ENDODONTIC MISHAPS

CONTENTS

INTRODUCTION

Endodontic mishaps or procedural accidents are those unfortunate occurrences that happen during treatment, some owing to inattention to detail, others totally unpredictable. Accurate diagnosis, proper case selection, and adherence to basic principles of endodontic therapy may prevent the occurrence of procedural accidents.

Recognition of a procedural accident is the first step in its management, which can be done by radiographs, clinical observation or by patient's discomfort. Correction of mishap can be done in one of several ways depending on the type and extent of the procedural accident. Sometimes, unfortunately it may have to be extracted. Re-evaluation of the prognosis is very important in an endodontic mishap as it may affect the entire treatment plan and involve dento-legal consequences.

Dental standard of care requires that patients be informed about any procedural accident. Literature provides much information that can help prevent accidents. Experience can teach many valuable lessons if one pay attention. We learn from our own and other's mistakes. We must recognize that the knowledge of these injuries must encourage reflection on the safe and prudent practice of endodontics.

MISHAPS DURING ACCESS OPENING, ORIFICE LOCATION & INITIAL PREPARATION:

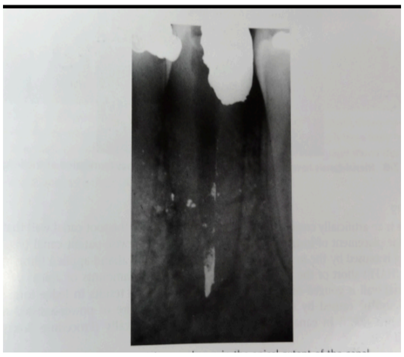
Factors:

- Failure to excavate all caries & remove unsupported tooth structure, faulty restoration.
- Failure to establish proper access to pulp chamber space & root canal system.
- Failure to identify the angle of tooth to the root.
- Failure to recognize problems in access openings through crowned teeth or extensive restorations.

Failure to excavate all caries & remove unsupported tooth structure or Faulty restoration

Removal of all compromised tooth structure is necessary for sound restorative dentistry. Removal of compromised tooth structure before the actual pulpal access is created not only ensures that sound, restorable tooth structure remains and that an uncontaminated environment can be established for aseptic root canal procedures, but it also prevents the development of various problems during access preparation and subsequent treatment phases such as the following;

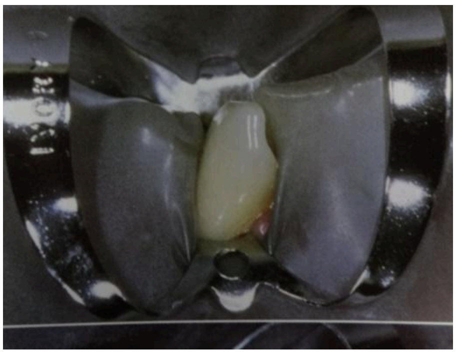
- Salivary & bacterial contamination.
- Inadequate assessment of restorative needs.
- Loosening of alloy in the canals.
- Fracture of tooth structure between appointments.

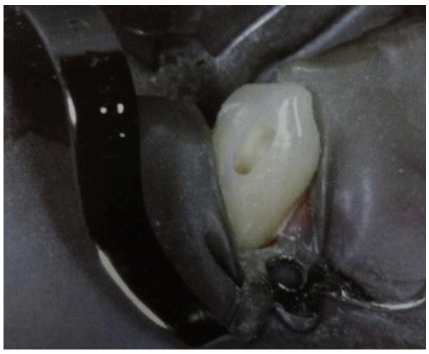


During excavation, the peripheral carious tooth structure is removed first, and then caries is removed inward toward the pulp chamber. Penetrating a pulp chamber in which pulp is hyperemic or purulence has accumulated creates the difficulties of working in a confined space in a pool of blood or pus. Attempts to unroof a chamber or to enlarge the access at this point can lead to crown or furcation perforation.

Reasons of Convenience to remove Restorations:

- In mal-positioned teeth that impede direct access to canals
- For searching calcified canals
- To establish tooth restorability
- To enhance clinician orientation





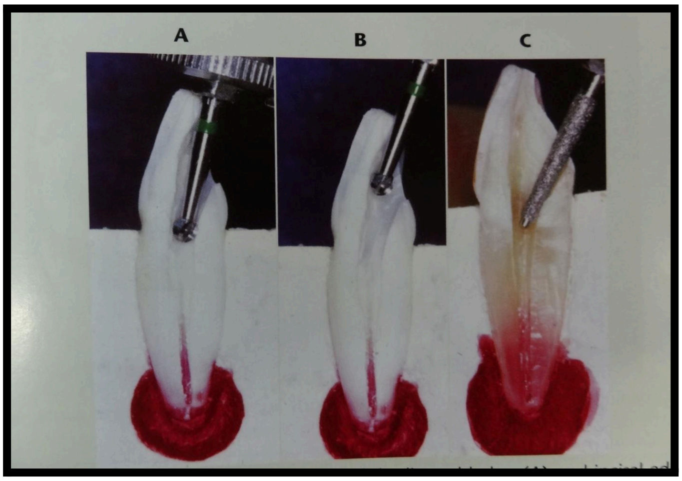
Failure to establish proper access to pulp chamber space & root canal system:

Pulp chamber spaces are generally located in the centre of the crown. Many teeth that have had multiple restorative procedures over time exhibit pulpal response to these irritations.

They usually reduce the root canal space visible on a good – quality, two dimensional radiographs. When large restorations are present, bite wing radiographs are necessary for proper visualization of the chamber space. Angled radiographs may be necessary when the teeth are rotated or have abnormal root configurations.

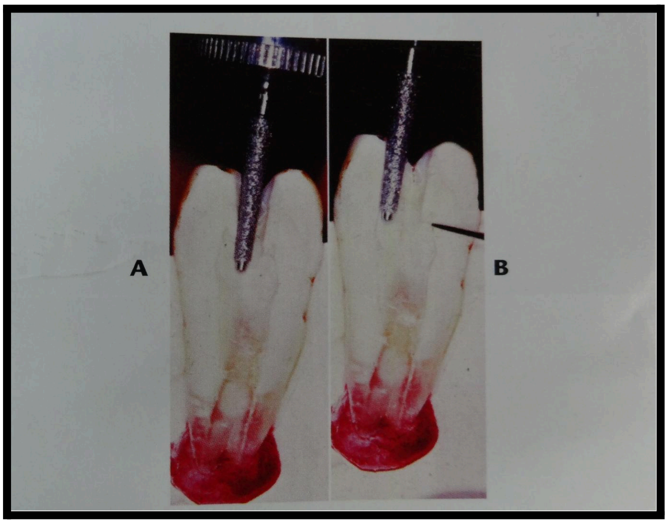
The old adage in access opening preparation, “Go for the pulp horns”, is reasonable. The pulp horn areas are targets in the process of early excavation. Failure to remove the entire roof of the pulp chamber is a common problem that precludes locating the canal systems in posterior teeth.

Access for anterior teeth:



1. Penetrate the lingual surface at right angles to the surface of the crown
2. After penetration, reorient as much as possible, the bur angle to the long axis of the root.
3. After pulp chamber has been accessed, remove the lingual ledge and incisal ledge. This is done to prevent gouging or perforation.
4. Once these obstructions are removed, complete access to the canal space is achieved, and such access allows penetration to the apical constriction and enhances thorough canal cleaning and shaping.
5. Complete removal of the lingual ledge will often uncover the extra canals in mandibular incisors, canines and premolars.

Access for posterior teeth:



1. Measure the size and depth of pulp chamber space on the radiograph
2. After the pulp horns have been identified, remove the dentin between the pulp horns.
3. Place a safe – ended bur adjacent to the overhanging roof, and cut laterally to unroof the over lying dentin and to flare the walls of the access opening occlusally.
4. Use a no.17 or no.23 explorer to evaluate the removal of the roof or dentin overhangs.
5. Inspect the chamber to ensure an unobstructed entry into the canal systems.

Cervical ledges:

- In posterior access opening – cervical ledges
- Impedes straight line access into the canals
- Must unroof the ledges to identify the canal orifices without gouging or perforating

Solution:

- Use No.2 or 4 round burs in position of mesiobuccal orifice and extended to the palatal orifice
- Identifies extra canal orifice
- Facilitates initial entry into extremely curved canals.

Calcification

- Calcified pulp chambers
- Pulp horns may no longer be present

- Inspect for calcified discolouration
- Probing with endodontic explorer – soft spots
- Use of ultrasonic instrument – opening orifice
- Operating microscopes or loupes are used if no irrigation is followed
- Irrigation – blocks visibility
- Both approaches must be used

Magnification

- In locating calcified canals
- At 30x – depth of field is shallow, field of vision is narrow
- Anatomy – gets disoriented (every discoloration looks like orifice)
- Only low power magnification is used for orifices.
- Radiographs – to check position of orifice

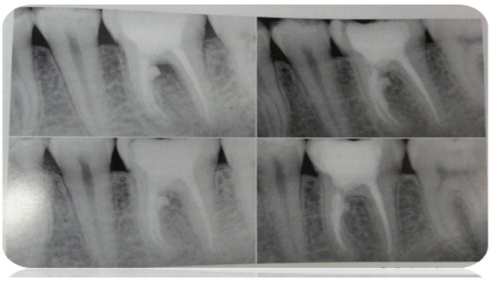
Perforation

- Occurs during access preparation
- Perforation of pulp chamber to oral cavity / periodontal tissues – most deleterious
- Maintaining the orientation to external anatomy
- Level of perforation above or below the crest of bone

At / above bone level

- Control hemorrhage with wet cotton pellet
- Seal with temporary cement
- Cover perforation with fast setting glass ionomer
- Proceed with root canal treatment

Below the bone level

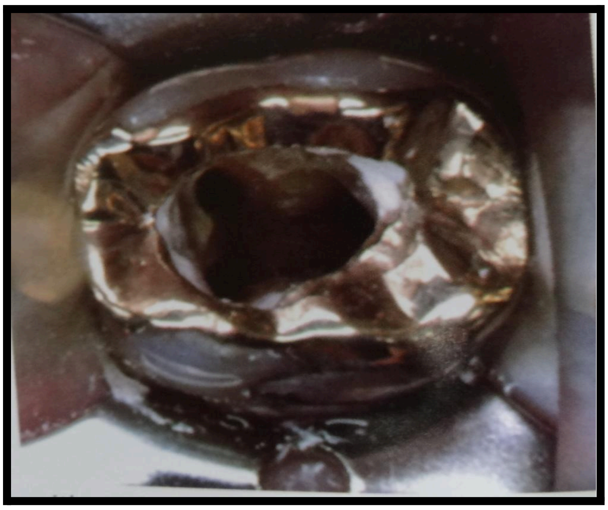


- Seal perforation
- Close to canal – locate canal orifice
- Avoid strong hemostatic agents
- Place MTA
- Surgical management of furcation perforations

Failure to identify the angle of tooth to the root.

- Commonly seen in maxillary lateral incisors & mandibular first premolars
- Misidentification of canals occur
- Inability to locate specific canal – gouging or perforation
- Extra canals are common
- Undermining / weakening coronal or radicular tooth structure is inevitable.

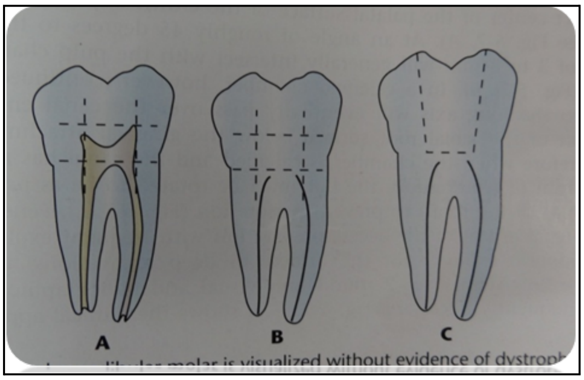
Failure to recognize problems in access openings through crowned teeth or extensive restorations.

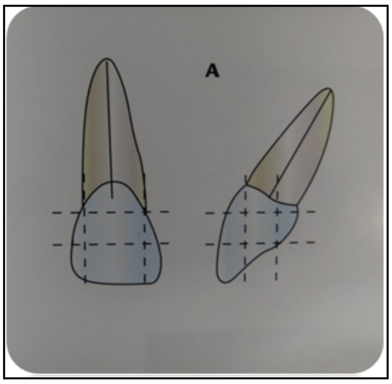


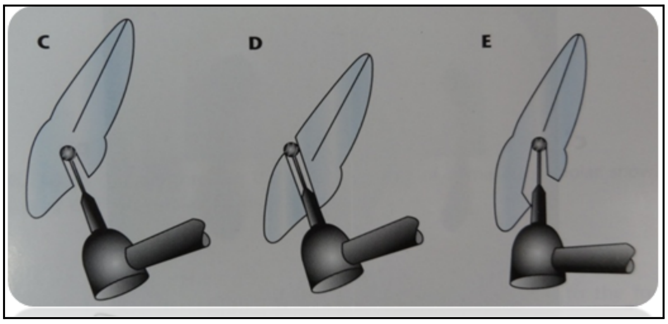
Calcification of the dental pulp and pulp canal space

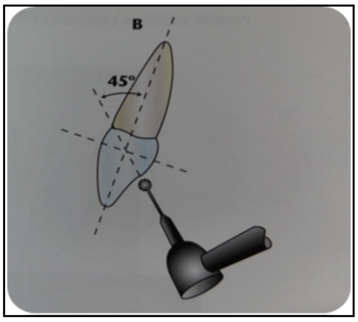
- Deposition of secondary dentin
- During bacterial invasion – minimal time for reparative dentin
- Dental pulp – necrosis – remains patent
- Pulp chamber & pulp canal system undergo calcific changes
- To locate calcified canals
- Proper access opening & locate orifice
- Correlation of 2-D radiograph with tooth structure
- Refining access preparation, locate orifice – ultrasonic instrument
- Procedure to locate calcified canals

Finding fine or calcified root canal in specific teeth









Maxillary anterior teeth:

- Exact centre of the palatal surface of the crown
- 45° to the long axis, 3 to 4 mm penetration
- In calcified teeth – continued penetration at 45° - perforation
- Endodontic explorer – DG 16 – is used to locate orifice

Maxillary premolars:

- Centre of occlusal surface
- Chamber wide buccal lingually

Maxillary molars:

- Preparation – triangle
- For MB2 canal – slot or trench is usually excavated in a straight line
- MB2 – is usually 0.5 to 5mm toward palatal orifice
- Occasionally – 1 to 2mm into mesiobuccal / palatal orifice.

Mandibular anteriors & Premolars:

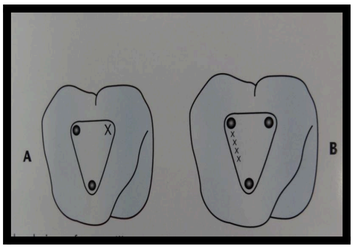
- Mostly single canal , if second present – lingual
- Second canal located – 10/ 15 size K-file with curve 1mm or 2mm from the tip of file
- Use no.2,3,4 gates-glidden drills or orifice shapers on lingual surface
- If fracture of instument occurs – at the shank

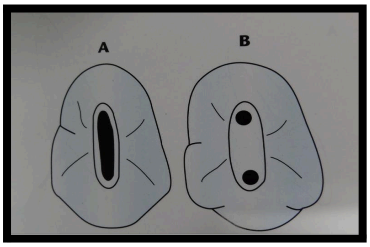
Mandibular molars:

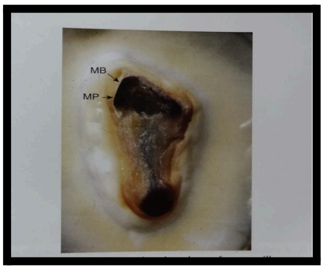
- Trapezoid in shape
- Second molars – single canal occassionally
- Canals – present in mesial distal midline
- Groove is made in locating the calcified orifice
- Might be 3 to 4mm to the located canal

Recognizing orifice location

- Locating the orifice – DG16
- Confirmed radiographically
- No. 10 or 15 size K- file is better in negotiating canals than no.6 or 8.
- C+ files or hand orifice openers are used
- Magnification – operating microscopes or loupes
- Dentinal mapping – colour of dentin – whitish spot at orifice.
- Problems in locating orifice







Perforation:

If the perforation is small and adjacent bone is healthy the prognosis is good. Instrument is used as a marker to identify the position of deviation from the canal system. Repair is by sealing the site with MTA followed by Glass ionomer above. Only water or saline is used as irrigant. Calcium hydroxide – is the best medication as interim intracanal medication.

Clinical considerations with complete canal calcification

- Copious irrigation - 2.5% to 5.25% NaOCl
- Slow advancement of instruments
- Instrument should be cleaned on withdrawal and inspected on reinserting
- Acids / alkalis should be used to aid in canal penetration
- Chelating pastes – assist in canal penetration
- Ultrasonic instruments – to loosen debris in canal orifices
- Canal orifice should be flared
- Ni-Ti instruments or orifice penetrating instruments should be used.

Rationale for use of Intracanal Irrigants

- Tissue dissolving attributes
- Bacteriostatic or cidal capabilities
- Rinsing debris
- Removing smear layer

- Lubricating instruments
- Demineralizing
- Irrigant of choice

Sodium hypochlorite in various concentrations

- It has anti-microbial & tissue dissolving capabilities
- Does not remove smear layer
- Concentrations 2.5% to 6% are favored
- Warming solution to 37 ° enhances its efficacy
- Time - 5 min to 30 min enhances its effectiveness.
- When used with a chelating liquid (EDTA) – antibacterial properties are enhanced

Disadvantages

- must be delivered passively to the canal
- Avoid wedging
- Side – delivery needles should be used
- Forceful extrusion of solution beyond apical foramen – deleterious
- Should not be used as final irrigant – resin bonded root canal filling material is used for obturation.
- Finish – EDTA , chlorhexidine , BioPure MTAD

Sodium hypochlorite accident

Accidental injection of NaOCl into the periapical tissues .

Severe pain, swelling, profuse bleeding may be experienced

Management

- Administer regional block with long acting anesthetic solution
- Bloody exudate may discharge into the canal
- Antibiotic coverage
- Analgesic
- Corticosteroid / antihistamines
- Cold compression – first 6 hrs followed by warm compression

Air emphysema

- Occurs due to pressurized air forced into the root canal by irrigation past the apex with hydrogen peroxide
- Signs – in the neck, face and suborbital regions
- Must prevent the usage of compressed air in drying of root canal that is open to the periapical tissues.

Chelating agents

- Assists in penetrating calcified or block canals
- Removes smear layer
- Lubricates canal - during hand-applied rotary instruments

Available forms

Pastes

RC – Prep: 10% urea peroxide, 15% EDTA, glycol in an aqueous base

Glyde file: 15% EDTA & 10% urea peroxide in an aqueous solution

File – EZE: 19% EDTA in an aqueous water- soluble solution

Disinfectants

- Cleaning the root canal system of its gross debris
- Dissolution of tissue – NaOCl
- Ability to penetrate into small irregular areas
- Removal of smear layer
- Prevents contamination of dentin with oral fluids

Types

- **Calcium hydroxide**
- **Iodine** – when used as iodine potassium iodide 2%
- **Ledermix paste** – 3.21% demethyl chlortetracycline, 1% triamcinolone acetonide
- **Chlorhexidine** - 2%
- **Odontopaste** – 5% clindamycin hydrocholride, 1% triamcinolone acetonide

Disadvantages

- If smear layer is not removed – agent has no access to the dentinal tubules
- If passes beyond apical foramen to the periradicular tissue – causes adverse sequelae
- Not to be used as canal irrigants during cleaning & shaping procedures.
- Phenolic agents & formaldehyde products should be abandoned.

Loss of working length

Blockage of canal:

It is an obstruction in a previously patent canal system that prevents access to the apical constriction or apical stop.

Causes – packing of dentin chips, tissue debris, restorative materials, cotton pellets, paper points, fractured instruments.

Prevention

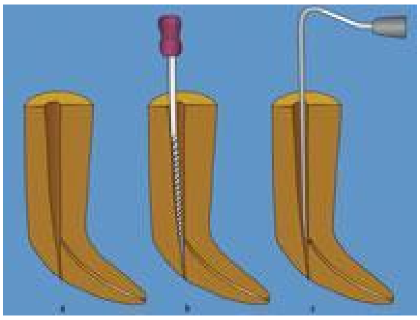
- Caries & unsupported tooth removal
- Unsupported restorations removed
- Flaring of access walls
- Use of water spray – eliminate accumulation of metallic / composite materials
- Copious irrigation
- Intracanal instruments are wiped clean
- K- files are sequentially used – to avoid binding into the canal
- Recapitulation is done
- Excessive pressure & rotation avoided
- Instruments are used in wet canal only
- Sound temporary filling is placed

Management

- Small stiff instrument – 15 K-file / reamer
- Dislodge metal fillings – by smaller instruments
- 45 degree curvature at 3 to 4mm of the instrument in slight in – out motion
- Small sized H – file is placed to the length
- Use of chelating agents
- Complete cleaning & shaping at new working length is done

- Periodic reassessment after obturation
- If further problem persists – surgery may be indicated .

Ledging



Ledging is caused by insertion of uncurved instruments short of the working length with excessive amounts of apical pressure.

Gouging or false canal is created

Caused due to hand applied filing instrument / power assisted rotary instrument (HAFI/ PARI)

Causes

- Not extending the access cavity sufficiently to allow adequate access to the apical part of the root canal
- Complete loss of control of the instrument if the endodontic treatment is attempted via a proximal surface cavity or through a proximal restoration
- Incorrect assessment of the root canal direction
- Erroneous root canal length determination
- Forcing and driving the instrument into the canal
- Using a noncurved stainless steel instrument that is too large for a curved canal
- Failing to use the instruments in sequential order

Prevention

- Determine accurate working length
- Precurve the file 3 to 4mm as the curvature of the canal

- Do not force file apically
- Copious irrigation
- Sequentially use the files
- If binding present skip to a smaller size file
- Circumferential filing should be done to remove dental irregularities
- Use crown down technique with NiTi flexible instruments

Management

Early recognition
Similar technique to remove the canal blockage is used here
If ledges cannot be bypassed, establish a new working length coronal to the ledge
Obturate with softened Gutta- percha and thin mix of root canal sealer.

Breakage of instruments in the canal

Separated instruments – potential hazard during root canal treatment
Due to incorrect instrument usage
NiTi files, H files, rotary instruments, are commonly misused during root canal procedures

Prevention

- Once file is placed to working length – filing action is used
- Rotation of file is contraindicated once it reaches the working length
- Apical termination – K file
- H file – efficient removal of dentin – more likely to break
- H file – used only in pull stroke to remove dentin
- Rapid advancement or skipping file sizes must be avoided
- Forcing instrument with apical pressure must be avoided

Discarding Intracanal Instruments

- Flaws – on the flutes – shiny areas
- Excessive use – bending or crimping
- Accidental file bending during usage
- When file kinks instead of curves

- Corrosion on instruments
- Compacting instruments have defective tips or been excessively heated

Microtube Tap & Thread method

These microtubular taps contain a reverse thread and engage an obstruction by turning in a *counterclockwise* (CCW) motion.

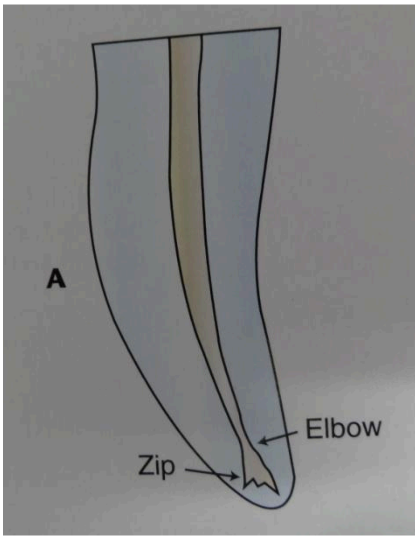
Used in post removal system

Instrument withdrawal

Deviations from the normal canal anatomy

Zipping:

It is the transposition or transportation of the apical portion of the canal. Occurs when a normally curved canal has been straightened especially in the apical one third.



Teardrop or elliptical shaped

Elbow – narrowest portion of the canal coronal to the elliptically shaped apical seat.

Prevention

- Files are over curved in apical 3 to 4mm especially in root curvatures greater than 20 °.
- File is worked in direction of curvature
- Rotation of file – avoided
- Small flexible files – prevent zipping
- Flutes or cutting edges are removed with diamond disc at certain areas

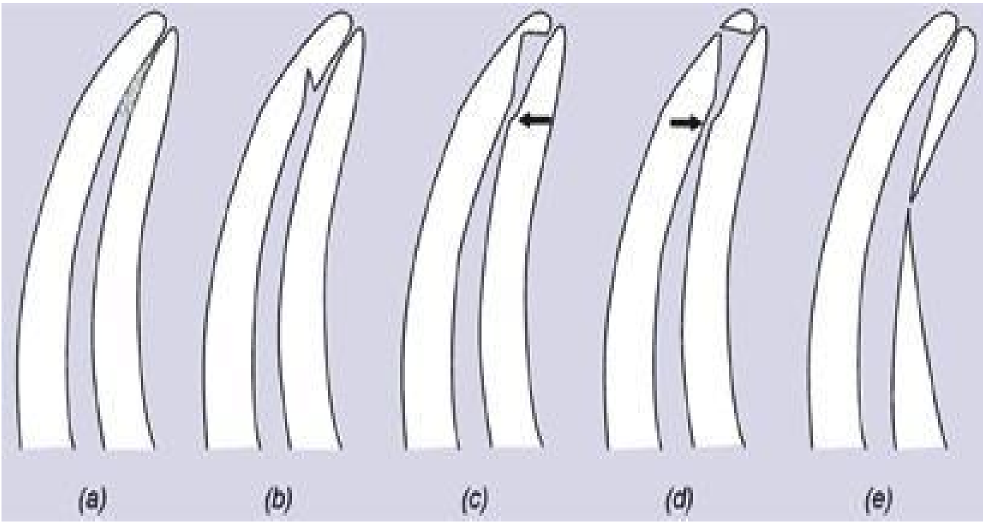
- Placing a pre-curved file into a noncompliant canal system – tends to reduce curvature of file
- Anticurvature or reverse filing can be used in curved canals.

Management

- Obturation of canal that has been zipped
- When zip is present with no perforation any obturating technique can be used
- Perforation – not evident clinically – calcium hydroxide sealers is preferred
- Signs / symptoms of failure – surgical intervention

Stripping / Lateral wall perforation

Stripping refers to a thinning of the lateral root wall with eventual perforation



Prevention

- Usually occurs in mesio buccal roots of maxillary molars & mesial root of mandibular molars
- Small files are used
- Large files, rotary files – must be avoided
- If perforation or hemorrhage is evident – lateral or apical must be evaluated
- Perforation repair – by MTA or calcium hydroxide

Shaping canal beyond terminus:

- Over instrumentation beyond the apical constriction violates the periodontal ligament & alveolar bone.

- Causes open apex --- lack of adequate seal --- pain & discomfort
- Hemorrhage may be evident from the apical portion of the canal.

Prevention

- Good radiographic techniques
- Reference points
- Instruments retained within the confines of the canal
- Occlusion – reduced / refined before working length
- Integrity of the apical stop is assessed with stiff paper points or files

Management

- Establish new apical stop – 1 to 2mm from radiographic apex
- Place plug of dentin chips / Ca (OH) 菱apically to control the movement of gutta percha & sealer.
- If dentin chips are contaminated – place MTA apically – use measured plugger

Excessive removal of root dentin:

Excessive removal of tooth structure in a mesial distal & buccal lingual direction can result in weakening, laceration of root wall or perforation.

Recommended sizes for final apical preparation

Maxillary centrals: 35 – 60
Maxillary laterals: 25 – 40
Maxillary canines: 30 – 50
Maxillary premolars: 25 – 40
Maxillary molars: MB/ DB: 25 – 40, Palatal: 25 – 50

Mandibular incisors: 25 – 40
Mandibular canines: 30 – 50
Mandibular premolars: 30 – 50
Mandibular molars: MB/ML: 25 – 40, Distal: 25 – 50

Special Anatomic problems

C – shaped canals:

- It is usually ribbon shaped
- Multiple concavities present along external surfaces of the root
- Prevention
- Power applied rotary instruments are used in crown down technique
- Fresh irrigating solution is used
- Calcium hydroxide is placed as intracanal medicament.

S – shaped canals

- Bayonet shaped

- At least two curves present
- Maxillary lateral incisors, canines, premolars and mandibular molars.
- Prevention
- Passively shape the canal
- Frequently recapitulate with small files & irrigate
- Over curve the apical 3mm of the file to maintain curvature
- Restrict master apical file to 20 or 25 size
- Use anti curvature or reverse filing.

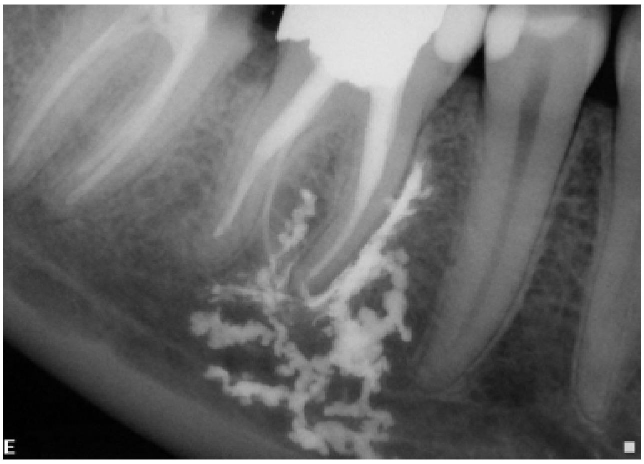
Problems preparing to obturate the canal

Failure to seat the master GP cone to full working length:

- The shape of the canal is improper for the cone chosen
- The wrong cone is chosen
- Debris is packed in the canal
- Prevention
- Cone size / shape – must be checked
- Recapitulation must be done with the last K file
- Radiograph – to assess the working length, ledges, blockages, false canals
- H – File of the master apical size must be used in step back circumferential method
- Copious irrigation
- Recapitulation – to remove dry packed chips from apical dentin matrix

Failure to achieve Tug back or Snugness

Tug back – is defined as the resistance felt when a master gutta percha cone is removed from the canal



The largest sized master cone that fits the full working length and produces a perceptive feel of snugness of fit is recommended.

Causes

Improper consistency in the taper of gutta percha cone

Prepared canal that has no taper from apex to orifice

Choice of too small master cone

Irregular canal preparation – zipping

Management:

Largest sized gutta percha must be chosen

Softening – aids in establishing snug fit

Breakage of master cone during trial placement

GP – aged & brittle – conversion to high crystalline form

Prevention:

Rotating the stock, keeping in frozen storage, pulling the cone to test the freshness

Problems during Obturation

Failure to place the compacting instrument to the prepared apical seat :

- Lack of proper canal shape & taper
- Use of compacting instruments that are too large
- Use of straight compacting instrument in curved canal
- Any combination of the above causes

Pulling the obturating material out of the canal on removal of the compacting instrument

- Too much canal wall divergence
- Too much sealer
- Failure to remove sealer from the spreader before reinserting
- Moisture in the canal
- Too small master cone
- Failure to loosen spreader passively
- Trying to rotate a curved spreader
- Problems identified after Obturation

Over extension:

- Excessive instrumentation beyond apical constriction
- Zipping, perforations, stripping

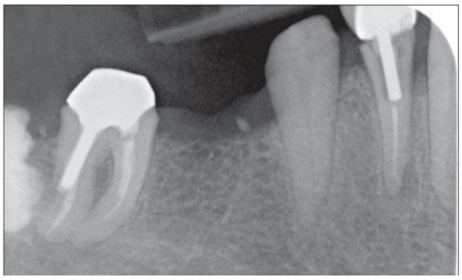
- Excessive compaction force
- Excessive amounts of sealer
- Too small master cone
- Excessive penetration of compacting instrument
- Combination of above causes

Failure to achieve adequate apical density (Underfills)

- Lack of canal patency or insufficient taper
- Failure to coat accessory cones with thin layer of sealer
- Failure to insert accessory cones to full length of the spreader penetration
- Use of too large a spreader or plugger
- Too much root canal sealer
- Rapidly setting root canal sealer
- Excessive packing of dentin chips
- Failure to soften the apical segment of gutta – percha before compaction in vertical compaction

Post space preparation

Perforations during space preparation



Excessive removal of dentin walls

Improper angle of instruments during preparation

Conclusion

- Mishaps potentially cause permanent injury to the patient.
- We must recognize that the knowledge of these injuries must encourage reflection on the safe and prudent practice of endodontics.

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