



Review Article

Literature review on procedural endodontic errors

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ABSTRACT

Lack of knowledge or its poor application in clinicals can lead to a number of accidental errors during the root canal therapy. The preventive measures and management of these mishaps is must for the success of the endodontic therapy and to maintain the natural integrity of the teeth. Thus, in this paper we are going to discuss about the different types of endodontic procedural mishaps with their management briefly.

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1. Introduction

Endodontics is the branch to maintain the natural integrity of the teeth by removing the microbial flora & cleaning of the root canals either by surgically or non-surgical root canal treatment followed by the restoration of the teeth. In other words, we can say that purpose of the endodontic treatment is to restore the health of pulp and peri-radicular tissues. As like in other medical or dental procedures, the complications may occur during the root canal or endodontic procedure. Thus, endodontic mishaps are the unfortunate accidental error occurs during the endodontic therapy iatrogenically or due to lack of knowledge.

1.1. Classification of endodontic mishaps

The procedural errors in the endodontic are classified as:

- 1. Related to access opening of the pulp space :** These includes.¹
 - Treating the wrong tooth
 - Missed canals
 - Damage to existing restoration
 - Access cavity perforations
 - Crown fractures
- 2. Related to canal shaping and cleaning :** The common procedural errors encountered during cleaning and shaping are as follows.²
 - Ledge formation & canal blockage
 - Cervical canal perforations
 - Deviation from normal canal anatomy
 - Separated instruments
 - Obstruction by previous obturating materials
- 3. Related to obturation :** These are accidental mishaps that occur during the obturation of the canal, these are sub-classified as follows.³
 - Over- or underextended root canal fillings
 - Nerve paresthesia

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- Vertical root fractures
- 4. **Miscellaneous :** These includes as
 - Post space perforations
 - Irrigant related mishaps
 - Tissue emphysema
 - Instrument aspiration

1.2. Brief description of different procedural mishaps

1.2.1. Treating wrong teeth

Treating the wrong tooth in a patient can occur due to incorrect diagnosis of the diseased tooth and this in turn, patient reports about the same symptoms continuously or may have pain in incorrectly opened tooth too after access. The reason for this mishap results due to incorrect diagnosis of the diseased tooth. And, one should make sure through inquiry, testing, examining, and radiography that which tooth require the treatment. The management include the treatment of the incorrectly opened tooth as well as treatment of the diseased tooth.⁴

1.2.2. Missed canals

Missed canals are one of the main causes in the endodontic treatment failure. Sometimes the additional canals remain inaccessible or not easily accessible to the dentists and that results either in endodontic failure or may lead to the worsening of the symptoms. It has been also suggested that untreated missed root canals may have a direct impact on the prognosis of root canal treatment. The study was conducted on 2305 endodontically treated teeth were taken as samples, of which the prevalence of the missed canals was 12% and out of which teeth with untreated missed canals were associated with 82.6% of peri-apical pathologies.⁵ Missed canals are linked with the different factors like failure to externalize the internal anatomy while studying the preoperative radiograph or the lack of knowledge pertaining to root canal anatomy. Sometimes it is associated with the improper access or incomplete deroofing of the pulp chamber.² During treatment, an instrument or filling material may be noticed to be other than exactly centered in the root, indicating that another canal is present.⁶ Good periapical radiographs with different angulations, use of magnifying loupes or microscopes, transillumination & use of methylene blue dye for detection of missed canals can be employed. Knowledge of canal anatomy and of the laws of access opening is very important in preventing these errors related to access opening. One of the advantages of using a microscope is to increase the possibility of locating calcified and additional canals and also, using a dental operating microscope can give intimate detail of an area that otherwise would be under-illuminated and under-magnified, requiring guesswork and great caution. Also, the magnifying loupes gives the magnification of 2.5x, 3.5x or more, that could be beneficial in finding the canals. The use of 1% methylene blue dye can also be implemented to identify the location

of the root canal orifice as the dye gets absorbed into canal orifices and serves to visually map the hard-to-find canals or sodium hypochlorite champagne bubble test can be useful to detect root canal orifices due to the dissociation of the sodium hypo solution into Na ion & Cl ion liberating the free oxygen when placed into the access cavity.⁷ Use of endo-explorer e.g., DG16 can also be used to negotiate the canals during access cavity. Retreatment is appropriate treatment for the missed canals.

1.2.3. Access cavity perforation

One of the irreversible complications of endodontics is access cavity perforation into the furcation area while gaining access to pulp chamber of tooth. Often the first sign of this kind of perforation is blood in the cavity or the patient complaining of a taste of NaOCl and most commonly occurs in the floor of molar preparations in the search of canals. There have been various materials recommended for the repair of the perforation like cavit, amalgam, calcium hydroxide paste, glass ionomer cement, gutta-percha, tricalcium phosphate or hemostatic agents such as geofoms and mineral trioxide aggregate (MTA), of which MTA has very convincing effects for repair.³ The ability of the MTA to form the mineralized tissue can be attributed due to the good sealing ability, alkalinity and other properties of MTA like biocompatibility, etc.⁸ The site of the perforation must be found, the floor of the preparation cleansed, the bleeding should be stopped with adrenaline, and mineral trioxide aggregate (MTA) applied to the Perforation. However, GIC can be used in favorable environmental conditions of the oral cavity like in case of no contamination especially light cure GIC as it is less sensitive to the moisture.

1.2.4. Ledge formations

A ledge is an iatrogenically created irregularity in the root canal that impedes access of instruments and in some cases irrigants to the apex, resulting in insufficient instrumentation and obturation,⁹ the causes for the ledge formation includes the Inadequate access to the apical part of the root canal, Loss of control of the instrument during root canal procedure, Inadequate irrigation of the canal, Curved canals, Incorrect assessment of the root canal direction.

Whenever the ledge is formed, the canal gets straightened usually at that point and the file no longer negotiates the curve but catches on a dead end.¹⁰ There might be a loss of normal tactile sensations of the tip of the instruments binding in the lumen of the canal. Use of preoperative radiographs for anatomy & working length of the canal, knowledge of the anatomy of teeth, good irrigation of the canal with irrigants, attentiveness of the dentist, can be helpful in the prevention of ledge formation. Passive step-back and balanced force techniques are two beneficial

methods of canal preparation that reduce the chances of ledge formation and the only management include – to bypass the ledge, and if it is not possible that is the ledge cannot be passed then the root canal system might be able to be filled by using thermoplasticized gutta-percha and a thin mix of the root canal sealer or periapical surgery with retrograde endodontic treatment is the only option.¹¹

1.2.5. Separated instruments

The limited flexibility, strength of endodontic instruments combined with improper or repeated use may result in an intracanal instrument separation or breakage¹² that include files and reamers, lentulo spirals, Gates-Glidden drills, and burs; but most commonly are files & reamers and these separated instruments can be recognized on the removal of the files or reamers from canal with incomplete patency or with a blunt tip. The proper knowledge of the root canal anatomy and clinical practice firstly on models or extracted teeth, avoid the use to excess force in the canal, inspection of instruments, proper use of lubricants & irrigants can be the preventive measures for instruments breakage in the canals. The optimal management of instrument fracture is retrieval of that separated part from the canal, and if it is bind to the dentin with no symptoms it can be bypassed with proper sealing. Ultrasonic instruments are effective in loosening and flushing out broken fragments of the files or reamers.

1.2.6. Canal blockage

Canal blockage can occur during the process of canal enlargement; files are known to compact debris at the apex; even vital tissue can be compacted against the apical restriction and this results in the shorter working length.¹³

1.2.7. Overextended and underextended root canal fillings

The extrusion of the gutta percha cone beyond the apical limit is the overextension whereas in underextended root canal fillings the gutta-percha or any other obturation material is even not able to reach up to its original working length that shorter obturation. The loss of apical constriction by the perforation is often the cause of overextension. The nerve paresthesia is often the result from the overextension due to overfills. The underextended obturation occurs mainly due to loss of working length as a result of packing dentinal mud into the pulp space without recapitulation or insufficient irrigation, thus copious irrigation is recommended & the radiographs should be taken with gutta percha to confirm the working length of root filling material and, it should be sealed. Whereas, to prevent the overextension use of apical stop is must, proper working length must be taken either with the radiographs or apex locaters.² In cases of overextension, the patient may experience complications such as pain or tissue necrosis¹⁴ which may require pharmacological management like NSAIDs, corticosteroids for pain &

inflammation with reRCT and if the symptoms don't resolve endo-surgeries requires, where tooth with underfilled root canal with necrotic pulp shows poor prognosis and the management for the same is retreatment of the tooth.

1.2.8. Tissue emphysema

The two main causes that can lead to tissue emphysema to happen are: a blast of air to dry a canal, and exhaust air from high-speed drill directed toward the tissue and not evacuated to the rear of the handpiece during apical surgery with the usual sequence of events is rapid swelling, erythema and crepitus.^{1,13} The prevention to the emphysema is to avoid the blow of air in an open canal.

1.2.9. Aspiration

Accidental aspiration during endo procedures can be life threatening to the patient's life in case of airway blockage and requiring ABC & CPR to the patient with medical or surgical intervention. The best way to prevent the aspiration during root canal is to use the rubber dam.

1.2.10. Vertical Root Fracture

Vertical root fracture may occur during compaction of gutta-percha, especially in lateral condensation techniques.¹³ The sudden crunching sound, that is similar to the crepitus in the diseased temporo-mandibular joint, accompanied with pain reaction on the part of the patient, is a clear indicator that the root has fractured.¹ which can be prevented by avoiding over preparation of the canal and the use of a passive, applying limited force during obturation technique and seating of posts.

1.2.11. Irrigant related mishaps

The most common irrigant solution used in root canal procedures is sodium hypochlorite can also result in peri-radicular tissue necrosis especially in an open apex which could be ranged from the mild to severity in intensity. When sodium hypochlorite is extruded beyond the root canal into the peri-radicular tissues, it leads to the chemical burns in turn leading the necrosis of the localized tissues with an acute inflammatory reaction of the tissues develops leading to the rapid tissue swelling both intra orally within the surrounding mucosa and extra orally within the skin and subcutaneous tissues. The clinical features can be pain, swelling, oedema, hemorrhage, secondary infection, hematoma, ecchymosis¹⁵ which are managed by the cold ice pack compress immediately, lavage with copious saline solution from the root canal route so the sodium hypo solution can be rinsed off from peri-radicular areas along with the hydrocortisone injection. In severe cases, referral to the oral & maxillofacial surgeon is necessary.

2. Conclusion

From the above discussion about the different mishaps in endodontic therapy, the only conclusion is that these errors could be either due to lack of knowledge or clinical skills of the dentists especially undergraduate students as well can occur iatrogenically even from well experienced doctors. The only measure to prevent these procedural complications is the well attentiveness of the dentist, good knowledge of the subject along with clinical skills, preventive measures should always be performed on daily basis like inspection of the files to avoid breakage or use of rubber dam helpful in aspiration prevention and many more; the enhancement in theoretical knowledge and its proper application in clinical grounds is the key to prevent or manage these mishaps.

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4. Conflict of Interest

The authors declare that they have no conflict of interest.

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