



BRIEF COMMUNICATION

Evaluation of irrigant extrusion in endodontic procedures

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ABSTRACT

Introduction: endodontics employs irrigants such as sodium hypochlorite and chlorhexidine to disinfect root canals, although their inappropriate use may cause clinical accidents with significant consequences for patient health.

Objective: to analyze the prevalence, complications, management, and preventive measures regarding accidental extrusion of endodontic irrigants among dentists in Ambato, Ecuador.

Methods: a quantitative, descriptive, non-experimental, cross-sectional study was conducted in 2024. Thirty dentists participated through convenience sampling. A structured questionnaire with closed and open-ended questions was administered electronically. Data were processed using descriptive statistics, respecting bioethical principles of informed consent and confidentiality.

Results: a total of 46,6 % of dentists reported having experienced irrigant extrusion. The most frequent complications were pain (43,3 %), edema (26,6 %), and bone necrosis (23,3 %). Management measures included rinsing with water (26 %), use of anti-inflammatory drugs and antibiotics (16,7 %), and suspension of irrigation with rest (16,7 %). For prevention, participants highlighted the importance of applying proper irrigation techniques (36,6 %) and controlling volume and pressure (23,4 %). The most frequently mentioned risk factors were complex canal anatomy (36,6 %) and iatrogenic perforations (22,4 %).

Conclusions: the study shows that irrigant extrusion is a frequent and potentially serious clinical event. The findings emphasize the need for continuous training, standardized protocols, and safe technologies to reduce risks. Identifying predisposing factors helps guide preventive strategies and improve safety in endodontic procedures, thereby strengthening the quality of dental care.

Keywords: Dental Pulp Cavity; Endodontics; Extravasation of Diagnostic and Therapeutic Materials; Therapeutic Irrigation.

INTRODUCTION

Endodontics, as a dental specialty, aims to treat diseases of the dental pulp and periapical tissues. During these procedures, irrigating solutions play a fundamental role in achieving adequate cleaning, disinfection, and preparation of the root canal system. Two commonly used endodontic irrigants are chlorhexidine (CHX) and sodium hypochlorite (NaOCl). Both chemical agents have proven effective in reducing microbial load and dissolving organic tissue. However, their clinical handling and application are not without risks, and accidents may occur that lead to undesirable complications for the patient.⁽¹⁾

Accidents involving NaOCl are more common and widely documented in the literature. However, CHX-related accidents—though less frequent—should not be underestimated. CHX is a broad-spectrum antiseptic with potent bactericidal action, but it also exhibits cytotoxic properties that can damage living tissues.⁽²⁾

Clinical manifestations of CHX and NaOCl extrusion share similarities, including intense pain, swelling, edema, and necrosis. However, notable differences exist in severity and management of these complications.⁽³⁾ Pain is a universal symptom in both types of extrusion, often described as severe, acute, and sharp. It may radiate to adjacent areas and persist for days or even weeks.

Irrigant extrusion in endodontics refers to the leakage of irrigant beyond the confines of the root canal system, which can cause edema due to fluid accumulation and tissue swelling, with intensity varying according to event severity and individual patient response. In more severe cases, it may trigger tissue necrosis—characterized by cell death, loss of sensation, and structural damage—a complication associated with both CHX and NaOCl use.^(4,5,6) Given this context, the present study was conducted to analyze the prevalence, complications, management, and preventive measures regarding accidental extrusion of endodontic irrigants among dentists in Ambato, Ecuador.

METHODS

An observational, descriptive, cross-sectional study was carried out in Ambato, Ecuador, during 2024. The population consisted of practicing dentists. The final sample included 30 dentists selected through non-probabilistic convenience sampling who met the following criteria:

- Inclusion criteria: Dentists performing endodontic procedures who voluntarily agreed to participate.
- Exclusion criteria: Professionals not practicing endodontics or who did not complete the survey.

Procedures and techniques

Data collection was performed using a structured questionnaire with closed and open-ended questions, administered electronically via an online platform. The instrument assessed: history of sodium hypochlorite or chlorhexidine extrusion (yes/no); observed complications (pain, edema, necrosis, persistent infection); management measures applied; perceived risk factors; and preventive strategies.

Statistical analysis

Data were analyzed using descriptive statistics. Absolute frequencies, percentages, and measures of central tendency (mean, median) were calculated for continuous variables, along with measures of dispersion (range, standard deviation). Analysis was performed using SPSS version 25. Incomplete responses were excluded.

Ethical considerations

The study was approved by the Ethics Committee of the Universidad Regional Autónoma de Los Andes. All participants provided electronic informed consent prior to survey completion. Confidentiality was guaranteed, and the study adhered to the principles of the Declaration of Helsinki.

RESULTS

Table 1 shows participant characteristics: most respondents practiced general dentistry (80 %), while only a small percentage specialized in endodontics (6,7 %), prosthodontics (10 %), or periodontics (3,3 %). Additionally, the majority had less than five years of clinical experience (66,7 %), reflecting a young cohort in the early stages of professional practice.

Table 1. Characteristics of study participants.

Variable		No.	%
Specialty	Endodontics	2	6,7
	Periodontics	1	3,3
	Prosthodontics	3	10
	General Dentistry	24	80
Years in practice	<5 years	20	66,7
	5–10 years	5	16,6
	11–15 years	3	10
	>15 years	2	6,7

46,6 % of dentists reported at least one episode of accidental irrigant extrusion, indicating this is a relatively common clinical event. The most frequently reported complications were pain (43,3 %) and edema (26,6 %), followed by bone necrosis (23,3 %) and persistent infection (6,8 %). These findings show that while pain and inflammation are the most common manifestations, more severe risks—such as necrosis—can compromise patient health and treatment quality.

In Table 2, dentists identified the most important preventive measures as proper irrigation techniques (36,6 %) and control of volume and pressure (23,4 %). For managing complications, they emphasized irrigation with water (26 %) and use of anti-inflammatories and antibiotics (16,7 %). They also highlighted continuous training in irrigation techniques (36,6 %) and implementation of standardized safety protocols (23,3 %) as useful resources—reflecting a strong emphasis on education and standardization of safe clinical practices.

Table 2. Measures to prevent and manage accidental extrusion.

	Question	No.	%
What measures are important to prevent accidental extrusion of NaOCl or CHX beyond the apex?	Use proper irrigation techniques	11	36,6
	Control irrigation volume and pressure	7	23,4
	Carefully aspirate excess irrigant	5	16,6
	Use rubber dam isolation	4	13,4
	Effective communication with dental assistant	3	10,0
What measures can be taken to manage extrusion complications?	Irrigation with water	8	26,0
	Remove excess irrigant	2	6,8
	Analgesics and rest	3	10,0
	Anti-inflammatories and antibiotics	5	16,7
	Follow clinical guidelines	2	6,8
What resources or tools are useful to improve prevention?	Continuous training in irrigation techniques	11	36,6
	Use of ergonomic instruments	4	13,4
	Implementation of standardized safety protocols	7	23,3
	Availability of modern endodontic equipment	6	20,0
	Research and development of new irrigation technologies	2	6,7

In Table 3, the most cited risk factors for extrusion were complex root canal anatomy (36,6 %) and iatrogenic perforations (22,4 %), followed by operator inexperience (17 %) and calcifications (14 %). Deficient equipment (10 %) was also noted as a contributing factor, demonstrating that both anatomical conditions and technical/human limitations significantly influence the occurrence of this clinical event.

Table 3. Factors increasing extrusion risk

Factor	No.	%
Complex root canal anatomy	11	36.6
Calcifications	4	14.0
Iatrogenic perforations	7	22.4
Operator inexperience	5	17.0
Deficient equipment	3	10.0

DISCUSSION

Based on study results, the most common complications associated with irrigant extrusion during endodontic procedures were pain (43,3 %) and edema (26,6 %). These findings align with international literature, which indicates that irrigant extrusion—particularly NaOCl—is a clinically relevant event due to its potential to cause immediate and occasionally severe adverse reactions. In this regard, Shetty et al.,⁽⁷⁾ conducted a systematic review of case reports analyzing NaOCl-related accidents in endodontics. Their results show such accidents can lead to serious complications—from intense pain and edema to tissue necrosis and even vision loss—highlighting the need for heightened clinical caution and clear emergency protocols.

Following the same line of research, the dentists who participated in this study indicated that the most useful resources for improving the prevention of extrusion are, first, continuous training in irrigation techniques, mentioned by 36,6 % of respondents; and second, the implementation of standardized safety protocols, reported by 23,3 %. These results are consistent with those reported by Salvadori M, et al.,⁽⁸⁾ who in a similar study found a prevalence of extrusion of 42,3 %, confirming that this is a frequent clinical problem with significant impact on dental practice. The high prevalence described in both studies highlights the crucial importance of continuous training as a preventive strategy, as it allows professionals to remain updated on safe techniques and the management of complications. Likewise, it underscores the need to follow appropriate and standardized protocols that ensure quality care, minimize the risks associated with the use of endodontic irrigants, and strengthen patient safety.

Regarding complication management, scientific literature offers various therapeutic proposals. Souza Santos, et al.,⁽⁹⁾ suggest systemic corticosteroids as an effective measure to control severe edema due to their anti-inflammatory properties and ability to reduce tissue response. Campos P, et al.,⁽¹⁰⁾ recommend hyperbaric oxygen therapy in cases of extensive bone necrosis, arguing it may promote tissue regeneration and improve prognosis in critical situations.

However, despite these recommendations, more research is needed to determine the long-term efficacy of these measures and establish evidence-based clinical protocols.^(11,12,13) The lack of consensus on management strategies reflects the need for continued clinical and experimental studies to validate proposed interventions and provide dentists with reliable therapeutic tools to address irrigant extrusion complications.^(14,15,16)

CONCLUSIONS

This study represents a milestone in preventing accidental extrusion of sodium hypochlorite and chlorhexidine in endodontic procedures, revealing a concerning prevalence and serious clinical consequences—including intense pain, edema, and bone necrosis. Beyond quantifying the problem, it offers a practical action guide by proposing preventive measures such as safe irrigation techniques, rubber dam use, and standardized protocols, while emphasizing recognition of risk factors like complex anatomy, iatrogenic perforations, and operator inexperience. It also highlights the importance of continuous training, technological innovation, and scientific research as pillars of a multifaceted approach involving dentists, healthcare centers, manufacturers, and researchers. Collectively, these findings constitute an urgent call to action to strengthen patient safety and elevate the quality of dental care.

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