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Unintended injury of the inferior alveolar nerve due to the extrusion of calcium hydroxide in endodontic treatment: A case report

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ABSTRACT

During clinical endodontic treatment, we often find radiopaque filling material beyond the root apex. Accidental extrusion of calcium hydroxide could cause the injury of inferior alveolar nerve, such as paresthesia or continuous inflammatory response. This case report presents the extrusion of calcium hydroxide and its treatment procedures. A 17 yr old female patient experienced (Calplus) extrusion into the inferior alveolar canal on left mandibular area during endodontic treatment of #37. A clinician should be aware of extrusion of intracanal medicaments and the possibility of damage on inferior alveolar canal. Injectable type of calcium hydroxide should be applied with care for preventing nerve injury. The alternative delivery method such as lentulo spiral was suggested on the posterior mandibular molar.

INTRODUCTION

Biomechanical cleaning and shaping can be achieved through mechanical instrumentation and chemical irrigation in order to remove tissue debris and microorganisms and to provide a 3D obturation and sealing of the root canal system. Calcium hydroxide has been used widely in the cleaning phase of endodontic treatment due to its high alkalinity and bactericidal effect. (1) The mechanism of action of calcium hydroxide is due to the Ca^{2+} and OH^- ion which involves the induction of hard tissue formation and the antibacterial effect. (2) There are several types of calcium hydroxide application according to its vehicle, such as aqueous vehicle, viscous vehicle, oily vehicle. (2)

The requirements for an ideal vehicle are as follows: it should allow a gradual and slow release of Ca^{2+} and OH^- ions, it should have low solubility in normal tissue fluids and it should not affect the induction of hard tissue formation. Calplus (Calcium Hydroxide paste with Iodoform) is one of the most popular calcium hydroxide paste with a viscous vehicle and is composed of calcium hydroxide, barium sulfate, iodoform and distilled water. As the application of calcium hydroxide paste at the apex of the root canal was difficult, the injectable type of calcium hydroxide paste was invented.

Some authors emphasized that the direct injection of calcium hydroxide into the periapical lesion has an osteoblastic effect on the epithelial cystic lining or inflamed tissue. (3) However, it has also been reported that direct injection or lack of control of calcium hydroxide may cause serious side effects such as nerve injury, paresthesia, and continuous inflammatory response. (4,5) Inferior alveolar nerve damage due to extrusion of endodontic material is related to the proximity of the tooth apex to the mandibular canal. (6) Recent studies have shown that although there are differences depending on gender, age, and size of the inferior alveolar canal, second premolars and second molars had the closest distance to the mandibular canal.(6)

There could be several possible mechanisms and treatment options when a patient who had received endodontic treatment develops an abnormal symptom. (7) Possible damage mechanisms include mechanical trauma, pressure phenomenon and/or neurotoxic effects. When the injected endodontic material is considered to cause neurotoxic symptoms, the clinician should choose between the following treatment options: wait-and-see approach(8,9) or an early, (10,11) if not immediate, surgical debridement (12,13) of the inferior alveolar nerve. Primary repair within one week of injury is known as the best time for nerve repair. However, since the nerve tissues are enclosed by the other tissues, it is not easy for the clinicians to notice the injury and perform immediate surgical treatment. Early secondary repair, which is within three months after injury, is the most favorable time for repair. (14) And also, some authors emphasize that an acceptable treatment result can be achieved at a later time. (15) The aim of this report is to present a case of extrusion of endodontic medicament into the mandibular canal. This report might be helpful for the clinicians when extrusion of dental material occurs and for deciding how to treat such a problem.

CASE REPORT

A 17-year-old female was referred to our Department of Dentistry by her general dentist. Her chief complaint was paresthesia in her lower left lip and chin area. Eight days before the referral, a root canal treatment of the lower left second molar (#37) was started. Four days before the referral, the dentist filled the root canal of the tooth with Calplus. Immediately after the treatment, she complained of sharp pain and paresthesia in her lower left lip and chin. Immediately after her complaint, the dentist removed Calplus from the root canal. However, the paresthesia did not disappear. Finally, she was referred to our division for investigation and treatment related to the paresthesia. No swelling, redness or other signs of infection were observed during the examination. Likewise, extraoral examination failed to identify swelling, alterations in skin color, or adenopathies.

The anesthetized zone was delimited by tactile exploration. IOPA radiograph (Fig. 1) revealed the presence of radiopaque material (Calplus) in the periapical area of tooth #37, spreading around and within the mandibular canal from the lower left first molar region to the lower left third molar region. The canal space was narrow, and Calplus was pressing upon the inferior nerve and vessels at the lower left first molar region till lower left third molar region. Initially, we planned tooth (#37) extraction and surgical removal of Ca $(OH)^2$ paste. However, the patient declined surgical treatment option because of anxiety regarding the exacerbation of paralysis after the surgery. She chooses conservative treatment with vitamin B12 medication, stellate ganglion light therapy and root canal treatment of #37. The root of the tooth was filled with gutta-percha and sealer approximately one year after her first visit and was able to be preserved. There was almost complete resorption of Calplus in the IOPA at 8 months after her first visit. The paresthesia area was about 1825 mm^2 at the first visit, which gradually reduced to about 225 mm^2 after six months.

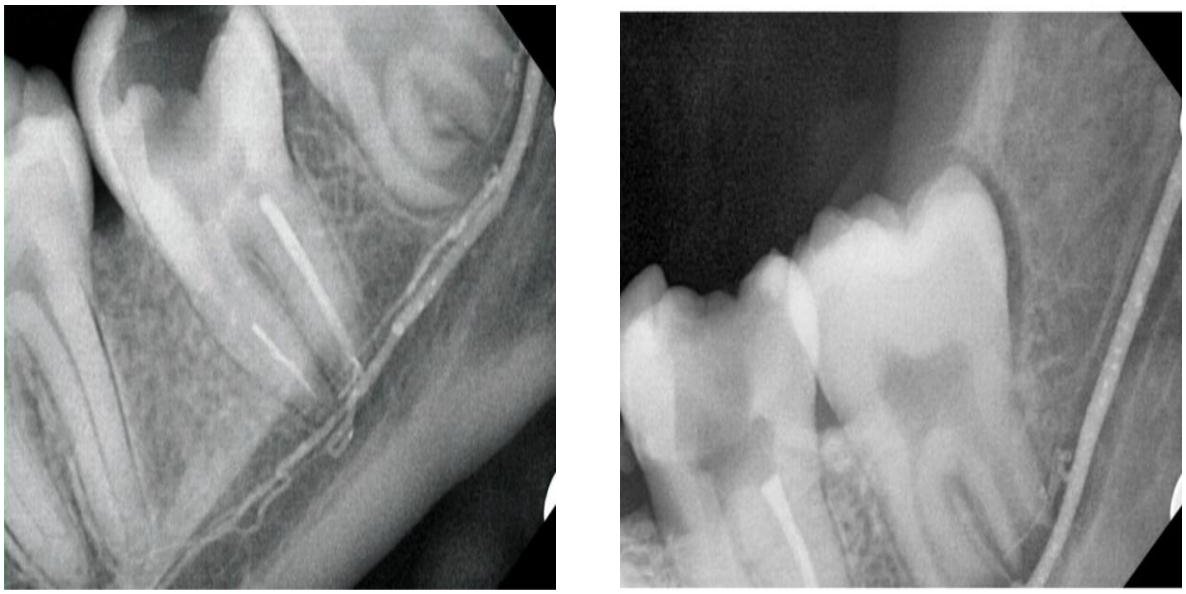

Figure 1: Extrusion of Calplus (Calcium hydroxide with Iodoform) in Inferior Alveolar Canal

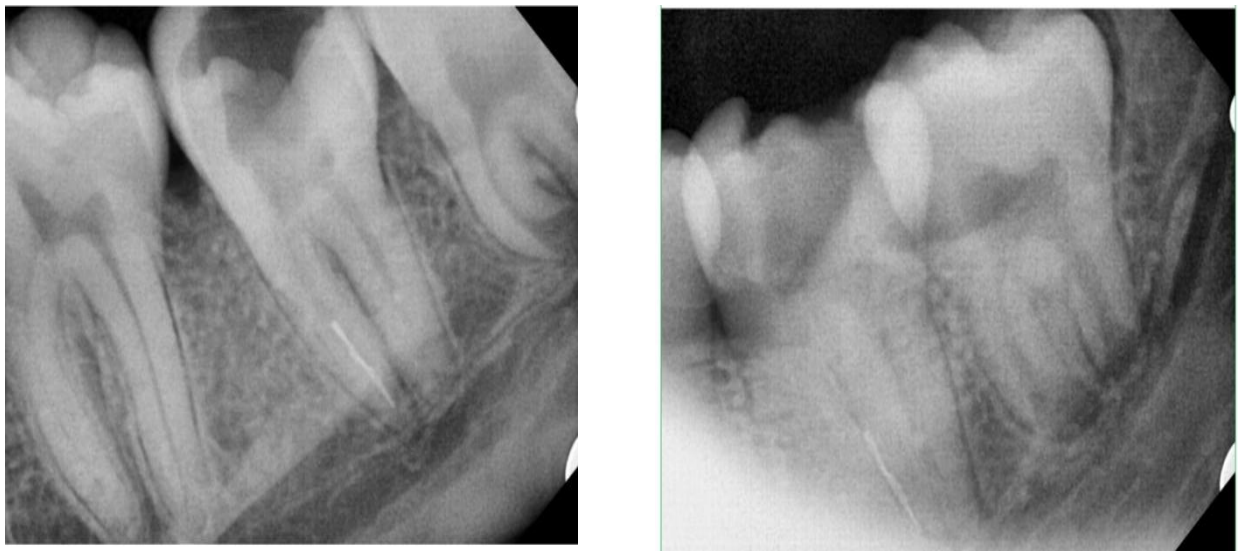

Figure 2: Resorption of Calplus (Calcium hydroxide with Iodoform) in Inferior Alveolar Canal (8 months)

DISCUSSION

Calcium hydroxide can remain in the tissue for a short period due to its low solubility at body temperature. In vitro study by Serper et al. has shown that calcium hydroxide can cause inflammation of the nerves, foreign body reactions and bone necrosis. (16) Also, irreversible blockage of nerve conduction may occur when the nerve tissue is exposed to calcium hydroxide for more than 30 minutes. This effect might be caused by the excess quantity of calcium hydroxide which could lead to destabilization of the nerve membrane potential. When extrusion of dental material occurs on the posterior mandibular teeth, the inferior alveolar canal could be damaged since the distance between the inferior alveolar canal and the apices of the teeth is very short. As per many studies, the mandibular second molar and second premolar have the high risk of injury. These data are important in invasive dental procedures such as extraction or dental implant placement. However, as seen in this case, there is also a risk of damaging the inferior alveolar nerve while performing the root canal treatment. The cause of inferior alveolar nerve damage is related to the neurotoxic material or mechanical compression. In an acute stage, an increased permeability of vessels can obstruct the blood supply which results in ischemia to nerve tissue and swelling. Hence, the application of tensile force and compression for a long period can cause irreversible damage. Neurotoxic effect can be caused by an inflammatory reaction or allergic reaction.

These reactions cause action potential instability and reduced nerve conduction. According to Serper et al., even complete inhibition of action potential could occur with the use of calcium hydroxide. (16) If the cause were removed within 30 minutes, nerve conduction could regain stable amplitude. (18) This indicates that recovery from damage can be achieved by the early removal of causative factors. If the mechanical compression has not caused necrosis of the nerve bundle, a prompt decision on the part of the dental practitioner can lead to a good prognosis. When surgical intervention is unavoidable, a surgeon should decide upon which treatment option to use among surgical debridement, nerve graft technique or nerve sliding technique. When complete neurotmesis (disrupted nerve tissue) or loss of nerve segment or neuroma occurs, surgical debridement is not sufficient for the recovery.

When the length of the predicted loss of nerve segment is not too long, the nerve sliding technique can be the treatment option. The nerve sliding technique has several advantages over the nerve graft technique, such as no donor defect, single suture lesion, and better nerve regeneration and conduction. (17) Kim et al. have suggested that the limit for nerve resection with this method is 7 - 12.8 mm. (17) It depends on the location of the mental foramen in the patient or the length of the inferior alveolar nerve. (17) Most accidental apical extrusion was related with the injectable delivery type of calcium hydroxide. Therefore injectable type of calcium hydroxide should be applied with care for preventing nerve injury. If calcium hydroxide with lentulo spiral was chosen as safer alternative delivery method, the clinician should apply the calcium hydroxide only in the root canal space.

CONCLUSIONS

As root canal medicaments have the potential to be neurotoxic, a clinician should be aware of the possibility of extrusion and damage to the inferior alveolar nerve. If a clinician detects any radiopacity near the inferior alveolar nerve, careful monitoring is needed. In this case, significant improvement in sensory nerve was seen after 08 months. The alternative delivery method with lentulo spiral was suggested on the posterior mandibular teeth.

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