH)_2$ paste was placed in the canal with a Lentulo® Spiral Filler (Dentsply Sirona, Ballaigues, Switzerland) and condensed with paper points and cotton pellet. The access cavity was

Figure 8.3 Access opening tooth #25 after obturation completed. The preparation has been extended half-way through the incisal edge to improve access to the large canal space in a young patient. The mesio-distal preparation is conservative to reflect the external and internal anatomy. (Photograph courtesy of Dr. Domenico Ricucci).

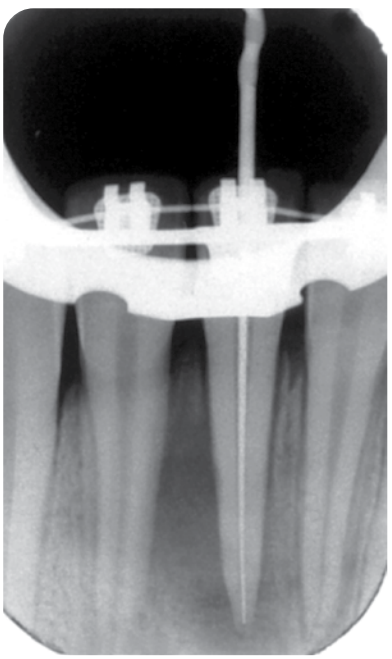


Figure 8.4 Working-length determination. (Radiograph courtesy of Dr. Domenico Ricucci).

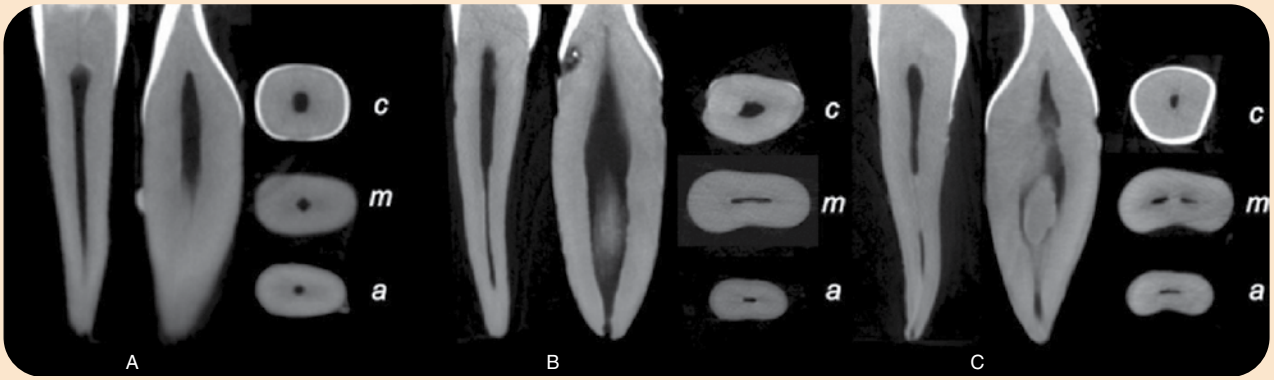


Figure 8.10 Micro-CT images of three different teeth to show the varying anatomic patterns: A: Vertucci type I with round canal, B: Vertucci type I with oval canal, C: Vertucci type III. Cross section images labeled as: c = cervical, m = middle, a = apical. (Image adapted from Paes da Silva Ramos Fernandes *et al.* (2014)).

the lingual surface of the tooth. Proper access preparation for mandibular incisors is depicted in Figure 8.11. Of note is the triangular outline on the central and lateral incisors to include the pulp horns. This important step will prevent future coronal discoloration due to pulp tissue left behind. The access shape may revert to oval in patients over the age of 40 as a result of the deposition of secondary dentin in the pulp chamber facilitating the conservation of coronal dentin (Nielsen & Shamohammadi 2005). It is important to extend the preparation both incisally and lingually toward the cingulum in all incisor teeth. It is the incisal extension that affords a straight-line instrument access to the apical foramen and the lingual extension along the cingulum that provides the operator visualization of the lingual canal orifice (Figure 8.12). Given the relatively high percentages of two canals in these teeth, radiographic imaging with varied horizontal angulation is recommended to determine the presence or absence of a second canal (Mahajan *et al.* 2016). Of course, if CBCT imaging was available, it would be the most definitive means of determining the root canal anatomy. Once the access preparation is properly oriented and extended, the case becomes more predictably treatable.

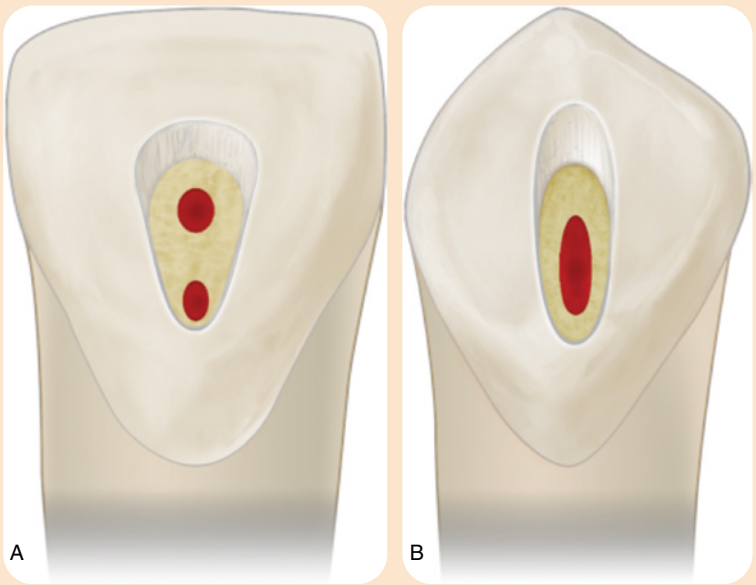


Figure 8.11 Access outline for A: the mandibular central and lateral incisors and B: the mandibular canine. (Illustration by Mr. Oran Suta.)

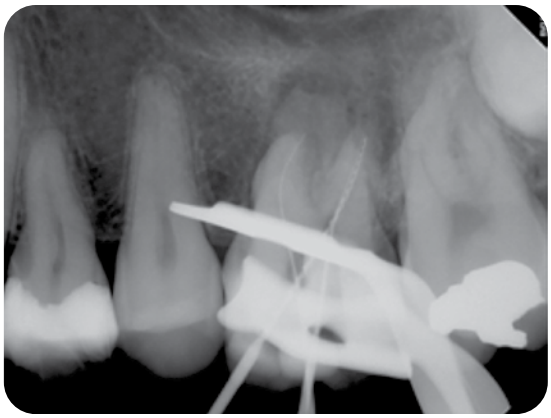


Figure 13.2 MB1 and DB length-estimation radiograph (Day 1).

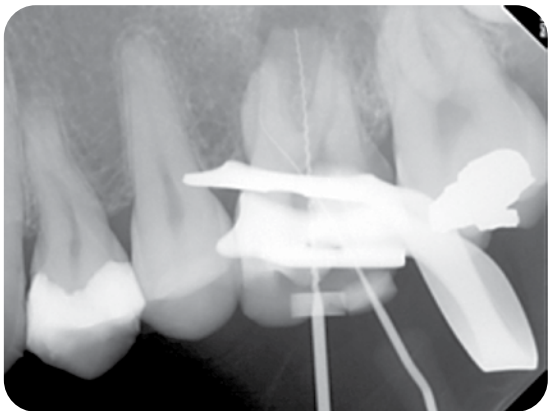


Figure 13.3 MB2 and P length-estimation radiograph (Day 1).

locator (Root ZX® II, J. Morita, Kyoto, Japan) (Figures 13.2 and 13.3). All canals were instrumented using .04 taper Vortex® Nickel Titanium (NiTi) rotary files (Dentsply Sirona, Johnson City, TN, USA). 2.5% NaOCl, 17% ethylenediaminetetraacetic acid (EDTA), and RC-Prep® were utilized throughout the procedure. Mesio-Buccal (MB) 1 and MB 2 canals were enlarged to a size #30, .04 taper, the Disto-Buccal (DB) canal was enlarged to a size #35, 0.04 taper, and the Palatal canal was enlarged to a size #60, .04 taper. The irrigants were then introduced to the canals after cleaning and shaping, followed by activation via ultrasonic activation files. All canals were dried with sterile paper points and medicated with calcium hydroxide ($Ca(OH)_2$) powder freshly mixed with sterile saline. The $Ca(OH)_2$ paste was packed and distributed throughout the canals. The access was closed with a sterile dry cotton pellet and Cavit™ (3M, Two Harbors, MN, USA). Occlusion was verified. Oral and written postoperative instructions were given.

Second visit (Day 2): Pt was contacted for postoperative follow-up; the Pt reported that the dull pain had subsided and that she was feeling well.

Third visit (Day 14): RMHX; no changes were noted. Local infiltration with 72 mg of 2% Xylocaine with 1:100,000 epi was administered. A RD was placed and access was made through the Cavit™. The pulp chamber was irrigated with 2.5% NaOCl and 17% EDTA. Ultrasonic files were utilized to remove the $Ca(OH)_2$ and the final rotary instruments were reintroduced in the canals to the previous diameters and working distances. All canals were dried with sterile paper points and obturated with gutta-percha (GP) and AH Plus® Root Canal Sealer (Dentsply Sirona, Konstanz, Germany) utilizing the warm vertical condensation technique. A radiograph was taken (Figure 13.4).

Working length, apical size, and obturation technique

Canal	Working Length	Apical Size, Taper	Obturation Material and Techniques
MB1	19.5 mm	30, .04	GP, AH Plus® sealer Warm vertical condensation
MB2	19.0 mm	30, .04	GP, AH Plus® sealer Warm vertical condensation
DB	19.5 mm	35, .04	GP, AH Plus® sealer Warm vertical condensation
P	20.0 mm	60, .04	GP, AH Plus® sealer Warm vertical condensation

Figure 13.4 Postoperative radiograph, second visit (Day 14).

Postoperative Evaluation

Fourth visit (15-month follow-up): Pt reported she had been asymptomatic. Soft tissues appeared to be normal and tooth had no apical tenderness or percussion sensitivity. PA radiograph demonstrated a healed tooth #14 with intact lamina dura (Figure 13.5).

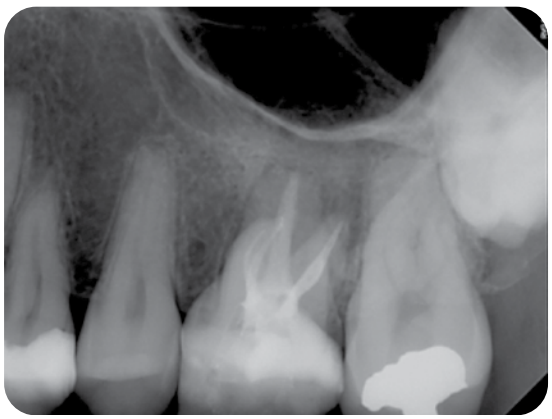


Figure 13.5 One-year follow-up radiograph showing healed lesion.

Figure 13.6 illustrates the location of MB2 intra-orally for the case.

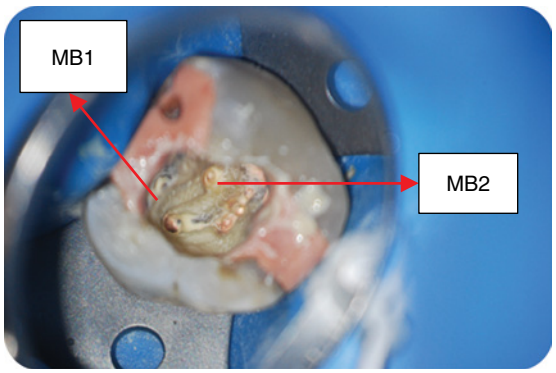


Figure 13.6 Intra-oral picture showing location of MB2 (Day 14).

Figures 13.7 to 13.11 illustrate the prevalence of MB2 in maxillary molars.

Figure 13.7 Maxillary 1st molar tooth #3 showing presence of MB2.

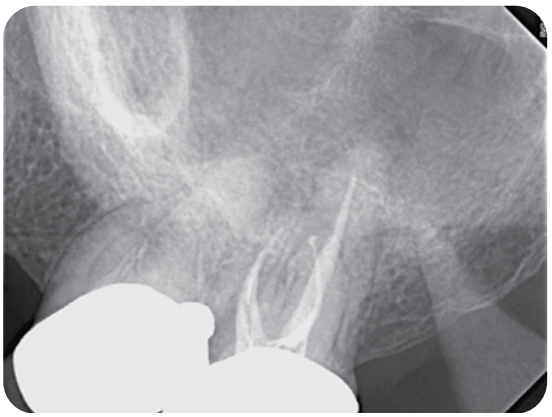


Figure 13.8 Maxillary 2nd molar tooth #15 showing presence of MB2.

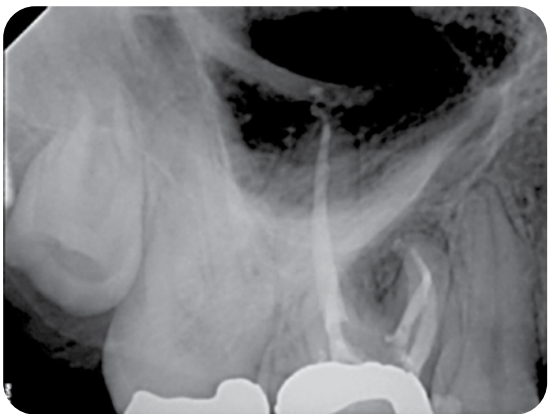


Figure 13.9 Maxillary 1st molar tooth #3 showing presence of MB2.

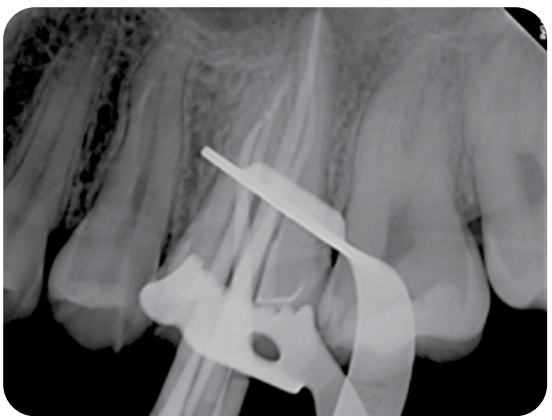


Figure 13.10 Maxillary 1st molar tooth #14 showing presence of MB2.

Chief Complaint

"I have a long-term dull pain around the right upper molar and premolar area."

Medical History

The patient (Pt) was a 34-year-old male. He had no relevant medical history and was not taking any medications at the time of visit. His vital signs were as follows: blood pressure (BP) 132/87 mmHg; pulse 78 beats per minute (BPM) and regular. A complete review of systems did not reveal any significant findings and there were no contraindications to treatment.

The Pt was American Society of Anesthesiologists Physical Status Scale (ASA) Class I.

Dental History

Three years before presentation, the Pt experienced dull pain around his right upper posteriors. After visiting a dental office, root canal treatment (RCT) was performed on teeth #3 and #4, and tooth #5 was extracted. Following treatment (Tx), his discomfort reduced but slight pain remained. A referral dentist observed changes in his discomfort for two years under temporary (temp) restorations. However, during the follow-up, two months before presentation, he experienced dull pain around the same area. Although the dentist initiated RCT for tooth #3, the pain was not resolved and he was referred to the University hospital.

Clinical Evaluation (Diagnostic Procedures)

Examinations

Extra-oral Examination (EOE)

The EOE did not reveal any significant findings, lymphadenopathy, or extra-oral swelling. There was no discomfort on opening or closing of the temporomandibular joint (TMJ), and no popping or clicking, or deviation to either side upon opening.

Intra-oral Examination (IOE)

The IOE revealed slight redness around the gingiva adjacent to teeth #3 and #4. These teeth had temp restorations (Figure 17.1).

Diagnostic Tests

Tooth	#2	#3	#4	#6
Percussion	–	+	+	–
Palpation	–	+	+	–
Cold	+	–	–	+
Probing depth	Within 3 mm	Within 3 mm	Within 3 mm	Within 3 mm

+: Response to pain on percussion or palpation and normal response to cold test; –: No response to percussion, palpation, or cold

Radiographic Findings

Periapical (PA) radiography (Figure 17.2) indicated that tooth #2 was free from decay and restorations, while tooth #3 indicated initiation of RCT with traces of root canal medication inside the root canals. Well-defined radiolucency of 1 mm diameter was associated with the apex of tooth #4. The root canal of this tooth had been previously insufficiently filled with material that was 3–4 mm short from the apex. A wide root canal suggested excessive removal of dentin by previous Tx. The remaining coronal tooth structure was insufficient. Tooth #5 was missing.

Figure 17.1 Intraoral photograph. Note: Root canal treatment has already been initiated as retreatment in teeth #3 and #4. In each tooth, access is sealed with Cavit™ temporary filling material.

Figure 17.2 Periapical radiograph taken at initial visit.

Alternative

Extraction and dental implant, fixed partial denture, or no treatment

Restorative

Composite or amalgam build up with either onlay or full crown coverage

Prognosis

Favorable	Questionable	Unfavorable
X		

Clinical Procedures: Treatment Record

First visit (Day 1): The medical history was reviewed (RMHX). Vital signs were as follows: BP 122/84 mmHg RAS; pulse 72 BPM and regular; RR 18 breaths per minute. The root tip was assessed based on previous measurements using an electronic apex locator (EAL) (Root ZX® II, J. Morita Kyoto, Japan) from the buccal cusp tip. This helped with creating a precise and conservative osteotomy during surgery. The Tx options were reviewed with the Pt including extraction and no treatment. The Pt elected for apical surgery and informed consent was obtained. The Pt was informed that vertical root fracture might be present. No concerns for anatomic structures were present. The Pt was scheduled for surgery in two months.

Second visit (2 months): RMHX. Vital signs were: BP 118/78 mmHg, pulse 72 BPM and regular. The Pt's mouth was rinsed with 0.12% chlorhexidine for 30 seconds. Anesthesia: two carpules of 2% lidocaine (lido) with 1:50,000 epinephrine (epi) were administered for infiltration, and palatal injections were made to tooth #12 and surrounding tissues. A full thickness mucoperiosteal flap was reflected using an intrasulcular incision from the mesial (M) of tooth #11 to the distal (D) of tooth #13. No apical lesion was present. Based on EAL measurements, a bony crypt was opened 19 mm apically from the alveolar crest using a #4 round bur with sterile saline irrigation. Once the root end was approximated and visualized (Figures 19.3 and 19.4), excess root filling was noted and removed during root resection.

Approximately 3 mm of the root apex was resected using a #171L bur with sterile saline irrigation. The tissue/root end was enucleated from the site. A biopsy was taken and sent to an oral pathologist for review. Hemostasis was achieved using epi pellets within the crypt. Then retropreparations of 3 mm in depth were made into the resected canal using ultrasonic instrumentation with copious amounts of water to prevent overheating and potential microfractures of the root surface (KiS 3 tip, Spartan/Obtura™ Figure 19.5).

Figure 19.3 Root end inspection and visualization of obturation material with dental operating microscope (DOM)

Figure 19.4 Surgical inspection with dental operating microscope (DOM).

Figure 19.5 Ultrasonic instrumentation (KiS 3 tip, Spartan/Obtura™) in parallel to long axis of root surface and into canal.

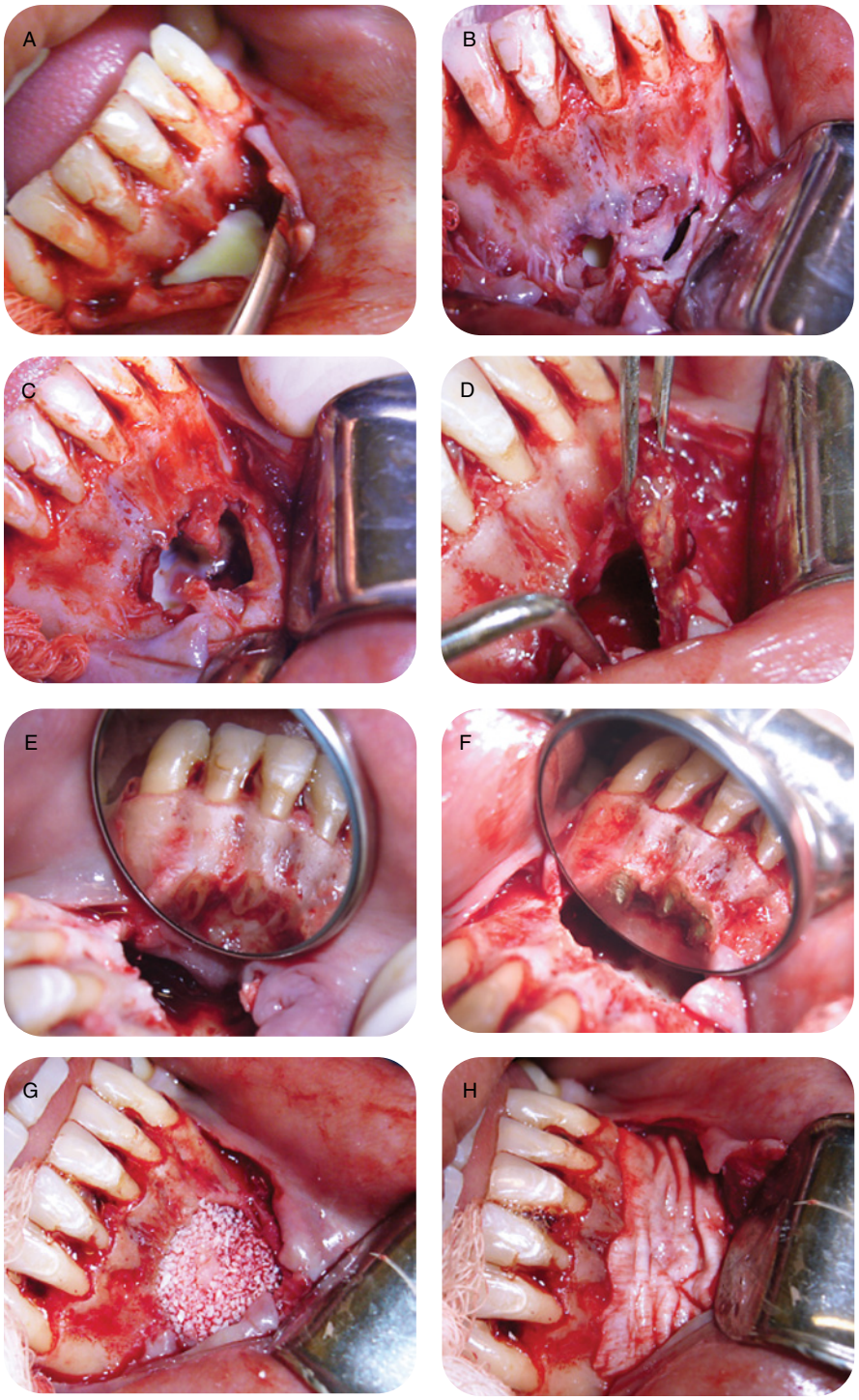


Figure 20.4 Root-end surgery on teeth # 23, 24, and 25. A: Purulent exudate was seen as the flap was being reflected near the apical area of teeth #23, 24, and 25. B: Inflamed periosteum. C: Periradicular lesion. D: Removed tissue attached to the apex of tooth #24 for biopsy. E: Root-end preparation. F: Root-end filling with white MTA. G: Bio-Oss was placed into the bony crypt. H: Bio-Gide membrane was placed. (With permission from Komabayashi, T., Jiang, J., Zhu, Q. (2011) Apical infection spreading to adjacent teeth: a case report. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* **111**(6), e15–20.)

modified with a #4 round bur around the dehiscence bone board. Inside the bone crypt a 10x8x4 mm tissue was attached to the apex of tooth #24. The tissue was removed and submitted for biopsy (Figure 20.4, D). Apical 3 mm of the root apices of teeth #23, #24, and #25 were resected using a #171L bur with sterile saline

Figure 24.6 Pulp hemostasis after pulpotomy and decay removal completed.

Figure 24.7 MTA placed in pulp chamber.

(Figure 24.9) showed continued root development. The Pt remained asymptomatic; there were no signs of pathosis, but tooth #31 still had a temporary filling. The importance of having the tooth restored was stressed.

Third visit (1 year 9 month follow-up): Clinical and radiographic exams were completed. PA of tooth #31 (Figure 24.10) showed continued root development. The Pt remained asymptomatic, with no signs of pathosis, but tooth #31 still had temporary filling. The importance of having the tooth restored was stressed.

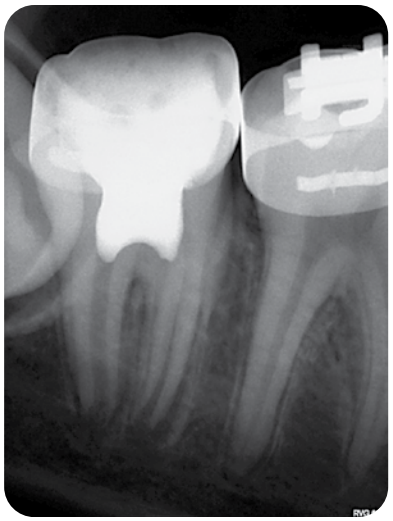


Figure 24.8 Postoperative radiograph (taken with sensor vertical).

Figure 24.9 Follow-up 1 year 1 month.

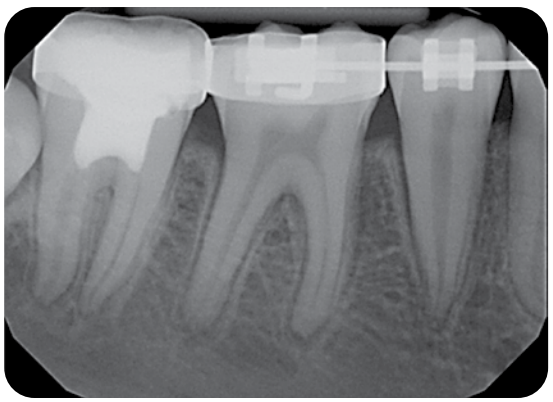


Figure 24.10 Follow-up 1 year 9 months.

Fourth visit (2 year 3 month follow-up): Clinical and radiographic exams were completed. PA of tooth #31 (Figure 24.11) showed root development complete. Pt

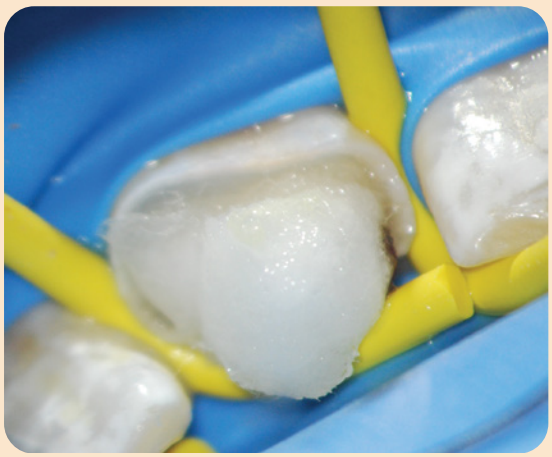


Figure 24.14 Sodium hypochlorite-saturated cotton pellet placed over pulp.

Figure 24.15 Pulp still bleeding after 10 minutes of use of sodium hypochlorite saturated cotton pellet.

to perform a pulpotomy (Figure 24.16) to ultimately obtain hemostasis. Hemostasis must be obtained prior to covering pulp with MTA (Figure 24.17; Bogen and Chandler 2008).

- Alternatively, in place of MTA, any other calcium silicate cement (e.g., Biodentine® and EndoSequence® Root Repair Material; Figure 24.18) can be used to prevent staining of the tooth.
- Cover with a thin layer of glass ionomer (e.g., GC Fuji Lining™ LC; Figure 24.19).
- Optional (only if MTA is used, but not required): Instead of covering with a layer of glass ionomer, place a wet (water) cotton pellet over the MTA and temporize coronal access with material of choice (e.g., Cavit™, FujiTriage® glass ionomer, etc.).

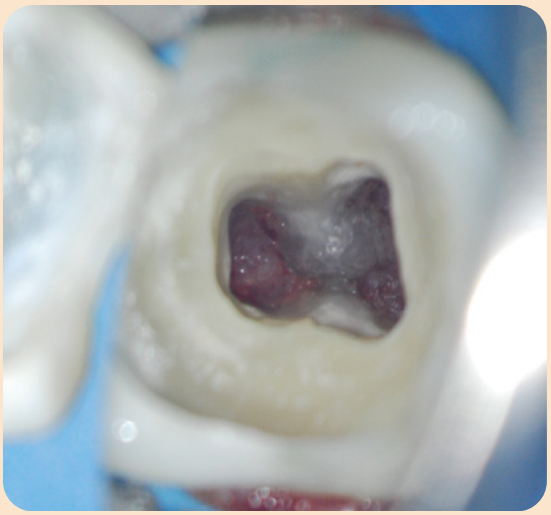


Figure 24.16 Pulpotomy on a molar.

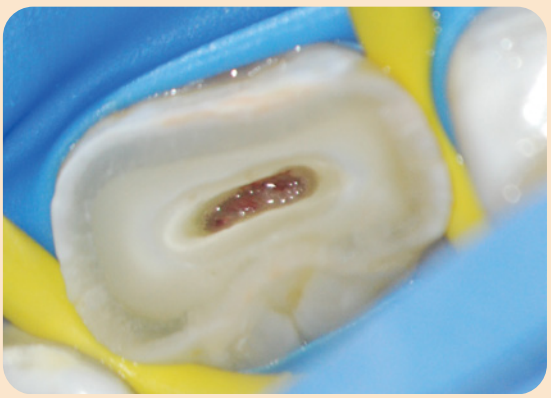


Figure 24.17 Pulp hemostasis after removing a few more millimeters of pulpal tissue and replacement of sodium hypochlorite pellet for a few minutes.

Figure 24.18 Endosequence® Root Repair Material covering pulp.