Journal of Dental Sciences 18 (2023) 1417–1418

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.e-jds.com

Letter to the editor

Clinical research on sodium hypochlorite irrigation and extrusion: The gap and scope

Letter to the Editor

Sodium hypochlorite (NaOCl) is a widely used root canal irrigant. However, its extrusion beyond root confines during irrigation is a major concern as this leads to NaOCl accident with serious effects.[1] Although relatively low frequency of NaOCl extrusion/accident has been reported by a study,[2] it is possible that many clinicians would have experienced this incident at least once in their practice or career.[3] There is also a high probability that many such incidents may go unreported. Currently, in the endodontic literature, clinical evidence on NaOCl extrusion is mostly based on few studies, mainly comprising of survey, retrospective, or observational studies, and couple of systematic reviews on the previously published case reports/series.[2–8] NaOCl extrusion is mainly related to iatrogenic factors such as technique or method, force, pressure, and flow rate employed by the operator during NaOCl irrigation, particularly in the presence of other predisposing factors such as open or widened root apex, apical root perforation, apical bony fenestration, root defects, and proximity of root apex to surrounding or anatomical structures.[3–5,8,9] Considering this background with medico-legal implications of NaOCl extrusion/accident,[6,7] obtaining higher level of clinical evidence on NaOCl irrigation factors and extrusion becomes more important.[2,6,10] However, there is a gap in this aspect due to availability of only limited clinical data and certain challenges and dilemmas in obtaining them. Presently, scientific data on NaOCl irrigation and extrusion is mostly derived from *in vitro* studies,[4,9] and clinical or *in vivo* studies have hardly been conducted.[2,8] Therefore, there is a need to conduct more clinical research on NaOCl irrigation and extrusion. One of the challenges here is about considering and standardizing various factors related to NaOCl extrusion. Clinically, although NaOCl extrusion is iatrogenic in nature, its occurrence is also influenced by factors related to patient (host), tooth, operator, and irrigant (NaOCl).[9] NaOCl extrusion may not occur clinically when these factors are controlled. Therefore, conducting a clinical study by controlling or excluding these factors can pose a challenge in truly reflecting and/or extrapolating the frequency of NaOCl extrusion to the incidence or rate of NaOCl extrusion as an iatrogenic occurrence. It is also difficult to accurately measure *in vivo* the irrigation pressure or force exerted by the operator. This throws another challenge of ensuring intra-operator or inter-operator consistency in exerting irrigation pressure or force. Moreover, the minimum or threshold of irrigation force or pressure which can lead to NaOCl extrusion is not yet known and the reported data are varying.[10] Clinically, NaOCl extrusion may not occur by mere application of higher irrigation force or pressure. It mainly occurs when higher irrigation force or pressure exceeds back pressure offered by the surrounding tissues and vasculature. This mechanism of NaOCl extrusion and infusion into the surrounding tissues or vasculature leads to NaOCl accident and its subsequent manifestations. The back pressure offered varies from case to case and is difficult to measure *in vivo* for conducting the clinical studies.[9,10] It is also equally challenging to objectively evaluate *in vivo* the volume of NaOCl extruded and infused into the surrounding tissues or vasculature.[10] On the other hand, conducting a clinical study on NaOCl extrusion can involve an ethical dilemma as NaOCl is highly cytotoxic with a potential for unpredictable extent of tissue damage and severe complications including short-term and long-term effects.[3,5,10] Additionally, there is no antidote to immediately neutralize NaOCl in the event of any complication during the clinical study. Another dilemma is regarding the volume of extruded NaOCl to be considered permissible or safe while conducting a clinical study as even a small amount of NaOCl can cause disproportionate extent of tissue damage and complications. Furthermore, there is lack of information on the association between volume of extruded NaOCl and extent of tissue damage or involvement though cytotoxicity of NaOCl is directly proportional to its volume.[9,10] Hence, as of now, survey, retrospective, or observational studies remain as the key sources for clinical data on NaOCl irrigation and extrusion. But any

https://doi.org/10.1016/j.jds.2023.05.005
1991-7902/© 2023 Association for Dental Sciences of the Republic of China. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

missing details due to lack of standardized process of documentation or methodology is a limitation here.[5,6,10]

Considering the aforementioned gap, challenges and dilemmas in clinical research on NaOCl irrigation and extrusion, the scope and future directions would include potential for creating biological models, *in vivo* models, or clinical study models, particularly by applying concepts such as tissue engineering, tissue regeneration, and cloning, promoting research based solutions or measures to address the challenges and dilemmas, developing clinical study design and universal template or online database towards standardized methodology, documentation, and data collection, conducting clinical studies employing multi-centre design and larger sample size, evaluating the frequency of NaOCl extrusion in the presence of various predisposing factors and their correlation, and assessing the outcome of extrusion of lower concentration of NaOCl ($\leq$0.5%) which is one of the measures recommended to prevent or minimize NaOCl accident without compromising much on the beneficial properties of NaOCl for irrigation.[3,5,10]

Declaration of competing interest

The author has no conflicts of interest relevant to this article.

Acknowledgements

None.

References

1. Nasiri K, Wrbas KT. Management of sodium hypochlorite accident in root canal treatment. *J Dent Sci* 2023;18:945—6.
2. Özdemir O, Hazar E, Koçak S, Sağlam BC, Koçak MM. The frequency of sodium hypochlorite extrusion during root canal treatment: an observational clinical study. *Aust Dent J* 2022; 67:S57—64.
3. 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.
4. Boutsioukis C, Psimma Z, van der Sluis LW. Factors affecting irrigant extrusion during root canal irrigation: a systematic review. *Int Endod J* 2013;46:599—618.
5. Guivarc'h M, Ordioni U, Ahmed HM, Cohen S, Catherine JH, Bukiet F. Sodium hypochlorite accident: a systematic review. *J Endod* 2017;43:16—24.
6. Swanljung O, Vehkalahti MM. Root canal irrigants and medicaments in endodontic malpractice cases: a nationwide longitudinal observation. *J Endod* 2018;44:559—64.
7. Givol N, Rosen E, Bjørndal L, Taschieri S, Ofec R, Tsesis I. Medico-legal aspects of altered sensation following endodontic treatment: a retrospective case series. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011;112:126—31.
8. Souza EM, Campos MG, Rosas Aguilar R. Mapping the periapex anatomical pattern of teeth involved in sodium hypochlorite accidents: a cross-sectional quasi-experimental study. *Int Endod J* 2021;54:1212—20.
9. Vivekananda Pai AR. Factors influencing the occurrence and progress of sodium hypochlorite accident: a narrative and update review. *J Conserv Dent* 2023;26:3—11.
10. Psimma Z, Boutsioukis C. A critical view on sodium hypochlorite accidents. *Endo EPT* 2019;13:165—75.

A. R. Vivekananda Pai
Department of Conservative Dentistry and Endodontics, Faculty of Dentistry, Manipal University College Malaysia (MUCM), Jalan Batu Hampar, Bukit Baru, Melaka 75150, Malaysia
E-mail address: vivekananda.pai@manipl.edu.my

Received 4 May 2023
Final revision received 4 May 2023
Available online 16 May 2023