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ORIGINAL ARTICLE

Difference In Effectiveness Between The Topical Application of Acidulated Phosphate Fluoride (APF) Gel and Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP) Paste in Reducing Plaque Accumulation in Children

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KEYWORDS

Plaque accumulation;
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Plaque score;
Topical aplication

ABSTRACT: Plaque accumulation is the buildup of bacterial substances on dental surface. Plaque can be controlled using anti-bacterial chemicals such as acidulated phosphate fluoride (APF) and casein phosphopeptide-amorphous calcium phosphate (CPP-ACP). The function of APF and CPP-ACP is to inhibit the growth and adhesion of bacterial plaque colonization by *S. mutans* on the tooth's surface. This study aims to identify differences in the effectiveness of the topical application of APF gel and CPP-ACP paste against plaque accumulation in children. The research applied a quasi-experimental method with a time-series design. The study was conducted at the Nur Hidayah and Ihsan Sakeena orphanages in Surakarta, where 30 children aged 6-12 were involved as research subjects, divided into two treatment groups namely the APF and CPP-ACP groups. Topical application of APF was given once on the first day, while that of CPP-ACP was administered once a day from the first until the seventh day. Plaque score data were obtained by PHP-M plaque score measurement. Total plaque scores were measured on day 1 before and after application, day 7 and day 14. Results show declining average plaque scores between the first day prior to topical application of APF and CPP-ACP and the fourteenth day afterwards. Independent samples tests reveal differences in effectiveness of topical APF gel and CPP-ACP paste application on plaque accumulation in children on day 7 and day 14, but no difference in plaque score change on day 1 ahead of and following application. Topical application of CPP-ACP paste decreases plaque accumulation in children more effectively than that of APF gel.

INTRODUCTION

Children like to consume sweet food without balancing it with good dental hygiene due to little dental health knowledge among them [1]. In the metabolism of sucrose, the bacterium that plays a central part is *Streptococcus mutans* [2-5]. Plaque is the accumulation of an extracellular matrix and bacteria which form a biofilm that adheres to dental surface [6]. Plaque is not a tooth and mouth disease but can lead to such ailment

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[7]. Plaque is formed by a series of events starting from the formation of acquired pellicle, where glycoproteins from saliva are selectively absorbed into the tooth's surface. The second phase includes initial colonization, in which the surface is at first colonized by gram-positive cocci, particularly *Streptococcus spp*. In the third or last phase are final colonization and maturation. If plaque formation is uninhibited, the plaque matures through further growth of existing species and the advent of late colonizing species [6, 8-9].

Various means have been developed to control plaque, one of which uses antibacterial chemicals to curtail plaque accumulation. Examples of such agents are acidulated phosphate fluoride (APF) and casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) [10-12].

The topical application of fluoride agent which is frequently used is APF 1,23% in gel preparation form. APF has stable properties which do not irritate the tissue. This topical application fluor agent curbs bacterial colonization on the tooth's surface and restrains microbiological enzyme systems that convert carbohydrate into dental plaque [13]. However, if the use of fluorine is undisciplined and uncontrolled, it can cause side effects such as enamel fluorosis and fluorine toxicity [10].

CPP-ACP is a topical dental varnish agent which protects the teeth and has anti-caries properties [14]. CPP-ACP is able to inhibit bacterial metabolism by severing the bond structure between bacterial receptors on the saliva pellicle and the bacterial extracellular polysaccharide protein matrix. This renders plaque-forming bacteria unable to adhere to the tooth's surface [15].

MATERIALS AND METHODS

The research method employed is quasi-experimental with a time-series design. Ethical clearance has been ratified in this study. The study was carried out at the Nur Hidayah and Ihsan Sakeena orphanages in Surakarta, involving 30 children aged 6-12 as research subjects who met the inclusion criteria of not having milk protein allergy and willing to participate with informed consent. The subjects were separated into two groups, namely 15 children receiving topical APF gel application and 15 with that of CPP-ACP paste.

The materials and tools utilized in this study are APF gel (Frutti Fluor®, Brazil), CPP-ACP paste (GC Tooth Mousse®, Japan), a disclosing agent (Judilee®, Canada), a microbrush, and an APF tray. The application was according to the instructions as recommended by the manufacturer. Topical APF application was administered on the subjects once on day 1 only, while that of CPP-ACP was given once a day before bedtime from day 1 to day 7 by the orphanage staff members who had received training from the researchers.

Plaque score data were gathered by Personal Hygiene Performance-Modified (PHP-M) plaque measurement [16]. Plaque scores were measured with the disclosing agent on the first day prior to and following application, the seventh day and the fourteenth day. The plaque score data obtained by PHP-M were subjected to parametric hypothesis testing by means of independent samples tests to identify any difference in effectiveness between the topical application of APF gel and CPP-ACP paste.

RESULTS AND DISCUSSION

Findings from observations and measurements of plaque scores on the groups treated with APF gel and CPP-ACP paste, each consisting of 15 children, are presented in Table 1.

Figure 1 indicates that the average plaque scores of the subjects from the first day to the fourteenth day declined after the topical application of APF and CPP-ACP. The data analysis results then underwent hypothesis testing by independent samples test. Outcomes of the independent samples test on plaque score changes in the APF and CPP-ACP groups on day 1 (before-after) are displayed in Table 2.

Table 1. Summary of means and standard deviations (SD) of plaque scores from the APF and CPP-ACP groups from day 1 (before application) to day 14.

Plaque score group	N	Mean ± SD				
		Day 1 (before)	Day 1 (after)	Δ Day 1 (before-after)	Day 7	Day 14
APF	15	31.27 ± 4.950	24.87 ± 3.563	6.40 ± 1.454	18.53 ± 2.232	13.40 ± 1.724
CPP-ACP	15	30.53 ± 3.543	23.13 ± 2.800	7.40 ± 1.298	14.73 ± 1.907	11.00 ± 1.890

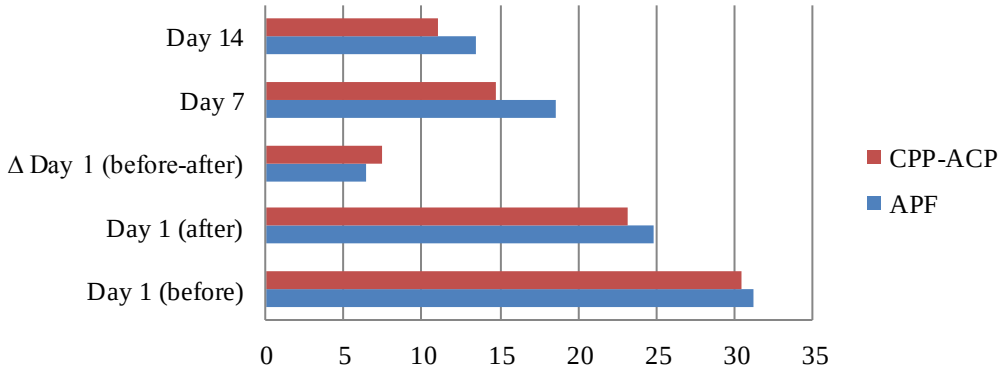

Figure 1. Average plaque scores of the APF and CPP-ACP groups from day 1 (before application) until day 14.

Table 2. Results of the independent samples test on plaque score changes in the APF and CPP-ACP groups on day 1 (before-after)

	Group	N	Mean	Std. Deviation	t-test Sig. (2-tailed)
Plaque score	Δ Day 1 (before-after) of APF	15	6.40	1.454	0.057
	Δ Day 1 (before-after) of CPP-ACP	15	7.40	1.298	

The test obtained a significance value of p>0.05, indicating that there is no significant difference between the plaque score changes of both subject groups on the first day pre and post-application. Results of the independent samples test on the APF and CPP-ACP groups on day 7 are shown in Table 3.

Table 3. Results of the independent samples test on the APF and CPP-ACP groups on day 7

	Group	N	Mean	Std. Deviation	t-test Sig. (2-tailed)
Plaque score	Day 7 APF	15	18.53	2.232	0.000
	Day 7 CPP-ACP	15	14.73	1.907	

The test produced a significance level of p<0.05, indicating that there is a significant difference between the two sample groups on the seventh day. As seen in Table 3, the average plaque score of day 7 CPP-ACP is lower than that of day 7 APF. The independent samples test on the APF and CPP-ACP groups on day 14 provided outcomes as described in Table 4.

Table 4. Results of the independent samples test on the APF and CPP-ACP groups on day 14

	Group	N	Mean	Std. Deviation	t-test Sig. (2-tailed)
Plaque score	Day 14 APF	15	13.40	1.724	0.001
	Day 14 CPP-ACP	15	11.00	1.890	

The test resulted in $p<0.05$, denoting a significant difference between both sample groups on the fourteenth day. Table 4 also shows that the average plaque score of day 14 CPP-ACP is lower than that of day 14 APF.

The research outcomes indicate decreasing plaque accumulation due to topical application of APF gel and CPP-ACP paste. However, the independent samples test did not find any significant difference between the plaque score change of the APF group on day 1 (before-after) and that of the CPP-ACP group on the same day. This corroborates previous studies that uncovered no significant difference between the topical application of CPP-ACP and fluorine in reducing biofilm adhesion of *Streptococcus mutans* bacteria on the first day [17].

According to the independent samples tests, the APF and CPP-ACP groups had significantly different plaque scores on days 7 and 14. On both days the CPP-ACP group gave a lower average plaque score than the APF group. Prior research revealed that, with topical CPP-ACP application in seven days and 14 days, plaque accumulation visibly diminishes, because longer topical application of CPP-ACP prevents plaque bacteria from adhering to the dental surface [15].

This study also disclosed that on the fourteenth day the average plaque score of the APF group was higher than that of the CPP-ACP. This aligns with past research in which the size of the *S. mutans* colony declined between the time before topical APF application, after three days and after 30 days, but there was no significant difference between three days and 30 days following application. This stems from the transient effect of fluorine which allows *Streptococcus mutans* to eventually adapt and become resistant to it [18].

According to preceding research, although both CPP-ACP and fluorine decrease the colony of *Streptococcus mutans* bacteria in dental plaque, this effect is significantly greater in CPP-ACP than in fluorine [19]. The anti-plaque attribute of CPP-ACP is characterized by direct binding of CPP-ACP to the bacterial surface, its ability to restrict calcium ion diffusion into the plaque, and its half-life in the plaque which lasts for more than two hours [20, 21].

CONCLUSIONS

This study aims to identify differences in the effectiveness of the topical application of APF gel and CPP-ACP paste against plaque accumulation in children. Based on findings of this study, from 30 children age of 6-12 from the Nur Hidayah and Ihsan Sakeena orphanages in Surakarta, Indonesia, it can be concluded that there is a difference in effectiveness between the topical application of APF gel and CPP-ACP paste in limiting plaque accumulation in children on day 7 (p=0,000) and day 14 (p=0,001). Topical CPP-ACP paste application was found to be more effective in reducing plaque accumulation in children than that of APF gel. In further study it is expected that CPP-ACP application could be done in varying dosages, frequency of time of use, and ability to stop caries severity in children.

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