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Causes, Diagnosis, Treatment And Prognosis Of Root Perforations

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ABSTRACT
A perforation is an artificial communication that occurs between the root canal system and the tissues enclosing a tooth. It can be made by the dentist during tooth preparation and passage into the root canal system, or it can happen naturally due to resorption or dental decay and cause connectivity between the root canal and periodontium. Both iatrogenic and non-iatrogenic factors can lead to a root being perforated. Most often, it happens at the coronal aspect of the tooth. Iatrogenic perforations can always be distinguished by the extensive bleeding that occurs after thewound. Serous discharge or fistula from the perforated site, sensitivity on percussing, isolated periodontal pocketing, and chronic gingivitis when the inflammation has reached the alveolus can all be signs of unresolved perforations. Cone beam computed tomography can be used to correctly identify and evaluate resorbing lesions and subsequent perforations. Successful perforation management involves adequately sealing the breach, using the right material, and closing the perforation in the right place as soon as feasible. Perforation management can be done in one of two ways: non-surgically or surgically. The prognosis of teeth with root perforations that have had endodontic treatment relieson a number of variables, including the amount of time that passed before the defect was sealed, the site of the perforation, the effectiveness of the perforation seal, and the size of the perforation. Due to the poor prognosis, teeth with suboptimal periodontal health or those with very wide perforations may be extracted

Keywords : Perforation, Diagnosis, Management.

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INTRODUCTION

A perforation is an artificial communication that occurs between the root canal system and the tissues enclosing a tooth. It can be made by the dentist during tooth preparation and passage into the root canal system, or it can happen naturally due to resorption or dental decay and cause connectivity between the root canal and periodontium. Root perforations were described by Fuss and Trope as "an artificial communication between root canal systems and the tissues anchoring teeth or the oral cavity".[1] Root perforations account for 9.62% of all failed treatments and were the second most common reason for failing. Seltzer et al also ascribed perforation as the cause of 3.52% of all endodontic failures.[2] If this perforation is not addressed, it can act as a possible path for pathogens from the periodontal tissues or the location of the perforation, causing secondary periodontal infection,abscess, fistula emergence, and a doubtful prognosis for the afflicted teeth that eventually results in tooth extraction.[3] The etiology, diagnosis, prognosis, and available treatments are covered in this review.

LITERATURE SEARCH

This study is based on a comprehensive literature search conducted on October 30, 2022, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database.

To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. Welooked for valuable information in papers that discussed the information about causes, diagnosis, treatment, and prognosis of root perforations. There were no restrictions on date, language, participant age, or type of publication.

DISCUSSION

According to reports, root perforations occur somewhere between 3% and 10% of the time.[1,3,4] Nonetheless, it is not an unfounded prediction that there would be a rise in the incidence of perforations in the coming years as more difficult endodontic treatments are performed.[1]Kvinnsland et al estimate that 53% of iatrogenic perforations happen at post insertion and the other 47% happen during normal endodontic therapy.[5] 73% of incidents involved the maxilla, with the remaining occurrences involving lower arch. According to research, all perforations in upper anterior teeth were discovered to be at labial root facet because clinician underestimatedthe palatal root incline. Yet, in a multi-rooted tooth, furcation may get perforated as dentine is taken out of thepulp chamber floor while looking for the canal orifices.

Etiology

Both iatrogenic and non-iatrogenic factors can lead to a root being perforated.[6] Iatrogenic perforation happens asa result of a lack of understanding of the internal architecture of teeth and a failure to consider potential changes to the root canal system. Any stage of endodontictherapy can result in iatrogenic perforation. Due to improper use of rotary burs at the time of access cavity preparation and searching for additional root canalorifices, the tooth's angulation is often not taken into due consideration. Most often, it happens at the coronal aspect of the tooth. Strip perforation is the term for the lateral extension of the canal preparation used when negotiating calcified and curved canals.[6] Strip perforation is also used to describe the perforations at apex/ crest of root canal wall caused by excessive instrumentation at thetime of post-space preparation. The coronal, middle, or apical third of the root may perforate while the root canal is being cleaned and shaped. Internal/ external resorption, trauma, and caries-mostly affecting the furcal area-are themain causes of non-iatrogenic perforation.[6]

Diagnosis

Iatrogenic perforations can always be distinguished by theextensive bleeding that occurs after the wound. When a perforation develops at the coronal part of the tooth, it is frequently visible immediately. However, a paper point pushed into the canal occasionally demonstrates the bleeding when a strip or apical hole arises further within the canal. A perforation may also be indicated by unexpectedly severe discomfort during treatment if local anesthesia is not administered. Apex locators are excellent tools for finding perforations. When the file is placed on the perforation, the reading will be zero, signifying connectivity with the periodontal ligament. Perforations are increasingly being found using operating microscopes. It is quite useful for determining the location and size of the perforation due to its bright operating light and magnification. The application of radiographs in cases of perforation is possible, although they do have some limitations because they only providea two-dimensional image, making it potentially challenging to determine the location and severity of the perforation. This can be somewhat remedied by taking a second film and changing the radiography beam angulation to the mesial or distal aspect. A combinationof clinical evaluation, radiography, and the features of the presentation are usually used to make a late diagnosis of pathological perforations. Serous discharge or fistula from the perforated site, sensitivity on percussing, isolated periodontal pocketing, and chronicgingivitis when the inflammation has reached the alveolus can all be signs of unresolved perforations.[7] Along with the previously mentioned techniques, radiography may show radiolucent areas that have grown after the perforation because there might be localized osteolytic lesions. Cone beam computed tomography (CBCT) is becoming more crucial for evaluatingperforations. There is proof that CBCT can be used to correctly identify and evaluate resorbing lesions and subsequent perforations. But, because to the higher radiation exposure from these three-dimensional images, CBCT referral should only be taken into account if it has the potential to alter the clinical course.[8] The referredpatients and the clinician should be informed that theexistence of pre-existing gutta percha, posts, and corerestorative dental materials will cause artefacts and may jeopardize the diagnostic output.

Management

Successful perforation management involves adequately sealing the breach, using the right material, and closingthe perforation in the right place as soon as feasible. Perforation management can be done in one of two ways: non-surgically or surgically.

Non-surgical management

Orthograde approach, crestal root perforation therapy, deliberate replantation, and iatrogenic perforation are all examples of non-surgical management for perforation. In the orthograde method, hemorrhage follows newly formed perforations that develop after endodontic and surgical procedures. Pressure or irrigation can be used to reduce bleeding initially, and perforated areas should be closed effectively.[6] Hemostatic compounds andbleeding-arresting materials can be used to controlbleeding.[9] Calcium hydroxide can be inserted into thecanal to stop bleeding. After allowing it to sit there for four to five minutes, it should be flushed out with sodium hypochlorite. Repeat this process two to three times. Collagen, calcium sulphate, freeze dried bone, and mineral trioxide aggregate (MTA) are further hemostatic substances used to stop bleeding.[10-12] For perforation management, material composed of calcium hydroxide is employed.[10] Collagen and calcium sulphates are employed as absorbable barrier substances. Mineraltrioxide aggregate (MTA), super EBA, resin cement, composite bonded restoratives, and calcium phosphate cement are examples of non-absorbable barrier materials.[13]

Crestal root perforation management

Any biocompatible substance with a quick setting time and good sealability should be used for sealing. For single-rooted teeth, it is advised to use orthodontic extrusion to move the perforation to the coronal position, where it can be superficially sealed without the need for surgery.[9] To prevent the ejection of repair material, internal matrix method is advised for significant perforations in the furcal zone of molars.[9,14] The finest materials for furcation perforation include MTA, iRoot BP, calcium-enriched mixture cement, Pro-root MTA, and biodentine.[15-20] Cementum-like tissue is created whenMTA and a cement mixture high in calcium are used.[21] The optimum material for crestal root perforations is thought to be biodentine.[22] In the treatment of perforation,the application of stem cells in combination with a cured dentin matrix improves bone development.[23]

Intentional replantation

When orthograde and invasive procedures are not an option, this approach is taken into account. It is indicated when the perforation is too large to heal and impossible to reach without removing a lot of bone.[6] The tooth should be extracted gently without causing any harm to the nearby tissues. A balanced salt solution should be used to gently wash the tooth after removal while it is being held in forceps. Replanting needs to be carried out as soon as feasible. Ankylosis and inflammatory root resorption are complications.

Iatrogenic perforation

The prognosis will be better, the more apically theperforation is located. A negative prognosis is associated with perforations that develop in the coronal third of the root underneath the crestal bone.[14] In cases of strip perforation, MTA can be utilized as an obturating agent and perforations situated at the point of epithelialattachment and bone.[24]

Surgical management

Large perforations, perforations brought on by resorption,and lack of healing following non-surgical repair all call for surgical intervention. The amount of surviving bone, the degree of osseous destruction, the age of the defect, the presence of periodontal pathology, the extent of soft tissue attached, dental hygiene, and the surgeon's skill in managing tissue are all factors taken into account before surgical therapy.[6] Perforation is being managed with guided tissue regeneration. An elevated buccal full- thickness flap enables the perforation location to be seen. MTA is then used to close the perforation, and the flap is sutured after that. Sutures are extracted from postoperative wound after they have healed, and the post can then be sealed.[25]

Multidisciplinary treatment

Sequential operations in a multidisciplinary approach comprise traditional endodontic retreatment, initial orthograde perforation seal, guided tissue regeneration,and reseal of perforation using ketac-endo and intermediate restorative agents.[26]

Traditional and novel agents utilized in repair of perforations

In order to repair perforations, a variety of materials are used, including 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 freeze-dried bone, calcium phosphate cement, tricalcium phosphate cement, hydroxyapatite, calcium using a microscope to treat perforations.[27] In a magnified field, a microscope improves the sight of perforation. It aids in finding even tiny perforation sitesso that they can be treated sooner and shielded from infection in the future. It mostly aids in closing the iatrogenic cervical perforation with vitremer duringaccess preparation.[28]

Prognosis

The prognosis of teeth with root perforations that have had endodontic treatment relies on a number of variables, including the amount of time that passed before the defectwas sealed, the site of the perforation, the effectiveness ofthe perforation seal, and the size of the perforation. Many authors believe that the best prognosis was obtained whena perforation was sealed right away after it was discovered.[3,29,30] Although the defect was produced in an aseptic environment, any delays in closing the perforationled to an infection of the wound, which slowed recovery.[30] Many researchers have claimed that the perforation's position in regard to the gingival sulcus hada significant impact on the likelihood of healing.[30-32] In 24cases of human root perforations, a mixture of gutta percha, glue, and chloroform was used to seal the holes,
according to Stromberg et al.[33] Except for instances of furcation perforations, the data showed satisfactory repair. These perforations raised the risk of epithelial growth and periodontal inflammation, which could significantly affect the prognosis of the tooth. Frank and Sinai made the assumption that holes in these places might promptly cause a communication with the oral environment, leading to unmanageable periodontal diseases.[29,34] The prognosis is often good for perforations that are far from the gingival sulcus and are encircled by robust periodontium. According to Lantz and Persson, apical third or midroot perforations without communication with the oral cavity had a favorable prognosis as long as an instantaneous seal was achieved.[30]Minor perforations are more amenable to direct and quicksealing with a lower chance of periodontal disintegration, according to Nicholls.[35] The likelihood of an overfilling and poor seal grows as the extent of the flaw does as well.According to Himel et al the relative size of a perforation and a tooth is connected to how well the perforation repair will go.[36] According to their findings, the propensity toward furcation involvement varied inversely with the dimensions of the tooth in cases with conventional perforation widths. Another crucial element in the prognosis of an endodontically treated tooth with a perforation defect is the choice of restoration material. The biocompatibility and seal ability of the repairmaterial have an impact on the prognosis. El Deeb et al and Balla et al connected the appropriate sealing of the defect with the fair prognosis for the restoration of the

perforated root.[37,38] Root perforations should be repaired with nontoxic, adequate-sealing, nonabsorbable, radiopaque, and bacteriostatic materials.

The superiority of the light-cured materials in sealing the root perforations has been stressed by Alhadainy and Himel.[39] Dazey and Senia observed that when inserted into lateral root perforations, light-cured calcium hydroxidedemonstrated increased sealing capacity than chemically cured glass ionomer and amalgam.[40] The chemically and light-cured counterparts of two materials, glass ionomer and calcium hydroxide, were compared. The results showed that compared to chemically cured materials, calcium hydroxide and glass ionomer allowed reduceddye leakage. We also underlined the importance of the repair material's flow characteristics in creating a strong seal. High flowability enabled the repair material to adhere to the perforation properly with little overextension into the periodontal space. In order to heal lateral root perforations, Soluti et al investigated the sealability of a mineral trioxide aggregate materialcreated at the University of Loma Linda, California, and still under investigation.[41] They contrasted it with an amalgam filling and strengthened zinc oxide and eugenol caulk (IRM, Caulk, Milford, Delaware). The findings showed that compared to IRM and amalgam, the mineral trioxide aggregate material offered a noticeably superior seal. The course of treatment for a perforation isdetermined by the ease of access and visibility of theperforation area, the size of the perforation, periodontal health, the strategic significance of the tooth, the patient's dental hygiene, the effectiveness of the root canalprocedure, and the clinician's experience. Due to the poor prognosis, teeth with suboptimal periodontal health orthose with very wide perforations may be extracted.[42] In individuals with poor dental care, teeth with little to no strategic relevance are also recommended for removal.

CONCLUSION

Chronic infections brought on by perforations can eventually lead to tooth loss. All medical interventions must include measures to reduce iatrogenic harm. Perforations can, and often do, happen for a wide range ofreasons. The physician must be able to spot a perforation when it occurs and know the best course of action for repairing the injury. All practitioners should think about doing an appropriate repair right away. Delaying treatment by referring to a more skilled peer may have a substantial bearing on the therapy's outcome. The drawbacks and benefits of either keeping the tooth untreated or having it extracted and replaced with a prosthesis must be explained to patients before they give their assent. Long-standing perforations may be challenging to correct.

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REFERENCES

1. Fuss Z, Trope M. Root perforations: classificationand treatment choices based on prognostic factors. Dental Traumatol. 1996;12(6):255-64.
2. Seltzer S, Bender I, Smith J, Freedman I, Nazimov H. Endodontic failures-an analysis based on clinical, roentgenographic, and histologic findings: part I. Oral Surg Oral Med Oral Pathol. 1967;23(4):500-16.
3. Seltzer S, Sinai I, August D. Periodontal effects of root perforations before and during endodontic procedures. J Dental Res. 1970;49(2):332-9.
4. Eleftheriadis G, Lambrianidis T. Technical quality ofroot canal treatment and detection of iatrogenic errors in an undergraduate dental clinic. Int Endodontic J. 2005;38(10):725-34.
5. Kvinnsland I, Oswald R, Halse A, Grønningsaeter A.A clinical and roentgenological study of 55 cases of root perforation. International endodontic journal. 1989;22(2):75-84.
6. Tsesis I, Fuss Z. Diagnosis and treatment of accidental root perforations. Endodontic Top. 2006;13(1):95-107.
7. Alhadainy HA. Root perforations: A review of literature. Oral Surg Oral Med Oral Pathol. 1994;78(3):368-74.
8. Sedentext C. Radiation protection: Cone beam CT for dental and maxillofacial radiology.

Evidence Based Guidelines. In: Sedentexct. 2011.
9. Kim S, Rethnam S. Hemostasis in endodonticmicrosurgery. Dental Clin N Am.1997;41(3):499-511.
10. Hammarström L, Blomlöf L, Feiglin B, Lindskog S. Effect of calcium hydroxide treatment on periodontalrepair and root resorption. Dental Traumatol. 1986;2(5):184-9.
11. Sottosanti J. Calcium sulfate: a biodegradable and biocompatible barrier for guided tissue regeneration. Compendium (Newtown, Pa). 1992;13(3):22634.
12. Arens DE, Torabinejad M. Repair of furcal perforations with mineral trioxide aggregate: two case reports. Oral Surg Oral Med Oral Pathol Oral Radiol Endodontol. 1996;82(1):84-8.
13. Behnia A, Strassler HE, Campbell R. Repairing iatrogenic root perforations. J Am Dental Ass. 2000;131(2):196-201.
14. Rafter M, Baker M, Alves M, Daniel J, Remeikis N. Evaluation of healing with use of an internal matrixto repair furcation perforations. Int Endodontic J. 2002;35(9):775-83.
15. Kerner S, Bronnec F. Conservative treatment of a large facial midroot perforation. Case Rep Dentistr. 2015;2015.
16. Wang M, Yin S, Wang Q, Gao Y, Wang Y, Zhang L.Study of molar furcal perforation repaired with iRootBP. Hua xi kou Qiang yi xue za zhi=Huaxi KouqiangYixue Zazhi=West Chin J Stomatol. 2013;31(3):257-9.
17. Asgary S. Furcal perforation repair using calcium enriched mixture cement. J Conservative Dentistr.2010;13(3):156.
18. Haghgoo R, Niyakan M, Moghaddam KN, Asgary S,Mostafaloo N. An in vitro comparison of furcal perforation repaired with pro-root MTA and new endodontic cement in primary molar teeth-a microleakage study. J Dentistr. 2014;15(1):28.
19. Haghgoo R, Abbasi F. Treatment of furcalperforation of primary molars with ProRoot MTA versus root MTA: A laboratory study. IranEndodontic J. 2013;8(2):52.
20. Silva LAB, Pieroni KAMG, Nelson-Filho P. Furcation perforation: periradicular tissue response tobiodentine as a repair material by histopathologic andindirect immunofluorescence analyses. J Endodont. 2017;43(7):1137-42.
21. Samiee M, Eghbal MJ, Parirokh M, Abbas FM, Asgary S. Repair of furcal perforation using a new endodontic cement. Clin Oral Investigations. 2010;14(6):653-8.
22. Kaushik A, Talwar S, Yadav S, Chaudhary S, Nawal RR. Management of iatrogenic root perforation with pulp canal obliteration. Saudi Endodontic J. 2014;4(3):141.
23. Bakhtiar H, Mirzaei H, Bagheri M. Histologic tissue response to furcation perforation repair using mineraltrioxide aggregate or dental pulp stem cells loaded onto treated dentin matrix or tricalcium phosphate. Clin Oral Investigations. 2017;21(5):1579-88.
24. Adiga S, Ataide I, Fernandes M, Adiga S. Nonsurgical approach for strip perforation repair using mineral trioxide aggregate. J Conservative Dentistr. 2010;13(2):97.
25. Nagpal R, Manuja N, Pandit I, Rallan M. Surgical management of iatrogenic perforation in maxillarycentral incisor using mineral trioxide aggregate. CaseRep. 2013;2013:bcr2013200124.
26. Goon WW, Lundergan WP. Redemption of a perforated furcation with a multidisciplinary treatment approach. J Endodontics.1995;21(11):576-9.
27. Kakani AK, Veeramachaneni C, Majeti C, Tummala M, Khiyani L. A review on perforation repair materials. J Clin Diagnostic Res. 2015;9(9):ZE09.
28. Schmidt BS, Zaccara IM, Só MVR, Kuga MC, Palma-Dibb RG, Kopper PMP. Influence ofoperating microscope in the sealing of cervical perforations. J Conservative Dentistr. 2016;19(2):152.
29. Sinai IH. Endodontic perforations: their prognosis and treatment. J Am Dental Asso. 1977;95(1):90-95.
30. Lantz B, Persson P. Periodontal tissue reactions after root perforations in dog's teeth. A histologic study. 1967.
31. Glickman GN, Dumsha T. Problems in canal cleaning and shaping. Problem Solving in Endodontics, 3rd edn St Louis, MO: Mosby. 1997:91-122.
32. Taatz H, Stiefel A. Zur therapie von zahnperforationen. Zahnaertztl Welt. 1965;66:814-9.

33. Stromberg T. Endodontic treatment of traumatic root perforations in man, A clinical and roentgenological follow-up study. Swed Dent J. 1972;65:457-66.
34. Frank AL. Resorption, perforations, and fractures.Dental Clin N Am. 1974;18(2):465-87.
35. Nicholls E. Treatment of traumatic perforations ofthe pulp cavity. Oral Surg Oral Med Oral Pathol. 1962;15(5):603-12.
36. Himel VT, Brady Jr J, Weir Jr J. Evaluation of repair of mechanical perforations of the pulp chamber floor using biodegradable tricalcium phosphate or calcium hydroxide. J Endodontics. 1985;11(4):161-5.
37. Eldeeb ME, Eldeeb M, Tabibi A, Jensen JR. An evaluation of the use of amalgam, Cavit, and calcium hydroxide in the repair of furcation perforations. J Endodontics. 1982;8(10):459-66.
38. Balla R, LoMonaco CJ, Skribner J, Lin LM. Histological study of furcation perforations treated with tricalcium phosphate, hydroxylapatite, amalgam, and Life. J Endodontics. 1991;17(5):234-8.
39. Alhadainy HA, Himel VT. Comparative study of the sealing ability of light-cured versus chemically cured materials placed into furcation perforations. Oral Surg Oral Med Oral Pathol. 1993;76(3):338-42.
40. Dazey S, Senia ES. An in vitro comparison of the sealing ability of materials placed in lateral root perforations. J Endodontics. 1990;16(1):19-23.
41. Lee S-J, Monsef M, Torabinejad M. Sealing abilityof a mineral trioxide aggregate for repair of lateral root perforations. J Endodontics. 1993;19(11):541-4.
42. Walton R, Torabinejad M. Principles and practice of endodontics. 2nd ed. WB Sounders Company. 1996:306-24.