Hazards of Improper Dispensary: Literature Review and Report of an Accidental Chloroform Injection

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Abstract

Several clear, transparent solutions are used in endodontics. Inappropriate dispensing methods can lead to accidental injection or accidental irrigation. These accidents can cause permanent tissue damage including damage to the bone, periodontium, nerves, and vasculature. This article reports on the consequences of an accidental chloroform injection. Nonsurgical retreatment of tooth #8 was planned as part of a restorative treatment plan in a 69-year-old woman. The dentist accidentally injected chloroform instead of local anesthesia because chloroform was loaded into the anesthetic syringe. The patient experienced severe pain and swelling and soft tissue necrosis and suffered permanent sensory and motor nerve damage. A review of the literature was performed on accidents caused by improper dispensary, namely accidental injections and accidental irrigations. The data were extracted and summarized. Sodium hypochlorite, chlorhexidine, formalin, formocresol, 1:1000 adrenaline, benzalkonium chloride, and lighter fuel were accidentally injected as an intraoral nerve block or as infiltration injections. Bone and soft tissue necrosis, tooth loss, and sensory nerve damage (anesthesia and paresthesia) were the most common consequences reported. Such disastrous events can be prevented by appropriate labeling and separate dispensing methods for each solution. There is a need for disseminating information on toxicity and biocompatibility of materials/solutions used in endodontics. The authors recommend training dental students and endodontic residents on immediate and long-term therapeutic management of patients when an accidental injection or accidental irrigation occurs. (J Endod 2018; :1-6)

Key Words

Accidental injection, accidental irrigation, chloroform, inadvertent injection, non-surgical retreatment

Nonsurgical retreatments are often the first choice to resolve endodontic disease caused by inadequate prior root canal treatment. One of the challenging parts of such a procedure is to remove the previous root canal

Significance

Accidental injection or accidental irrigation with toxic solutions can lead to permanent tissue damage. This case report describes consequences of an accidental chloroform injection, and a literature review is presented for accidental use of hazardous solutions.

filling material. Removing the root canal filling material gives the clinician the opportunity to irrigate the root canal system with antibacterial solutions and to perform chemomechanical debridement. There are several methods to remove gutta-percha, including thermal, mechanical, and chemical solvents. Among chemical solvents, chloroform, which softens gutta-percha very quickly, is the most popular one (1).

Chloroform is a trihalomethane that exists at room temperature as a clear, colorless, highly refractive heavy liquid with a pleasant ethereal odor (2). Animal studies on chloroform showed a carcinogenic potential for this material (3, 4). Ingestion of chloroform significantly increased the incidence of hepatocellular carcinoma (5), renal tubular adenomas, and adenocarcinomas (3) in rats and mice. Chloroform is classified as a group 2B carcinogen by the International Agency for Research on Cancer. This category is used for agents, mixtures, and exposure circumstances for which there is inadequate evidence of carcinogenicity in humans, but there is sufficient evidence of carcinogenicity in experimental animals (2, 6).

Chloroform and chloroform-containing sealers were shown to be highly toxic in several *ex vivo* (7-12) and *in vivo* (8) studies. On the other hand, it was shown that the health risk of using solvents for removing gutta-percha during nonsurgical retreatments is negligible (13). This assessment was done based on the amount of solvent extrusion through the apical foramen, which was several orders of magnitude below the permissible toxic dose (13). Therefore, using chloroform as a solvent during nonsurgical retreatments might not impose a significant health risk to patients. However, if it is improperly labeled or improperly dispensed, this toxic solution can potentially lead to dangerous accidents like inadvertent injections.

The primary aim of this article was to present a case of accidental chloroform injection. The secondary aim was to review the published literature on the accidental use of hazardous solutions (in the form of injection or irrigation), consequences, and treatments.

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Case Report/Clinical Techniques

Case Report

A 63-year-old woman attended a dental treatment appointment with her general dentist for nonsurgical retreatment of tooth #8. The patient had lost the coronal restoration on #8, and retreatment #8 was recommended for restorative reasons. When the dentist started the buccal infiltration injection with what he thought to be local anesthetic, the patient felt excruciating pain, which made the dentist stop the procedure. The dentist immediately realized that the assistant had dispensed chloroform into a similar cartridge as the local anesthetic, and chloroform had been injected instead of local anesthetic.

Within several minutes after the incident, swelling developed on the upper lip (Fig. 1*A*), which later extended into the right side of the face and right lower eyelid (Fig. 1*B*). The initial sharp pain turned to a burning pain on the gingival tissues and lip. Meanwhile, the patient felt a tingling sensation and paresthesia on her upper lip gradually extending toward the right side of the nose and the lower eyelid. Motrin (ibuprofen) was dispensed to alleviate pain, and Benadryl (diphenhydramine) was prescribed to control the swelling and allergic reaction to chloroform. No further action was taken by the dentist, and the patient was sent home. Over the next few days, the tingling and paresthesia turned into total numbness.

A few days later, a large area (\sim 20-mm diameter) of soft tissue necrosis formed at the base of the buccal vestibular mucosa adjacent to tooth #8. The necrotic tissue gradually turned into a hard black scab, detached from the underlying inflamed tissues (Fig. 1*C*), and fully sloughed off after 3 weeks. The swelling of the upper lip and right side of the face was completely resolved at 4 weeks, but the patient still experienced numbness in her mouth, lower nose, and sections of the right side of her face and a tingling sensation extending up to her eye. She realized that when she spoke or smiled, the right upper lip and parts of the right side of her face did not move, which affected her appearance.

One year after the accident, the following areas showed a lack of sensation (total numbness) with a margin of paresthesia: the right upper lip, the right nostril, and the middle half of the lower eyelid. The muscle movements on the upper lip were not symmetric, indicating motor nerve damage to the branches of the facial nerve on the right side. As a result, the patient's face had an asymmetric appearance when she smiled or talked. She complained of occasional pain and throbbing in the area, lisping, inadvertent spitting while speaking, and saliva drooling while sleeping. Overall, the accidental injection permanently affected the patient's quality of life.

Review of the Literature

In dentistry, local anesthesia, saline, sodium hypochlorite, chloroform, hydrogen peroxide, formalin, and alcohol are frequently used. They are all clear, transparent solutions, and each has specific indications for use. Three types of accidents can occur because of inadvertent substitution of any 1 of these clear solutions:

- 1. Accidental injection: most commonly occurs when a clear solution like sodium hypochlorite, chloroform, or formalin is loaded into an empty local anesthetic cartridge
- 2. Accidental irrigation: substitution of intracanal irrigation solution (eg, chloroform instead of sodium hypochlorite) or substitution of surgical irrigation solution (eg, formalin instead of saline)
- Accidental extrusion: most commonly occurs when sodium hypochlorite is extruded into the periapical tissues during nonsurgical endodontic treatment

Accidental injections and accidental irrigations are caused by inappropriate labeling and dispensing methods, whereas accidental extrusions are caused by inappropriate clinical techniques. All 3 types of accidents can have significant consequences, but the first category of accidental injections is the most serious and consequences can be long-lasting.

A MEDLINE database search was performed via the PubMed search engine. The following key words were used: "accidental injection" OR "inadvertent injection" AND "dentistry." Articles meeting the following criteria were selected for review:

- 1. Full text available
- 2. A solution other than local anesthetic was inadvertently injected before or during dental treatment
- 3. A solution other than the recommended irrigation solution was used during the dental or surgical procedure

Reports of a sodium hypochlorite accident in which the solution was inadvertently extruded through the apical foramen were excluded. The reader is referred to the systematic review by Guivarc'h et al (14) for thorough information on accidental extrusions.

After reviewing the full text of relevant articles, the following data were extracted from the articles: type and concentration of solutions injected/irrigated, type of injection, location of injection, immediate and long-term consequences, and the medical care (procedures and medications) that the patient received.



Figure 1. (*A*) Swelling on the upper lip a few minutes after accidental injection of chloroform. (*B*) Swelling extended to the right side of the face and lower right eyelid a few hours after the injection. (*C*) A few days after the injection, the necrotic tissue gradually turned into a hard black scab, detached from the underlying inflamed tissues.

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