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Review Article

Management of root perforation: A review

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ABSTRACT

The aim of this review is to discuss the etiology, classification, diagnostic methods, treatment methods, and significant factors for prognosis. The objective is to review the literature through electronic search and hand articles regarding etiology, classification, diagnostic methods, methods of management, and significant factors for prognosis. Root perforation causes communication of tooth to the surrounding tissues which may act as the source of infection if left untreated. Treatment of perforation at the right time reduces the risk of teeth from being severely infected. One should know how to manage perforation to minimize the infective factor damaging the tooth. Successful treatment of root perforation with proper diagnosis and treatment reduces the risk of infection.

Keywords: Perforation, diagnosis, management

Introduction

Perforation is an artificial opening between the root canal system and the surrounding tissues of teeth, which are either created by the clinician during entry into the root canal system and during cavity preparation or by a biological event such as resorption or caries, resulting in communication between root canal and periodontal tissues.

Fuss and trope defined root perforation as an artificial communication between root canal systems to the supporting tissues of teeth or to the oral cavity.[1]

Root perforations were the second greatest cause of failure accounting for 9.62% of all unsuccessful cases.[2] Seltzer *et al.* also attributed 3.52% of all endodontic failures to perforation.[3] This perforation if left untreated leads to act as a pathway for microorganisms either from periodontal tissues or perforation site, results in secondary periodontal infection, suppuration, fistula formation, and prognosis of that infected teeth become questionable and which leads to extraction of teeth. This review discusses the etiology, classification, diagnosis, significant factors in prognosis, and treatment options.

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Etiology

The causes of perforation can be of iatrogenic and non-iatrogenic.[4] Iatrogenic perforation occurs due to lack of knowledge about the internal anatomy of tooth structure and in the failure of analyzing the possible variations in root canal system. Iatrogenic perforation can occur in any level of endodontic treatment.

During access cavity preparation, due to misaligned use of rotary burs without appreciating the angulation of the tooth and search for other root canal orifices. It occurs mostly at coronal level of the tooth. During negotiating of calcified and curved canals, the lateral extension of the canal preparation called strip perforation, and during post-space preparation, over instrumentation of rotary instruments causes apical or crestal perforations of root canal wall, which is also called as strip perforation.[4] During cleaning and shaping procedure, the perforation may occur in coronal, middle, or apical third of the root.

Non-iatrogenic perforation occurs due to internal or external resorption,[4] trauma, and caries mostly involving the furcal area.

Classification

Based on factors impacting the outcome of treatment, fuss and trope classified perforation as follows:[1,4]

Based on time

a. Fresh perforation: Fresh perforation occurs during operative or endodontic procedure characterized by fresh blood at the site of perforation. If treated immediately, it has a good prognosis.
b. Old perforation: The untreated perforation acts as a source of infection either from periodontium or by secondary caries.

Based on size

a. Small perforation: These are smaller than size 20 endodontic instrument and have a good prognosis.
b. Large perforation: It occurs during post-space preparation, and due to salivary contamination and coronal leakage, these have a questionable prognosis.

Based on location

a. Coronal perforation: These are perforations that occur coronal to crestal bone and epithelial attachment and have a good prognosis.
b. Crestal perforation: These occur at the level of epithelial attachment into the crestal bone, and these have a questionable prognosis.
c. Apical perforation: These occur apical to the crestal bone and epithelial attachment and have a good prognosis as there is less risk of salivary contamination.

Diagnosis

Location and presence of perforation can be determined by the study of Tsesis and Fuss:[4]

1. Radiographs
    - X-ray
    - Digital radiography.
2. Sudden bleeding and pain during instrumentation of root canals or post preparations.
3. Electronic apex locator.
4. Appearance of blood on paper points.
5. Dental operating microscope.

Management of perforation

Successful perforation management is achieved by sealing the perforation immediately or as early as possible, type of material used, location of perforation, and by adequate sealing the perforation. There are two types of management of perforation, by non-surgical approach or surgical approach.

Non-surgical management

Non-surgical management of perforation includes orthograde approach, management of crestal root perforation, intentional replantation, and iatrogenic perforation.

Orthograde approach

Fresh perforations that occur during endodontic and operative procedure are followed by hemorrage. Hemorrage can be controlled first by applying pressure or irrigation and perforation should be sealed adequately.[4]

Bleeding can be controlled using hemostatic agents and materials that arrest bleeding.[5] To control bleeding, calcium hydroxide can be syringed into the canal and allow to remain for 4–5 min and then flush calcium hydroxide using NaOCl, repeat this procedure for 2–3 times.[6]

Other hemostatic materials used to control bleeding are collagen, calcium sulfate, freeze-dried bone, and mineral trioxide aggregate.[5,7,8] Calcium hydroxide material is used for perforation management.[9]

Absorbable barrier materials used are collagen and calcium sulfates. Non-absorbable barrier materials are mineral trioxide aggregate (MTA),[10] super EBA, resin cement, composite bonded restoratives, and calcium phosphate cement.

Management of Crestal Root Perforation

Sealing should be done with any biocompatible material with short setting time and good sealability properties. For single-rooted teeth, orthodontic extrusion is recommended to bring the perforation to a coronal position so that it can be sealed externally without surgical intervention.[4]

Internal matrix technique is suggested for large perforations in the furcal region of molars to avoid extrusion of repair material.[4,11] MTA,[12] iRoot BP,[13] calcium-enriched mixture cement,[14] Pro-root MTA,[15,16] and biodentine[17] are considered as the best material for furcation perforation. MTA and calcium-enriched mixture cement induce the formation of cementum-like tissue.[18] For crestal root perforations, biodentine is considered to be the best material.[19] The use of stem cells with treated dentin matrix in the management of perforation enhances bone formation.[20]

Intentional replantation

It is considered when orthograde and surgical treatment are not possible. It is indicated when perforation is too large for repair and inaccessible without excessive bone removal.[4]

Atraumatic extraction of the tooth should be done without damaging the surrounding tissues. After removal, tooth should be held in forceps and bathed gently in a balanced salt solution. Replantation should be done as quick as possible.

Complications are inflammatory root resorption and ankylosis.

Iatrogenic perforation

The more apical the perforation, the prognosis will be more favorable. Perforations occurring in the coronal one-third of the root below the crestal bone has a poor prognosis.[11] MTA can be used as a obturating material and perforations located at the level of epithelial attachment and bone in case of strip perforation.[21]

Surgical management

Surgical approach is done in cases of large perforation, perforation as a result of resorption, and failure of healing after non-surgical repair. Parameters considered before surgical management are the amount of bone remaining, extent of osseous destruction, duration of defect, periodontal disease status, attachment level of soft tissue, oral hygiene, and surgeons expertise in tissue management.[4] Guided tissue regeneration is attempted to manage perforation.

Buccal full-thickness flap is raised for visibility of perforation site. Perforation is then sealed with MTA; then, sutures are placed on the flap. After healing, surgical wound sutures are removed, and then, the post can be cemented.[22]

Multidisciplinary treatment approach

In multidisciplinary approach, sequential procedures include conventional endodontic retreatment, an initial orthograde sealing of perforation, guided tissue regeneration, and resealing of perforation with ketac-endo and intermediate restorative material.[23]

Old-to-new materials used in repair of perforation

There are various materials used in perforation repair such as indium foil, amalgam, plaster of paris, zinc oxide eugenol, super EBA, intermediate restorative material, gutta-percha, cavit, glass ionomer cement, metal modified glass ionomer cement, composite, dentin chips, decalcified freezed dried bone, calcium phosphate cement, tricalcium phosphate cement, hydroxyapatite, calcium hydroxide, portland cement, MTA, biodentine, endosequence, bioaggregate, and new endodontic cement.[24]

Microscope in management of perforation

Microscope enhances the visibility of perforation in a magnified field. It helps in locating even smaller perforation site so that it can be treated earlier preventing from future infection.

It helps mainly in sealing the cervical perforation with vitremer, iatrogenic cervical perforation during access preparation.[25]

Significant factors for prognosis

Time

Early treatment of perforation has a good prognosis. If perforation left untreated, it leads to secondary inflammation of periodontal attachment and leads to tooth loss.[26]

Size and shape of perforation

Smaller the size of perforation, better will be the prognosis.[27]

Location

Perforation located near gingival sulcus promoting inflammation and loss of epithelial attachment results in pocket formation.[28] Perforation locating away from gingival sulcus in healthy periodontium has a fair prognosis.[29]

Conclusion

The perforation management should be decided on the above-discussed factors. Thus, the clinician should have a thorough knowledge of the anatomy of tooth to prevent the chances of perforation. With the advent of newer materials and techniques for sealing, the clinical management and prognosis have been improved.

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