The Effect of 1% Chlorhexidine Gel Delivered with Toothpicks on Proximal Dental Plaque. A Pilot Study

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The aim of this study was to determine the effect of 1% chlorhexidine gel delivered with toothpicks on interproximal dental plaque. Seven follow-up patients participated in two treatment periods of 1 week each, separated by a normal oral hygiene period of one week. The study had double-blind design. The plaque index by Silness and Löe (Acta Odontol Scand 22: 121-135, 1964) was scored on mesial, distal, buccal and lingual surfaces of each tooth after plaque disclosure, with an aqueous solution of erythrosine and the measurements were performed by the same examiner, at the initial visit and at the end of every experimental week. The ability to use toothpicks was checked and upgraded to the individual need. The participants were instructed to carry out their normal oral hygiene procedures, with placebo gel or 1% chlorhexidine gel delivered interproximally with toothpicks once daily. No significant differences in the measurement of plaque were noted between placebo gel and 1% chlorhexidine gel at interproximal areas. After treatment with 1% chlorhexidine gel, the mean distribution of plaque score 0 was increased significantly (P < 0.05), from 30.7 sites (52%) to 42 sites (71.1%) when all sites are taken into account and compared to the placebo period. 1% Chlorhexidine gel delivered by toothpick on interproximal areas had a limited effect on reduction of dental plaque.

Key Words: plaque control, 1% chlorhexidine, toothpicks.

Introduction

It is well known that bacteria on the tooth surface adjacent to the gingival margin causes gingivitis (Silness and Löe, 1964; Löe et al., 1965). Removal of all bacterial deposits leads to the healing of gingivitis, and subsequent rigorous supragingival plaque removal should prevent recurrence of gingivitis.

Several oral hygiene aids are available to perform and optimize supragingival plaque control. The toothbrush is the most popular, but its effect is limited to buccal and lingual surfaces. Therefore, a multitude of interproximal oral hygiene aids have been produced to meet the need of removing interdental plaque. The width of the interdental space, the shape of gingival papillae, the morphology of the teeth and the ability of the individual should be taken into consideration when recommending an interdental cleaning aid (Glavind and Nyvad, 1986).
Studies comparing the efficacy of available interproximal aids indicated that dental floss was more efficient in removing dental plaque than toothpicks when the interdental space was filled completely with gingival papilla (Gjermo and Flotra, 1970). The interdental brush was superior to toothpicks and dental floss when interdental papilla was absent (Gjermo and Flotra, 1970; Hall and Douglass, 1990). The triangular toothpick and dental floss were equally effective in interdental spaces not completely filled by interdental papillae (Bergenholtz et al., 1980). Despite the proven effectiveness of interdental oral hygiene aids, interproximal sites are more difficult to keep plaque free and are consequently more prone to develop gingivitis. The use of interdental aids also requires a certain dexterity of the patient.

Antimicrobial agents have been introduced as adjuncts to supragingival plaque control. The most extensively studied chemical plaque control agent is chlorhexidine, which was found to reduce plaque formation (Löe and Schiött, 1970; Briner et al., 1989). Chlorhexidine digluconate solution 0.4% or 1%, twice daily for two years, did not reduce dental plaque (Johansen et al., 1975).

The short-term use of 1% chlorhexidine as a brushing gel reduced the amount of plaque accumulation (Bain and Strahan, 1978). In a group of maintenance patients with poor oral hygiene, brushing with 1% chlorhexidine twice daily for 4 weeks decreased dental plaque (Lie and Enersen, 1986). Further investigation confirmed that 1% chlorhexidine gel used in a tray for 1 minute twice a day was more effective than either the 0.2% mouthrinse or the 0.2% spray for four weeks (Francis et al., 1987).

The aim of this study was to determine the effect of 1% chlorhexidine gel delivered with toothpicks on interproximal dental plaque.

Material and Methods

Seven patients (age: 50-72 years) treated at the Department of Periodontology in Malmö, Sweden, were selected to take part in this study. All subjects were recently treated for periodontitis and were recalled for follow-up. They had various degrees of gingivitis and 50% interdental plaque.

The study had a double-blind design. During week 1, the subjects performed their habitual oral hygiene including the use of a toothpick. During week 2, they applied a placebo gel in the interproximal areas with the aid of a toothpick, after their own habitual tooth cleaning. Week 3 was identical to week 1. During week 4, 1% chlorhexidine gel was delivered interdentally as described for the placebo gel.

A tube containing enough gel for one week was given to each patient who also received a 5-ml recipient which was used to control the maximum gel intake enabling him/her to carry a sufficient amount of gel per day. The patients were instructed to put 2 cm of placebo or 1% chlorhexidine gel in this recipient.

The plaque index (Silness and Løe, 1964) was scored on the mesial, distal, buccal and lingual surfaces of each tooth after plaque disclosure, with an aqueous solution of erythrosine. All clinical measurements were done by the same examiner, at the initial visit
and at the end of each experimental week. After plaque scoring, the subjects' teeth were professionally cleaned to eliminate all remaining plaque from the previous experimental week. At the initial visit all participants were re instructed in the use of the toothbrush and the triangular toothpick after plaque disclosure.

The Wilcoxon signed rank test was used to compare placebo and chlorhexidine gel treatment, using the frequencies of the respective plaque index scores as test parameters. This was done since the plaque index scores are an ordinal scale. Differences were considered statistically significant at $P < 0.05$.

Results

The subjects had 7 to 28 remaining teeth. The mean number of sites per patient was 59 (range: 28-112). The mean number of interproximal or buccal and lingual sites was 30 (range: 14-54).

At the start of week 1 the mean distribution of sites with no visible plaque (PI = 0) was 13.7 (23.2%) on all sites, 3.2 (10.6%) on interproximal sites and 10.4 (34.7%) on buccal and lingual sites (Figures 1, 2, 3). For the interproximal sites, no significant difference was found in the reduction of dental plaque between placebo and 1% chlorhexidine gel (Figure 2, Table 1).

![1% Chlorhexidine gel delivered by toothpicks](image)

Figure 1 - Mean percentages of all sites with PI = 0, PI = 1, PI = 2+3 scores at baseline and final examination of normal oral hygiene periods, placebo gel and 1% chlorhexidine gel treatment. After chlorhexidine treatment, the distribution of PI = 0 increased significantly ($P < 0.05$).
1% Chlorhexidine gel delivered by toothpicks
Interproximal sites

mean % of sites

Figure 2 - Mean percentages of interproximal sites with PI = 0, PI = 1, PI = 2+3 scores at baseline and final examination of normal oral hygiene periods, placebo gel and 1% chlorhexidine gel treatment. No significant differences were found.

1% Chlorhexidine gel delivered by toothpicks
Buccal and lingual sites

mean % of sites

Figure 3 - Mean percentages of buccal and lingual sites with PI = 0, PI = 1, PI = 2+3 scores at baseline and final examination of normal oral hygiene periods, placebo gel and 1% chlorhexidine gel treatment. No significant differences were found.
After treatment with 1% chlorhexidine gel, the mean distribution of plaque score 0 was increased significantly (P < 0.05), from 30.7 sites (52%) to 42 sites (71.1%) when all sites are taken into account and compared to the placebo period (Figure 1, Table 1).

Table 1 - Mean ± SD of all sites, interproximal sites or buccal and lingual sites with PI = 0, PI = 1, PI = 2+3 at baseline and final examination of treatment with placebo gel and 1% chlorhexidine gel. After chlorhexidine treatment, the distribution of PI = 0 increased significantly (*P < 0.05) when all sites were pooled.

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Discussion

The delivery of 1% chlorhexidine gel by toothpicks has the advantage of bringing the drug into direct contact with the interproximal surface, and could enhance plaque control in areas not accessible with toothbrushes.

The results of this pilot study showed that application of placebo gel and 1% chlorhexidine gel did not enhance dental plaque control significantly in the interproximal sites. The reduction of plaque accumulation that occurred during the study period may have been due to the characteristics of the experimental situation and the motivation of participants to perform mechanical tooth-cleaning.

The toothpick may not have carried the 1% chlorhexidine gel properly into interproximal sites. Instead, it may have accumulated on the buccal surface. This fact could explain the better results among all sites together. Perhaps, the anatomy of the local oral tissues prevented the drug from penetrating further into interproximal areas. The capacity of the gel to spread over the tooth surface depends partly on the viscosity of the gel, on the roughness of the tooth surface and on other rheological properties. Our observations agree with a previous study which showed that chlorhexidine gel lacks spreading at interproximal sites (Saxen et al., 1976). Further investigations are needed to describe physico-chemical properties that may influence the clinical behavior of chlorhexidine, both as a solution and as a gel.
It seems that the successful use of chlorhexidine as a gel, applied with a toothpick, depends on the cooperation of the patients. The patients used the amount of chlorhexidine determined in the protocol but it was not possible to standardize the application or the amount of chlorhexidine gel in each interproximal area. An in vivo study has indicated that repeated exposure to chlorhexidine is important to enhance the bactericidal effect (Maltz et al., 1981). An antimicrobial agent needs a certain amount of contact time with the bacteria in order to inhibit or kill the organism. The amount of chlorhexidine retained during mouthrinsing is dependent on the drug's concentration, dosage, and rinsing time (Bonesvoll et al., 1974a). Chlorhexidine adsorbs to oral structures and is then slowly desorbed in an active form. In the saliva, chlorhexidine can be detected for many hours after rinsing (Bonesvoll et al., 1974b). Contradictory evidence indicates that the chlorhexidine found in saliva after rinsing is unavailable for plaque inhibition (Bonesvoll, 1977). An in vivo study has presented a hypothesis suggesting that chlorhexidine promotes plaque inhibition by an immediate bactericidal action, during the time of application and by a prolonged bacteriostatic action from a slow desorption of the compound primarily from the pellicle-coated surfaces (Jenkins et al., 1988).

The subjects performed their habitual oral hygiene procedures which may have interfered with these results. Dentifrices containing sodium lauryl sulfate are reported to act as antagonists to chlorhexidine (Barkvoll et al., 1989).

In this study, the mean percentage of sites without plaque increased significantly after the use of 1% chlorhexidine gel when the result of buccal, lingual and interproximal sites were pooled. These results are supported by other investigations that have shown a reduction in plaque accumulation after application of chlorhexidine gel (Usher, 1975; Bain and Strahan, 1978; Lie and Enersen, 1986). Furthermore, comparison of three delivery methods of chlorhexidine in handicapped children demonstrated that 1% gel was more effective (Francis et al., 1987).

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References


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