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Effect of temperature and agitation on tissue dissolution efficacy of new sodium hypochlorite irrigating solutions

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Introduction

Success of endodontic treatment depends on the elimination of microorganisms as completely as possible. This can be accomplished using mechanical instrumentation complemented by chemical irrigation. Sodium hypoclorite is the most commonly used endodontic irrigant because of its antimicrobial and tissue-dissolving activity.

Aim

To evaluate and compare *in vitro* the tissue-dissolving efficacy of five different sodium hypochlorite solutions under distinct conditions of temperature and agitation.

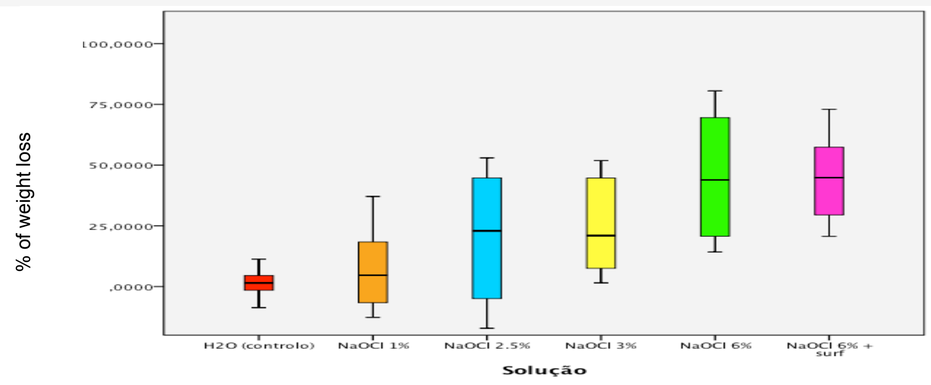
Methodology

Five sodium hypochlorite solutions 1%, 2.5% (dilutions from stock solution), 3%, 6% and 6% with surfactant (CanalPro™ irrigating solutions – Coltène), were tested at room temperature and 37ºC, with or without agitation by pipetting. Distilled water was used as control. Pieces of bovine muscle tissue (70±5mg) were submersed in 10 mL of each solution for five minutes. In selected samples, agitation was performed during a period of 15-seconds per each minute. The tissue specimens were weighed before and after the exposure, and the percentage of weight loss was calculated. Sample size was 72, with 3 replicas per solution/testing condition. Evaluation of the pH (ScanInst-pH meter) and chlorine (ion-exchange chromatography) was done before and after exposure of the samples. The Kruskal-Wallis non-parametric test and Mann-Whitney U post-hoc tests were used for statistical analysis (level of significance $p<0.05$).

Results

Table 1. Tissue weight loss (% ± standard deviation) after 5 minutes exposure to different NaOCl concentrations and experimental conditions.

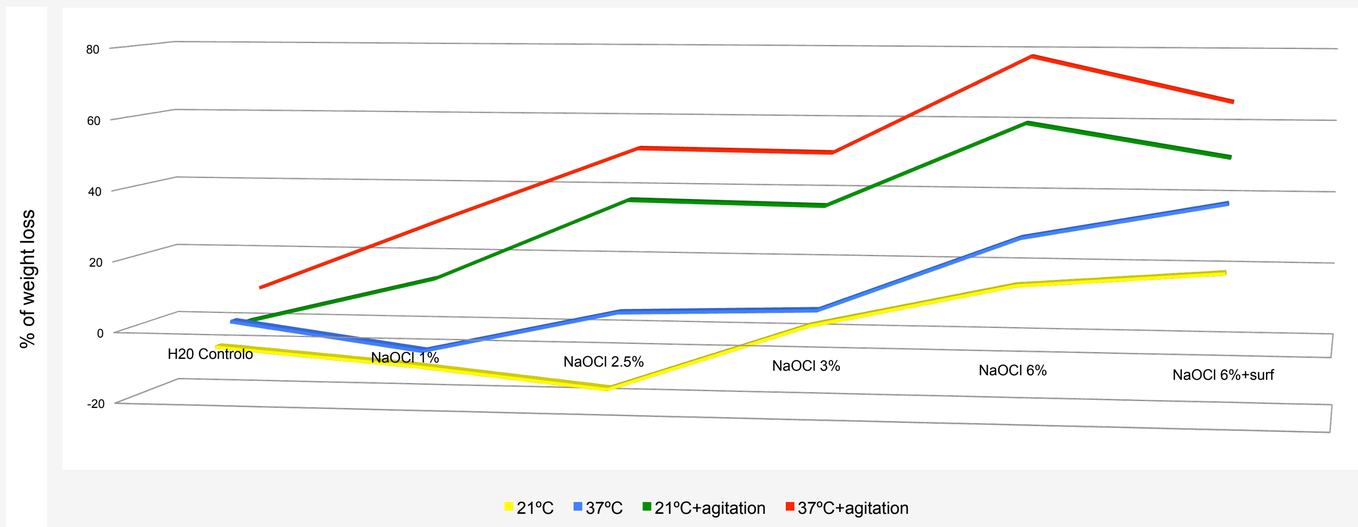
	21ºC	37ºC	21ºC+agitation	37ºC+agitation
H_2O	-4,0318 ± 4,5534	1,6354 ± 0,3067	0,0342 ± 2,7983	8,5257 ± 2,6714
1%	-8,1316 ± 5,2005	-5,7031 ± 2,4453	13,4787 ± 1,4935	29,8508 ± 7,5768
2.5%	-13,5351 ± 3,1886	6,2852 ± 5,9469	36,7620 ± 4,8275	50,5435 ± 2,9527
3%	5,1891 ± 4,1782	7,9219 ± 1,1980	35,8571 ± 4,6390	49,9124 ± 1,8052
6%	17,1904 ± 2,6548	28,9101 ± 6,4520	59,6421 ± 6,0765	77,6436 ± 3,2079
6%+surfactant	21,4455 ± 0,9816	39,0778 ± 2,5005	50,6526 ± 3,6890	65,2336 ± 6,8778



Graph 1. Percentage of weight loss ± sd considering all experimental conditions together

Table 2. Variation of pH and Cl^- in solution before and after tissue dissolution (average values).

	pH initial	pH final	Residual Cl^-
1%	10,46	9.57	68%
2.5%	11,97	11,29	76%
3%	11,55	9,81	73%
6%	12,34	12,19	86%
6%+surfactant	12,68	12,56	87%



Graph 2. Performance of study solutions in the different experimental conditions tested (average values).

Weight loss showed a directly proportional correlation with the concentration of the tested solution. Agitation (statistically significant p=0,004) and higher temperature improved the efficacy of sodium hypochlorite. The effect of agitation was more relevant than that of temperature. Considering all the experimental conditions together, 6% NaOCl with added surfactant (CanalPro™ EXTRA) showed the best dissolution results (1%NaOCl vs CanalPro™ EXTRA, p=0,003). After contact with the tissue, all solutions showed a consistent reduction in the level of pH and residual chlorine, inversely proportional to the concentration.

Conclusions

Within the conditions of this study, tissue-dissolving effect of sodium hypochlorite can be maximized with:

- agitation,
- warming,
- higher concentrations,
- and addition of surface active agents.