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RESEARCH ARTICLE

The Effects of an Alum-containing Mouthrinse and a Saturated Saline Rinse on Existing Plaque Levels in Children

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ABSTRACT

Aims and objectives: The present study compared and evaluated the effects of an alum-containing mouthrinse and a saturated saline rinse on existing plaque levels in children.

Materials and methods: The investigation was a double blind, stratified comparison of three parallel groups of children who used either an alum-containing mouthrinse or a saturated saline rinse twice daily under professional supervision for a 21 days period. Dental plaque was recorded using the plaque index described by Silness and Loe at baseline, on days 10 and 21.

Statistical analysis: All data were subjected to statistical analysis using Wilcoxon's signed ranks sum test and Mann-Whitney U-test.

Results and conclusion: The results of the present study show that alum and saturated saline mouthrinse groups showed statistically significant reductions in dental plaque levels on comparison of the data obtained at baseline, 10th and 21st days over the control group. Among the two adjunctive oral hygiene measures that were evaluated, alum rinse was the most effective in reducing the dental plaque levels.

Keywords: Alum, Saturated saline, Mouthrinse, Dental plaque.

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INTRODUCTION

Mouthrinsing as a formal practice has its first reference credited to Chinese medicine, about 2700 BC, for treatment of disease of the gums. The recommendation was for rinsing with the urine of a child. Mouthrinsing as an adjunct to mechanical cleansing became popular with the upper classes in the Roman period with Pliny recommending salty water as the mouthrinse. Mouthrinsing also had a religious connection. The Talmud contains instructions for rinsing the mouth between meals to remove food remnants and prevent admixing of meat and milk products. In ancient times, hippocrates advocated mouthrinsing with a mixture of alum, salt and vinegar.[1] Although, bathing was not very popular, both mechanical cleaning and mouthrinsing were established practices by the 16th century. The Zene Artzney (medicines for the teeth), published in Germany in 1530, the first printed work devoted exclusively to dental therapeutics, contained a section on 'How to save the teeth'. The recommendations included washing the mouth with burnt alum mixed with vinegar or myrrh boiled in wine.[2]

Aluminum has demonstrated activity against oral bacteria. Early studies indicated that several aluminum salts, including potassium aluminum sulfate (alum), inhibit the growth of salivary bacteria.[3] Aluminum has shown antimicrobial activity, against cariogenic streptococci as well as normal oral flora and periodontal pathogens, by significantly reducing the ability of streptococci to colonize on enamel surfaces and decreasing the colloidal stability of oral bacteria.[4] More recently, use of alum mouthrinse has also shown significant reductions in salivary levels of *Streptococcus mutans* in children.[5]

In humans, mouthrinsing with aluminum solutions has shown to affect plaque accumulation and to alter the pathogenicity of established plaque. Within 3 days, twice daily rinsing with 0.02 M alum inhibited *de novo* plaque formation on clean teeth in young adults. Aluminum concentrations as low as 0.008 M inhibited phosphorolytic activity of several enzymes of bacteria present in human plaque. The acid producing capability of plaque in adults was reported to reduce significantly for several hours with a 1 minute rinse of 0.02 M aluminum chloride.[1]

Even if caries is undoubtedly a multifactorial disease, dental plaque plays a major role in its pathogenesis. In the evaluation of caries risk, it is interesting to estimate the amount of plaque globally present on the tooth surfaces.[6] The relative importance of oral hygiene in caries prevention and control is often debated, but no one can

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question the old concept that a clean tooth never decays. In addition to tooth brushing, simple everyday oral hygiene procedures, such as tongue scraping and tongue brushing, have also been proven to reduce plaque levels in children.[7]

Saltwater rinses are a very archaic, yet effective way of killing the bacteria in the mouth. Long prescribed by physicians for sore throats, saturated saltwater rinses have never truly become mainstream, probably because of the unfavorable taste. The saturated solution of saline is defined as 9 tsp of salt per 2/3 cup of water (US Army Guidelines).[8] There is a scarcity of studies on saturated saline rinses in the dental literature, especially with respect to their ability to reduce plaque levels in children. Hence, the present study was attempted to compare and evaluate the effects of saturated saline rinse and 0.02 M alum mouthrinse on existing plaque levels in children.

MATERIALS AND METHODS

The investigation was a double-blind stratified comparison of three parallel groups of children who either used saturated saline rinse, a 0.02 M alum mouthrinse or a distilled water rinse twice daily under professional supervision for 21 day period. The dental plaque was assessed at entry (baseline), 10 and 21 days (3 weeks). All children in the age group of 9 to 12 years from a residential school were examined using oral health survey forms and 45 children were selected based on the following selection criteria:

- At least four restored decayed and/or missing teeth (DMFT/dmft ≥4).
- Subjects adhering to twice-daily tooth brushing routine (using toothbrush and toothpaste) and practicing no other oral hygiene measures, both professional and home based, other than the requisites of the research project.

Table 1: Sample characteristics of the study population

	Mean and standard deviation values			
Groups	*Age*	*No. of teeth*	*dmft/ DMFS*	*dmfs/DMFS*
I (N = 12)	10.42 ± 1.08 (9-12)	23.50 ± 0.91	7.08 ± 2.68	11.25 ± 6.27
II (N = 12)	10.50 ± 1.17 (9-12)	23.50 ± 0.91	7.00 ± 3.19	11.33 ± 7.38
III (N = 12)	10.53 ± 1.16 (9-12)	23.42 ± 0.79	7.67 ± 3.75	11.33 ± 8.04

- No history of current or recent (at least for the past 1 month) antibiotic usage.
- No abscess, draining sinus, cellulitis or other conditions requiring emergency dental treatment.

Verbal consent from children and signed consent forms from parents or guardians were obtained after the nature of the study and the possible risks were fully explained. The study project was approved by the concerned institutional ethics committee. The allocation of subjects resulted in three balanced treatment groups that were comparable in terms of gender, age, number of teeth, average dmft/DMFT and dmfs/DMFS (Tables 1 and 2). The oral hygiene measures assigned to each group were as follows:

- *Group I:* Saturated saline rinse [a saturated solution of saline is defined as 9 tsp of salt per 2/3 cup of water (US Army Guidelines)].
- *Group II:* 0.02 M alum mouthrinse [a solution containing 0.02 M (0.885%) hydrated aluminum potassium sulfate in distilled water at a pH of 3.6; prepared by dissolving 8.85 gm of alum in 1 l of distilled water].
- *Group III:* Distilled water rinse (placebo rinse).

A dental prophylaxis was not performed so that subjects began treatment regimen with their normal existing levels of plaque deposits. A monitor trained to instruct the subjects and to assist them to perform the various oral hygiene procedures directly supervised the treatment regimen. The procedures were performed twice daily (once in morning after breakfast and once after the evening meal).

The beakers containing the mouthrinse were coded and the data decoded at the end of the investigation. The monitor measured 10 ml of the rinse into disposible cups. The subjects performed an oral rinse by swishing the 10 ml of the solution in the mouth for 30 seconds twice daily. After rinsing, the subjects expectorated into the cups and placed them in a waste can. The subjects were instructed not to eat/drink/rinse for 30 minutes thereafter.[9]

CLINICAL PROCEDURE

Clinical assessments were performed at the residential school by a single examiner using portable dental operatories and accepted methods of infection control. Dental plaque was scored by the examiner on individual

Table 2: The mean and standard deviation values of plaque index at baseline, 10th and 21st days of all groups

	Mean and standard deviation values at				
Groups	*Baseline*	*10th day*	*21st day*	*ANOVA*	*p-value*
I	1.61 ± 0.51	1.46 ± 0.43	1.33 ± 0.40	Groups = 0.46	0.762
II	1.51 ± 0.50	1.31 ± 0.41	1.17 ± 0.38	Days X groups = 13.57	<0.001
III	1.53 ± 0.53	1.52 ± 0.51	1.58 ± 0.45		

plaque assessment forms. Separate plaque assessment forms were used at each examination. The plaque was disclosed using disclosing solution and the examiner performed the clinical measurements at the same time of the day throughout the study. The plaque index described by Silness and Loe (1964) was used to assess the existing dental plaque in children.[10] The teeth used for plaque index measurements were 16, 12, 24, 36, 32, 44. Deciduous counterparts were used in case of unerupted permanent teeth. Each of the four gingival areas of the tooth was given a score ranging from 0 to 3. By adding the scores for each tooth and dividing by the number of teeth examined, plaque index for the individual subject was obtained.

STATISTICAL EVALUATION

All the data was entered into a database on Microsoft Excel and analyzed using SPSS software with two-way ANOVA (for overall group mean comparisons), Wilcoxon's signed ranks sum test (for intragroup comparison of differences between baseline, 10th day and 21st day examinations for plaque index data) and Mann-Whitney 'U' test (for inter-group comparisons of plaque index values).

RESULTS

The sample characteristics of the study population are presented in Table 1. The mean values of plaque index data of all the groups at baseline, at 10 and 21 days, are shown in Table 2.

All the experimental groups (groups I and II) exhibited significant reductions in plaque scores when baseline values were compared with post-treatment values after 10th and 21st days (Table 3). These results indicate a definite decrease in the plaque scores after daily practice of the respective adjunctive oral hygiene measure. The control group (group III), however, did not show any significant change when 10th and 21st day values were compared with baseline values.

Intergroup comparisons (Table 4) revealed that there were no significant differences in plaque scores between the groups at baseline. This implies that the groups were statistically equivalent with respect to plaque scores before the start of the study. Again, no significant differences were observed between the groups 10 days after starting of treatment, i.e. the control group showed reductions equivalent to that of the experimental groups. However, this trend did not seem to last till the end, as it was observed that, after 21 days, the experimental groups showed statistically significant differences over the control group.

DISCUSSION

Aluminum has been used in oral preparations since ancient times and has demonstrated its potential as a cariostatic agent.[3] *In vitro* studies have shown that aluminum reacts with dental enamel, both intact and powdered, and also with synthetic apatite crystals, reducing the susceptibility to subsequent acid dissolution and thus exhibiting the cariostatic mechanism. In human studies, aluminum solutions have demonstrated inhibitory activity on plaque accumulation and are efficient in reducing the acidogenicity of dental plaque.[11] Aluminum salts have inhibited growth of oral bacteria including streptococci and have reduced their ability to colonize enamel surfaces.[12,13]

Keeping in mind, the inhibitory activity on plaque accumulation of aluminum salts, alum rinse was incorporated as one of the main experimental groups in the present study, which proposed to compare and evaluate its effectiveness on reduction of existing plaque levels.

Saltwater rinse is a very commonly used age-old antibacterial measure. The efficacy of saturated saline

Table 3: Comparison of differences between baseline, 10th and 21st days examinations for plaque index data using Wilcoxon's signed rank sum test

	Baseline vs 10th day		*Baseline vs 21st day*		*10th vs 21st days*	
Groups	*z*	*p*	*z*	*p*	*z*	*p*
I	3.064	0.002***	3.065	0.002***	3.072	0.002***
II	3.061	0.002***	3.061	0.002***	3.071	0.002***
III	0.393	0.694*	1.338	0.181*	1.582	0.114*

*Not significant; **Significant; ***Highly significant

Table 4: Intergroup comparison of plaque index data at baseline, 10th and 21st days using Mann-Whitney 'U' test

	Baseline		*10th day*		*21st day*	
Groups	*z*	*p*	*z*	*p*	*z*	*p*
I *vs* II	0.694	0.488*	1.041	0.298*	1.012	0.311*
I *vs* V	0.376	0.707*	1.034	0.664*	2.591	0.012**
II *vs* V	0.491	0.623*	1.071	0.284*	2.914	0.005***

*Not significant; **Significant; ***Highly significant

rinses lies in the scientific concept behind a diffusion gradient, which leads to dehydration and death of bacteria, and it is well established that the formation of plaque is closely related to bacterial counts in the oral cavity.[8] There is a scarcity of studies on saturated saline rinses in the dental literature, especially with respect to its ability to reduce plaque levels and hence the present study was carried out to evaluate its use as an agent for plaque reduction in children. The saturated solution of saline for mouth rinsing in our study was prepared as per the US Army Guidelines recommended by White and Armaleh.[8]

A control group, which used a placebo rinse with distilled water, was also incorporated to facilitate comparison with other groups. Dental plaque was assessed at baseline, after 10 and 21 days. The length of this trial was 21 days and an interim assessment of plaque was included on the 10th day. In addition, all the subjects were questioned and an intraoral examination was performed at each visit to detect any unusual soft or hard-tissue reaction to the test materials.

Although, a previous 1 week study using saturated saline rinse in adults and a 6-week study using alum containing mouthrinses in children reported no side effects, the interim assessment on the 10th day served as a safety check to detect any potential problems or adverse reactions to these agents.[8,14] Our study was designed to be discontinued at the 10th day assessment if there was evidence of adverse effects attributable to the rinses. The study was completed without observing any indications of negative effects resulting from the mouthrinse use and the rinses were well accepted by the children who took part in the experiment.

Age is a critical factor in subject selection for many reasons, of which the most important is the number of tooth surfaces at risk. Subjects with a mean age of approximately 11 years were chosen, since, they were entering a period of high caries activity, with many permanent teeth erupting.[15]

As the present study was conducted in a residential school for boys, female subjects could not be selected. However, epidemiological studies in caries prevalence have not shown any significant difference in the caries susceptibility of boys and girls at an average age.[16]

Since, our study was conducted in a residential school, all the subjects consumed the same diet during the period of investigation. Dental caries is a dietary carbohydrate modified infectious disease, because the major causative factors are believed to be local in nature.[17] The frequency of exposure to a cariogenic diet and the form of intake of cariogenic food substances appear to be important factors in the development of plaque and dental caries.[18] As diet (an important factor in dental caries and plaque flora) was controlled in our study, the different mouthrinses were possibly given the best chance of demonstrating their efficacy against dental plaque.

Subjects with either rampant tooth decay or very poor oral hygiene were also included in the study, as this was important to see if the protocol remained effective for all ranges of hygiene with different baselines for plaque levels. Dental plaque was assessed at baseline, 10th and 21st day using the plaque index of Silnes and Loe (1964), as suggested by Sjorkland et al in their investigation.[10,11] This index has been criticized as being highly subjective and it is therefore recommended that a single examiner be trained and used with each group of patients throughout the clinical trial.[19] In our study, the dental plaque measurements were made by a single examiner. Ekbom and Hultgren (1982) demonstrated that saline rinses can reduce the amount of plaque formation, which support the plaque inhibitory effects of saturated saline rinse demonstrated in the present study.[20]

Skjorland et al (1978), Putt et al (1996) and Bihani and Damle (1997) evaluated the effect of 0.02 M alum mouthrinse on plaque inhibition and observed significant reductions in the amount of plaque after 2 to 4 weeks of supervised use.[2,11,21] The plaque inhibitory activity of alum demonstrated by these authors compare well with our findings, in spite of the various differences in the methodology.

However, these oral hygiene measures should be evaluated over a longer duration of time, utilizing a more representative subject population and in different caries risk groups before recommending them as a compulsory part of routine oral hygiene measures. Clinical research is also necessary to determine the optimum number of times per day for mouthrinsing. Other anti cariogenic properties of alum, such as reduction of enamel dissolution and symbiotic activity with fluoride, may also be considered for future in-depth research.

CONCLUSION

1. Groups I and II (experimental groups) showed statistically significant reductions in dental plaque levels on comparison of the data obtained at baseline, 10th and 21st days. Group III (control group) did not exhibit any significant reduction in dental plaque levels.
2. Among the two adjunctive oral hygiene measures that were evaluated, alum rinse (group II) was the most effective in reducing the dental plaque levels.

REFERENCES

1. Fischman SL. The history of oral hygiene products: how far have we come in 6000 years? Periodontology 2000-1997;15: 7-14.
2. Putt MS, Kleber CJ, Smith CE. Evaluation of an alum containing mouthrinse in children for plaque and gingivitis inhibition during 4 weeks of supervised use. Pediatr Dent 1995;18:139-144.

3. Kleber CJ, Putt MS. Aluminium and dental caries: a review of the literature. Clin Prev Dent 1984;6(6):14-25.
4. Simonssen T, Glantz PO, Edwardsson S. Effects of cations on the colloidal stability of some oral bacteria. Acta Odontol Scand 1988;46:83-87.
5. Rupesh S, Winnier JJ, Nayak UA, Rao AP, Reddy NV. Comparative evaluation of the effects of alum containing mouthrinse and a saturated saline rinse on salivary levels of streptococcus mutans. J Indian Soc of Pedod and Prev Dent 2010 Jul-Sep;28(3):138-144.
6. Brambilla E, Garcia-Godoy F, Strohmenger L. Principles of diagnosis and treatment of high caries risk subjects. Dent Clin North Am July 2000;44(3):507-540.
7. Winnier JJ, Rupesh S, Nayak UA, Reddy V, Rao AP. The comparative evaluation of effects of tongue cleaning on existing plaque levels in children. Int J Clin Pediatr Dent 2013 Sep;6(3):188-192.
8. White GE, Armaleh MT. Tongue scrapping as a means of reducing oral mutans streptococci. J Clin Pediatr Dent 2004; 28(2):163-166.
9. Putt MS, Kleber CJ. Effect of pH; concentration and treatment time of aluminium solutions on acid dissolution of enamel. J Dent Res 1986;65(11):1356-1358.
10. Silness J, Loe H. Periodontal disease in pregnancy (II). Correlation between oral hygiene and periodontal condition. Acta Odontol Scand 1964;22:121-135.
11. Skjorland K, Gjermo P, Rolla G. Effect of some polyvalent cations on plaque formation in vivo. Scand J Dent Res 1978; 86:103-107.
12. Olmez A, Can H, Ayhan H, Olur H. Effect of an alum containing mouthrinse in children for plaque and salivary levels of selected oral microflora. J Clin Pediatr Dent 1998;22(4):335-341.
13. Olsson J, Glantz PO. Effect of pH and counterions on the zetapotential of oral streptococci. Arch Oral BioI 1977;22: 461-466.
14. Mourughan K, Suryakanth MP. Evaluation of an alum containing mouthrinse for inhibition of salivary streptococcus mutans levels in children: a controlled clinical trial. J Ind Soc Pedod Prev Dent Sept 2004;22(3):100-105.
15. Kleber CJ, Putt MS, Smith CE, Gish CW. Effect of supervised use of an alum mouthrinse on dental caries incidence in caries susceptible children: a pilot study. ASDC J Dent Child 1996 63:393-493.
16. Klein H, et al. The epidemiology of dental disease. US public health service, 1948. As cited from: Finn SB. Clinical Pedodontics. 4th ed. Philadelphia: WB Saunders Company; 1999. p. 454-474.
17. Schafer T, Adair SM. Prevention of dental disease. Pediatr Clin North Am 2000;47(5):1021-1042.
18. Nikiforuk G. Nutrition, diet (local substrate) and dental caries (ch. 7). Understanding Dental Caries-1. Etiology and mechanisms. 1st ed. New York: Karger; 1985. p. 182-187.
19. Fischman SL. Clinical index systems used to assess the efficiency of mouthrinses on plaque and gingivitis. J Clin Periodontol 1988;506-510.
20. Ekbom B, Hultgren L. Saltwater rinses can effect plaque formation. Abstract used from Tandlakartingen (Swedish) 1982;74:291-295. As cited from: White GE, Armaleh MT. Tongue scrapping as a means of reducing oral mutans streptococci. J Clin Pediatr Dent 2004;28(2):163-166.
21. Bihani SN, Damle SG. Evaluation of an alum-containing mouthrinse on plaque and gingivitis inhibition over 2 weeks of supervised use. J Ind Soc Pedod Prev Dent 1997;15(1): 34-38.