Global Journal of Dentistry and Oral Hygiene

ISSN: xxxx-xxxx Vol. 1 (1), pp. 041-044, December, 2013. ©
Global Science Research Journals

Case Report

Accidental extrusion of sodium hypochlorite during endodontic treatment: A case report

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Accepted 11 March, 2013

Root canal irrigants **play a significant role in the elimination of microorganisms, removal of debris and smear layer from the root canals, and tissue dissolution. However, there remains a risk of extrusion of** irrigants **beyond the root canal system. Sodium hypochlorite is the most commonly used irrigant in endodontics due to its ability to dissolve organic soft tissue in the root canal system and its action as a powerful antimicrobial agent. However, if the sodium hypochlorite comes into contact with vital tissues, it can lead to complications ranging from minor discomfort to severe tissue damage. The present case report discusses the inadvertent effects and management of accidental extrusion of sodium hypochlorite solution into the periradicular tissues through lateral perforation of maxillary right second premolar in the course of root canal treatment.**

Key words: Sodium hypochlorite, irrigation, root canal treatment, extrusion.

INTRODUCTION

Success of the root canal treatment relies on thorough debridement and shaping of root canals. It is well documented that instrumentation alone cannot clean all the internal surfaces of the root canal as residual pulpal tissue, bacteria, and dentin debris may persist in the irregularities of canal systems (Zehnder, 2006; Haapasalo et al., 2005). Irrigants and disinfectants have become an integral parts of root canal therapy (RCT). Ideal antibacterial irrigants should flush out dentin debris, dissolve organic tissue, disinfect the canal system, and provide lubrication during instrumentation, without irritating the surrounding tissues (Mehdipur et al., 2007).

Sodium hypochlorite (NaOCl) has been one of the most popular and effective irrigant, because of its physicochemical and antibacterial properties. Though it has been has been largely used to support the mechanical preparation of root canals, there are several reports about the complications of irrigation with NaOCl during root canal therapy (Pontes et al., 2008; Crincoli et al., 2008). This paper presents a case of inadvertent effects of accidental extrusion of NaOCl solution into the periradicular tissues through lateral perforation during instrumentation in the course of root canal treatment of maxillary right second premolar.

CASE REPORT

A 65-year-old male patient was referred to us with the chief complaint of pain and swelling in right upper premolar region since 4 days. Clinical examination revealed erythematous, tender and

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Figure 1. Initial clinical appearance of the lesion.

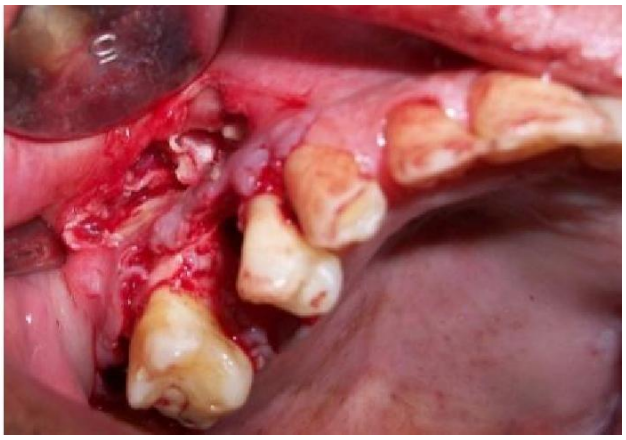

Figure 3. View after extraction of the involved tooth and debridement.

Figure 2. Periapical radiograph of offending tooth.

Figure 4. Extracted tooth.

soft swelling extending from right canine eminence to right maxillary first molar region intraorally and a sharp incised wound in the buccal vestibule pertaining to maxillary right second premolar. There was evidence of pus discharge and pale white necrotic tissue from the incised wound (Figure 1). Extraorally, the swelling extended from right infraorbital margin to right corner of the mouth and laterally to the right malar region measuring 3.5×4 cm. The swelling was tender, soft and temperature was raised. A periapical radiograph revealed perforation of the mesial aspect of the middle third of root (Figure 2).

The history of presenting illness dates back to 10 days due to pain in the maxillary right second premolar region, the patient visited a dentist who made a clinical diagnosis of irreversible pulpitis and advised RCT under local anaesthesia. During the RCT, NaOCl used as irrigant extruded through lateral perforation of root into the periradicular area and buccal mucosa which presented as throbbing pain and swelling in the operated region. Antibiotics, analgesics and steroid therapy were prescribed by the dentist but the swelling increased. The dentist made a vestibular incision in order to drain out the abscess which was inadequately done. Medical history revealed that the patient was on medication for diabetes and hypertension. After 2 days of incision and drainage, the patient had no relief and there was pale white tissue protruding out of the wound. At this stage the patient was referred for further management.

Treatment plan was made which included extraction of maxillary right second premolar, exploration of the wound and meticulous debridement of grossly necrotic tissue (Figures 3 and 4). Thick purulent discharge was drained through the mucosal perforation and direct irrigation of affected site was performed with normal saline and 5% betadine to create an environment conducive to healing. Antibiotics and analgesics were prescribed for a period of 5 days. After 2 weeks, the extra- and intra oral swelling and symptoms had completely resolved. The patient was recalled after 2 months when clinical examination revealed uneventful and satisfactory healing (Figure 5).

DISCUSSION

The major objective in endodontic therapy is to achieve complete chemomechanical debridement of the entire root canal system. This can be accomplished with biomechanical

Figure 5. Healed wound after 2 months.

instrumentation and chemical irrigation. An effective irrigating solution in root canal preparation aids in cleaning and shaping and neutralizes necrotic content which favours root canal enlargement for subsequent filling. NaOCl is advocated as an irrigant of choice in endodontic therapy mainly due to its efficacy for pulpal dissolution and antimicrobial activity. Estrela et al. (2002) reported that it exhibits a dynamic balance as shown by the reaction between organic tissue or microbes and NaOCl:

$$NaOCl + H_2O \leftrightarrow NaOH + HOCl \leftrightarrow Na^+ + OH^- + H^+ + OCl^-$$

The peculiar characteristics of NaOCl observed are:

(1) The high pH of NaOCl influenced by the release of hydroxyl ions, alters the integrity of the cytoplasmic membrane of microorganisms, causes irreversible enzymatic inhibition, biosynthetic alterations in cellular metabolism and phospholipid degradation by lipid peroxidation.

(2) A strong dissolving action occurs in the presence of microorganisms and organic tissue. NaOCl degrades lipids and fatty acids resulting in the formation soap and glycerol by saponification reaction.

(3) NaOCl neutralizes amino acids forming water and salt. Hypochlorous acid, a substance present in NaOCl solution, when in contact with organic tissue/microbes acts as solvent, releases chlorine that combines with the protein amino group and forms chloramines. This leads to amino acid degradation and hydrolysis and interferes in cell metabolism. Chlorine (strong oxidant) presents antimicrobial action by inhibiting bacterial enzymes leading to an irreversible oxidation of sulfhydryl group (SH group) of essential bacterial enzymes (Zairi and Lambrianidis, 2008).

(4) Unique property to disrupt or to remove biofilms. It is distinctly more effective in rendering biofilm bacteria nonviable and in physically removing the biofilm than other commonly used irrigants (Clegg et al., 2006).

In contrast to these advantageous properties, NaOCl has been shown to exert manifold toxic effects. In direct contact with vital tissues, it entails acute inflammation, cellular destruction in all tissues except heavily keratinised epithelium, followed by necrosis of the tissues concerned (Mehdipur et al., 2007). NaOCl has a pH of approximately 11 to12 and induces injury primarily oxidation of proteins.The cytotoxic effect of NaOCl on vital tissues results in haemolysis, inhibition of neutrophil migration, damage to endothelial and fibroblast cells and facial nerve demyelination (Gernhardt et al., 2004; Hulsmann and Hahn, 2000). NaOCl promotes vascular permeability in blood vessels, probably as a result of damage to the vessels as well as the release of chemical mediators, such as histamine, from involved tissues. These properties cause immediate swelling and often profuse bleeding.

In this case, accidental extrusion of NaOCl solution into the periradicular tissues occurred through lateral perforation of maxillary right second premolar in the course of root canal treatment. This lead to severe tissue damage associated with chemical necrosis over a period of days. Depending upon the nature and severity of the incident, management of the lesion included extraction of the offending tooth, exploration of the wound and meticulous debridement of grossly necrotic tissue. Wound debridement is required where there is extensive soft tissue necrosis, which if left, would lead to secondary infection. Appropriate antibiotic therapy is highly recommended in almost all such cases to prevent the risk of infection being forced from the root canal into the periradicular tissues and to avoid secondary infection, which can be easily promoted by the presence of necrotic tissue and osseous lesions.

How to prevent NaOCl extrusion

(1) Good access cavity design and ensure adequate coronal preparation.

(2) A pre-operative periapical radiograph to assess angulation of the root canal system and correct handpiece positioning to prevent root perforation.

(3) Use of side delivery needles that are specifically designed for endodontic purposes.

(4) Calculate working length accurately and stop if bleeding continues, which might indicate a perforation.

(5) Do not lock the syringe in the canal and keep the end of the syringe well short of the working length.

(6) Use very low digital pressure but not the thumb, to trickle the irrigant into the canal and observe irrigant leaving the canal through the access cavity.

How to recognize a NaOCl accident

(1) Immediate severe pain (for 2 to 6 min).

(2) Ballooning or immediate edema in adjacent soft tissue, because of perfusion to the loose connective tissue.

(3) Extension of edema to a large site of the face such as cheeks, periorbital region, or lips.

(4) Ecchymosis on skin or mucosa as a result of profuse interstitial bleeding.

(5) Profuse intraoral bleeding directly from root canal.

(6) Chlorine taste or smell, because of injected NaOCl to maxillary sinus.

(7) Severe initial pain replaced with a constant discomfort or numbness, related to tissue destruction and distension.

(8) Reversible or persistent anesthesia.

(9) Possibility of secondary infection or spreading of former infection.

How to treat a NaOCl accident

(1) Remain calm and inform the patient about the cause and nature of the complication.

(2) Immediately irrigate with normal saline to decrease the soft-tissue irritation by diluting the NaOCl.

(3) Let the bleeding response continue as it helps to flush the irritant out of the tissues.

(4) Recommend ice bag compresses for 24 h (15 min intervals) to minimize swelling.

(5) Recommend warm, moist compresses after 24 h (15 min intervals).

(6) Recommend rinsing with normal saline for 1 week to improve circulation to the affected area.

(7) For pain control: (a) initial control of acute pain could be achieved with anesthetic nerve block; (b) acetaminophen-based narcotic analgesics, if not contraindicated, for 3 to 7 days (NSAID analgesic should be avoided to decrease the amount of bleeding into the soft tissues); (c) prophylactic antibiotic coverage for 7 to 10 days to prevent secondary infection or spreading of the present infection; (d) steroid therapy with methylprednisolone for 2 to 3 days to control inflammatory reaction; (e) daily contact to monitor recovery; (f) reassure the patient about the lengthy resolution of the inflammatory reaction; (g) provide the patient with both verbal and written home care instructions; (h) monitor the patient for pain control, secondary infection, and reassurance.

Conclusion

NaOCl is an effective antibacterial agent but can be highly irritating when it comes in contact with vital tissue. Extrusion of NaOCl beyond the root canal can occur when there is iatrogenic widening of the apical foramen, lateral perforation, or wedging of the irrigating needle.

This report demonstrates destructive effect of concentrated NaOCl solution on soft tissues following inadvertent extrusion through lateral perforation of root canal, and subsequent management of the case. Injudicious use of the irrigant should be avoided to prevent the NaOCl accidents. If a perforation or open apex exists, then great care should be exercised to prevent a NaOCl accident or an alternative irrigation solution should be considered. The result of accidental NaOCl extrusion is unpredictable with no set level in terms of concentration and volume that determine the severity of patient symptoms. The early recognition and appropriate management of these complications by the dental practitioner is essential in case an extrusion occurs to ensure best clinical practice.

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