

Complications and Management of Sodium Hypochlorite Extrusion in Root Canal Treatment: A Clinical Case Report

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ABSTRACT

Sodium hypochlorite (NaOCl) is commonly chosen as the gold standard irrigant for root canal treatments due to its notable antibacterial effectiveness and efficient tissue-dissolving properties. As the preferred solution in these procedures, NaOCl offers a cost-effective method with potent antimicrobial activity against the microbiota in infected root canals. Despite its advantages, the solution's cytotoxic features can lead to complications. Extrusion into surrounding tissues often results in intense pain for the patient, requiring immediate treatment to prevent long-term consequences. This article outlines the complications of sodium hypochlorite extrusion and reviews the appropriate management of patients with NaOCl injury.

Keywords: Sodium Hypochlorite, Root Canal Treatment, Extrusion, Complications, Management, Cytotoxicity, Endodontics, Dental Injuries.

INTRODUCTION

The success of root canal treatment (RCT) hinges on the meticulous cleaning and shaping of the canals, a process heavily reliant on effective irrigants. Among these, Sodium hypochlorite (NaOCl) stands out as the gold standard, boasting concentrations ranging from 0.5% to 5.25% [1]. Its exceptional bactericidal activity, coupled with its ability to dissolve organic matter and dislodge debris, renders it indispensable for canal disinfection and cleaning during RCT [2]. Moreover, NaOCl facilitates instrument maneuvering and lubrication. However, handling this potent agent demands caution due to its caustic nature, as exposure to vital tissues can result in significant injury—a well-acknowledged risk linked to NaOCl [3].

In cases where sodium hypochlorite inadvertently extends beyond the root apex during root canal treatment, it is commonly termed a "sodium hypochlorite accident"[4]. This occurrence typically manifests similar symptoms across documented cases, encompassing intense pain, swelling, bruising, and hematoma caused by tissue necrosis [3]. Some instances may even report secondary infections, while more

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severe injuries can lead to rare neurovascular complications affecting motor and sensory functions [5]. The primary focus of this clinical report is to delve into the clinical signs, symptoms, and management of a “sodium hypochlorite accident” during root canal treatment.

CASE REPORT

A 54-year-old female patient, with an unremarkable medical history, presented to our clinic with complaints of swelling, ecchymosis, and pain on the right side of her face. According to her dental history, an endodontic treatment session had been initiated on her maxillary right first molar tooth two days prior. However, the procedure had to be halted due to severe pain and hemorrhage from the root canal during irrigation. No efforts were made to manage this injury,

except for placing a cotton pellet into the access cavity and a temporary restoration.

Despite experiencing swelling in her cheek a few hours post-procedure, the patient did not seek immediate medical attention. However, her facial swelling worsened significantly over the next 24 hours, prompting a referral from the general dentist to our department. Approximately 48 hours after the incident, an extra oral examination revealed significant swelling extending from the periorbital and the nasolabial regions to the mandibular inferior border. Infraorbital ecchymosis and slight bruising near the nasolabial fold were observed (Figures 1 & 2). Upon palpation, the swelling was firm and indurated. Intraorally, there were no signs of mucosal ulceration or necrosis. The tooth being treated was tender to vertical and horizontal percussion.



Figure 1. Clinical examination 48 hours after hypochlorite accident: Ecchymosis, trismus and bruising in the infra-orbital region.



Figure 2. Lateral view of the patient 48 hours after sodium hypochlorite

Further investigation, including a contrast computed tomography, revealed tissue thickening and diffuse emphysema in the left infraorbital and buccal regions, with no obvious signs of pus collection (Figure 3). The

condition was diagnosed as air emphysema resulting from the extravasation of sodium hypochlorite solution during the endodontic treatment.

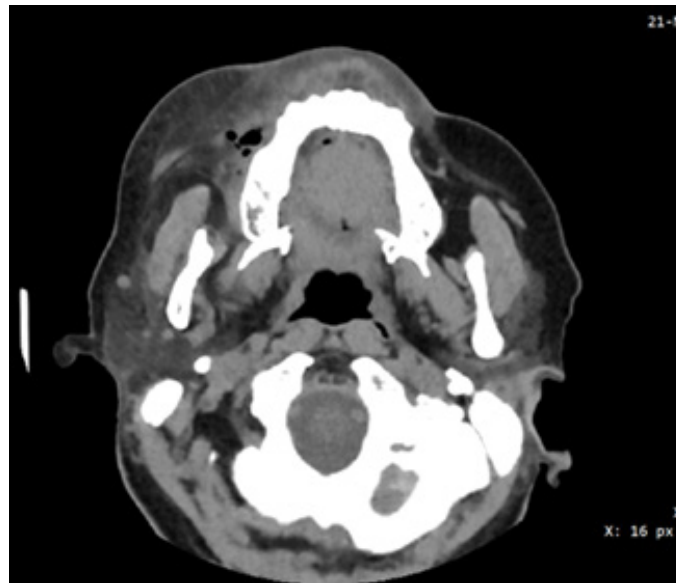


Figure 3. Axial CT SCAN demonstrating tissue thickening and diffuse emphysema in the left infraorbital and buccal regions, with no obvious signs of pus collection.

The root canals were irrigated with saline solution; however, despite the use of paper points, the exudate within the canal could not be controlled. Consequently, the canal was left to drain openly for 24 hours. To prevent the risk of infection, Amoxicillin and clavulanic acid (1000/125mg twice a day) Augmentin® were administered for six days, and paracetamol (1000 mg) was prescribed for pain management, to be taken as required. The use of cold packs externally for the first day was replaced by warm compresses on the second day for the treatment of the swelling. On the first recall, both

swelling and ecchymosis were progressively decreasing (Figure 4). After 15 days, the symptoms had completely resolved (Figure 5). At this point, root canal treatment of the affected molar was performed, and irrigation was carried out with 2% chlorhexidine and EDTA solutions. A root canal dressing with Ca(OH)₂ was placed in the canal. In the final appointment after two weeks, the root canals were filled with a bioceramic sealer (Ceraseal by Metabiomed) and gutta-percha.



Figure 4. Clinical examination at six days after hypochlorite accident; oedema decreased considerably, but still ecchymosis in the right genial and infra-orbital region as well in the lip.



Figure 5. Regression of signs and symptoms with no signs of sequelae after 15 days.

DISCUSSION

In the field of endodontics, sodium hypochlorite (NaOCl) is widely acknowledged as the primary irrigant due to its robust antibacterial and tissue-dissolving properties. Till date, no other solution has matched the efficacy of NaOCl, it is the only root canal irrigant that can destroy the microbial biofilm effectively [2,6]. However, it is crucial to note that this chemical solution is also recognized for its high cytotoxicity [7]. As indicated by Heling et al, concentrations of NaOCl surpassing 0.01% were found to be lethal to fibroblasts in vitro [8]. When in contact with living tissue, sodium hypochlorite induces hemolysis and ulceration, impedes neutrophil migration, and causes damage to endothelial and fibroblast cells. These detrimental effects stem from its alkaline nature (pH 10.8-12.9) and hypertonicity, resulting in injury primarily through the oxidation of proteins and lipid membranes [2,9,10].

Various incidents of NaOCl extrusion have been documented in the literature, encompassing three types: inadvertent iatrogenic injection, extrusion into the maxillary sinus, and the release of NaOCl beyond the root apex into periradicular regions [11]. Notably, case reports predominantly focus on accidents falling within the third category, aligning with our clinical situation [12].

In this case, the unintentional extrusion of NaOCl beyond the root apex during root canal treatment was inadvertent and could potentially be linked to elevated pressure applied during the irrigation process [13,14].

To prevent such situations, several steps can be taken. Firstly, it is advisable to refrain from using NaOCl for irrigation in the apical region without prior measurement of working lengths [10,15]. After determining all working lengths, positioning

rubber stops on irrigation needles, preferably with lateral exits, is suggested to avert pressure during irrigation and unintended injections [16]. Additionally, operators should ensure that irrigation is carried out under controlled and minimal pressure to avoid any solution leakage into the root canal [12]. When unintentional injection of NaOCl occurs in periapical tissues, similar clinical signs and symptoms have been reported by various authors [9,17,18]. An initial painful swelling may extend to adjacent tissues, including the periorbital area, upper lip, and cheek, often accompanied by profuse interstitial bleeding leading to a haemorrhage of the skin and mucosa.

If the irrigant seeps into the maxillary sinus, patients may experience a chlorine taste and throat irritation [19]. Ultimately, necrosis and secondary infection may manifest, and severe complications such as anesthesia or paresthesia may be observed [20].

The present case report highlights a failure of the initial management in response to this incident by the first dentist. Appropriate medical practice suggests that following NaOCl extrusion into the tissue, it is advisable to administer local anesthesia for pain relief. Immediate irrigation of the canal with copious amounts of physiological saline is crucial. It's advisable to address the swelling using cold compresses. Then, after a day has passed, transitioning to warm compresses can help enhance local microcirculation, fostering the healing process [21]. Additionally, prescribing analgesics and antibiotics is recommended for effective postoperative pain control and to prevent secondary infections [17,18,20].

The patient should understand that the healing process may span several days or even weeks, and in most instances,

symptoms will fully dissipate. Once the acute symptoms have subsided or lessened, it may be appropriate to proceed with endodontic treatment. In such cases, it's advisable to utilize a gentle, non-irritating irrigation solution, such as sterile saline or chlorhexidine gluconate [22,23].

CONCLUSION

Dentists performing endodontic procedures must possess a deep understanding and cautious handling of irrigants like NaOCl. While accidents involving sodium hypochlorite extrusion beyond the root apex are uncommon and rarely life-threatening, it can lead to significant morbidity. Prompt recognition of signs and symptoms, including pain, swelling, hematoma, ecchymosis, necrosis, burning sensation, edema in adjacent soft tissues, or bleeding, is crucial for effective management. Preventive measures like using a rubber dam, pre-operative radiographs, and side-exit needles for irrigation, alongside employing needles shorter than the working length and avoiding excessive pressure are essential to minimize accidents during root canal therapy. However, in the event of accidental NaOCl extrusion, established treatment protocols should be implemented based on the severity of each case. Clinicians must be well-equipped and trained to effectively manage any potential repercussions arising from such accidents.

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