A 30 year old female with continuous dull pain following perforation during root canal treatment in lower left first molar tooth

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Presentation of Case

Dr. Md. Abdul Hannan Sheikh: A 30 year old female reported to the Department of Conservative Dentistry and Endodontics with the complaint of continuous dull pain in her lower left first molar tooth. She told that the tooth was attempted for endodontic treatment three weeks earlier and the perforation might occur at that time. On clinical examination, although the tooth was found sealed coronally with a temporary cement but it was sensitive to percussion and palpation. The mean probing pocket depth was within the normal level of 2 mm.

Radiographic examination revealed a destruction of pulpal floor area with radiolucency. The condition was diagnosed as symptomatic chronic periodontitis along with floor perforation in the lower left first molar tooth. Considering the above conditions, endodontic treatment and non-surgical repair of pulpal floor perforation with mineral trioxide aggregate were planned followed by permanent restoration.

Treatment Procedure

Dr. Sheikh: The whole treatment procedure was explained to the patient and a written consent was taken. In the first visit, following cotton roll isolation, the temporary filling was removed and a large cavity of 5 mm wide and 11 mm depth was found. The perforation site was detected by a bleeding point at the cavity floor which was about 1 × 1 mm in diameter (Figure 1). Furthermore, it was confirmed by inserting a #30 gutta percha point into the perforation site. The perforated area was then cleaned with copious irrigation with 0.9% saline solution. A cotton pellet was placed over the orifice of the perforation site. After measuring the working length, the root canal was cleaned and shaped according to the standardized technique and irrigated with 1% sodium hypochlorite and 2% chlorhexidine solution. Calcium hydroxide dressing was given for one week as an intracanal medicament.

In the next visit, root canals were irrigated with large volume of normal saline followed by 1% sodium hypochlorite to remove all the calcium hydroxide properly. Final irrigation was done to remove the smear layer with 17% liquid EDTA. The canals were dried and obturated with gutta percha and sealer. After that, the perforation was sealed with white mineral trioxide aggregate (Angelus, Brazil) mixed with distilled water according to the manufacturer instructions; one sachet of mineral trioxide aggregate was mixed with one drop of distilled water for 30 sec on a sterile glass slab by a stainless steel spatula. It was then placed on the perforation site with a sterilized amalgam gun and was condensed with dam cotton. The excess moisture was removed from a wet cotton pellet and placed in contact with mineral trioxide aggregate. The rest of chamber was closed with glass ionomer. After 24 hours, before removal of the temporary cement another radiograph was taken to see the expansion of mineral trioxide aggregate. Temporary cement was removed to check if mineral trioxide aggregate was set and the tooth was restored with the direct restorative material of miracle mix. The patient was advised to visit at 3 and 12 months for clinical and radiological analysis. Figure 2 shows the radiological findings at the preoperative, during root canal

Figures 1: The clinical photograph of the case. The site of perforation can be seen at the floor of the cavity

treatment, after completion of the treatment and then 3 and 12 months follow-up.

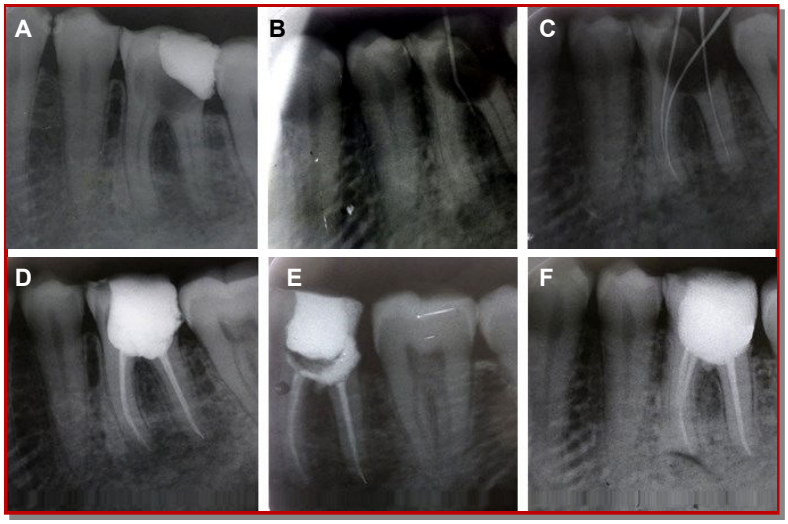

Figure 2: The clinical procedure and follow-up observation. (A) Initial radiograph, (B) Perforation tracing by gutta percha point, (C) Working length determination, (D) Radiograph after obturation, (E) Follow-up radiograph at 3 months and (F) at 12 months

Radiological Findings

Dr. Mozammal Hossain: In the initial radiograph (Figure 2A), there was a radiolucency in the floor area which was continued with the underlying periodontium. There was a slight widening of the periodontal ligament in the mesial root of lower left first molar tooth. Normally gutta percha point tracing was done to see the communication radiographically as it radiopaque in nature (Figure 2B). Figure 2C showed the working length determination. It is generally performed by inserting a file into the canals and then takes a radiograph to confirm that it reached-up to the apical constriction and to prevent over or under obturation. Working length was fixed as follows: Distal canal: 21 mm, mesiobuccal and mesiolingual canal: 20 mm. After obturation of the root canal with gutta percha point and sealer, a radiograph was taken to confirm the three-dimensional obturation (Figure 2D). Figure 2E and F showed the follow-up radiograph where the complete healing of periodontium was seen. There was no periapical radiolucency and periodontal ligament, lamina-dura was intact.

Provisional Diagnosis

Periradicular periodontitis

Differential Diagnosis

Dr. Sheikh: As radiographic examination revealed destruction of pulpal floor area with radiolucency, the condition was diagnosed as symptomatic chronic periodontitis along with floor perforation. Therefore, the diagnosis was performed based on the patient symptom, clinical and radiological findings and the following differential diagnosis was considered.

Root perforation

Dr. Md. Joynal Abdin: Root perforations that make a communication between the root spaces with the periodontal ligament may occasionally occur during endodontic procedures.[1,2] It may also occur due to gingival recession, root resroption and caries.[3-5] Identification of root perforations usually performed by direct observation of bleeding point, indirect bleeding assessment using a paper point and a radiography. As the perforation area does not have any radiological sign of root perforation, this case disfavors the diagnosis as root perforation and resorption.

External root resorption

Dr. Abdin: External root resorption may results in trauma to the periodontium, especially when a perforation occurs at the pulpal floor.[6,7] This condition often lead to periodontitis.[8,9] However, in the present case, as there is no clinical and radiological sign of external root resorption that opposes the diagnosis, the present case is not confirmed as external root resorption.

Dr. Sheikh's Diagnosis

Chronic periodontitis

Discussion

Dr. Sheikh: Perforation at the pulpal floor may occur during root canal treatment or cavity preparation for restorative procedures.[10] It is followed by chronic inflammatory reaction of the periodontium and the formation of granulation tissue may cause irreversible loss of attachment or loss of the tooth.[11-14] This artificial communication results in irreversible loss of periodontal attachment in the perforation site and the surrounding periodontium may also be damaged due to mechanical trauma and introduction of microbially derived substances that inevitably accompany the perforation.[15]

Materials used for perforation repair

Dr. Hossain: Various materials have been used in managing perforations such as zinc oxide eugenol cement, amalgam, gutta percha, calcium hydroxide, calcium phosphate, composite resin, glass ionomer and resin-modified glass ionomer cement, super EBA.[16] However, none of the above materials have shown an adequate repair of this accident.

Therefore, many researchers suggested the use of mineral trioxide aggregate that is considered as an ideal material for the perforation repair.[17, 18]

Mineral trioxide aggregate is a mineral powder consisting of hydrophilic particles. The main components are tricalcium silicate, tricalcium aluminate, tricalcium oxide and other mineral oxides.[19] It has a pH of 12.5 and sets in the presence of moisture within 4 hours.[19] Furthermore, it has the good sealing capability, biocompatibility, antibactericidal activity, radiopacity, and the ability to set in the presence of moisture, blood or tissue fluids.[20, 21] Several studies have indicated that it is also capable to repair the periodontium as well as new cementum formation over the material, and promote the growth of the cementum and formation of the bone.[20-22] The sealing ability is better than that of other materials such as amalgam, zinc oxide eugenol cement, resin-modified cement and intermediate restorative material.[23-25] However, it has long setting time (around 3 hours), less compressive and flexure strength, non-bonding to enamel and dentin, discoloration of teeth and high price.[26]

Perforation with chronic periodontitis

Dr. Farzana Hoque Tanmi: Pulpal floor perforation is a communication between root canals and periodontal ligaments through the pulp chamber.[14] It can occur at any stage during endodontic therapy such as access cavity preparation or during instrumentation or due to the pathological condition such as caries, resorption etc. This results in a chronic inflammatory reaction of the periodontium which lead to either irreversible loss of attachment or loss of the tooth.[15] Factors that influence the repair of perforated teeth includes the size of the perforation, time of repair, level and location of the perforation, the presence of periodontal disease and pre-endodontic pulp vitality test.[16] It is, therefore, decided that perforation can be managed either surgically or non-surgically, and the prognosis is generally outstanding if the problem is diagnosed at an early stage and the repair can provide proper sealing ability and biocompatibility.

Time of perforation repair with mineral trioxide aggregate

Dr. Tanmi: Pulpal floor perforation is a procedural accident. It is, therefore, necessary to prevent the bacterial contamination and the perforation sites should be repaired as quickly as possible by using a suitable material.[21] Holland et al.[22] showed that if perforations sealed with mineral trioxide aggregate after contamination results in impaired healing when compare to non-contamination. In the present case, the time between perforation and repair was three weeks.

Control of the inflammatory process

Dr. Sheikh: Previous study has indicated that the control of inflammatory processes in the defect area plays a vital role in the perforation repair and promotes the health of the surrounding tissue.[27] In this case, to achieve a better tissue response, the perforation site was disinfected with 2% chlorhexidine, 1% sodium hypochlorite. Another study recommended that contaminated perforations can be washed out with hypochlorite.[28] In the present case, calcium hydroxide was used to disinfect the perforation site because in the infected area such as in acidic media mineral trioxide aggregate cannot show its proper setting ability. Mineral trioxide aggregate is said to have an antibacterial effect on the facultative bacteria, but there is no effect on the strict anaerobes.[29] So, it is used as a bacteriostatic agent in endodontics.

Regarding surgical treatment

Dr. Sheikh: In this case, the perforation defect was managed non-surgically; it is non-invasive, less technique sensitive, cost-effective and the prognosis is usually better than that of the surgical procedure. Other options for perforation repair include premolarization and hemisection. These are indicated where the periodontal involvement of one root is severe, loss of bone is extensive in the furcation area and when extensive bone loss has occurred around one root of the molar.

Follow-up

Dr. Sheikh: The prognosis of teeth with pulpal perforations depends on the various factors such as damage to the periodontal tissues, the ability to prevent the bacterial infection, perforation size and location, the time lapse between injury and repair and the adequacy of the perforation seal. Furthermore, several subjective factors such as technical competence of the dentist, the oral hygiene condition of the patient and the biocompatibility of the repair material also responsible for its clinical success.

Dr. Md. Asaduszaman: What are the reasons for using mineral trioxide aggregate in this case?

Dr. Sheikh: The material is used in direct contact with underlying periodontal tissues and is, therefore, it should be highly biocompatible and nontoxic.[23] Furthermore, the release of hydroxyl ions, modulation of cytokine production and a mineralized interstitial layer may be responsible for biological activity of the material. The material should have no mutagenic potential, low cytotoxicity, and stimulates the formation of mineralized tissue.[19] Comparing to the other repair material, mineral trioxide aggregate does not require a barrier and due to its hydrophilic nature, it can work even contamination by moisture or blood.[24]

Mineral trioxide aggregate also showed less micro-

leakage and provides better sealing when used for furcation repair.[26] Expansion of mineral trioxide aggregate during setting is responsible for its excellent sealing ability. A thickness of 3 to 5 mm allows good sealing of the material.[26] Furthermore, the high pH of this material provides antimicrobial action and biological activity such as the formation of calcium hydroxide during hydration. Previous studies have indicated that compressive strength of mineral trioxide aggregate increased within 21 days and lack of solubility has been stated as an ideal characteristic for perforation repair by mineral trioxide aggregate.[27-30]

Dr. Rubiya Hakim: What are mechanisms involved of inducing bone with mineral trioxide aggregate?

Dr. Sheikh: Mineral trioxide aggregate has an ability to induce dentin, cementum, bone and regeneration of periapical tissues. It is reported that the release of lymphokines and bone coupling agents are required for the repair and regeneration of cementum as well as healing of osseous defects.[27] As like dental hard tissues, it is also composed of calcium and phosphate ions, and has the ability to release calcium ions that helps in the formation of hydroxyapatite and initiate dentinogenic activity.[26] Microscopic examinations also confirmed that perforations sealing with mineral trioxide aggregate offers the repair of periodontium, and new cementum formation over the material.[31]

Final Diagnosis

Chronic periodontitis due to pulpal floor perforation

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