

The Effect of Topical Iodine and Fluoride Varnish Combination in Preventing Early Childhood Caries: A Pilot Study

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Abstract

Background: Early Childhood Caries (ECC) in the earliest stage is preventable. The studies indicate oral bacteria play an important role in pathogenesis of dental caries. According to high prevalence of ECC, alternative therapies should be explored in order to reduce the occurrence of it. **Aim:** This study aims to assess the effectiveness of a product containing Povidone Iodine 10% and Sodium Fluoride 0.2% as a supplementary intervention for preventing ECC. **Materials and Methods:** Thirty-seven children aged 4 to 6 year-old were recruited. Maxillary incisors on each side of the mouth were selected either as a test or control group. Early caries detection examinations were conducted using International Caries Detection and Assessment System (ICDAS) clinically and photographically. In a double-blind, placebo-controlled clinical study, a product containing a mixture of Povidone Iodine 10% and Sodium Fluoride 0.2% was applied to the designated incisors of the test group participants. This application was performed every week for a 3-month. The control group participants received a placebo mixture during the same time interval. The caries detection examinations were conducted again after 6 months and the results were compared. The data was analyzed with SPSS V.18, using McNemar test. **Results:** The incidence of carious

lesions increased for the control group while it decreased in the test group ($P < 0.05$)

Conclusion: A product containing PI and F can be effective in preventing ECC.

Key words: Early childhood caries, Povidone-iodine, Prevention, Sodium fluoride.

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Introduction

Current management of early childhood caries (ECC) consists of either an extraction or a restoration protocol of the carious teeth in conjunction with supplemental dietary counseling and/or behavioral modification advice.¹ Some studies also indicate about 40% of children treated for Severe ECC under general anesthesia have experienced new carious lesions within 6–12 months post treatment.² It is evident that restorative procedures minimally effect Streptococcus Mutans (SM) counts in the oral cavity of children with ECC1; whereas behavioral modification advise and/or

supplemental dietary counseling are complex approaches to reduce ECC. Furthermore, the compliance rates regarding the at home self-management/personal use of therapeutic agents yield variable ECC rates and results, and is contingent upon self reporting. Existing preventive practices aiming to reduce ECC include clinical topical fluoride application and/or at-home fluoride use .

To date, the most commonly used preventive agents in the management of ECC include fluoride gel application, fluoride varnish, chlorhexidine varnish, povidone iodine 10%, and xylitol oral syrup. The use of a topical or systemic fluoride is the most effective protocol in the prevention and control of ECC of very young children.¹ However, sufficient tooth structure, especially enamel, is essential in order for fluoride to act as a re-mineralization agent by decreasing the demineralization process. In addition, fluoride do not reduce or prevent the level of SM in saliva but only cause remineralization of early carious lesions.³

Numerous studies have documented the instant bactericidal effect of povidone iodine 10% and its effect on SM (effect in decreasing the salivary counts of SM in children with ECC^{4, 5, 6} as well as a reduction rate up to 61% in caries recurrence at one year follow up^{7, 8}). Povidone-iodine has also been used in conjunction with fluoride by researchers as a bacteriostatic and cariostatic agent.⁹ The US Food and Drug Administration has approved 10% povidone iodine as a safe pre-surgical disinfectant to the skin and mucous membranes of children⁽¹⁾.

Lopez et al., studied a group of 12-19 month old participants who received a povidone-iodine mixture every 2 months for 12 months as an anti-caries agent. They concluded that the use of topical antimicrobial therapy decreases the incidences of ECC in high-risk children. ¹⁰ A study showed the combine preparation of fluoride and povidone-iodine decreased the caries rate of up to 13% as compared to the use of fluoride varnish alone. For the test group, the preparation was applied to tooth surfaces 2-3 times during a 9-month protocol period, where only 41% of children developed new carious lesions. ⁽¹¹⁾

Some studies have recommended the use of fluoride combined with an antibacterial agent, especially for children with limited access to oral health care services. ¹² It is noteworthy to stress that topical fluoride application alone cannot be of a protective nature against cariogenic bacteria. The current research recommendations support the use of combination Fluoride and antibacterial agents like chlorhexidine and povidone-iodine ^{13, 14}. The therapeutical application of fluoride is considered effective when used in conjunction with antibacterial agents like chlorhexidine or povidone-iodine in attempts to target the cariogenic

bacteria. However, it is prudent to use fluoride concentrations that are non-toxic or that do not result in fluorosis. Given the fact that a 0.2% topical sodium fluoride product is the safest weekly dose, this study hypothesized the effect of 0.2% sodium fluoride (NaF) in combination with 10% povidone-iodine as a therapeutic agent to control ECC incidence

Materials and Methods

In a double-blind, placebo-controlled clinical settings, 37 healthy kindergarten children with existing early signs of ECC (white spots) were voluntary recruited from the city of Kerman. The participants were selected from the patient pool of community referrals to the Faculty of Dentistry, Department of Pediatric Dentistry at Kerman University of Medical Sciences in Iran. The sample size was calculated at $n=25$ by observing prevalence of dental caries among preschool children, up to 72%,¹ and the parameters $\alpha=5\%$ and $\beta=20\%$, which is similar to the rates of previous relevant studies^{4,5}. In order to account for dropout rates, a final number of 37 subjects were selected. Furthermore, the current study is an exploratory pilot study. The exploratory studies need smaller sample size. The inclusion criteria are represented in Figure 1.

Prior to the study, the Ethics Committee of Kerman University of Medical Sciences (K/90/228) approved the research project where all volunteer participants' parents were fully informed and agreed to participate by signing the appropriate informed consent forms. In accordance with the Kerman University ethical guidelines, participants also received complimentary restorative procedures at the end of the study protocol with parental consent.

A combination of NaF 0.2% and povidone-iodine 10% was prepared in the Faculty of Pharmacy at Kerman University of Medical Sciences for the test product as well as the placebo combinations (Table 1). This combination dose preparation was not considered a new therapeutic agent since these products are currently being used separately. However for the purpose of this study, the products were combined.

Povidone-iodine solution alone is a water soluble compound that liberates iodine, which has antimicrobial action. The slow release of iodine from povidone-iodine then facilitates the long term antibacterial effect.¹⁵ With this selected combination, the bond capacity of povidone-iodine is saturated by iodine and therefore the two compounds cannot interact with one another. Additionally, fluoride does not form a chemical bond with povidone-iodine and is available as free form. ^{5, 9} A toffee flavor was then added to both the test and placebo in order to enhance the taste and increase compliance for the child participant. This sticky end-product

compound will then adhere to surfaces of teeth similar to that of fluoride varnish. The compound was stored in closed containers in a moisture-free environment at the refrigerator temperature.¹⁶

Regarding every participant child had both control and test teeth and participants' mouths were divided into two quadrants, one quadrant as the test site and one as the control, there was no need for randomization during the subject selection process. However, the site where each subject was to receive each product was randomly selected according to Head or Tail. One tooth on the right and one on the left quadrant were selected as either the test or control tooth, and the order was reversed for the remaining half. The operator of the protocol did not have any prior knowledge about the test or the control sites. In an effort to relative uniformity all of the subjects in relation to oral hygiene and fluoride intake, the researchers distributed Darougar children's toothpaste (from Kaf Co., Iran) at the beginning of the study for all participants to use.

Dental caries examinations were conducted by utilizing the International Caries Detection and Assessment System (ICDAS) criteria before and after interventions. The following codes were recorded on the maxillary incisors labial and proximal surfaces (Figure 2). Caries detection was carried out using the defined codes, relying on visual or palpation examination after the tooth surfaces were completely clean. All clinical examinations were carried out with a round-ended probe (in order to remove additional plaque from the tooth surface and evaluate caries status) and a toothbrush or prophylactic prophylaxis prior to each examination as recommended by supportive similar studies and by the same examiner. For the purpose of this study, the Code 1 or the existence of first visible changes was selected depending on the severity of the lesion.¹⁷ The study examiner was trained on how to use the ICDAS codes and was calibrated with the chief examiner prior to the study initiation (kappa coefficient= 80%).

Procedures

All selected teeth were air dried and evaluated under a 100-watt electric light using a dental mirror and a disposable round-ended probe again. All tooth surfaces were dried and photographed by a standard intraoral camera (Sony, α -200, Japan). The chief examiner and the study examiner recorded ICDAS code 1 from the photographs of the selected sites (85% agreement). Then, the chief examiner applied the test and placebo products on tooth surfaces once a week for three months, according to similar studies.^{4, 7} The chief examiner was blinded to the study design, the contents

of the products, and the test and control sites. The products were labeled indicative of which subject would receive what product and in which designated site. The operator followed the protocol precisely. The first order was to separate the left and right quadrants with a stainless steel matrix band (located between central incisors), where the incisor surfaces were dried with a standard gauze pad. Next, the designated product was applied to the tooth surface/s with a brush applicator for one minute every week for a 3-month duration interval. The subjects were then given the post-operative instructions of not to eat or drink for half an hour. At the end of the three-month timeline, applications of the combination product were completed and nutritional counseling along with oral hygiene instructions was administered to the parents of the participants. The parents were then asked to return to the clinic after three months for the 6-month follow-up protocol. Six months after the initiation of the study, the participant children's incisors were re-examined under the same conditions as the initial examinations to determine the caries status (active caries or arrested caries). The conditions were including using the round-ended probe, as well as the additional photographs. The collected data was analyzed by SPSS 18 software and McNemar's test. The statistical significance was defined at $p < 0.05$.

Results

Thirty-seven children were recruited and examined during the first days of the study with 25 children completing the study protocol (68% completion rate). At the six-month interval of the study, 12 participants were disqualified due to a lack of patient and parental compliance and/or the use of antibiotics during the gap study interval. Any participants were not disqualified due to toothache. The mean age of all participants for the first and second stage was between 4.6 and 4.4 years, respectively. Assessment of caries activity indicated that the caries rate was arrested in 68% of teeth in the test group as compared to that of only 6.3% for the control group. There was a significant difference between the test and control groups ($P < 0.001$) (Tables 2).

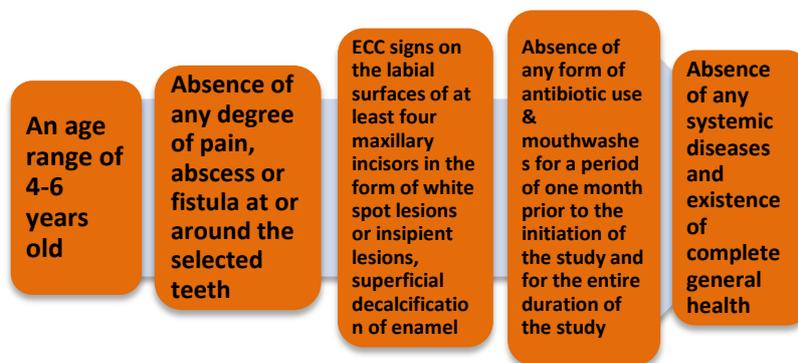


Figure 1. Inclusion Criteria for Study Participants

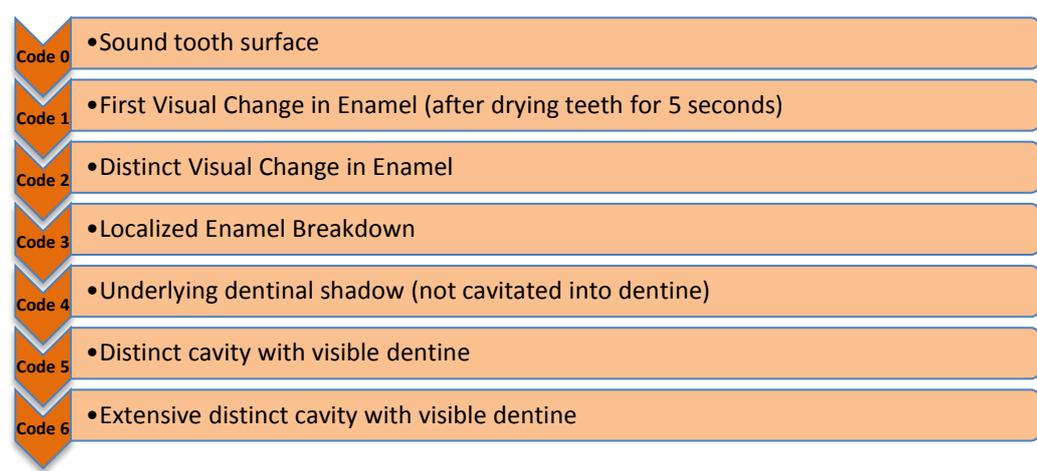


Figure 2. The International Caries Detection and Assessment System (ICDAS) Codes & Criteria Classification Utilized for the Study

Table 1. The Percentage of Test and Control (Placebo) Group Product Compositions

Material Composition	Test Group Composition	Control Group Composition (Placebo)
Gelatin	11.7%	16.7%
Pectin	14.7 %	16.7%
Carboxymethyl Cellulose	13.7 %	16.7%
Povidone-iodine + Sodium Fluoride	10% + 0.2%	0.0 %
Plastibase (Paraffin + Low Density Polyethylene)	50.0 %	50.0 %

Table 2. Comparison of Caries Activity in Maxillary Incisors for the Test and Control Groups at the Second Stage of the Study (6 Month interval)

Caries Activity	Test Group Teeth N (%)	Control Group Teeth N (%)	P value
Arrested caries	34(68)	3(6.3)	
Active caries	16(32)	44(93.7)	<0.001
Total	50(100)	47(100)	

Discussion

For the purpose of this study, povidone-iodine was selected because it has an instant bactericidal effect and has a long track record of utilization for the surface of skin and mucosa as well as its effect on MS, as supported by a number of studies.^{4, 5} A fluoride concentration of NaF 0.2% was also chosen for this combination protocol. The present study demonstrated that the mean caries rates decreased after a test group application of a combination of fluoride and povidone-iodine as compared to that of a placebo application for a control group. This study found that caries activity decreased when comparing the test to the control group, as documented by findings from the Lopez et al., study. Lopez et al. concluded that the use of topical antimicrobial therapy decreases the incidences of ECC in high-risk children.¹⁰ Amin et al. indicated a significant initial decrease in SM counts at the six-month interval in all the children in the test group compared to those in the control group.⁴ Later on, they noticed that there were no significant differences observed in SM counts between the two groups. This finding was attributed to the fact that povidone-iodine is a potent antiseptic; it immediately influences bacterial membranes, destroying SM where it does not have a long-term effect.

For the Milgron et al. study, the control group applications of only fluoride varnish, 54% of children exhibited newly developed carious lesions.¹¹ Comparing the Milgron results with that of our study, there is a strong indication that the combination effect of fluoride and povidone-iodine on caries activity is preferred as compared to that of fluoride alone. For our study, carious lesions were arrested in the test group ten times more than the control group. Based on the results of our study and supportive similar studies, it is evident that povidone-iodine has an instant antibacterial effect when applied. Therefore, it should be used continuously and in combination with a low concentration fluoride, and in particular a NaF 0.2% as used in this study.

Children experiencing ECC are three times more susceptible to carious lesions of permanent teeth in comparison with children without the incidence of ECC, which influences their oral health related quality of life.¹ Therefore, in order to decrease the rate of carious lesions for the permanent teeth, great efforts should be made to prevent and reduce the incidence of ECC rate for the deciduous teeth. In addition to parental empowerment and guidance regarding prevention of

early oral cavity contamination of SM for breast-fed babies and the feasible possibility of cross-contamination from mother to infant, all efforts should be made to prevent the accumulation of this bacterial species at pathologic levels with the use of topical antibacterial agents. Our study design included a combination of topical fluoride application and antibacterial agents like chlorhexidine and povidone-iodine as supported by other studies.^{13, 14}

We have documented that the combination preparation of povidone-iodine 10% and NaF 0.2% can effectively decrease caries activity for the selected test group. Our study confirms the results of the Xu et al. protocol that compares the bacteriostatic effect of povidone-iodine and fluoride to that of regular fluoride use for a one-year period for the preventions of ECC.⁹ Finally, it is recommended that additional larger scope studies with longer durations need to be conducted in order to reproduce and support this study's hypothesis. Our study improved previous studies through the use of a separator to isolate the left and right quadrants during the product application phase, allowing the sticky products (test and placebo products) to adhere to the labial surface of the selected teeth. This action facilitates the separation of the test sites from that of the control teeth. It is recommended that future similar studies duplicate this concept in testing for specificity and reproducibility of test and control group separations.

Conclusion

It is encouraging to realize that this combination therapy can prevent or reduce the incidence of ECC rates for very young, vulnerable children experiencing ECC. This population is often challenged with socioeconomic, access to care, financial, and paternal educational barriers. In an ongoing effort to reduce deprivation gaps and limit ECC, the results of this study have shown that a product containing a combination of fluoride and povidone-iodine can act as an effective alternative anti-caries agent.

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