REVIEW ARTICLE

Endodontic Failures and its Management: A Review

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ABSTRACT

The main goal of endodontic treatment is the correct diagnosis, optimal mechanical and chemical preparation and three-dimensional obturation of the root canal. The causes of the endodontic failures can be variations in the anatomy of the teeth, the presence of additional root canals, lateral canals, depend on technical, biological and iatrogenic factors which contribute to accomplishment of treatment. Knowing and understanding the relation between these factors may help in increasing the chances of preventing the possible endodontic treatment failures.

KEYWORDS: Root canal treatment, Endodontic Failures, Root Canal Retreatment

INTRODUCTION

The general purpose of the endodontic treatment is to maintain teeth duration as long as possible in the oral cavity. The main purpose of root canal treatment is to fill up or block all root canal and to form a fluid-tight seal on the apical foramen of the tooth, so that any possibility of a secondary infection occurrence due to the mouth cavity or periradicular tissue leakage into the root canal system can be avoided.[1] The necessity for properly filling the canal seems obvious, once cleaning, shaping and disinfection are completed, yet ineffective obturation is often a prelude to eventual endodontic failure.[2]

For symptoms such as fistulation, swelling, pain, percussion, tenderness, discomfort during chewing and in cases in which the apical lesion becomes larger or is not diminishing retreatment is indicated. The goals of nonsurgical retreatment are to remove materials from the root canal space.[3]

ETIO-PATHOGENESIS OF ENDODONTIC FAILURE

Even though endodontic procedures have relatively high success rate compared with other disciplines, it is unwise to guarantee a perfect result even when procedures have been performed with the greatest of care. It is most important to understand the mechanisms of failure so that it can be recognized and dealt in an appropriate fashion. The causes of the endodontic failures have been classified into three phases:-

I. Factors resulting in failures prior to root canal treatment

1. Incorrect diagnosis
2. Technical difficulties
3. Vertical root fracture
4. Systemic diseases

II. Factors resulting failures during root canal treatment

1. Anatomical variations
2. Missed canal
3. Ledge formation
4. Infections
5. Poor debridement
6. Mechanical and chemical irritants
7. Access preparation
8. Improper obturation
9. Overfillings of root canals
10. Furcation perforations

III. Factors Resulting in Failures after Root Canal Treatment

1. Failure following retreatment
2. Failure following surgical retreatment

IV. Miscellaneous

1. Nerve paresthesia
2. Tissue emphysema
3. Instruments aspiration and ingestion

DIAGNOSIS OF ENDODONTIC FAILURE

The most accurate determinations of healing and nonhealing are based on sign and symptoms, radiographic and histologic examinations. [7]

Clinical Examination: Signs and/or symptoms, if marked and persistent, are probably indications of disease and failures. Persistence of adverse significant signs (e.g., swelling or sinus tract) or symptoms (e.g., spontaneous pain, dull persistent ache or mastication sensitivity).

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indicates endodontic failures.[9]

Radiographic Findings: The importance of radiographic evaluation in determining endodontic success or failure cannot be overemphasized. It is a universal tool in the assessment of treatment results without which no claim of success could be justified. Since the radiographic evaluation plays a basic role in the assessment of treatment results, any fallibility associated with the interpretation of radiograph directly distorts the reported rates of success and failure.[4]

Histologic Examination: Routine histologic evaluation of periradicular tissues after root canal treatment is impractical and not possible without surgery. If treated tooth were to be evaluated histologically, successful treatment would be indicated by reconstitution of periradicular structures and an absence of inflammation.[8]

CRITERIA FOR CASE SELECTION IN ENDODONTIC FAILURE

The purpose of case selection is to determine the feasibility and practicality of treatment, so as to avoid treating cases that will fail regardless of the quality of treatment.[10]

Diagnosis: The presence or absence of periradicular disease is determined according to clinical and radiographic findings. Differential diagnosis of non-endodontic disease is also considered.[11]

Selection of Treatment: Currently, the patient ultimately selects the treatment, based on information communicated by the clinician.[8]

Treatment of Existing Disease: Post-treatment disease definitely requires intervention, even when symptoms are absent. When treatment is preferred over extraction, re-treatment and apical surgery should be considered for both. Comparing the two modalities, retreatment offers a greater benefit and better ability to eliminate the disease's etiology (root canal infection) with minimal invasion and a smaller risk such as significantly less postoperative discomfort and a lesser chance of injuring nerves, sinuses or other structures. Therefore, case selection is based on patient, tooth and clinician considerations that either preclude retreatment or restrict its feasibility in a way that decreases the potential benefits and increases the potential risks; the modified benefit-risk balance may not outweigh that of apical surgery.[12]

ENDODONTIC MISHAPS AND THEIR PREVENTION

1. Incorrect Diagnosis

Incorrect oral examination leading to incorrect diagnosis is usually due to an interpretation of pain, vitality test and radiographs.

Recognition-The wrong tooth has been treated is sometimes a result of re- evaluation of a patient who continues to have symptoms after treatment.[6]

Correction- Treating the wrong tooth includes appropriate treatment of both teeth i.e.; the one tooth incorrectly opened and the one with the original pulpal problem.[13]

2. Missed Canal

Some canals are not easily accessible or readily apparent from the chamber.[6]

Recognition- Missed canal occurs during or after treatment. 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.[14]

Correction- Retreatment is appropriate and should be attempted before recommending surgical correction.[6]

3. Access cavity perforations

One of the irreversible complications of endodontics is perforation into the furcation area while gaining access to pulp chamber of tooth.[15]

Recognition- If the access cavity perforation is above the periodontal attachment, the first sign of the presence of an accidental perforation will often be the presence of leakage: either saliva into the cavity or sodium hypochlorite out into the mouth, at which time the patient will notice the unpleasant taste.

Correction- Several materials have been recommended for perforation repairs such as cavit, amalgam, calcium hydroxide paste, super ethoxy-benzoic acid (EBA), glass ionomer cement, gutta-percha, tricalcium phosphate or hemostatic agents such as gelfoam and mineral trioxide aggregate (MTA) which has shown convincing results in apical cavity perforations.[6]

4. Apical perforations

Perforations in the apical segment of the root canal may be the result of file negotiating a curved canal or not establishing accurate working length and instrumenting beyond the apical confines. A paper point when inserted to the apex, will confirm a suspected apical perforation.[16]

Recognition- An apical perforation should be suspected if the patient suddenly complains of pain during treatment, if the tactile resistance of the confines of the canal space is lost. A paper point inserted to the apex will confirm a suspected apical perforation.[6]

Correction- Effort to repair apical perforations may be to attempt to renegotiate the apical canal segment or to consider the perforation site as the new apical opening and then decide what treatment the untreated apical root segment will require.[17]

5. Crown Fractures

The tooth may have a preexistent infarction that becomes a true fracture when the patient chews on the tooth weakened additionally by an access preparation. Such fracture is usually recognized by direct observation.

Correction-Crown fractures usually have to be treated by extraction unless the fracture is of a **"chisel type"** in

which only the cusp or part of the crown is involved; in such cases, the loose segment can be removed, and treatment completed.[6]

6. Separated Instruments

Limited flexibility and strength of intracanal instruments combined with improper use may result in an intracanal instrument separation.[8]

Recognition- Removal of small size file with a blunt tip from a canal and subsequent loss of patency to the original length are the main clues for the presence of a separated instrument.

Correction- The optimal correction of instrument fracture or the presence of other foreign objects in a canal is to remove the obstruction. Ultrasonic fine instruments have proven most effective in loosening and "flushing out" broken fragments. Using microscopy and special fine diamond tips a tunnel can be created around the separated instrument, which can then be vibrated and dislodged.[6]

7. 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. Suddenly, working length is shorter because the instruments are working against the packed mass at the apex.[5]

Recognition-When the confirmed working length is no longer attained canal blockage is recognized. Evaluation radiographically will demonstrate the file is not reaching near the apical terminus.

Canal blockage corrections are accomplished by means of recapitulation. Starting with the smallest file used, the quarter turn technique using a chelating agent can be helpful.[6]

8. Over or Underextended Root Canal Fillings

Root canal filling material is sometimes inadvertently extruded beyond the apical limit of the root canal, ending up in the periradicular bone, sinus or mandibular canal or even protruding through the cortical plate.[18]

Inaccurately placed root canal filling usually takes place when a post-treatment radiograph is examined. Underextended filling is accomplished by re-treatment.[6]

9. Vertical Root Fracture

A sudden crunching sound during obturation is a clear indication for the root fracture. This may occur during compaction of gutta-percha. It occur more often during lateral than vertical compaction.[5]

Recognition- Sudden crunching sound, similar to that referred to as 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.[6] It can be prevented by avoiding over preparation of the canal and the use of a passive, less forceful obturation technique and seating of posts.

10. Tissue Emphysema

It is relatively uncommon but should not be overlooked. Two actions may cause tissue emphysema to happen: 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.[5] The usual sequence of events is rapid swelling, erythema and crepitus.[19]

Correction- Treatment recommended for tissue emphysema varies from palliative care and observation to immediate medical attention if the airway or mediastinum is compromised.[6]

RETREATMENT TECHNIQUES

Numerous techniques have been suggested for retreatment of root canals. They are discussed below according to the root filling materials that are proposed for retreatment.

I. Retreatment of Pastes and Cements

A) Soft-setting pastes- Normally soft-setting pastes do not interfere with the negotiation of the root canal. Therefore, their removal does not require specific techniques. In such cases, instrumentation of the root canal with the use copious irrigation suffices to remove the paste.[4]

B) Hard-setting cements- If possible, hard-setting cements should be dissolved. When this is not possible, their removal may be attempted by either of the following two techniques:

- **i) Dispersion by Ultrasonic Vibration-** Endosonic files are placed in the orifice of the obturated canal and activated with light apical pressure. The ultrasonic vibration pulverizes the cement, while the continuous irrigation flushes out the dispersed particles. This procedure is gradually continued apically, until the entire obturation is removed.
- **ii) Drilling with Rotary Instruments**- Hard cements may be drilled out by rotary endodontic instruments, such as Beutel-rock or engine reamers or by using bur.[4]

II) Retreatment of gutta-percha

A) Techniques for Dissolving Gutta-Percha

1) **Solvents of gutta-percha**- Gutta-percha is soluble in chloroform, methylchloroform, carbon disulfide, carbon tetrachloride, benzene, xylene, eucalyptol oil, halothane and rectified white turpentine.[20]

2) **Hand Instrumentation**- This is the most commonly practiced technique, although it is time-consuming and occasionally yields limited results. By the use of solvent, the canal is negotiated with files or reamers to the desired working length estimated from the preoperative radiograph.

3) **Automated Instrumentation-** This technique is fast and safe and short-filled curved canals may be negotiated beyond the obturation. Thus, a radiograph may be obtained at an early stage, without the need to first instrument the canal extensively to remove the bulk of the material from it. The Canal Finder system also has a built in apex locator that may be used as an aid in preventing overinstrumentation with this technique.[4]
4) **Ultrasonic Instrumentation-** Ultrasonic instrumentation following softening with chloroform does not facilitate the removal of gutta-percha from the root canal, even when continuous irrigation with a solvent is used.[21]

B) Solid Gutta-Percha Techniques

i) **Pulling out gutta-percha-** Reamers or K-files are used to bypass the obturation, and Hedstrom files are engaged into the loosely condensed gutta-percha cones, which are then retrieved in one piece by pulling back the instrument.[4]
ii) **Rotary removal of gutta-percha-**Removal of gutta-percha with rotary instruments is safe only in straight canals.[22]

II. Retreatment of Solid Objects

A) Bypassing with hand instruments- Reamers and files may be used to bypass an obstructing object in the root canal, and solvents can be used to soften its cementation.

B) Bypassing with automated and ultrasonic instruments- Silver cones that cannot be bypassed with hand files may be bypassed and subsequently retrieved by the Canal Finder.

C) Special grasping devices-

i) **Masserann and alternative extractors-** The Masserann kit consists of an extractor into which the object to be retrieved is locked .
ii) **Wire loop technique-** A thin steel wire is inserted into a 25-gauge hypodermic needle. On the sharp side of the needle a loop is formed and on its other side, the free ends of the wires arc pulled to tighten the loop. The needle is placed in the canal so that the loop contacts the broken instrument, and then the loop is tightened and the instrument may be retrieved by pulling the needle back.[4]

CONCLUSION

Endodontic failure still occur despite technological advancements in the field of dental instrumentation and materials. Endodontic procedural errors are not the direct cause of treatment failure. The technological boom in endodontics has provided the methods and instruments that allow successful treatment of teeth with calcified chambers, calcified canals, severe root curvature, ledging, resorptive defects, perforations and canal blockage due to separated instruments. With enhanced magnification by operating microscope, direct lighting, use of ultrasonics, NiTi instruments, multiple delivery systems for obturation, almost all procedural errors during endodontic therapy can be minimized or prevented/ successfully treated with predictable prognosis.

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