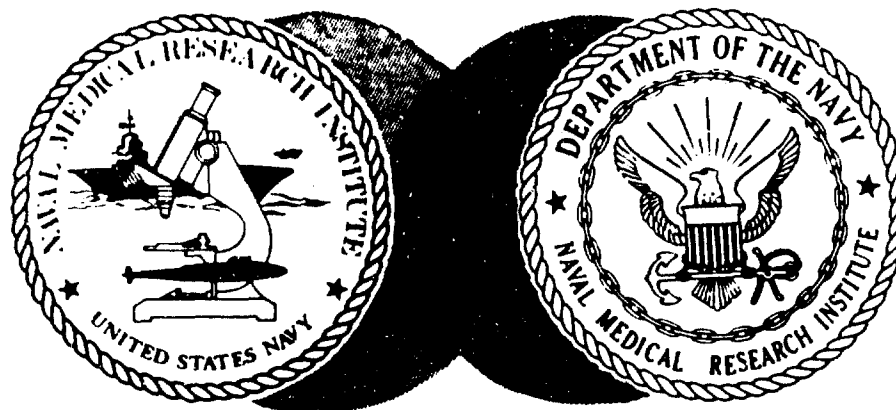


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EFFECT OF ALCOHOL ON THE SPREADING
ABILITY OF SODIUM HYPOCHLORITE
ENDODONTIC IRRIGANT.

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Effect of alcohol on the spreading ability of sodium hypochlorite endodontic irrigant

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As a measure of the effect of ethanol on the ability of sodium hypochlorite to penetrate narrow openings such as root canals, mean distances of movement for combinations of these agents were measured in capillary tubes. The addition of ethanol as a surface tension depressant significantly increased the ability of the sodium hypochlorite endodontic irrigant to penetrate in vitro. A freshly mixed solution containing 30 percent ethanol is recommended.

Thorough débridement of the root canal space is considered to be essential for successful endodontic treatment. Many previous studies have shown sodium hypochlorite to be an excellent endodontic irrigant exhibiting both antimicrobial and tissue-dissolving properties.

However, it has also been shown that sodium hypochlorite is unable to penetrate and cleanse the narrow, confined portions of the root canal.¹ The studies of Senia, Marshall, and Rosen,² Salzgeber and Brilliant,³ and Ram⁴ have all demonstrated that little or no spreading of the irrigant occurs in canals that are smaller than file size 30 to 40. In an article also describing the effective solvent action of sodium hypochlorite, Rosenfeld, James, and Burch⁵ stated that "the major barrier to be overcome in the clinical use of this popular irrigant is its inability to penetrate confined areas."

Since sodium hypochlorite is a water-based solution, it is possible that a surface tension depressant such as ethanol could be mixed with the hypochlorite in order to allow an increased fluid movement, or spreading, of the irrigant drug. Surface tension is

defined as the tension or strain upon the surface of a liquid in contact with another substance with which it does not mix. Ethyl alcohol, an intermediate-level germicide, has a surface tension of only 24 dynes per centimeter, whereas water and most water-based solutions have a surface tension of 71 to 79 dynes per centimeter. It is known that a mixture containing 95 percent water and 5 percent ethanol has a reduced surface tension of 54.9; increasing the percentage of ethanol to 48 percent will further reduce this figure to 28.0 dynes per centimeter. It has also been shown that ethyl alcohol will spread when placed on a dentin surface.⁶ This is unlike saline solution and many endodontic medicaments which will form a lens on dentin, rather than exhibiting the spreading phenomena. The purpose of this investigation is to evaluate the effect of ethanol on the spreading property of the commonly used endodontic irrigant, sodium hypochlorite.

MATERIALS AND METHODS

The movement of multiple samples of various volume-to-volume mixtures of sodium hypochlorite, distilled water, and reagent-grade dehydrated ethanol were measured in glass tubes. The tubes were 25 μ micropipettes that were heat sealed at one end. The proportion of sodium hypochlorite in the solutions was maintained at 50 percent in every case, with the proportions of water and ethanol being variable. A monostaltic pump (Buchler, Fort Lee, N. J.) was used to inject the test solutions uniformly into the simulated canals. This apparatus was used to ensure that the solutions were injected with a more uniform pressure than could be achieved by hand injection.

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Table I. Mean distances of movement for combinations of sodium hypochlorite, water, and ethanol in glass tubes

No.	NaOCl (ml.)	H ₂ O (ml.)	C ₂ H ₅ OH (ml.)	Distance (mm.)	± S.D.
10	5.0	5.0	0.0	30.15	0.64
10	5.0	4.0	1.0	33.17*	1.73
10	5.0	3.0	2.0	34.57*	2.23
10	5.0	2.0	3.0	38.20*	3.08
10	5.0	1.0	4.0	39.63*	1.16
10	5.0	0.0	5.0	45.93*	3.25

*P < 0.001.

Vernier calipers measured the distances moved by each combination of irrigant and surface tension depressant. From each group of ten samples, the mean of the maximum movement within the tubes was calculated. The differences of the means were compared with Student's *t* test.

In order to determine the stability of alcohol-hypochlorite solutions, both 50 percent and 30 percent alcohol mixtures were prepared. Samples were removed at 15 and 30 minutes for assay of available chlorine content by iodometric titration.⁷

RESULTS

Table I summarizes the mean distances that the combinations of sodium hypochlorite, water, and ethanol moved in vitro. Statistical comparisons between groups demonstrated that a significant difference existed between all of the combinations that contained ethanol versus the one that contained no ethanol.

As seen in Table II, the addition of alcohol to sodium hypochlorite reduces the residual available chlorine content, the effect being much greater and more rapid with the higher proportion of alcohol.

DISCUSSION

A significant difference existed between each combination containing ethanol and those containing no ethanol. The mean distances that the irrigant combinations moved were consistently and significantly greater as the proportion of alcohol was increased from 0 percent to 50 percent. The effect can be easily demonstrated by placing equal volume drops of the various mixtures on a glass slab and then noting the area over which the drop spreads.

The titration data point out that these solutions are not stable over time and must be mixed fresh in order to prevent the conversion of hypochlorite and ethanol into chloroform. The combination containing 30 percent ethanol was much more stable than the

Table II. Available chlorine determinations of sodium hypochlorite, water, and alcohol solutions

Time (min.)	Chlorine titer (%)	
	50% Ethanol	30% Ethanol
0	2.01	2.01
15	0.10	1.62
30	0.03	0.59

50/50 mixture; yet its useful working time was only approximately 15 minutes. The solution containing 50 percent ethanol was almost totally depleted of available chlorine in this same 15-minute time period and thus would not seem practical for clinical use.

The importance of these findings is that a part of the common endodontic armamentarium, alcohol, can be used as a surface tension depressant to aid the fluid movement of an irrigant into the narrow areas of the root canal space. Even though the irrigant might be diluted by the ethanol, it still can act as a germicide and a debriding agent in those areas that might otherwise not be penetrated and cleansed. The disinfection and débridement may even be enhanced by this improved wettability,⁸ since a more intimate contact of irrigant and dentin is provided. In addition, mechanical manipulation of narrow canals may be enhanced by the increased spreading of the lubricant irrigant. Because chloroform may have a harmful effect when injected through a large apical foramen into the periapical tissues, the use of alcohol as a surface tension depressant is not recommended when the canal is enlarged sufficiently to be penetrated by standard irrigation procedures.

SUMMARY

This study investigated the effect of ethanol on the spreading property of the endodontic irrigant, sodium hypochlorite. The distances moved by various mixtures of sodium hypochlorite, water, and ethanol were measured in glass tubes. The mean distances of movement were significantly greater for those combinations containing ethanol. Thus, the addition of ethanol to act as a surface tension depressant significantly increased the ability of the irrigant to spread in vitro.

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