



Evaluation of the knowledge levels of dentistry undergraduate students regarding sodium hypochlorite accidents and management

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Purpose: This study aimed to evaluate the knowledge of 4th- and 5th-year dental students about NaOCl accidents and the management options.

Methods: A questionnaire, which included 296 students, was conducted among 4th and 5th-year dental school students. The researcher conducted the data collection process face-to-face. The survey questions included multiple-choice questions about the factors that may cause NaOCl accidents, symptoms observed in the patient in accidents, and intervention methods against complications. The frequency, chi-square test was used for statistical analysis with Bonferroni correction.

Results: Regarding NaOCl accidents, 4th and 5th grade students were found to have a general awareness of the causes and prevention methods. The presence of preoperative pain and localized abscess have been regarded as factors increasing the risk of NaOCl extrusion. The respondents indicated sudden pain occurrence as the first symptom in NaOCl accidents and preferred to prescribe medication to the patient after NaOCl accident. After the NaOCl accident the majority of the respondents choose to recalling the patient for control and referring the patient to the relevant health institution when necessary.

Conclusion: The study determined that 4th and 5th grade students had general awareness about the causes and precautions of NaOCl accidents at similar levels. The 5th-grade students think they have more knowledge and confidence to intervene in NaOCl accidents than 4th-graders.

Keywords: Endodontics; sodium hypochlorite accidents; survey.

Introduction

For a successful root canal treatment (RCT), organic and inorganic structures such as microorganisms, necrotic tissues, smear layer, and biofilm should be removed from the root canal system as much as possible. Sodium hypochlorite (SH) is considered to be the gold standard among root canal irrigants because of its antibacterial and tissue-dis-

solving properties (1). However, despite its effectiveness, SH's high cytotoxicity can lead to severe complications if extruded beyond the root canal system or improperly used during clinical procedures. These complications, commonly referred to as "SH accidents," may include pronounced facial swelling, localized edema, sudden pain, hematoma formation, and tissue necrosis (2-4).

The occurrence of SH accidents has been extensively re-

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ported in dental literature, with numerous studies emphasizing the risks associated with sodium hypochlorite extrusion. Factors such as solution concentration, application pressure, and patient anatomy significantly influence the severity of injuries. For example, higher concentrations of SH are often linked to more severe tissue damage, while improper irrigation techniques can increase the likelihood of extrusion (2,3). Case reports have detailed a range of symptoms, from severe pain and swelling to rare instances of life-threatening complications such as airway obstruction (4). Effective management typically involves the use of analgesics, antibiotics, corticosteroids, or antihistamines, tailored to the injury's severity. Recovery times vary, with minor cases resolving within weeks and more complex injuries requiring extended care (2-4).

Dentists' knowledge and equipment concerning scenarios that can lead to SH accidents, as well as their preparedness to manage such incidents effectively, are critical in minimizing risks and improving patient outcomes. This survey study aimed to evaluate the knowledge and attitudes of Ondokuz Mayıs University Faculty of Dentistry 4th- and 5th-year students regarding the prevention and intervention of SH accidents. Considering their advanced education and internship experiences, it was assumed that 5th-year undergraduate students would demonstrate a higher level of awareness and competency in managing SH-related complications compared to 4th-year students. The null hypothesis was that there would be no significant difference in the knowledge and attitudes of 4th- and 5th-year dental students regarding the prevention and management of sodium hypochlorite accidents.

Materials and Methods

This study was designed as a cross-sectional survey covering all 4th- and 5th-year students who are actively studying at Ondokuz Mayıs University Faculty of Dentistry. Ethics committee approval for the study was obtained from the local university clinical research ethics committee (Date: 18/05/2023, No:2023/175). The study was conducted under the principles of the Declaration of Helsinki. The principal investigators conducted the data collection process face-to-face. The inclusion criteria of the volunteers were as follows: Being a 4th- and 5th-year dentistry student, having taken an endodontic internship, volunteering to participate in the study, and answering the questions thoroughly. Graduates of the faculty of dentistry and 1st-, 2nd-, and 3rd-year students of dentistry were not included in the study. The participants participated in the study by approving the paragraph containing voluntary consent and the purpose of the study at the beginning of the questionnaire form. The 29-question questionnaire

used in the study included multiple-choice questions on factors that may cause SH accidents, symptoms observed in patients in accidents, and intervention methods against complications. The full questionnaire is available as a Supplementary Table.

A total of 296 students participated in the survey, of which 141 (47.6%) were 4th-year students and 155 (52.4%) were 5th-year students. All questions in the questionnaire were fully answered by the participants, and no incomplete or omitted responses were observed. During the data collection and entry process, the accuracy and consistency of the responses were regularly verified by the principal investigators. Any potential issues in the dataset were carefully monitored to ensure its validity and reliability. Therefore, the analysis included the complete dataset without any exclusions.

The data obtained in this study were analyzed using SPSS v21 (Chicago, IL, USA) with chi-square tests and Bonferroni correction. The significance level was set at $P < 0.05$.

Results

A total of 296 students, 141 (47.6%) 4th-year and 155 (52.4%) 5th-year students, participated in the survey. More 4th-year students think that SH may cause complications such as clothing discoloration, eye damage, skin and mucous membrane irritation, and tissue necrosis than 5th-year students. A significant difference was found between the groups regarding the complications that SH may cause in the clinic ($P < 0.001$). The 5th-year students agreed with the precautions such as protective measures (goggles, mask, patient gown), rubber dam isolation, use of a powerful aspirator, determining the correct working height, not applying too much pressure while irrigating, using syringes designed for irrigation, using different colored syringes for irrigation at a higher rate than 4th-year students. There was a significant difference between 4th-

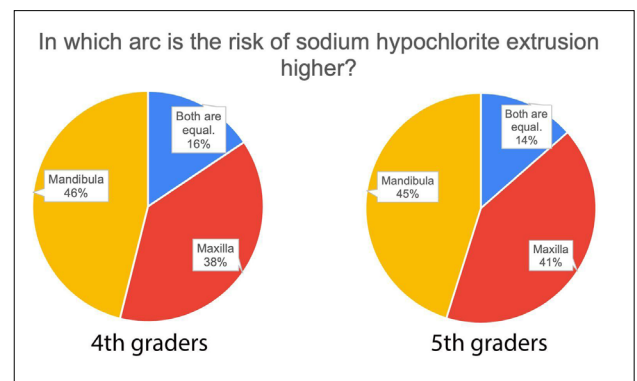


Fig. 1. Distribution graph of sodium hypochlorite extrusion risk according to arcs, based on the answers of 4th and 5th graders.

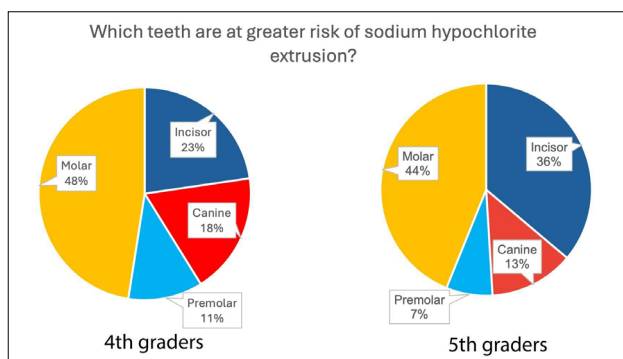


Fig. 2. Distribution graph of sodium hypochlorite extrusion risk according to teeth, based on the answers of 4th and 5th graders.

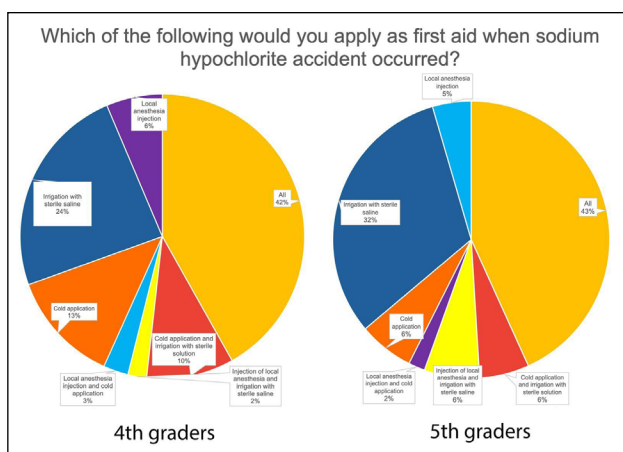


Fig. 3. Distribution graph of preferred emergency response method in sodium hypochlorite accidents based on the responses of 4th and 5th graders.

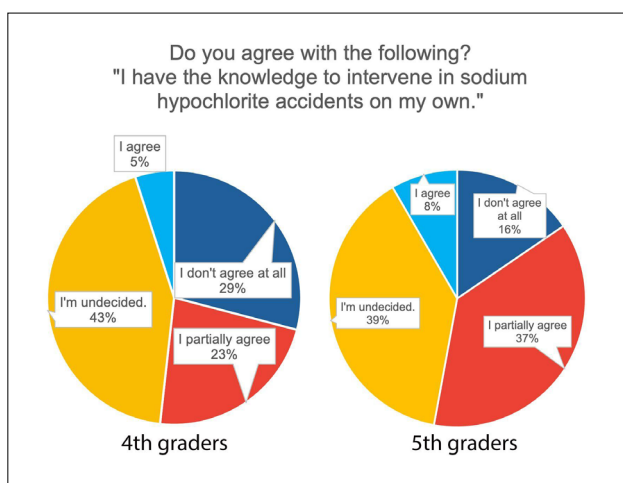


Fig. 4. Distribution of 4th and 5th grade students' competence level in responding to sodium hypochlorite accidents.

and 5th-year students in terms of the precautions for SH accidents that may occur in the clinic ($P < 0.002$).

Between 4th- and 5th-year students, there was no signifi-

cant difference in the assessment of the risk of extrusion of SH between the maxillary and mandibular arch. Students from both semesters similarly assessed that the risk of extrusion was independent of the arch (Fig. 1). When the extrusion risk of SH was evaluated regarding tooth types, a significant difference was found between the groups. Fourth graders were more likely to think that the risk of extrusion may be higher in molar teeth ($P < 0.006$) (Fig. 2).

There was a significant difference between the preoperative symptoms and the risk of extrusion of SH into periapical tissues ($P < 0.003$). Both groups agreed that the presence of preoperative pain, edema, localized abscess, and sinus tract might increase the risk of extrusion. A significant difference was found between the groups regarding the effect of periapical conditions of the teeth on extrusion. The 5th-year students reported a higher risk of extrusion in cases of open apex, external resorption, internal resorption, and proximity to the maxillary sinus more frequently than 4th-year students ($P < 0.001$).

As a precaution against SH accidents, SH concentration preference between 4th- and 5th-year students also showed a significant difference. The concentration range between 2.5%-5% was most abundantly preferred by 4th-year students; while 5th-year students mostly preferred 2.5% SH ($P < 0.006$).

There was a significant difference between the 2 groups in terms of the first symptoms reported in SH accidents, such as the sudden onset of pain, edema, and intense bleeding from the apical area ($P < 0.002$). While 4th-year students thought that only severe and sudden pain was more likely, 5th-year students thought that all of the symptoms of sudden and severe pain, edema, hemorrhage, and intense bleeding from the apical area were more likely.

A significant difference was found between the groups in terms of the choice of the first intervention to be applied after SH extrusion ($p < 0.003$). The 5th and 4th terms similarly preferred local anesthesia injection, cold application, and irrigation with sterile saline solution as the first intervention after SH extrusion (Fig. 3).

A significant difference was found between the groups in terms of the drug preference prescribed to the patient after SH injection. 5th-year students preferred to prescribe antibiotics, antihistamines, corticosteroids, and NSAIDs more than 4th-year students. ($P < 0.002$). A significant difference was found between the groups in terms of the belief that they had the ability to intervene in SH accidents alone ($P < 0.006$). Compared to 4th-year students, more semester 5 students reported that they knew to intervene in SH accidents alone (Fig. 4).

Discussion

A survey of American Association of Endodontists members concluded that maxillary premolars and molars with periapical radiolucency and necrotic pulps were more prone to SH accidents. One possible reason for this finding is that pulpal necrosis is often associated with pulpal bacterial infection and periarticular inflammation, external apical root resorption, and bone resorption (5). When SH accidents are examined in detail in the literature, it is seen that most of these accidents occur in the maxilla (6-18). Compared to maxillary teeth, mandibular teeth are surrounded by a denser cortical plate, and the mandibular premolar and molar apices are more centrally located within the body of the mandibular bone. The buccal roots of maxillary premolars and molars have only a thin cortical bone covering, possibly predisposing these teeth to SH accidents (19). This study concluded that 5th-year students thought that the risk of SH extrusion was higher in incisors, and there was no difference between maxillary and mandibular teeth. In addition, 5th-year students think the risk of extrusion is higher in cases of open apex, external resorption, internal resorption, and proximity to the maxillary sinus.

A study conducted among members of the Hellenic Society of Endodontology, reported that SH-related accidents affecting the ocular region occur when protective equipment is not used or is inadequate (20). In another study, it was concluded that the application of rubber covers would prevent SH accidents. (21). In our questionnaire study, it was concluded that 4th- and 5th-year grade students thought that protective measures such as goggles, rubber dam, and selection of appropriate syringes for irrigation should be taken to prevent SH accidents.

A systematic review emphasized that the knowledge to prevent SH accidents and the knowledge of intervention in case of SH accidents are important (3). In a survey of members of the American Association of Endodontists, no correlation was found between years of professional experience and the occurrence of more than one SH accident (5). A significant difference was found between the groups regarding the ability to intervene alone in SH accidents. 5th-year students think that they have the knowledge to intervene alone more than 4th-year students.

One of the factors determining SH injury is the concentration of SH, along with the volume and exit pressure of SH (22). When the concentration used in SH accidents was analyzed, it was reported that SH was not diluted or a 1:1 dilution ratio was used in 83% of the accidents (5). It has been reported that as the concentration of SH increases, it becomes more toxic to living tissue (23).

When the clinical features of hypochlorite-induced injury were evaluated, a sudden onset of sharp, burning pain, swelling, swelling and bruising, and ulceration were reported (4,5,24-29). Airway obstruction has also been reported in one case (30). In this survey, results parallel to these findings were also found.

The majority of the participating volunteers reported that they were treated immediately after the accident by applying additional anesthesia and flushing the canal with saline solution or water (5). A significant difference was found between the groups in terms of first intervention practice after SH extrusion. The 5th-year students prefer local anesthesia injection and cold application more frequently as the first intervention after SH extrusion.

In the literature, there are at least 3 case reports of accidental SH injection (31-33). In these reports, SH used for endodontic irrigation was placed in anesthetic cartridges and then used for accidental anesthetic injection. One patient was reported to require hospitalization following a mandibular block (31). SH used for endodontic irrigation should be stored only in labeled and easily identifiable containers and irrigation syringes.

Analgesics and antibiotics are the most commonly used drugs in the treatment of SH accident cases. Information from the literature revealed that antibiotics and analgesics were the most commonly used drugs (2,3). Antibiotics are prescribed to prevent an increased risk of infection from local hematoma and bruising (34). Other drugs in the case reports included in this review were corticosteroids and antihistamines. The use of antihistamines has been reported to limit edema expansion and also inhibit histamine-associated increase in vascular permeability (35). In this study, the results were consistent with the findings reported in previous studies.

Our survey was answered by a limited number of dental students, providing the education point of view of a single faculty. A similar study can be conducted in larger populations with a larger number of dental students to obtain more comprehensive results.

Conclusion

In our study, it was concluded that 4th- and 5th-year students were generally aware of the factors that lead SH accidents and methods to prevent them. 4th- and 5th-year students think that the presence of pain as a preoperative symptom and a localized abscess may increase the risk of extrusion of SH. In terms of radiologic examination, they think that the risk of extrusion is higher in cases of external resorption, internal resorption, and proximity to the maxillary sinus. They responded that the first symptom of SH

accidents is sudden pain. It was stated that they prefer to prescribe medication to the patient after SH extrusion and injection, call for control, and refer the patient to the relevant health institution when necessary. 5th-year students think that they have the knowledge to intervene in SH accidents alone more than 4th-year students.

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References

- Haapasalo M, Shen Y, Wang Z, et al. Irrigation in endodontics. *Br Dent J* 2014; 216: 299–303. [\[CrossRef\]](#)
- Farook SA, Shah V, Lenouvel D, et al. Guidelines for management of sodium hypochlorite extrusion injuries. *Br Dent J* 2014; 217: 679–84. [\[CrossRef\]](#)
- Guivarc'h, M, Ordioni U, Ahmed HMA, et al. Sodium hypochlorite accident: A systematic review. *J Endod* 2017; 43: 16–24. [\[CrossRef\]](#)
- Shetty SR, Al-Bayati SAAF, Narayanan A, et al. Sodium hypochlorite accidents in dentistry. A systematic review of published case reports. *Stomatologija* 2020; 22: 17–22.
- Kleier DJ, Averbach RE, Mehdipour O. The sodium hypochlorite accident: Experience of diplomates of the American Board of Endodontics. *J Endod* 2008; 34: 1346–50. [\[CrossRef\]](#)
- Hales JJ, Jackson CR, Everett AP, et al. Treatment protocol for the management of a sodium hypochlorite accident during endodontic therapy. *Gen Dent* 2001; 49: 278–81.
- Gernhardt CR, Eppendorf K, Kozłowski A, et al. Toxicity of concentrated sodium hypochlorite used as an endodontic irrigant. *Int Endod J* 2004; 37: 272–80. [\[CrossRef\]](#)
- Tosti A, Piraccini BM, Pazzaglia M, et al. Severe facial edema following root canal treatment. *Arch Dermatol* 1996; 132: 231–3. [\[CrossRef\]](#)
- Cymbler DM, Ardakani P. Sodium hypochlorite injection into periapical tissues. *Dental update* 1994; 21: 345–6.
- Calışkan MK, Türkün M, Alper S. Allergy to sodium hypochlorite during root canal therapy: A case report. *Int Endod J* 1994; 27: 163–7. [\[CrossRef\]](#)
- Linn JL, Messer HH. Hypochlorite injury to the lip following injection via a labial perforation. Case report. *Aust Dent J* 1993; 38: 280–2. [\[CrossRef\]](#)
- Ehrlich DG, Brian Jr JD, Walker WA. Sodium hypochlorite accident: Inadvertent injection into the maxillary sinus. *J Endod* 1993; 19: 180–2. [\[CrossRef\]](#)
- Joffe E. Complication during root canal therapy following accidental extrusion of sodium hypochlorite through the apical foramen. *Gen Dent* 1991; 39: 460–1.
- Becking AG. Complications in the use of sodium hypochlorite during endodontic treatment: Report of three cases. *Oral Surg Oral Med Oral Pathol Oral Radiol* 1991; 71: 346–8. [\[CrossRef\]](#)
- Neaverth EJ, Swindle R. A serious complication following the inadvertent injection of sodium hypochlorite outside the root canal system. *Compendium* 1990; 11: 474, 476, 478–81.
- Reeh ES, Messer HH. Long-term paresthesia following inadvertent forcing of sodium hypochlorite through perforation in maxillary incisor. *Dent Traumatol* 1989; 5: 200–3. [\[CrossRef\]](#)
- Grob R. An incident with sodium hypochlorite--only my error? [Article in German] *Schweiz Monatsschr Zahnmed* 1984; 94: 661–2.
- Becker GL, Cohen S, Borer R. The sequelae of accidentally injecting sodium hypochlorite beyond the root apex: report of a case. *Oral Surg Oral Med Oral Pathol Oral Radiol* 1974; 38: 633–8. [\[CrossRef\]](#)
- Vertucci FJ, Haddix JE, Britto LR. Tooth morphology and access preparation. In M Kenneth, S Cohen, eds. *Cohen's Pathways of the Pulp*, 10th Ed. 2010, pp. 197–199.
- Zarra T, Lambrianidis T. Occupational ocular accidents amongst Greek endodontists: A national questionnaire survey. *Int Endod J* 2013; 46: 710–9. [\[CrossRef\]](#)
- Jain P. Common complications in endodontics: prevention and management. New York City: Springer; 2017. [\[CrossRef\]](#)
- Mehdipour O, Kleier DDJ, Averbach DRE, et al. Anatomy of sodium hypochlorite accidents. *Compend Contin Educ Dent* 2007; 28: 544–6, 548, 550.
- Pashley EL, Birdsong NL, Bowman K, et al. Cytotoxic effects of NaOCl on vital tissue. *J Endod* 1985; 11: 525–8. [\[CrossRef\]](#)
- Aguiar BA, Gomes FA, Ferreira CM, et al. Hypochlorite-induced severe cellulitis during endodontic treatment: Case report. *RSBO* 2014; 11: 199–203. [\[CrossRef\]](#)
- Laverty DP. A case report of accidental extrusion of sodium hypochlorite into the maxillary sinus during endodontic retreatment and review of current prevention and management. *J Res dent* 2014; 2: 96–100. [\[CrossRef\]](#)

26. Rai K, Goel M, Mandhotra P, et al. Management of sodium hypochlorite accident: A case report. *Br J Med Med Res* 2016; 18: 1–5. [\[CrossRef\]](#)
27. Deliverska E. Oral mucosa damage because of of hypochlorite accident-a case report and literature review. *J IMAB-Ann Proc Sci Paper* 2016; 22: 1269–73. [\[CrossRef\]](#)
28. Faras F, Abo-Alhassan F, Sadeq A, et al. Complication of improper management of sodium hypochlorite accident during root canal treatment. *J Int Soc Prev Community Dent* 2016; 6: 493. [\[CrossRef\]](#)
29. Campos P, Roa E, Montaña J, et al. Inadvertent extrusion of sodium hypochlorite during endodontic treatment: case report. *JSM Dent* 2016; 4: 1067.
30. Al-Sebaei MO, Halabi OA, El-Hakim IE. Sodium hypochlorite accident resulting in life-threatening airway obstruction during root canal treatment: A case report. *Clin Cosmet Investig Dent* 2015; 7: 41–4. [\[CrossRef\]](#)
31. Herrmann JW, Heicht RC. Complications in therapeutic use of sodium hypochlorite. *J Endod* 1979; 5: 160. [\[CrossRef\]](#)
32. Gursay UK, Bostancı V, Kosger HH. Palatal mucosa necrosis because of accidental sodium hypochlorite injection instead of anaesthetic solution. *Int Endod J* 2006; 39: 157–61. [\[CrossRef\]](#)
33. Pontes F, Pontes H, Adachi P, et al. Gingival and bone necrosis caused by accidental injection of sodium hypochlorite instead of anaesthetic solution. *Int Endod J* 2008; 41(3): 267–70. [\[CrossRef\]](#)
34. Goswami M, Chhabra N, Kumar G, et al. Sodium hypochlorite dental accidents. *Paediatr Int Child Health* 2014; 34: 66–9. [\[CrossRef\]](#)
35. Crincoli V, Scivetti M, Di Bisceglie MB, et al. Unusual case of adverse reaction in the use of sodium hypochlorite during endodontic treatment: A case report. *Quintessence Int* 2008; 39: e70–3.