

Effectiveness of Fluoridation Depending on Periodicity in 6–10-year-old Children

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ABSTRACT

Background: The cost-effectiveness of this study was achieved in the group that was treated every three months with periodic intervals, which had a reduction of caries with 62%. The relative effectiveness of our study is the application of fluoride treatment every 3 months compared with treatments done every 4 and 6 months, respectively.

Objective: To evaluate the reduction of caries disease depending on the time period of fluoride gel application. The sample was chosen randomly.

Main hypothesis: The frequency of fluoride gel application every 3 months has positive impacts on reducing dental caries.

Basic design: This is a cross-sectional study with a controlled sample for a period of 24 months. Durashield fluoride fluid (5% sodium fluoride) was used for the treatment of permanent dentition of the 6–10-year-old children.

Clinical setting: This study proves that fluoride application every 3 months significantly reduces caries morbidity.

Participants: Our study included 400 children, who were divided into 4 groups, 100 children in each group.

Intervention: The first group did not undergo any treatment and it is called the control group. The second group was under fluoride treatment every 4 months. The third group was treated with fluoride every 3 months, and the fourth group was treated every 6 months.

Results: The data collected from the control group showed that there is an increase in 24% of the caries incidence. In the group treated with fluoride every 4 months, caries incidence decreased to 30%. The group treated every 3 months with periodic intervals had a reduction of caries with 62%, while the group treated every 6 months had a reduction of 40%. Based on the analysis of variance (ANOVA) test, the fluoridation application every 3 months is significant for $p = 0.000$.

Conclusion: The best results were achieved in the treatment with fluoride in a 3-month periodic interval.

Keywords: Caries, Caries risk, Dentition, Topical fluoride.

International Journal of Clinical Pediatric Dentistry (2019): 10.5005/jp-journals-10005-1648

INTRODUCTION

Dental caries is the most common and the most prevalent disease of the oral health of people worldwide.^{1–3} There is a significant decline in caries morbidity in the most developed countries and it is thought to be caused by the increase of preventive measures about the fluoride application.^{4–6}

The use of this element in different forms and methods has a notable impact on the reduction of dental caries.⁷ Therefore, a regular exposure to fluoride is required to maintain its concentration in the tooth enamel and saliva.⁷

Fluoride ions, apart from their role in the processes of demineralization and remineralization, also have a role in the physiology of microbial cells and more precisely to the *Streptococcus mutans*.^{8,9}

Nowadays, there is enough scientific evidence supporting the idea that the main mechanism of fluoride action in preventing caries is the post-eruptive or the topical action rather than the systemic one.^{10,11}

The purpose of this study is to evaluate the reduction of caries disease depending on the time period of fluoride gel application.

MATERIALS AND METHODS

This is a cross-sectional study, with a controlled sample for a period of 24 months. The study was part of the program for preventing dental caries in permanent dentition. The children in the study have different economic and social backgrounds. The sample was selected through the “random clustering method.” The number of

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How to cite this article: Canga M, Malagnino VA *et al.* Effectiveness of Fluoridation Depending on Periodicity in 6–10-year-old Children. *Int J Clin Pediatr Dent* 2019;12(4):280–282.

Source of support: Nil

Conflict of interest: None

participants was statistically calculated taking into consideration the *t* test with a statistical significance of $p < 0.05$. The study had no dropouts. The standard deviation was taken into consideration for each group. The literature review refers to the reduction of dental caries within a period of 2 years after the fluoride application.^{12,13}

Durashield fluoride fluid (5% sodium fluoride) (22,600 ppm) was used for the treatment of permanent dentition of the 6–10-year-old children. The diagnosis of dental caries was performed through intraoral examination for each child. Intraoral examinations were performed through a dental mirror and exploration probe. Five doctors were participated in our study. Two of them were examiners and three dentists were who registered the children.

Our study included 400 children aged 6–10-year old, who were separated into four groups, 100 children in each group. The control group consisted of 100 children and this group did not undergo any

treatment. After 24 months, the control group was checked to see the progression of the caries process. The second group consisted of 100 children who were under the fluoride prophylactic protocol every 4 months, the third group was treated with fluoride every 3 months, and the fourth group was treated every 6 months.

Based on the Declaration of Helsinki issued by the World Medical Association, our research, which was on human participants, was clearly formulated in experimental protocols. In our study, we anticipated the benefits and the potential risks to our sample and after that we took the consent of children's parents.

Study Design

This descriptive and analytical research was designed as a cross-sectional study. There were 400 children selected as the sample of this study with a confidence interval = 0.95. The sampling method was a combination of simple randomization and clustering. Totally, 4 clusters with 100 children each were formed in order to see the effect of fluoridation periodicity. The sample was not kept under hospital observation. The treatment with fluoride was done in a dental clinic and after that the children were free to go. As we mentioned, the participants were selected through simple randomization and were invited to take part in the research. The inclusion criteria were in the age range of 6–10-year old. Informed written consent was obtained from all parents of the participants. This study was approved by the University of Vlora, Albania.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics 23.0. Data were analyzed by one-sample *t* tests. The significance level (α) was set at 0.001–0.05, with a confidence interval (CI) of 95%, whereas *p* value and ANOVA are used to compare independent samples.

RESULTS

The data collected from the control group showed that there is a 24% increase of the caries incidence and the number of children with caries increased from 40 to 64 children. In the group treated with fluoride every four months, caries incidence decreased with 30%, the group treated every three months periodic intervals had a reduction of caries with 62%, while the group treated every 6 months had a reduction of 40%.

The data show that the group treated with fluoride within a three-month periodicity has higher remineralization compared to the group treated with fluoride in 4- and 6-month periodicity. There were 80 children with caries initially vs 100 children in the group treated every three months; 60 children have full signs of improvement in remineralization and the number of children with caries declines with 20 children. We see that in the group of children treated every four months in the end of the treatment, there were 25 children with caries and 25 children that have started the process of remineralization. We notice that the treatment with fluoride gel every six months is positive and reduces the number of children with caries from 60 to 40 children. Based on the results, the most significant correlation was the fluoride application within 3-month periodicity (Table 1).

The results of Table 2 show the difference between the means of the groups, standard deviation, and confidence interval according to the treatment periodicity. The difference between means are due to the treatments done every 3, 4, and 6 months, which were controlled by the examiners.

To evaluate the effectiveness of fluoride gel application, we took as a reference the *t* test. According to it, the value obtained was

Table 1: Correlation of fluoride application and dental caries reduction every 3, 4, and 6 months

		3 months	4 months	6 months	F
3 months	Pearson	−0.973**	0.998*	0.954*	122.72
	Sign	0.000	0.042	0.012	
	N	9	3	5	
4 months	Pearson	0.998*	−0.989**	0.962	227.66
	Sign	0.042	0.000	0.172	
	N	3	7	3	
6 months	Pearson	0.954*	0.962	−0.994**	251.71
	Sign	0.012	0.175	0.001	
	N	5	3	5	

*Significant correlation

**Strong correlation

Table 2: Difference between the means of the groups, SD and CI, according to periodicity

	Mean	SD	t	Sign.	CI 95%
Caries after 3 months	55.67	22.760	7.33	0.000	38.1–73.11
Caries after 4 months	39.14	9.281	11.15	0.000	30.5–47.78
Caries after 6 months	49.40	8.112	13.61	0.001	39.3–59.46

bigger than the critical value. That means that the null hypothesis is rejected. So, the alternative hypothesis is proved, which means that the treatment with fluoride gel every 3 months is statistically significant.

Based on the results obtained by the group treated with fluoride gel every 3 months, the deviations are bigger compared with the deviations of the groups treated with fluoride every 4 and 6 months. This means that the treatment with fluoride every 3 months is more effective.

DISCUSSION

Caries is an infectious, bacterial, multifactorial, and transmissible disease, which is associated with the decay of teeth structure. Caries also is the main cause of premature pain and premature extractions in the oral cavity.³ Oral hygiene and fluoride application are the most effective methods in reducing dental caries.

The professional topical application of fluoride is performed through products that have high fluoride doses such as spray, gel, etc.⁶ The concentration of fluoride in the dental enamel generally reflects the level of exposure to fluoride during the formation period of the enamel.⁷ It should be noted that there is no hemostatic mechanism to maintain the concentration of fluoride in the body.⁷

In our study, the effect of fluoride treatment refers to the number of teeth gained vs the initial values of the time treatment. The periodicity of the fluoride gel treatment every three months has higher effect than the treatments every four months and six months. The lack of treatment in the control group for 24 months increased the number of caries with 24%. After the treatment with fluoride, the frequency of caries declined from 20% in the six-months group to 60% in the three-month group, so we can state that the effectiveness of fluoride treatment may go from 44% to 84%.

The results of our study state that the role of fluoride treatment is very highly recommended. These results are similar to the global studies which state that fluoride is the main responsible factor for the reduction of caries prevalence.^{14–17} Other studies conform the local effect of the fluoride contact with the superficial teeth enamel in the process of mineralization and demineralization.¹⁸ Fluoride is

not present when the pH level goes lower than 5.5 in the oral cavity, it starts to dominate the process of demineralization.¹⁹ When the pH reaches 5.5, it starts the mineralization process, as the saliva is enriched with mineral salts.²⁰ Evidences show that the fluoride application in a professional method reduces the caries during a two-year period. The fluoride gel is the element where the fluoride concentration is higher, 22,600 ppm.^{21,22}

The reduction of dental caries from the use of fluoride gel is around 38%.²³ Caries prevention varies from 53% with fluoride application to 93% with three or four applications in a two-year period.^{24,25} Our results are similar to the results of the study above. Also the results of our study are similar to the study of Dohnke and Zimmer, who studied the prevalence of caries and the effect of fluoride gel for a time period of four years. According to their results, the prevalence of caries declined to 40%.^{26,27}

Based on our results, we came to the conclusion that fluoride application done every three months within a 2-year period will reduce caries morbidity.

CONCLUSION

The treatment with fluoride is necessary if we want caries reduction. The best results were achieved in the treatment with fluoride within a 3-month periodicity.

CLINICAL SETTING

This study proves that fluoride application every three months significantly reduces caries morbidity.

ACKNOWLEDGMENT

Author would like to thank his professor for his support, contribution, and the time he dedicated to this study.

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