

# Accidental injury of the inferior alveolar nerve due to the extrusion of calcium hydroxide in endodontic treatment: a case report

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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 treatment procedures including surgical intervention. A 48 yr old female patient experienced Calcipex II extrusion in to the inferior alveolar canal on left mandibular area during endodontic treatment. After completion of endodontic treatment on left mandibular first molar, surgical intervention was planned under general anesthesia. After cortical bone osteotomy and debridement, neuroma resection and neuroorrhaphy was performed, and prognosis was observed. But no improvement in sensory nerve was seen following surgical intervention after 20 mon. 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. (*Restor Dent Endod* 2016;41(1):63-67)

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## 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.<sup>1</sup> The mechanism of action of calcium hydroxide is due to the Ca<sup>2+</sup> and OH<sup>-</sup> ions which involves the induction of hard tissue formation, and the antibacterial effect.<sup>2</sup> There are several types of calcium hydroxide application according to its vehicle, such as aqueous vehicle, viscous vehicle, oily vehicle.<sup>2</sup> The requirements for an ideal vehicle are as follows: it should allow a gradual and slow release of Ca<sup>2+</sup> and OH<sup>-</sup> ions, it should have low solubility in normal tissue fluids, and it should not affect the induction of hard tissue formation.<sup>2</sup> Calcipex II (Morita, Osaka, Japan) is one of the most popular calcium hydroxide paste with a viscous vehicle, and is composed of calcium hydroxide, barium sulfate, propylene glycol 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.

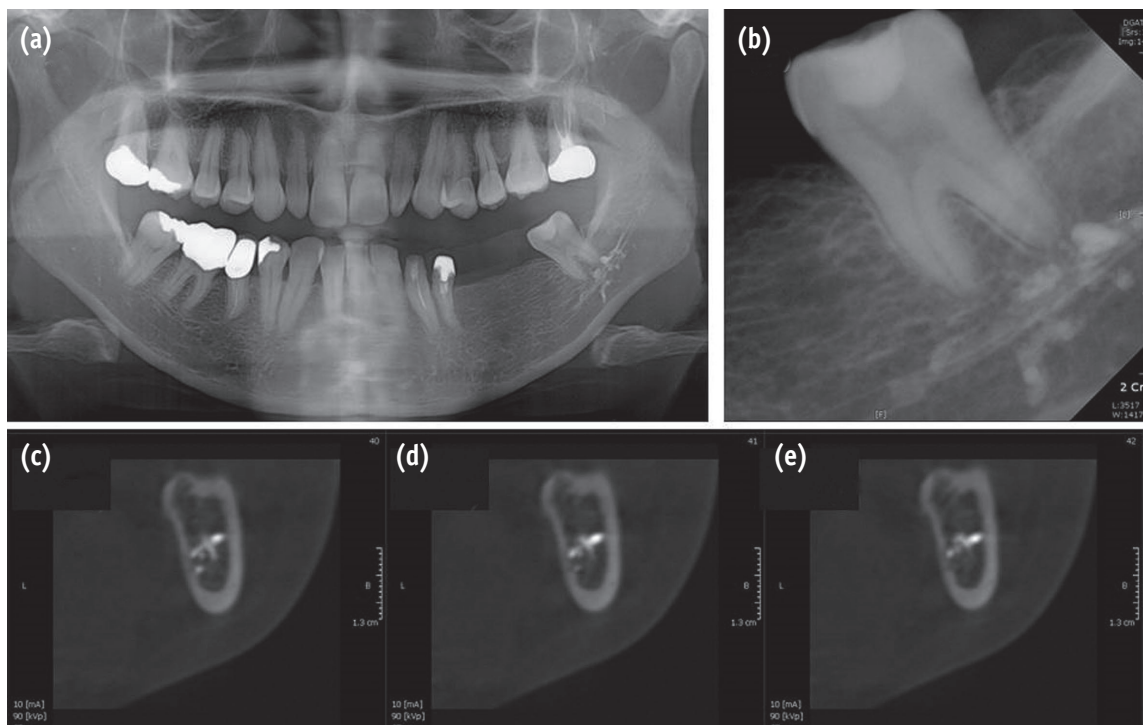
Some authors emphasized that the direct injection of calcium hydroxide into the periapical lesion has an osteoblastic effect on the epithelial cystic lining or inflamed tissue.<sup>3</sup> However, it has also been reported that direct injection or lack of control of calcium hydroxide may cause serious side effects such as nerve injury, paresthesia, and continuous inflammatory response.<sup>4,5</sup> Inferior alveolar nerve damage due to extrusion of endodontic material is related to the proximity of the tooth apex to the mandibular canal.<sup>6</sup> 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.<sup>7</sup> According to Littner *et al.*, the upper border of the mandibular canal is located 3.5 to 5.4 mm below the root apices of the first and second molars.<sup>8</sup>

There could be several possible mechanisms and treatment options when a patient who had received endodontic treatment develops an abnormal symptom.<sup>9</sup> 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<sup>10,11</sup> or an early,<sup>12,13</sup> if not immediate, surgical debridement<sup>14,15</sup>

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.<sup>16</sup> And also, some authors emphasize that an acceptable treatment result can be achieved at a later time.<sup>17</sup> 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 48 year old female patient was referred to the Department of Oral and Maxillofacial Surgery, Yonsei University Dental Hospital due to paresthesia of the left mandibular area after endodontic treatment of the left mandibular second molar. The patient had received endodontic treatment at a private clinic about 6 weeks ago. Conventional radiographs and computed tomography of the mandible showed radiopacity around the left mandibular canal (Figure 1). Dental history from the private clinic

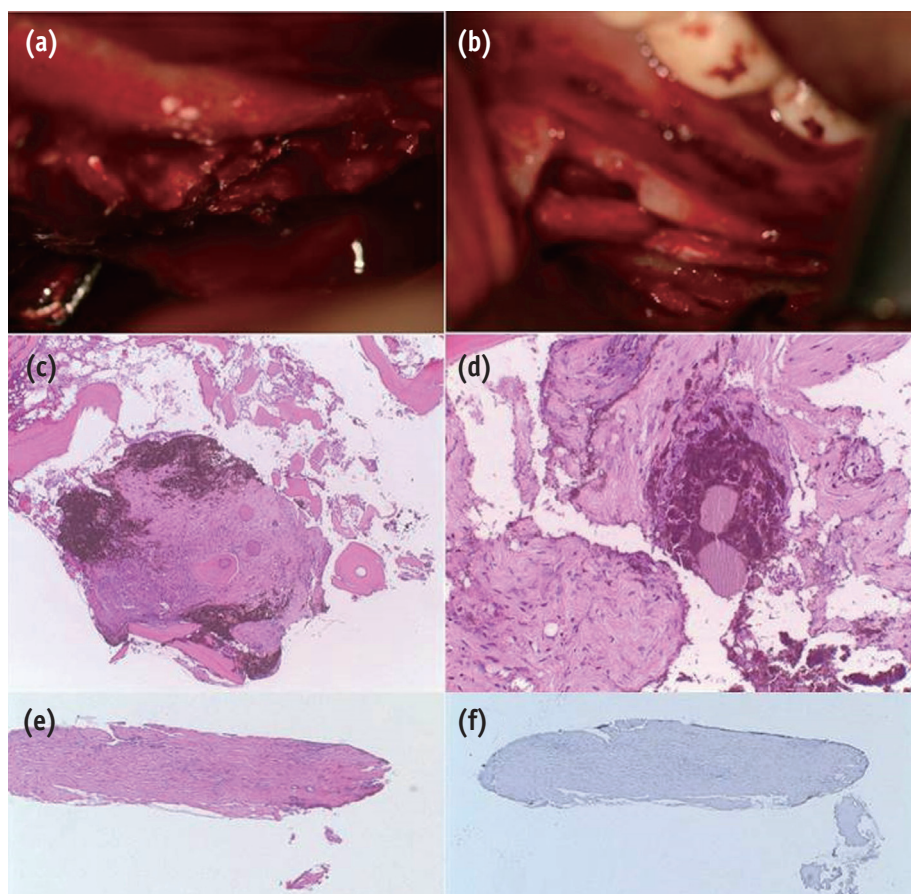


**Figure 1.** (a) Panoramic view of the patient after extrusion of calcium hydroxide. Increased radiopacity around periapical area on left second molar; (b) Periapical view after canal cleaning and shaping; (c - e) On the cross sectional view of CBCT, excessive radiopaque material was spread into the left mandibular canal.

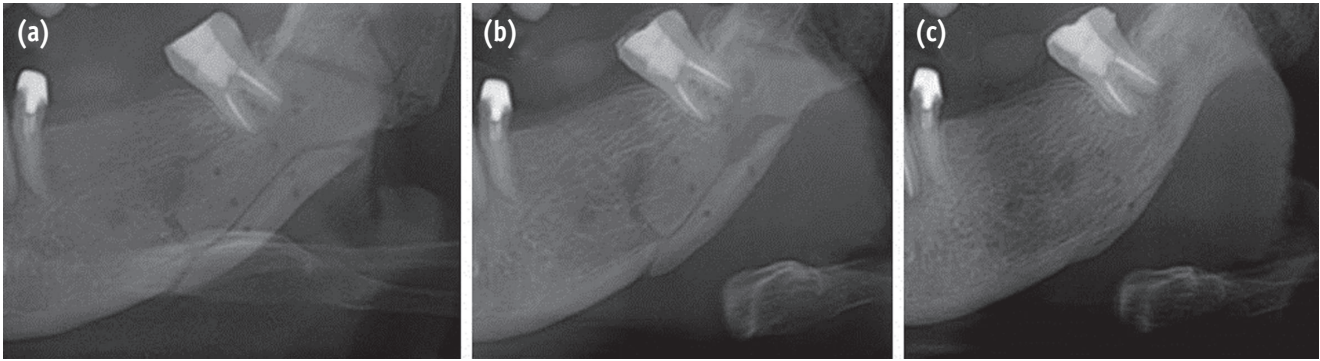
and radiographs confirmed the extrusion of Calcipex II (Morita). After prescribing steroid medications for 2 weeks, the patient was sent to the Department of Conservative Dentistry for the removal of extruded material through canal irrigation. Although the complete removal of foreign material through conventional endodontic approach was impossible, endodontic re-treatment was scheduled and performed after getting informed consent from the patient. Before performing endodontic re-treatment, the pin-prick test result was 200 in the left mandibular area and 50 in the right mandibular area. The two-point discrimination test result was 30 mm in the left mandibular area and 9 mm in the right mandibular area.

After the endodontic re-treatment, the patient felt a mild improvement of the paresthesia. The two-point discrimination test result was 16 mm in the left mandibular area and 7 mm in the right mandibular area. However, no discrimination could be made between the left and right mandibular areas with the brush direction test.

Hence, neuroplasty and foreign body removal from the left mandibular canal under general anesthesia was planned. However, the patient wanted to postpone the surgery for 2 months, hoping for an improvement without undergoing surgery. After 2 months, the pain threshold test result was 125 in the left mandibular area and 100 in the right mandibular area, and this result was inconsistent when the pin-prick test was performed. Since the patient's symptoms did not show any further improvement, surgical treatment was performed. Surgical treatment included neuroma (growth of nerve tissue), neurorrhaphy (end-to-end reconnection of nerve tissue), and foreign body removal under general anesthesia (Figures 2a and 2b). Under general anesthesia, a cortical bone osteotomy was performed and a monocortical block overlying the subapical area of the second molar was removed. Calcium hydroxide paste was found in the spongy bone, and injured inferior alveolar canal was debrided. Radiograph after surgical intervention showed no foreign material (Figure 3a).



**Figure 2.** (a) Before debridement. Injured tissue was seen. It's hard to distinguish inferior alveolar nerve and other structures; (b) Inferior alveolar nerve was sutured, granulation tissues and destroyed bones are removed; (c - e) Particles of foreign bodies and multiple fragment of bone and fibrous or fibroadipose tissue of varying size represented the curetted material submitted for histopathological examination (H-E staining); (f) S100 protein on nerve bundle was not seen on nerve staining.



**Figure 3.** Radiographic view of left mandibular area after surgical intervention. (a) 3 months follow up; (b) 20 months follow up; (c) Healing of bony fragments was found between separated block bones and mandibles.

The histopathological analysis showed that the curetted material contained foreign bodies and multiple fragments of bone and various sizes of fibrous or fibroadipose tissues. On histological examination, chronic nonspecific inflammatory cell infiltration without foreign body reaction was seen (Figures 2c and 2d). Some of the blackish particles contained endodontic pastes. There were no findings of S100 protein which is used as cell markers for anatomic pathology in the nerve bundle (Figure 2f).

At 3 months follow up after surgery, no improvement was seen in paresthesia, and the patient was sent to the Department of Prosthodontics for a provisional restoration in the treated area (Figure 3b). On 20 months follow up, healing of bony fragment was observed on panoramic x-ray, and the endodontically treated tooth was used as abutment for provisional fixed partial denture, without improvement of sensory nerve (Figure 3c).

## 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.<sup>18</sup> 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 mentioned previously, 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.<sup>18</sup> If the cause were removed within 30 minutes, nerve conduction could regain stable amplitude.<sup>18</sup> 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.<sup>19</sup> Kim *et al.* have suggested that the limit for nerve resection with this method is 7

- 12.8 mm.<sup>19</sup> It depends on the location of the mental foramen in the patient or the length of the inferior alveolar nerve.<sup>19</sup>

Most accidental apical extrusion was related with the injectable delivery type of calcium hydroxide.<sup>20</sup> 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, no improvement in sensory nerve was seen following surgical intervention after 20 months. The alternative delivery method with lentulo spiral was suggested on the posterior mandibular teeth.

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