

Procedural errors in endodontics - A literature Review

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Abstract- Endodontics is the branch to maintain the natural integrity of teeth by removing the microbial flora and cleaning of the root canal either surgically or non surgical endodontic procedures followed by restoration of teeth. Due to lack of knowledge or its poor application in clinicals, it may leads to number of accidental errors, during the root canal therapy. This must be prevented or managed to provide a successful endodontic treatment and to maintain the natural integrity of teeth. This article must provide a detailed information regarding the Endodontic mishaps and their management.

Key words: Missed canals, Perforation, Ledge formation, Emphysema, Pain

1.Introduction

Endodontics is the branch of dentistry which deals with maintaining the natural integrity of teeth removing the microbial flora and cleaning the root canal either surgically or non surgical root canal treatment followed by restoration. The main aim of the treatment is to preserve the vitality of tooth and pulp and periapical tissues. Due to lack of knowledge, there is a high occurrence of endodontic mishaps. So This article may provides a wide information about Endodontic mishaps and their management.

1.1.Classification of procedural errors in endodontics

Related to access opening of the pulp space:[1]

1. Treating the wrong tooth
2. Incomplete removal of caries
3. Inability to locate extra canals/ missed canals
4. Iatrogenic perforations {cervical perforations}

Related to canal shaping and cleaning: [2]

1. Canal blockage and ledge formation
2. Deviation form normal anatomy: Zipping, Transportation, Elbow
3. Instrument separation in the canal
4. Obstruction from previous obturating material

Procedural errors from obturation:[3]

1. Under filling of GP
2. Over filling of GP
3. Vertical root fractures
4. Nerve parasthesia

Miscellaneous:

1. Tissue emphysema
2. Post space Perforations
3. Aspiration or ingestion of endodontic instruments
4. Irrigant related mishaps
- 5.

1.2. Brief description about Mishaps occuring during endodontic Procedures

1.2.1. Treating the wrong tooth

Treating the wrong tooth may occur due to misdiagnosis of the diseased tooth and this in turn may Have pain and other symptoms. This may be completely due to improper diagnosis of the diseased tooth.[4]

Management: This can be solved by making incorrectly opened tooth as well as the treatment of the diseased tooth. Also one examiner should need to be thorough with patient history, clinical examination, radiographic details, other investigations and with a proper diagnosis and isolation before treatment.

1.2.2. Missed canals

One of the major cause of failure in RC treated tooth is due to missing the canals. Sometimes the additional canals remains inaccessible (or) not easily accessible to the dentists and results in endodontic failure and leads to worsened symptoms[2]. It may be due to (a)failure to externalise internal anatomy; (b) lack of knowledge of dental root canal anatomy and it's configurations; (c)due to improper access and not understanding the basic cavity design.[4]

Management: The dentist must need to visualise a good periapical radiograph to understand the morphology of the tooth structure.

1.2.3. Incomplete removal of caries

Secondary caries beneath the restoration must be studied under the pre operative radiograph under good magnification and lighting. This is the most commonest error which can cause re-infection. If there is any doubt regarding the Restoration, the entire filling must be removed and the cavity must be redesigned. In case of distal caries, mesial type of access cavity preparation, if concentrated more then it may leads to incomplete removal of caries. Such teeth may gets re-infected and may cause coronal leakage.

Management: It can be managed by doing re-endodontic procedure by removal of all the endodontic material restored.

1.2.4. Canal perforations

A direct perforation is a channel or communication between the root canal space and surrounding cementum. Such a perforation can result in the destruction of cementum and the irritation and/or infection of the periodontal ligament in the surrounding area. As with ledging, perforation of curved canals is associated with stiff instruments with sharp cutting tips used in a rotational motion. Depending on the location, a perforation cannot easily be sealed and/or bypassed, which results in an inadequately prepared and sealed root canal. A perforation that occurs along the inner wall of a curved root canal is referred to as a "strip perforation".[3] This results from over-preparation and straightening along the concavity and is of particular concern in the mesiobuccal roots of maxillary molars and mesial roots of mandibular first molars. The root walls facing the furcal aspect of roots are often extremely thin and are therefore termed "the danger zone".[8]

Management: 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 haemostatic agents such as geofoms and mineral trioxide aggregate (MTA), of which MTA has very convincing effects for repair. 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 favourable Environmental conditions of the oral cavity like in case of no Contamination especially light cure GIC as it is less sensitive To the moisture.

1.2.5. Canal blockage and ledge formation

Canal blockage can occur during the process of canal preparation. Files are known compactible to produce the debris at the apical portion of the root structure.[13][20]

Management: Always use a small instrument for canal Preparation and should need to increase the size of instrument gradually. Recapitulation should be done frequently.

A ledge is an iatrogenically formed irregularity in the root canal space which may impedes access of the instruments and sometimes irrigants to 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.[10]

Management: There may be a mild loss of tactile sensation of the tip of instrument binding in the lumen of the canal. Use of a preoperative radiograph can easily able to predict the ledge formation. With the good knowledge of dental anatomy, understanding the working length which was determined previously, good irrigation into the canal prepared, attentiveness to the dentist will help in preventing from ledge formation. Two beneficial methods are passive step back technique and balanced forces techniques will lead in preventing the ledge formation. To bypass the ledge, if it is not Possible root canal system might be able to be thermoplastized Gutta percha and a thin mix of zinc oxide eugenol root canal sealer (or) periapical surgery with retrograde filling material.

1.2.6. Transportation and Zipping

Canal transportation is a sustained deviation of long axis of the tooth during instrumentation. Apical canal transportation is described as the removal of canal wall structure on the outside curve in the apical half of the canal due to the tendency of files to recover to their original linear shape during canal preparation.[17] As a result, the main axis of the root canal is transported away from its original axis. Other terms for canal transportation include "canal straightening" and "zipping". Stiff endodontic instruments, particularly large-sized stainless steel files, tend to exert elevated lateral forces in curved canals and can result in straightening, especially in the middle and apical thirds.[19][20] This straightening or transportation can create problems with canal cleaning, obturation and, ultimately, healing. Apical canal transportation can cause enlargement of the apical foramen, which

compromises the apical seal. Lack of an apical stop might result in extrusion of irrigants and/or obturation materials and cause irritation to the peri-radicular tissues. [18]

Management: This can be managed by removing all the Gutta Percha from the canal and should need to irrigate well. Patient is kept under observation for 1 week. After that re RCT should be done. Aliter, we can able to do periapical flap surgeries. A case have been reported in Government dental college and Hospital, Kerala showing Type 3 canal transportation. This had been managed by doing a periapical surgery under LA and rectangular incision placed. This reveals both non surgical and surgical management helps in managing canal transportation.

1.2.7. Instrument Separation

A common problem with the use of rotary files is the potential risk of separation or breakage within the canal. In most clinical situations, most likely the breakage of the instrument occurs in the apical third of the canal and the remaining portion is very difficult or impossible to remove. Attempts on removal of the broken instrument from the canal may leads to perforation. The broken fragment left behind the apical portion results in inadequate cleaning, shaping and obturation. [12]

Fracture of Rotary instruments occurs due to torsional overload or fatigue through flexure. The torsional fracture occurs when tip or any other part of instrument binds with the canal while the handpiece keeps turning. If the binding occurs and elastic limit of metal exceeded, fracture of the instrument occurs. [12]

Management: The treatment of cases with a separated instrument can either be conservative or by surgical management. Conservatively, a) bypass of the fragment; b) Removal of the fragment; c) Instrumentation and obturation coronally to the fragment. It is also to be advised to manage with a combination of ultrasonic instrumentation and operative microscope for an easy handling and better prognosis. Prognosis of the treatment depends on the microbial periapical infection and the quality of obturation.

1.2.8. Obstruction from previous obturating material

Obstruction may occur in the endodontically treated tooth which may be due to improper preparation of the canal. In these cases, the patient is advised for retreatment of the tooth either surgically or conservatively. The main aim of the retreatment is to bypass or remove the material and to reobturate. In few cases, it may be considered as Root Canal Failure tooth and it will be advised for extraction. Mostly, the main aim is to preserve the natural integrity of the tooth structure. In cases with hopeless prognosis will be referred to the extraction. [2]

Gutta Percha: It can be removed by applying a mechanical forces in the form of instrumentation and canal orifices are reopened mechanically by forcing No 20 or 25 H file through the orifice or Gates Glidden Drill. Heat the seat and soften the Gutta Percha with an excavator. Solvents are used to assist the sequential instrumentation, and used carefully. In general it is not recommended for apical third. On those cases, we can advise for ultrasonic instrumentation. The combination of both gives a good net result of removal of material.

Silver cones: In general, it can removed easily as GP unless the butt end of the silver cone extends into the pulp chamber which is vibrated with an ultrasonic scaler to break the cementing media. Cone is then ceased with a pair of narrow breaking pliers. If the cone extends slightly into the pulp chamber, it can often be made loose by vibrating with an ultrasonic scaler.

1.2.9. Underfilling of GP

It may be due to instability to seat the master cone to the estimated working length. It occurs due to loss of working length due to accumulation of dentinal mud in the pulpal space. [16]

Management: It can be managed easily by doing recapitulation and saline irrigation of the canal.

1.2.10. Overfilling of GP.

This may happen due to over apical preparation or instrumentation beyond the constriction. [16]

Management: This can be managed by a good periapical radiograph and should need to remove the material. After that, it should need to be re-obtured the canal orifices.

1.2.11. Vertical Root Fracture

Vertical root fracture is one of the commonly associated procedural error in endodontics. According to American Association of Endodontics, A Vertical root fracture is a longitudinally oriented root fracture that originates apically and propagates to the coronal part. [1] It is very important to diagnose the vertical root fracture under a good periapical radiographs. [13]

Management: This can be avoided by limiting the preparation of the canal. It can be easily managed by either surgical or non surgically. We can advise the patient for the root canal treatment. But the demerit is that the patient wants to visit the dentist for a longer time of reviews. Also, we can advise the patient for a periapical surgery to preserve the vitality and the natural integrity of the tooth structure. In case of hopeless prognosis, we can also simply extract the tooth and should need advise them for a prosthetic FPD.

1.2.12. Nerve parasthesia

Generally, endodontical management of mandibular posterior teeth has a higher risk of damaging the inferior alveolar canal. This may leads to parasthesia. It may be temporary or permanent. Also on performing root canal management in mandibular canine and premolar region, there is a high chance of traumatizing the mental nerve

leading to parasthesia. It may be presented with the pain and swelling. The pain may be characterized as burning, tingling, prickling, numbness etc. Over- preparation of the root canal and violation of apical foramen may leads to nerve injury and may cause parasthesia.[2]

Management: Patient have been advised for immediate management of the nerve injury. This may be pharmacologically or surgically. Generally, it may be treated with dexamethasone 0.5mg for 3 days and other oral methylcobalamine supplementation for enhancing the neural stimulation. In case of failure of improving the function of the nerve, then the patient is advised for microsurgery of the nerve for a speedy recovery.

1.2.13. 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 tissues and should not be evacuated to thw rear of handpiece during apical surgery may leads to the presenting complaints like rapid swelling, erythema and crepitus etc.[1][13]

Management: It can be easily prevented by avoiding the air blowing into the open canal.

1.2.14. Aspiration

Accidental aspiration during the endodontical procedures is one of the life threatening severities to the patient's life leads to airway blockage.

Management: An immediate Requirement of Basic Life support management by maintaining the airway, breathing and circulation and to provide Cardiopulmonary resuscitation for the patient. The best way to prevent aspiration is to perform the procedure under a good isolation by rubber dam.

1.2.15. Irrigant related mishaps

The most commenest irrigant used in the endodontic procedure is sodium hypochlorite which may results in periradicular tissue showing manifestations of swelling and pain over the facial. It may be due to the forceful irrigation into the canal. [15]

Management: This can be easily managed by changing the irrigant and by irrigating the canal at normal force. Patient is advised for antibiotic medications for the subsiding of infection.

1.2.16. Post space perforations

An Iatrogenic perforation during the preparation and flaring of the obturated canals with the intention of placing prosthesis of post endodontic restoration.

Management: Generally, the perforation initially diagnosed with a good periapical radiograph and it may shows some kind of periapical pathologies. This can easily managed by root end filling by MTA. After years, the patient is asked to visit the dentist for a review after 1 month and also on 8th month. This may reveals drastical change in the periapical pathologies.

2. Conclusion

A dentist must be able to perform every clinical steps in every procedure by following all the aseptic protocols and steps followed. So in case of any deviation of procedures the above iatrogenic errors may happen. So , this review helps the dentist to acknowledge the procedural errors and they can able to learn how to rectify the errors.

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