

# Sodium Hypochlorite Accident: A Systematic Review

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## Abstract

**Introduction:** Sodium hypochlorite (NaOCl) extrusion beyond the apex, also known as “a hypochlorite accident,” is a well-known complication that seldom occurs during root canal therapy. These “accidents” have been the subject of several case reports published over the years. Until now, no publication has addressed the global synthesis of the general and clinical data related to NaOCl extrusion. The main purpose of this article was to conduct a systematic review of previously published case reports to identify, synthesize, and present a critical analysis of the available data. A second purpose was to propose a standardized presentation of reporting data concerning NaOCl extrusions to refine and develop guidelines that should be used in further case report series. **Methods:** A review of clinical cases reporting NaOCl accidents was conducted in June 2016 using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist; it combined an electronic search of the PubMed database and an extensive manual search. **Results:** Forty full-text articles corresponding to 52 case reports published between 1974 and 2015 were selected. Four main categories of data were highlighted: general and clinical information, clinical signs and symptoms of NaOCl extrusions, management of NaOCl extrusions, and healing and prognosis. Overall, up to now, clinical cases were reported in a very unsystematic manner, and some relevant information was missing. **Conclusions:** A better understanding of the potential causes, management, and prognosis of NaOCl accidents requires a standardization of reported data; this study proposes a template that can fulfill this objective. (*J Endod* 2017;43:16–24)

## Key Words

Apical extrusion, endodontics, irrigant, review, sodium hypochlorite

Sodium hypochlorite (NaOCl), because of its antimicrobial properties and tissue-dissolving capabilities, has been used as the irrigant of choice for cleaning root canals in endodontic therapy (1). When confined to the root canal system, these properties enable thorough disinfection. Until now, no other solution has matched the efficacy of NaOCl. However, cytotoxic activity is a well-known shortcoming of NaOCl that may cause acute injuring effects if it reaches the periapical area. In contact with vital tissues, NaOCl quickly oxidizes surrounding tissues leading to rapid hemolysis and ulceration, inhibition of neutrophil migration, and destruction of endothelial and fibroblast cells (2).

NaOCl extrusion during root canal therapy (RCT) is commonly referred to as “the hypochlorite accident”; it causes acute immediate symptoms and potentially serious sequelae (3). The frequency of such events remains unknown because it is not systematically reported to insurance companies and cannot be diagnosed retrospectively. Considering the millions of RCTs performed all over the world, it is believed to be a relatively rare occurrence. However, 1 study showed that almost half of endodontic practitioners described the occurrence of at least 1 NaOCl accident in their career (4).

In a study reviewing the factors affecting NaOCl extrusion during RCT, the authors concluded that the literature did not allow establishing reliable conclusions but rather led to speculation regarding the risk factors (5). To the best of our knowledge, and up to this date, no publication has provided a global synthesis of the general and clinical data related to NaOCl extrusions.

The main aim of this study was to conduct a systematic review focused on previously published case reports to identify, synthesize, and present a critical analysis of available data on hypochlorite accidents. A second purpose was to propose a standard presentation of reported data concerning NaOCl extrusions that could be used in case report series. Developing systematic documentation that can be adapted universally may pave the way to a better understanding of the factors related to NaOCl extrusion and its consequences as well as proper guidelines for optimizing subsequent management strategies.

## Significance

Knowledge on hypochlorite extrusions during endodontic treatment is primarily based on previously published case reports. A new proposal is introduced to provide better standardization of data reporting, which can pave the way for more systematic identification of etiology and prevention or, if necessary, management and prognosis of NaOCl accidents.

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## Materials and Methods

In June 2016, a literature search was performed on clinical cases reported on hypochlorite accidents according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist (6) (Fig. 1). An electronic search of the PubMed database (1950-present) was conducted using 5 combinations of the following key words: [SODIUM HYPOCHLORITE], [IRRIGANT], [EXTRUSION], [ACCIDENT], [COMPLICATIONS], and [ENDODONTICS]. A manual search of the *Journal of Endodontics* (1975-); *International Endodontic Journal* (1980-); *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontics* (1995-2011); *Australian Endodontic Journal* (1982-); *British Dental Journal* (1970-); and *Journal of the American Dental Association* (1910-) was performed. Furthermore, the references listed in the retrieved full-text articles were reviewed to identify additional publications. After the removal of duplicate publications, title review, and abstract selection, 57 articles were screened to fulfill the inclusion criteria as follows:

1. Indexed case reports from peer-reviewed journals written in English and
2. A hypochlorite accident occurring during canal irrigation with the full text available.

Finally, 40 full-text articles corresponding to 52 cases reports published between 1974 and 2015 were selected and reviewed by the authors. Two different reviewers (M.G. and U.O.) independently identified and categorized the available information in the publications.

## Results

### General and Clinical Information

The patients' sex and tooth scheduled for treatment were always specified (Table 1). The occurrence of NaOCl extrusions was mainly reported in females (44/52) and maxillary teeth (41/52). The predominance of these 2 categories in cases reports was consistent with previously experienced NaOCl extrusions by endodontists (4). Despite the lack of scientific evidence, it seems that the decrease of bone density in women compared with men and the thinness of cortical bone

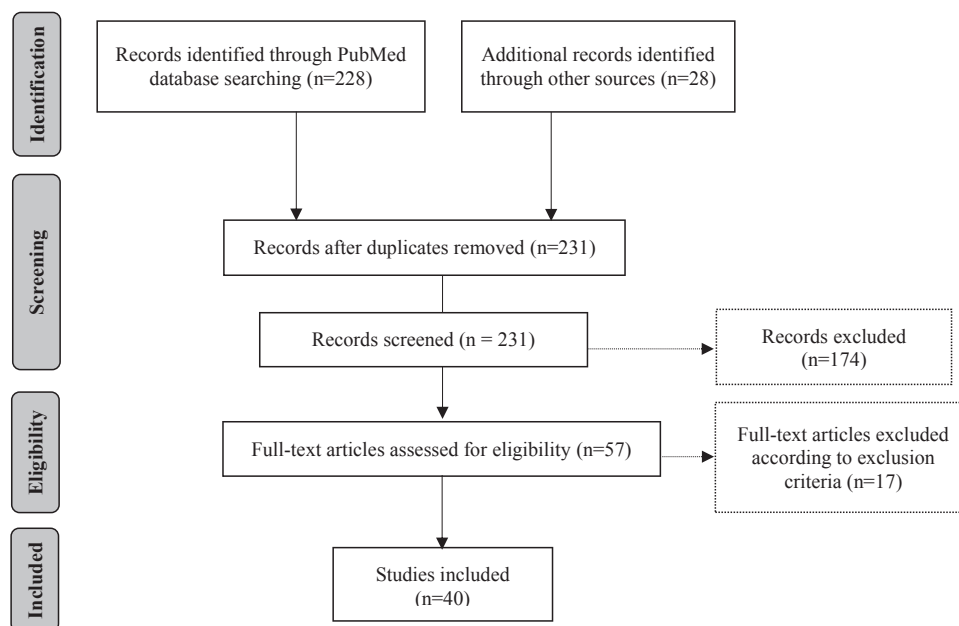
surrounding the buccal roots of maxillary teeth could be 2 contributing factors enabling the spread of NaOCl into the surrounding soft tissues (4, 5). Half of the retrieved data did not provide information on the patients' health status or the initial pulpal and periapical status. It is worth noting that these parameters may constitute additional risk factors and may impact the severity of the complications (4).

The toxicity of NaOCl is mainly caused by its chemical composition, but other factors such as the concentration, volume, and pressure of extrusion could exacerbate the consequences of these accidents (47). The volume of NaOCl extruded was provided in only 5 reports. However, the reliability of this information remains unclear. Unfortunately, the NaOCl concentration was mentioned in only half of the cases (30/52) even though this is essential information. From what we could glean from the articles that did mention the concentration of NaOCl, it ranged from 1%–5.25%. No information on how the solution was obtained (ie, pharmaceutical preparation or over-the-counter purchase) was provided.

A few reports (10/52) provided information about the irrigation method, needle design, and syringe capacity, which play a significant role in the strength of the irrigant flow (48, 49). Information related to rubber dam usage, which does not directly influence NaOCl extrusions, was present in 20 of 52 cases. The hypothesis of potential factors having favored the occurrence of irrigant extrusion was present in only 29 of the 52 cases. Factors such as open apices, either iatrogenic or anatomic (7, 15, 21, 23, 32, 33, 37, 39); undiagnosed perforation (8, 10, 13, 15, 18, 28–30, 35, 46); needle wedging (17, 44); and close approximation with surrounding structures such as an antral tooth (10, 12, 24, 41) may have facilitated NaOCl extrusion.

### Manifestations of NaOCl Extrusion

The description of the symptoms after NaOCl extrusion was shown to be acute and of sudden onset (Fig. 2). Severe pain was almost systematic (45/52) even though the patients were anesthetized (36). Profuse hemorrhaging through the root canal was reported in one third of the cases (17/52). Swelling occurred in almost every case (49/52),



**Figure 1.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart of the systematic review process (meta-analysis was not performed).

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