The Effect of Sodium Hypochlorite and Chlorhexidine as Irrigant Solutions for Root Canal Disinfection: A Systematic Review of Clinical Trials

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Abstract

Introduction: This systematic review aimed to compare the effectiveness of sodium hypochlorite and chlorhexidine for root canal disinfection during root canal therapy. **Methods:** A literature search for clinical trials was made on the PubMed (MEDLINE), Web of Knowledge, SCOPUS, and Science Direct databases and in the reference lists of the identified articles up to January 2015. Quality assessment of the selected studies was performed according to the Consolidated Standards of Reporting Trials statement. **Results:** One clinical trial and 4 randomized clinical trials were selected from the 172 articles initially identified. There was heterogeneity in the laboratory methods used to assess the root canal disinfection as well as in the concentrations of the irrigants used. Therefore, meta-analysis was not performed. Two studies reported effective and similar reductions in bacterial levels for both irrigants. Sodium hypochlorite was more effective than chlorhexidine in reducing microorganisms in 1 study, and another reported opposite findings. Both root irrigants were ineffective in eliminating endotoxins from necrotic pulp root canals in 1 study. Trial design and information regarding randomization procedures were not clearly described in the clinical trials. No study compared laboratory results with clinical outcomes. **Conclusions:** The available evidence on this topic is scarce, and the findings of studies were not consistent. Additional randomized clinical trials using clinical outcomes to compare the use of sodium hypochlorite and chlorhexidine during root canal therapy are needed. *(J Endod 2016;42:527–532)*

Key Words

Chlorhexidine, clinical trial, endodontic, sodium hypochlorite

The effectiveness of endodontic therapy involving pulp necrosis depends on the adequate disinfection of the root canal and appropriate seal during canal obturation. In those clinical cases, instrumentation and irrigation procedures using chemomechanical techniques are crucial for root canal disinfection (1, 2). The cleaning and shaping of the root canal system using irrigant solutions play an essential role in the success of debridement and disinfection (3, 4).

The failure of root canal treatment has predominantly been associated with an ineffective removal of microorganisms from the root canal system. Therefore, persistent infection in the root canal is related to remaining necrotic tissue and bacteria, which in turn affects tissue healing in the periapical area (5).

Distinct chemicals have been suggested as efficient irrigant solutions for root canal disinfection. Among them, sodium hypochlorite (NaOCl) is the most widely used in endodontic treatment because of its effective antimicrobial activity and ability to dissolve organic tissues (4). Nonetheless, there is a lack of agreement concerning the ideal concentration of NaOCl. According to 1 study, there was a remarkable reduction in the levels of bacteria in the root canal when NaOCl at 0.5% and 3% was used (6). In another study, bacterial diversity of the root canal decreased significantly after chemomechanical endodontic preparation using NaOCl at 2.5% (7). The excellent organic solvent properties of NaOCl give it its antimicrobial effectiveness as an irrigant agent (8). On the other hand, NaOCl is a potential irritant of periapical tissues, especially at high concentrations (9–11). Thus, the search for other root canal irrigants with a lower potential to induce adverse side effects is desirable.

Chlorhexidine gluconate (CHX) has been proposed as a promising irrigation agent to replace NaOCl during root canal disinfection and endodontic instrumentation (12, 13). The antibacterial properties of CHX have been extensively demonstrated when used as an adjunct treatment to different oral diseases (14, 15). CHX also has excellent antiseptic properties, and its effectiveness in the chemical control of dental biofilm in patients with periodontal disease has already been proven (16–18). The main limitation of CHX as an endodontic irrigant is its inability to dissolve pulp tissue (19).

The evaluation of endodontic therapy protocols in terms of the chemical irrigant used during root canal disinfection is essential to establish evidence-based guidelines to improve clinical outcomes in endondontics. Antimicrobial effectiveness is undeniably the foremost chemical property of irrigant solutions used in the treatment of root canals with apical periodontitis (20). Previous studies have pointed out the antimicrobial effectiveness of NaOCl and CHX during root canal treatment. However, no systematic

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review comparing the effectiveness of these irrigant agents during endodontic treatment has been conducted. The aim of this study was to conduct a systematic review of clinical studies on the effectiveness of NaOCl and CHX for root canal disinfection during root canal therapy.

Materials and Methods

The methodology used in this systematic review includes (1) a literature search strategy, (2) selection criteria, (3) screening and data extraction and (4) a quality assessment.

Literature Search Strategy

The search strategy covered electronic databases and the reference lists of such articles identified published through to January 2015. The electronic databases searched were the following: PubMed (MEDLINE), Web of Knowledge, SCOPUS, and Science Direct. The following combination of key words and Medical Subject Heading terms through the Boolean operator were used: "sodium hypochlorite," "chlorhexidine," "endodontic treatment," and "clinical trials."

Selection Criteria

Clinical trials and randomized controlled trials were selected; however, only articles comparing CHX and NaOCl as irrigant agents during root canal treatment were included. Other inclusion criteria were studies published in English, root canal treatment involving permanent teeth with pulp necrosis, and the use of laboratory outcome measures to assess root canal disinfection. Observational studies, previous reviews, case studies, case series, *in vitro* studies, and those that did not quantify the antimicrobial effect of irrigants were excluded.

Screening and Data Extraction

Initially, potential relevant publications involving endodontic irrigants were retrieved independently by 2 reviewers (C.V.A.J., R.C.V.R). All articles were submitted to selection criteria, and those that fulfilled all criteria were read in full. Disagreements were resolved by consensus after discussion with a third reviewer (L.S.G.). The extraction of information from studies was conducted by the same reviewers.

Quality Assessment

The quality of the selected studies was assessed according to the Consolidated Standards of Reporting Trials (CONSORT) statement (21). The following sections of articles were analyzed using the CONSORT 2010 checklist: title and abstract, introduction, methods, results, and discussion. Each section was subdivided into items as described in the CONSORT statement (21).

The methodologic parameters related to the validity of the studies were as follows:

1. *Description of trial design (including allocation ratio):* Was the trial design clearly defined? Yes/No
2. *Intervention:* Were the interventions clearly defined? Yes/No
3. *Concentration of endodontic irrigants:* Was the concentration of the endodontic irrigants clearly defined? Yes/No
4. *Calibration:* Were the examiners calibrated for endodontic clinical procedures? Yes/No
5. *Outcomes:* Were the outcomes clearly defined? Yes/No
6. *Outcomes assessment:* Was the outcome assessed in the same manner between groups? Adequate: When the effectiveness of irrigant solution was assessed in the same manner between groups. Inadequate: when the effectiveness of irrigant solution was not assessed in the same manner between groups.
7. *Laboratory method to evaluate root canal disinfection:* Was the laboratory method used to evaluate root canal disinfection clearly informed: Yes/No
8. *Sample size calculation:* Did the article explain the rationale for the study sample size? Yes/No
9. *Randomization:* Were the irrigant agents randomized among participants? Yes/No
10. *Randomization/sequence:* Was the method used to generate the random allocation sequence reported? Yes/No
11. *Randomization/generation:* Was the type of randomization reported? Yes/No
12. *Randomization/allocation concealment:* Concealment/mechanism: was the mechanism used to implement the random allocation sequence reported? Yes/No
13. *Randomization/implementation:* Was the information concerning who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions reported? Yes/No
14. *Blinding:* Were the examiners blinded regarding the endodontic irrigants? Yes/No
15. *Statistical procedures:* Was adjusted analysis carried out? Yes/No
16. *Intention-to-treat analysis:* Was intention-to-treat analysis conducted? Yes/No

When the information was not available, the article was classified as unclear.

Results

Figure 1 summarizes the search strategy process. The initial search identified 172 potential articles. However, 152 were *in vitro* studies and therefore were excluded. Twenty of the remaining 15 clinical trials were also excluded because no comparisons between NaOCl and CHX were made (14 articles), and the effectiveness of root disinfection was not tested (1 article). In the end, 4 randomized clinical trials and 1 nonrandomized clinical trial were included in this systematic review.

Because of the heterogeneity of the laboratory methods used to evaluate the effectiveness of endodontic irrigants, meta-analysis could not be performed.

The characteristics of the studies comparing the effectiveness of NaCl and CHX in the root canal disinfection during root canal therapy are presented in Table 1. Of the 5 selected studies, 4 reported the eligibility criteria (20, 22–24). These studies only included single-rooted teeth and teeth with pulpal necrosis. Patients who had received antibiotic treatment had been excluded from these 4 studies.

All studies reported the concentration and amount of the irrigants used in the trials as well as the microbiological techniques to assess the effectiveness of the irrigant. Distinct protocols of endodontic treatment were assessed because different concentrations of irrigant solutions were compared. NaOCl concentrations were tested at 2.5% (20, 22–24) and 5.25% (25), whereas CHX was evaluated using 0.12% (20), 0.2% (22), and 2% (23–25). Calibration of the examiners for the endodontic clinical procedures was not conducted in any study. Outcomes were clearly reported in 4 studies (20, 22–24). The effectiveness of the irrigant solution was assessed in the same manner between groups in all studies.

The laboratory methods used to evaluated root canal disinfection were heterogeneous among studies; the main ones were culture techniques (22–25) and molecular methods (20, 23).

The 5 studies (20, 22–25) investigated the effectiveness of root canal disinfection comparing NaOCl and CHX by collecting samples from the root canal before and after the protocol treatments. Periapical radiographs were used to confirm the presence of