European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 07, Issue 5, 2020

AN OVERVIEW ON ROOT PERFORATIONS: DIAGNOSIS, PROGNOSIS AND MANAGEMENT.

Running title: Root perforations: a review

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ABSTRACT:

Root perforations occur most frequently during endodontic treatment procedures, in cases of calcified canals and curved canals which compromise the prognosis of the affected tooth. The prognosis of the perforated tooth depends on the time, location and the size of the exposure. The success of the procedures to repair perforation totally depends on proper diagnosis and sealing of the perforated site. The present article highlights the causes, diagnosis, and management of root perforations.
Keywords: Root perforations, Repair, Endodontic treatment, prognosis

INTRODUCTION

A communication between the root canal system and the external tooth surface is called Root perforation [1]. Perforations cause destruction of the radicular dentine root wall or floor along with the cementum. Health of the periradicular tissues is compromised due to this communication and compromises the vitality of the tooth [2].

Pathological process (dental caries, root resorption) or an operative procedural accident is the possible reason for such accidental errors. During clinical examination pathological perforations are found routinely, whereas iatrogenic root perforations be observed during access cavity opening, root canal preparation or during post preparation[3,4]. During endodontic treatment procedural operative errors occur at any phase, resulting in treatment failure. Previous research shows that 2–12% of endodontically treated teeth are associated with accidental root perforation, which may have serious implications[5].

Once the infectious process is started at the perforation site either from the root canal or from the periodontal tissues it disturbs the healing process, causing an inflammatory process which exposes the supporting tissues to infection, pain and suppurations. If left untreated there

will be the formation of abscess or fistulae and resoprtion in case of chronic condition. Hence, the prognosis of the treatment procedure will become questionable eventually leading to tooth extraction [6]. But with early diagnosis and proper management of the perforation, will lead to long term survival of the tooth. This review aims to discuss the various available treatment options for root canal perforations. It also highlights the diagnosis, prognosis and various materials available to seal the perforation.

DIAGNOSIS AND PROGNOSIS OF ROOT PERFORATION

There are various clinical diagnostic aids to determine root perforations. The basis of diagnosing root perforation is by clinical and radiographic examination[7,8].

If there is persistent bleeding with during coronal access or root canal preparation is a sign of perforation. A paper point inserted into the root canal soaked with blood suggests perforation. Certain incidents may be associated with excessive bleeding include systemic conditions, medications, teeth with an open apex, internal resorption and acute apical periodontitis should not be confused with root perforation[9].

Another method for accurate diagnosis is by applying calcium hydroxide paste in the canals to detect the direction of perforation. If there is crestal perforation, precaution should be taken as it may result in extrusion of the material into the periodontal tissue spaces and produce unnecessary irritation, thus affecting the prognosis of the treatment [10].

Radiolucency associated with a communication between the root canal walls and the periodontal space in a periapical radiograph taken in different angulations gives a hint of this accidental error. The dental operating microscope and Cone-beam computed tomography (CBCT) also aid in detecting perforations during surgical endodontics[11]. A study comparing the sensitivity and specificity of CBCT scans and digital periapical radiographs (PR) shows that both the methods show high risk of misdiagnosis of strip and root perforations[12].

CLASSIFICATION OF ROOT PERFORATIONS:

Fuss and Trope classified root perforations based on the factors affecting the outcome of treatment[10]:

- Fresh perforation treated as soon as possible after first observation under aseptic conditions - Good Prognosis.
- Old perforation, previous perforation not treated which is contaminated with bacteria- Questionable Prognosis.
- Small perforation (smaller than #20 endodontic instrument) trauma to the tissue is small with ease of sealing- Good Prognosis.
- Large perforation usually seen while post preparation, with high amount of trauma to the tissue and there is difficulty in providing an optimum seal, along with bacterial contamination with coronal leakage along temporary restoration- Questionable Prognosis.
- Coronal perforation seen coronal to the level of crestal bone and epithelial attachment with less trauma to adjacent tissues and easy access possible- Good Prognosis.
- Crestal perforation into the crestal bone at the level of the epithelial attachment- Questionable Prognosis.
- Apical perforation, apical to the crestal bone and the epithelial attachment- Good Prognosis

FACTORS AFFECTING THE PROGNOSIS OF PERFORATION REPAIR:

Presence or absence of bacterial contamination at the site of perforation decides the success in the management of perforation[13]. It also depends on other factors like time elapsed from the perforation to the detection of the size and shape of the perforation and also its location. Healing response occurs sooner when the perforation repair is done as soon as possible. Large perforation has poor prognosis and leads to an increased amount of tissue destruction and higher chances of contamination from the oral cavity. Small perforations are easier to seal and shows faster healing[14]. A perforation close to the crestal bone and to the epithelial attachment is very crucial as there is more chances of contamination from the oral environment through the gingival sulcus. It is easier to access and repair perforations coronal to the crestal bone and the teeth may be restored without periodontal involvement. Good prognosis is observed when perforations are apical to the crestal bone and epithelial attachment; however prognosis depends upon cleaning, shaping and obturation procedures [13]. According to a study furcal areas in molars are more troublesome as there is an increased chance of periodontal involvement and tissue destruction[4].

MATERIALS USED TO REPAIR PERFORATION

The repair material should be biocompatible as it is kept in close contact with hard tissue and the structures of periodontium. Several intracanal medicaments have been studied to treat the infected root canals. Among which Calcium hydroxide has been extensively utilized and shows promising results [15]. Nowadays, the selection of material for root perforation is focused more on the ability to demonstrate antibacterial potential for infection control of the root canal system promoting the healing by mineralized tissue deposition and sealing ability[16].

The various materials with the potential of repairing perforation are described below:

1. Mineral trioxide aggregate

Mineral Trioxide Aggregate (MTA) was introduced in 1990 in Endodontics. It is an ideal material for perforation repair. MTA is a mineral powder that contains dicalcium silicate, tricalcium of silica aluminium and oxide along with other mineral oxides[17]. A study states that MTA provides an optimum repair of tooth perforations and enhances the prognosis of perforated teeth[18] with the ability to induce hard tissue formation [19]. MTA shows lesser bacterial leakage, biocompatibility and better adaptation to cavity walls which makes it a useful material in sealing the root and furcal perforation[20].

MTA has difficult handling, slow setting of 3-4 hours, and gets soluble when in contact with oral fluids. The two commercially available MTA are: MTA angelus and ProRoot MTA. MTA Angelus has shorter setting time compared to MTA pro-root according to manufactures.

2. Calcium silicate based cements (biodentine)

It is available in a powder liquid system. The powder contains Tri-calcium silicate, Dicalciumsilicate, Calcium carbonate and oxides such as Iron oxide, Zirconium oxide and Liquid consist of Calcium chloride, Hydro soluble polymer. It shows shorter setting time approximately 12 minutes, easy to manipulate with high alkaline pH. This makes it a biocompatible material and a favorable material for perforation repair [21].

3. Endosequence

It is a bioceramic cement with particle size less than 2 µ, which enables the material to enter in the dentinal tubules and initiates the setting reaction by interacting with the moisture and creates a mechanical bond on setting and makes it dimensionally stable. Published research on furcation repair with Endosequence, biodentine and MTA, showed that endosequence has better sealing ability compared to others [22].

4. Bioaggregate

It is also a bioceramic cement composed of tricalcium silicate, dicalcium silicate, calcium phosphate monobasic, amorphous silicon dioxide and tantalum pent oxide.A study suggests that bioaggreagate has the capacity to promote mineralized tissue formation and precipitation of apatite crystals that become larger which increases the immersion time suggesting it to be bioactive [23].

5. Calcium enriched mixture (CEM)

This bioactive material is a mixture of calcium oxide, calcium phosphate, calcium carbonate, calcium silicate, calcium sulphate, calcium hydroxide and calcium chloride. It forms greater amount of calcium and phosphate ions thus producing higher concentration of hydroxyapatite. A study proved that CEM has the ability to cause cementogenesis and periodontal regeneration during perforation repair [24].

6. **Repair using internal matrix**

Research observed a positive outcome in teeth with open apices using collagen sponge as a barrier prior to the apexification with MTA [25]. Another in vitro study on female baboons was conducted to compare the healing at the perforation site with and without internal matrix, it was seen that there was a marked extrusion of the material when matrix was not used and also the healing was compromised throughout their experiment [26,27].

CONCLUSION

During endodontic procedures root perforations should be avoided. Good prognosis of the perforation requires proper knowledge regarding the size, site, time and various materials that are used to seal the perforation**.** The operator should be skilled enough to deliver materials used for perforation in order to obtain permanent seal between the peridontium and root canal system. Hence, proper diagnosis alongwith proper treatment planning is required for adequate healing of the perforation defect.

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