

Surgery for widespread bone and soft tissue necrosis associated with extrusion of a calcium hydroxide paste containing barium sulfate: a case report with submandibular spread

 Halil İbrahim Durmuş*,  Mehmet Sait Şimşek,  Tervfik Kızılsaki,  Kağan Fatih Kuşan

Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Adıyaman University, Adıyaman, Türkiye

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ABSTRACT

Calcium hydroxide, a commonly used intracanal medication in endodontic treatment, can lead to serious bone and soft tissue damage if it is extruded uncontrollably. This case report describes the surgical management of extensive tissue necrosis resulting from the extrusion of a calcium hydroxide paste containing barium sulfate. A fourteen-year-old female patient presented with severe pain and diffuse, firm swelling in the posterior right mandibular region after root canal treatment. Cone beam computed tomography revealed that the extruded material extended beyond the lingual cortex into the submandibular space, causing bone destruction; however, the inferior alveolar nerve was spared. Surgical treatment included removal of the extruded material, debridement of necrotic tissue, and extraction of the affected tooth. Histopathological examination revealed necrosis and a foreign body reaction. No complications occurred during the postoperative period. This case demonstrates that serious tissue destruction can occur even without nerve damage and highlights the importance of early surgical interventions.

Keywords: Calcium hydroxide extrusion, necrotic changes in bone tissue, complications related to endodontic treatment, surgical debridement, inferior alveolar nerve

INTRODUCTION

Calcium hydroxide is an intracanal medication widely used in endodontic treatments because of its potent antimicrobial properties and high alkaline pH.^{1,2} It is frequently preferred in clinical practice because it reduces the microbial load in the root canal system and contributes to periapical tissue healing. However, if the material extends beyond the apical limits, it can cause serious and, in some cases, irreversible damage to the surrounding hard and soft tissues.³

The high pH level of calcium hydroxide (approximately 12.5) causes tissue necrosis through protein denaturation, disruption of cell membrane integrity, and adverse effects on microvascular circulation. This pathophysiological process may manifest as pain, inflammation, ulceration, and delayed healing.⁴ The literature reports that such complications are most frequently associated with inferior alveolar nerve injury, with neurosensory disorders such as paresthesia, dysesthesia, and anesthesia being among the primary symptoms.⁵

However, current case reports indicate that significant bone and soft tissue destruction can occur, despite the preservation of nerve structures.⁶ The potential for extruded material to advance through anatomical spaces is considered a determining factor in the extent of damage. The thinness of the lingual cortex, particularly in the posterior mandibular

region, can facilitate the passage of materials into the submandibular space. This study aims to present the surgical treatment of bone and soft tissue necrosis extending to the submandibular space due to extrusion of a calcium hydroxide paste containing barium sulfate and to highlight the importance of early diagnosis and an appropriate surgical approach in such complications.

CASE

A 14-year-old girl in good general health presented to our clinic with symptoms that developed following the application of intracanal calcium hydroxide during an interim session of root canal treatment initiated on the right mandibular second molar (#47). The patient reported intense pain in the right mandibular region that began shortly after the procedure and increased in severity over time, accompanied by firm and widespread swelling. The symptoms increased significantly within the first 24-48 h, and sensitivity during chewing and palpation became more pronounced (**Figure 1**). No findings suggestive of fever, systemic illness, or systemic infection were observed in the patient. Panoramic radiography revealed a radiopaque appearance around the affected tooth, consistent with extruded material (**Figure 2**). Cone-beam computed tomography revealed that the foreign

*Corresponding Author: Halil İbrahim Durmuş, halilibrahimdurmus@adiyaman.edu.tr



body had penetrated the lingual cortical bone, causing bone destruction in the mandibular basal region and extending into the submandibular space (**Figure 3**). However, the integrity of the inferior alveolar nerve canal was maintained. Clinical neurosensory examination was performed using light-touch, pin-prick, and two-point discrimination tests in the distribution of the inferior alveolar and mental nerves. No sensory deficits were detected at presentation. Based on the clinical and radiographic findings, a preliminary diagnosis of chemical tissue injury and osteonecrotic changes secondary to extrusion of a calcium hydroxide paste containing barium sulfate was made. Owing to the progressive nature of the clinical picture, surgical treatment was planned. Under local anesthesia, a lingual sulcular incision was made, and a full-thickness mucoperiosteal flap was elevated (**Figure 4**). Local anesthesia was achieved using 4% articaine with 1:100,000 epinephrine. Following flap elevation, extensive necrotic soft tissue and devitalized bone were identified. The affected soft tissues appeared grayish, nonviable, and lacked normal vascularity, consistent with extensive soft tissue necrosis. The clinical appearance was consistent with extensive soft tissue necrosis, which was subsequently confirmed by histopathological examination. The extruded calcium hydroxide paste was carefully removed using surgical curettes and copious saline irrigation. Debridement was continued until viable bleeding bone and healthy soft tissue margins were observed.



Figure 1. Firm swelling of the right mandible with facial asymmetry secondary to paste extrusion



Figure 2. Radiopaque lesion in the right mandible consistent with extruded paste

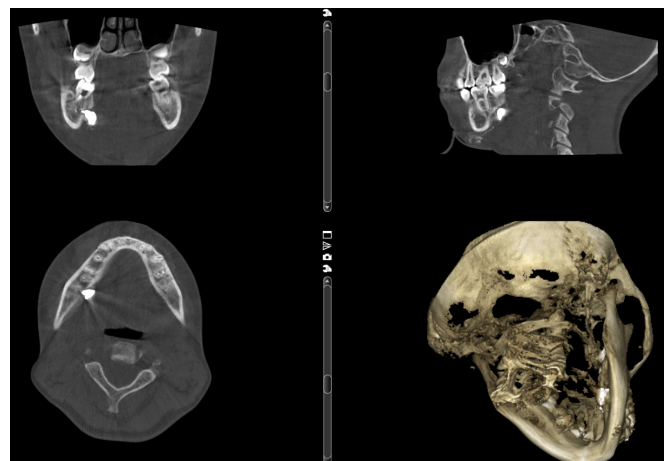


Figure 3. Cone-beam computed tomography showing a hyperdense lesion in the right mandible with surrounding bone necrosis

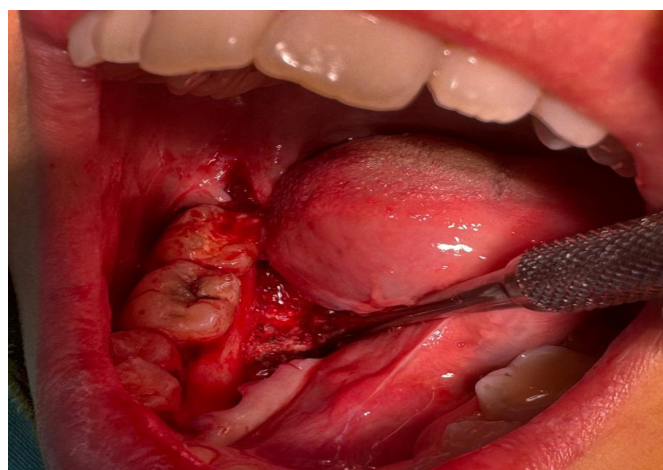


Figure 4. Intraoperative view of extruded paste following the sulcular incision

During surgical exploration, necrotic soft tissue and destructive bone were observed. The extruded material was carefully removed, and the necrotic tissue was debrided (**Figure 5**). Tooth 47, which had a poor prognosis, was extracted. Extraction was considered necessary because of extensive surrounding bone destruction, contamination by the extruded material, compromised periodontal support, and the low likelihood of predictable long-term functional preservation. The surgical site was copiously irrigated with sterile saline and rifampicin solution to remove residual foreign material and necrotic debris before primary closure was achieved with sutures. Histopathological examination revealed necrotic bone tissue, inflammatory cell infiltration, and foreign body reactions. These findings support the clinical diagnosis.

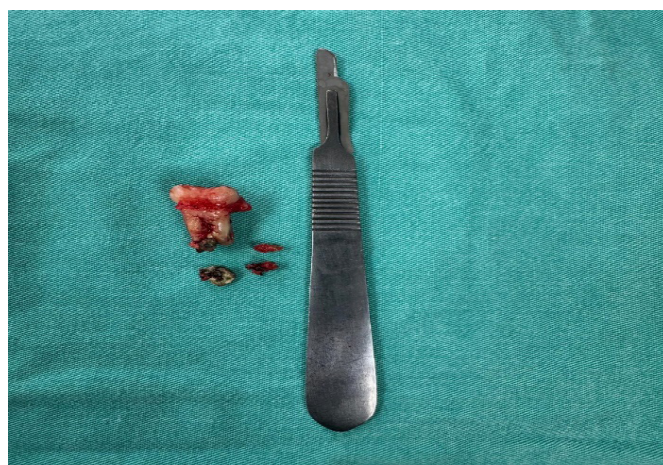


Figure 5. Extracted tooth No. 47 with the paste material removed



In the postoperative period, the patient received amoxicillin-clavulanic acid, nonsteroidal anti-inflammatory analgesics, and chlorhexidine mouthwash. Detailed oral hygiene instructions were provided, and the patient was closely monitored for signs of infection, wound dehiscence, or neurosensory complications.

The patient was followed up regularly, and no complications were observed at the 1-week and 1-month follow-up visits (Figure 6, 7).



Figure 6. Panoramic radiograph taken 1 week postoperatively showing removal of the paste material

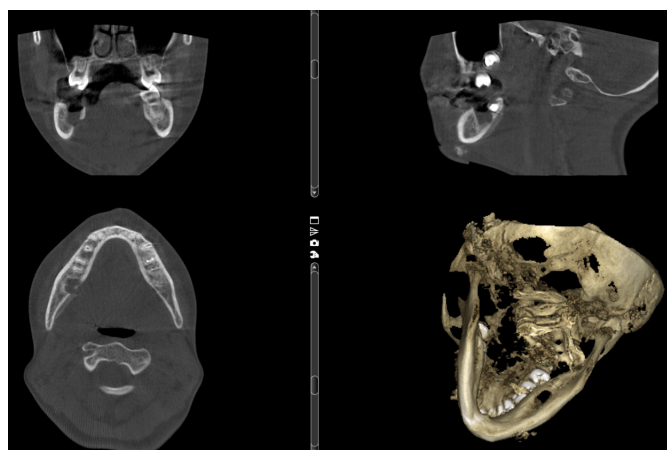


Figure 7. Cone-beam computed tomography at 1 month postoperatively demonstrated bone healing

DISCUSSION

Although rare, calcium hydroxide extrusion can lead to serious iatrogenic complications. The chemical burn effect, resulting from a highly alkaline pH, causes coagulation necrosis through protein denaturation and microvascular damage.⁴ Calcium hydroxide-induced tissue injury is mediated by multiple mechanisms, including cellular membrane destruction, vascular thrombosis, protein denaturation, and disruption of local blood supply. These effects may lead to progressive soft tissue necrosis and osteonecrosis, particularly when large volumes of material are extruded into confined anatomical spaces. In the literature, the vast majority of these complications have been associated with inferior alveolar nerve injury.⁵ However, it is noteworthy that the nerve structures were preserved in the present case.

Previously reported cases have generally described sensory disturbances following extrusion into the inferior alveolar canal, frequently requiring prolonged follow-up and, in some instances, microsurgical intervention. Unlike those reports, the present case was characterized by extensive osseous

and soft tissue necrosis without neurosensory impairment, suggesting that tissue destruction may occur independently of direct nerve injury.

Nevertheless, the significant bone destruction and submandibular extension observed indicate that tissue damage is not limited to neurological findings.⁶ This highlights the need for clinicians to consider that serious complications can develop even without neurological findings. The ability of the extruded material to spread through anatomical spaces facilitates its extension into the submandibular space, especially in the presence of lingual cortical perforation. This suggests that mechanical spread, along with chemical toxicity, plays a role in pathogenesis. Preservation of the inferior alveolar nerve in this patient may be explained by the anatomical pathway of material dissemination. CBCT imaging indicated preferential spread through the lingual cortex toward the submandibular space, thereby minimizing direct contact with the neurovascular bundle. Although the exact mechanism of extrusion could not be determined retrospectively, excessive pressure during intracanal medicament placement and the presence of an open apical pathway may have contributed to displacement of the calcium hydroxide paste beyond the root canal system. Similar mechanisms have been proposed in previously reported cases of calcium hydroxide extrusion.⁷

Cone-beam computed tomography plays a significant role in the diagnosis of this condition. Three-dimensional imaging allows for detailed assessment of the location of the extruded material, the direction of its spread, and its relationship with vital anatomical structures. While a conservative approach may be sufficient in cases with minimal symptoms, surgical intervention is required in cases of progressive pain, the presence of necrotic tissue, and spread into anatomical spaces.⁸ In the present case, progressive pain, cortical perforation, extensive necrotic tissue formation, and extension into the submandibular space constituted clear indications for surgical intervention. Surgical debridement allows for the control of inflammation by removing extruded materials and eliminating necrotic tissues. This approach plays a critical role in preventing the progression of complications of the disease.⁹ In the present case, a successful clinical outcome was achieved with early surgical treatment. This supports the decisive impact of early diagnosis and appropriate surgical approaches on prognosis. Furthermore, the current literature shows that delayed intervention in similar cases is associated with greater tissue loss.¹⁰

A limitation of the present report is the relatively short follow-up period, which precluded assessment of long-term bone remodeling and neurosensory outcomes.

CONCLUSION

Although calcium hydroxide is an effective and reliable intracanal medication for endodontic treatment, it can lead to serious iatrogenic complications in the event of uncontrolled extrusion. This case demonstrates that significant bone and soft tissue destruction can develop even when the inferior alveolar nerve is preserved. Particular attention should be paid to the proximity of anatomical structures in the mandibular posterior region, and excessive pressure should be avoided during medication administration. Early diagnosis, use of appropriate imaging methods, and determination of the correct treatment approach are critical for prognosis. In



the presence of progressive symptoms and widespread tissue damage, successful clinical outcomes can be achieved through surgical debridement, removal of extruded material, and elimination of necrotic tissue. Therefore, clinicians must be aware that complications associated with calcium hydroxide extrusion are not limited to neurosensory findings and should be attentive to early intervention.

ETHICAL DECLARATIONS

Informed Consent

Informed consent was obtained from the legal guardians of the pediatric patient described in this report. Where developmentally appropriate, assent was also sought from the child. The inclusion of vulnerable populations in this study adhered to national and international ethical guidelines. Extra care was taken to ensure voluntary participation, understanding, and protection of participant dignity and autonomy.

Peer Review Process

This report underwent external peer review.

Conflict of Interest

The authors declare no conflicts of interest.

Financial Disclosure

This case report did not receive any financial support.

Author Contributions

Concept: HİD, MSŞ, TK, KFK; Design: HİD, MSŞ; Control: HİD, MSŞ; Data Collection and/or Processing: TK, KFK; Analysis and/or Interpretation: HİD, MSŞ; Literature Review: TK, KFK; Writing the Article: HİD, MSŞ, TK, KFK; Critical Review: HİD, MSŞ, TK, KFK.

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