ORIGINAL ARTICLE

Comparative Evaluation of the Efficacy of a Novel Composition based on Hypochlorous Acid vs Sodium Hypochlorite in Prevention of Cross-infection during Dental Treatment Procedures: A Pilot Study

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Abstract

Introduction: The probability of infection during dental practice is extremely significant, particularly when utilizing water from the dental chair's water boosters, which is often provided directly to the patient. As a result, there is a pressing need to create a unique disinfection composition for use in dental treatments, particularly in water lines.

Aim: The aim of this study is to examine and compare the efficacy of a novel composition based on hypochlorous acid (HOCl) vs sodium hypochlorite in preventing cross-infection during dental treatment operations.

Materials and methods: Patients with moderate-to-severe gingivitis were randomly assigned to one of three groups of five. They had been designated for ultrasonic scaling. Group I (control): For ultrasonic scaling, freshly prepared reverse osmosis (RO) water was utilized in the dental unit water booster. Group II (test group 1): As a disinfectant in the dental unit water booster, sodium hypochlorite (100 ppm) was utilized. Group III (test group 2): A novel (100 ppm)-based composition was used as a disinfectant in the dental unit water booster. The water units' oxidation-reduction potential (ORP) after scaling was also assessed.

Results: Postoperatively, all three groups exhibit a decrease in oxidation-reduction potential. Group II has a significant decrease in ORP ($p = 0.001$).

Conclusion: This study found that using sodium hypochlorite as an ultrasonic liquid coolant considerably decreases the ORP during scaling when compared to RO water and HOCl.

Clinical significance: As an ultrasonic liquid cooler, sodium hypochlorite considerably decreases the ORP during scaling.

Keywords: Disinfection, Hypochlorous acid, Sodium hypochlorite, Ultrasonic scaling.

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Introduction

The possibility of infection during dental therapy is exceedingly high, especially when utilizing water from the dental chair's water boosters, which are often provided directly to the patient.

During dental practice, the risk of cross-infection between dentist and patient, as well as among patients, is exceedingly high. Cross-infection during dental operations must thus be avoided, and water must be cleansed on a regular basis.[1]

As a result, there is an urgent need to create innovative disinfection compositions for use in dental treatments, particularly in water lines. There is also a need for a disinfectant composition that can overcome the inadequacies associated with the known arts and provide safe disinfection for use in water lines as well as the patient's oral cavity.

A dental aerosol consists of an aerosol formed during dental operations employing dental tools and other high-speed devices. These bioaerosols contain a variety of microorganisms, including germs from the mouth cavity, in addition to contaminants in the water from dental units.

In more contemporary systems, oxidation reduction potential (ORP) sensors are used in conjunction with pH sensors to give automated "demand-based administration of hypochlorite (or equivalent oxidizing disinfectant) and acid.[2]

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Table 1: Preoperative values of ORP

Group	*Mean*	*SD*
Group I	261.0	30.1
Group II	751.2	21.9
Group III	526.8	90.5

SD, standard deviation

Table 2: Postoperative values of ORP

Group	*Mean*	*SD*
Group I	210.4	23.0
Group II	369.8	52.4
Group III	331.6	42.1

SD, standard deviation

Aim

The aim is to assess and contrast the efficacy of a novel composition based on hypochlorous acid (HOCl) vs sodium hypochlorite in preventing cross-contamination during dental treatment operations.

Objective

To compare the ORP of dental water units after using a novel composition based on HOCL (100ppm) and sodium hypochlorite (100ppm) individually.

Materials and Methods

The patients in the current research were from the Department of Periodontology at Vinayaka Mission's Shankaracharya Dental College in Ariyanur, Salem, Tamil Nadu, India. Patients were informed about the study, and their informed consent was obtained. Patients with moderate-to-severe gingivitis aged 18–55 years were included in the study. The study comprised patients who had been advised for ultrasonic scaling.

Patients with systemic disorders, smokers, pregnant women, patients on antibiotics or other medications, patients who had oral prophylaxis in the previous 6 months, and patients wearing orthodontic equipment were all excluded.

Methodology

Participants with moderate-to-severe gingival inflammation were distributed at random to one of three distinct groups of five patients. They were allotted for ultrasonic scaling.

- Group I (control): Freshly prepared reverse osmosis (RO) water was used in the dental unit water booster for ultrasonic scaling.
- Group II (test group 1): Sodium hypochlorite (100 ppm) was used as a disinfectant in the dental unit water booster.
- Group III (test group 2): A novel composition based on HOCl (100 ppm) was used as a disinfectant in the dental unit water booster.
- The ORP of the water units after scaling were also evaluated.

Results

In this study, 15 patients were selected and were randomly divided into 3 groups of 5 patients each. Oxidation-reduction potential was evaluated preoperatively and postoperatively. Table 1 shows preoperative values and Table 2 shows post-operative values.

Table 3 shows the comparison. All three groups show a decrease in ORP postoperatively. In comparison, group II shows a significant reduction in ORP ($p < 0.001$) (Fig. 1).

Table 3: Comparison of the ORP between groups

	Preoperative	*Postoperative*	*Mean difference*	*p-value*
Group I	261.0 (30.1)	210.4 (23)	−50.6 (11.4)	0.001*
Group II	751.2 (21.9)	369.8 (52.4)	−381.4 (51.1)	<0.001**
Group III	526.8 (90.5)	331.6 (42.1)	−195.2 (107.7)	0.02*

*Significant at 5%. **Significant at 1%

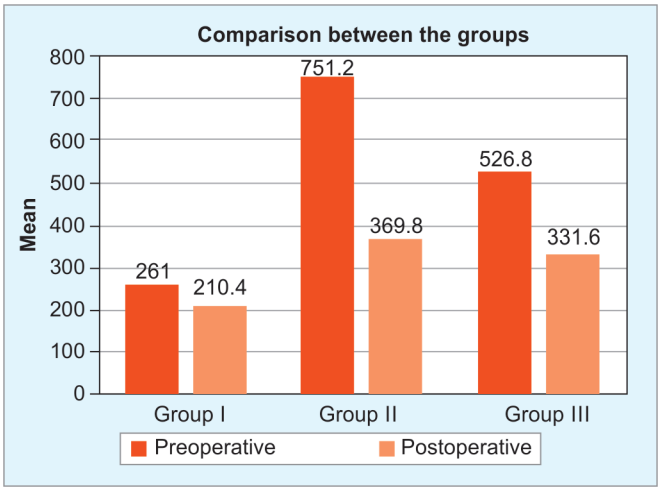

Fig. 1: Graphical comparison of the ORP between groups

Discussion

Periodontal disease is a recurrent inflammatory illness caused by bacteria that causes loss of tissue in the dentition's attachment apparatus. Periodontal disease risk factors are environmental responses that may or may not be associated with periodontal disease, and their combination may or may not be causal. Some risk factors are modifiable, while others are not. Dental plaque is a breeding place for a wide range of oral germs.[3]

To disturb tooth plaque, a variety of mechanical tools can be employed. However, eliminating plaque and calculus completely is difficult. Incomplete removal of bacteria and their metabolites may result in germ development.[4]

Aerosols created during operative procedures such as scaling and restorative operations provide a substantial risk of nosocomial infection to dental professionals Legnani et al.[5] and Bennett et al.[6] revealed that employing ultrasonic scaling treatments resulted in the highest microbial aerosol levels in dental therapy. Preprocedural mouth-rinsing, along with universal barrier defense and high-power evacuation, has been proven in studies by Worrall et al. and Gupta et al. to significantly reduce the risk of aerosols.[7]

Various dental operations, such as ultrasonic scaling, crown preparation, caries excavation, and so on, produce aerosols that may contain potentially contagious bacteria.

Barrier protection (mask, gloves, and eye protection), pre-operative rinse with antiseptic mouthwash such as chlorhexidine, high-volume evacuator, high-efficiency particulate air room filters, and ultraviolet treatment of the ventilation system are all

methods for controlling airborne contamination produced by dental procedures.[8]

The intent of this research was to examine and compare the efficacy of a novel HOCl-based composition to sodium hypochlorite in preventing cross-infection during dental treatment procedures.

Water disinfection is a crucial step in minimizing disease transmission from a water supply to a lot and across lots over time. ORP, which is measured in millivolts (mV), has become a common method for standardizing water disinfection properties.[9]

The ORP sensors, which work identically to a digital thermometer or a pH probe, will allow for convenient tracking and surveillance of essential disinfection levels in water systems.[10]

Among the several advantages of ORP is the capacity to monitor and record disinfection of water potential, a critical water quality indicator, in real time. Innovations in probe design and continuous digital recording via computer-linked data input have occurred. Maintaining records can be largely automated. The graphical projections of diverse systems, for example, make it simple to analyze process control by water quality, product, and season. To alert the person in charge of out-of-range operations, probes have been combined with audible, visible, and distant alarm systems. Portable devices, such as more typical dose-related test kits, are inexpensive and an important backup for cross-referencing the functioning of an inline ORP sensor.[11]

The main benefit of adopting ORP for water system monitoring is the fact that it enables the operator to instantly examine the disinfecting capabilities of water in a postharvest system. Instead of assessing the dose, the operator can evaluate the disinfectant's activity.

The ORP values accurately show the water's antimicrobial capability for free-floating bacteria in postharvest applications such as transport flumes, cooling flumes, and ice injection.

Sahrmann et al. discovered that subgingival instrumentation combined with povidone iodine rinse reduced but did not fully eliminate bacteremia. Povidone iodine is thus acceptable for use as an ultrasonic liquid coolant.[12]

Muir et al. observed that a 2-minute prerinse with CHX greatly reduced ultrasonic scaler emissions.[13]

Limitations

Anaerobic culture would have improved the study by influencing the retrievable CFU counts. Despite the best efforts to unify the ultrasonic scaler settings, evacuation system, and patient, operator, and assistant positions within the realm of human error, there may be some variability in the same.

Conclusion

The authors conclude that when compared to RO water and HOCl, sodium hypochlorite as an ultrasonic liquid coolant significantly decreases the ORP during scaling.

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References

1. Veksler A, Kayrouz G, Newman M. Reduction of salivary bacteria by preprocedural rinses with chlorhexidine 0.12%. J Periodontol 1991;62(11):649–651. DOI: 10.1902/jop.1991.62.11.649.
2. Suslow TV. Oxidation-reduction potential (ORP) for water disinfection monitoring, control, and documentation. 2022. Available at: https://escholarship.org/uc/item/1730p498#author.
3. Swaminathan Y, Thomas JT. Aerosol: A prospective contaminant of dental environment. IOSR J Dent Med Sci 2013;11(2):45–50. DOI: 10.9790/0853-1124550.
4. Harrel S, Molinari J. Aerosols and splatter in dentistry. A brief review of the literature and infection control implications. J Am Dent Assoc 2004;135(4):429–437. DOI: 10.14219/jada.archive.2004.0207.
5. Legnani P, Checchi L, Pelliccioni GA, D'Achille C. Atmospheric contamination during dental procedures. Quintessence International 1994;25:435–439.
6. Bennett AM, Fulford MR, Walker JT, Bradshaw DJ, Martin MV, Marsh PD. Microbial aerosols in general dental practice. British Dental Journal 2000;189:664–667.
7. Wunderlich RC, Singelton M, O'Brian WJ, Caffesse RG. Subgingival penetration of an applied solution. Int J Periodontics Rest Dent 1984;4(5):64–71. PMID: 6596297.
8. Suslow TV. Ozone applications for postharvest disinfection of edible horticultural crops, University of California: Division of Agriculture and Natural Resources Publication 8133, 2022. Available at: https://anrcatalog.ucanr.edu/pdf/8133.pdf.
9. Suslow TV. Postharvest chlorination: Basic properties and key points for effective disinfection, University of California: Division of Agriculture and Natural Resources Publication 8003, 1997. Available at: https://ucfoodsafety.ucdavis.edu/sites/g/files/dgvnsk7366/files/inline-files/26414.pdf.
10. Bartz JA, Kader AA, editors. Postharvest Technology of Horticultural Crops, 2nd edition, University of California, Division of Agriculture and Natural Resources Publication 3311, 2002.
11. Suslow TV. Water disinfection: A practical approach to calculating dose values for preharvest and postharvest applications, Publication 7256, 2001. DOI: 10.3733/ucanr.7256.
12. Sahrmann P, Andrea M, Thomas A, Reinhard Z, Patrick RS. Effect of application of a PVP-iodine solution before and during subgingival ultrasonic instrumentation on post treatment bacteraemia: A randomized single-centre placebo-controlled clinical trial. J Clin Periodontol 2015;42(7):632–639. DOI: 10.1111/jcpe.12416.
13. Muir KF, Ross PW, MacPhee IT, Holbrook WP, Kowolik MJ. Reduction of microbial contamination from ultrasonic scalers. Br Dent J 1978;145(3):76–78. DOI: 10.1038/sj.bdj.4804123.