

Clinical and microbiological effects of local chlorhexidine applications

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Aim: To study the effects of an application of chlorhexidine varnish (40%) on dental plaque. **Design:** Randomised controlled clinical trial. **Subjects:** 40 patients (50% females), aged 25–34 years after undergoing any necessary restorative treatment. Exactly one half of these individuals practiced good oral hygiene, the efforts of the others were poor. **Method:** Test groups received a chlorhexidine varnish application, the control group received a placebo varnish. Initially and after 2 and 6 weeks, a modified Dentocult® SM-test, bleeding on probing, and a plaque index (Quigley-Hein) were recorded. **Results:** In contrast to the control group, improvements in plaque index and bleeding on probing scores were found in patients with poor oral hygiene. The results of the Dentocult® SM-tests showed a considerable reduction of streptococcus colonisation. The test group with good oral hygiene showed only slight improvement of the examined indices after chlorhexidine application. The index parameters of all patients of the placebo groups remained unchanged over the examination time period. **Conclusion:** The application of a chlorhexidine varnish reduced the quantity of the *Streptococcus mutans* colonies significantly and improved clinical parameters in patients with elevated plaque accumulation.

Key words: Plaque, chlorhexidine, oral hygiene, *Streptococcus mutans*

In dentistry, chlorhexidine (CHX) is regarded as an effective locally applied antimicrobial. It temporarily reduces the level of bacteria in the saliva and on the oral mucosa¹. Chlorhexidine is usually applied as solution or gel. In order to maintain the reduction of oral microbiota, this procedure has to be repeated frequently. Since experience in dentistry has proved this antimicrobial substance to be beneficial, it is likely that the accumulation and activity of dental plaque can be influenced by local applications of CHX as an anti caries agent^{2–4}. The most suitable forms for application are varnishes, which can be applied in interproximal and cervical areas and in fissures and teeth^{5–8}. Varnishes allow application of a sufficient dose over a longer period of time and minimise the known side effects of staining of the teeth and of a bad taste⁹.

Since 1993/94, some basic studies investigating the effects of chlorhexidine varnishes in caries inhibition have been conducted^{1,3,5}. It was shown that such varnishes have a higher caries-protective effect than fluoride-preparations¹⁰. However, it could not be established how effective this anti-caries varnish was in high-caries-risk young adults compared to that of patients practising good oral health care.

In previous years, considerable success was achieved in caries prevention programmes with rela-

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tively simple aids. However, it became apparent that a relatively small group of caries-active patients required additional aids, in order to achieve an effective reduction of caries¹¹. The cost effectiveness of preventive measures, however, requires a knowledge of whether an over- or undertreatment within prophylaxis takes place. To establish optimal programmes in caries prevention, on the one hand, indicators of risk are needed. On the other hand, a determination of efficacy and side effects of preventive strategies including anti-caries agents are required¹².

The aim of this randomised controlled clinical trial was to determine the efficacy of a chlorhexidine varnish on patients with insufficient oral hygiene compared to that of a low caries-risk.

Materials and methods

An examination of the effect of a chlorhexidine varnish was conducted on 40 volunteers (20 male/20 female) after informed consent had been obtained. They were selected from outpatients in a private dental practice and were between 25 and 35 years of age (average age 29.58 ± 1.1) and whose general state of health was good. All active caries lesions were restored prior to testing. At baseline, after the application of the disclosing solution, the approximal plaque-index (API) was determined, including all teeth according to the modifications of Lange¹³. One half of the females and of the males had an approximal plaque index (API) < 30 per cent, the other half an API > 30 per cent. The values of the API were used to establish 4 groups of volunteers: A and B (test/control) with good oral hygiene (API < 30 per cent) and C and D (test/control) with poor oral hygiene (API > 30 per cent) (Table 1).

The clinical trial was carried out over three sessions (Table 2). In the first session (day 0), the API, Community Periodontal Index of

Table 1 Basic data

Group	Oral hygiene	Average age (years)	Max. CPITN score			Mean DMF-T
			0	1	2	
A Test (n = 10)	API < 30%	29.5	2	8	Ø	8.9
B Control (n = 10)	API < 30%	29.4	2	7	1	8.2
C Test (n = 10)	API > 30%	29.4	Ø	6	4	12.2
D Control (n = 10)	API > 30%	30.0	Ø	4	6	13.7

Table 2 Experimental procedure

1 st Session (Day 0)	2 nd Session (Day 14)	3 rd Session (Day 42)
API, CPITN, DMF-T		
Plaque-index	PI	PI
Gingival bleeding index	Gb	Gb
Microbiological testing	Mt	Mt
Plaque removal		
Varnish application		

Treatment Needs (CPITN) and DMF-T were recorded. Moreover, the Dentocult[®] SM test, the SBI and the plaque-index according to Quigley and Hein¹⁸ were determined on all three occasions. In the first session, a professional prophylaxis was carried out and either a placebo or a chlorhexidine varnish was applied to the teeth.

The CPITN was ascertained in accordance with Ainamo *et al.*¹⁴. The DMF-T was determined as outlined by Piper and Kessler¹⁵. The index of gingival bleeding was determined in accordance with Mühlemann *et al.*¹⁶, using Lang's modifications¹⁷. The accumulation of plaque on the teeth was determined in accordance with the plaque-index after Quigley and Hein¹⁸. The *Streptococcus mutans* colonisation of the test-teeth was determined with the Dentocult[®] SM test. According to the modifications of Wallmann and Krassen¹⁹, plaque was taken from the interdental area with a non-recyclable-brush. The test-teeth were the so-called 'Ramfjord teeth' (teeth nos. 16, 21, 24, 26, 41, 44)²⁰. The microbiological testing and the application of the varnish following professional scaling was located at tooth no. 16 disto-palatinal, at teeth no. 12 and 24 disto-buccal, at tooth no. 36 disto-lingual and at teeth no. 14 and 44 disto-vestibu-

lar in the interdental area. The test tubes were incubated according to manufacturer's advice in an incubator for 48 hours at 37°C. After incubation and drying, the number of colonies on the strips was counted by means of a magnifying glass. The number of colony forming units was determined (CFU) according to Twentmann *et al.*²¹. The results of this evaluation were split into four scores:

- 0: no CFU
- 1: 1–10 CFU
- 2: 11–100 CFU
- 3: more than 100 CFU

In order to examine the efficacy of the locally applied varnish, a chlorhexidine-varnish (40 per cent) was used according to the following formula²²:

Chlorhexidin.acet.:	1.60g
Ethanol 96 per cent:	1.08g
Sandarac 2-fold ger:	1.32g
2 OP to:	4.00g

As a placebo, a chlorhexidine-free varnish with identical basis-composition was mixed according to the following prescription:

Ethanol 96 per cent:	1.88g
Sandarac 2-fold ger:	2.12g
2 OP to:	4.00g

After scaling, polishing and drying the teeth with cotton wool-rolls, the varnish was applied in the marked area of the Ramfjord teeth with non-recyclable-brushes. One

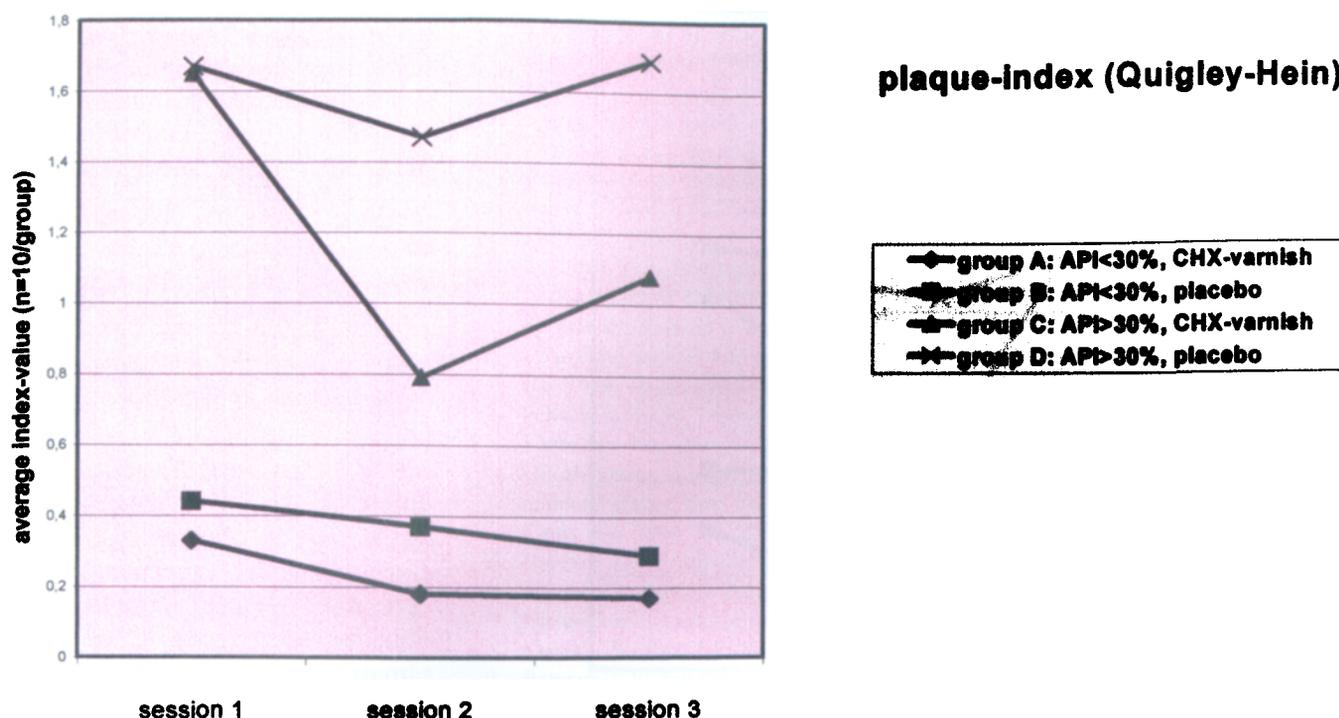


Figure 1. Effects of a CHX varnish on individuals with good and poor oral hygiene. CHX application significantly decreases plaque values in volunteers with poor oral hygiene.

new brush was used for each tooth-surface.

The second and third session took place at intervals of 2 and 6 weeks after the beginning of the trial (Table 2). The microbiological test was repeated as well as the recording of the SBI and the plaque-index according to Quigley and Hein¹⁸.

For statistical analysis of the plaque-index and sulcus-bleeding-index, values were analysed by means of a non-parametric test (Wilcoxon rank sum test). To evaluate differences between colony forming units (CFU) measured at the three sessions, values were analysed statistically using the χ square test. Differences were considered as statistically significant at $P=0.05$.

Results

Basic data

The highest CPITN scores and the average DMF-T values of the groups with good oral hygiene (A and B) were below the results of

the groups with insufficient oral hygiene (C and D) (Table 1). Concerning average age, the maximum CPITN scores and mean DMF-T scores showed no differences between test and control groups (A versus B/C versus D).

Within the scope of the statistical evaluation, for all parameters, no significant sex-specific differences could be determined. Therefore, no sex-specific statistics were required.

Plaque-index (Quigley and Hein)

Within the 6 weeks of examination the test-groups with good oral hygiene showed stable, low level index-values. The values of the subjects with insufficient oral hygiene differed significantly from each other. In the first session, the index-value of both groups was approximately 1.7. In the placebo-group no extensive change of the index-value occurred. However, after the application of chlorhexidine in the test-group, the index-value decreased significantly to 0.8 and rose to approximately 1.1

within the next four weeks. At the end of the trial, a considerable difference existed between the placebo-group and the chlorhexidine-test-group (Figure 1).

Sulcus-bleeding-index (SBI)

In the two groups with good oral hygiene, the determined index-values remained stable and low. After application of chlorhexidine, more favourable values emerged. It became apparent that two weeks after the CHX application, the SBI of the groups with insufficient oral hygiene decreased to that of the control groups. In the following four weeks of the examination the value ascended slowly again. Although the values of the placebo-group with unsatisfactory oral hygiene were lower than that of the test-group at the beginning of the test, these values remain consistently high (Figure 2).

The Dentocult® SM test

In the groups with good oral hygiene, no major changes in the

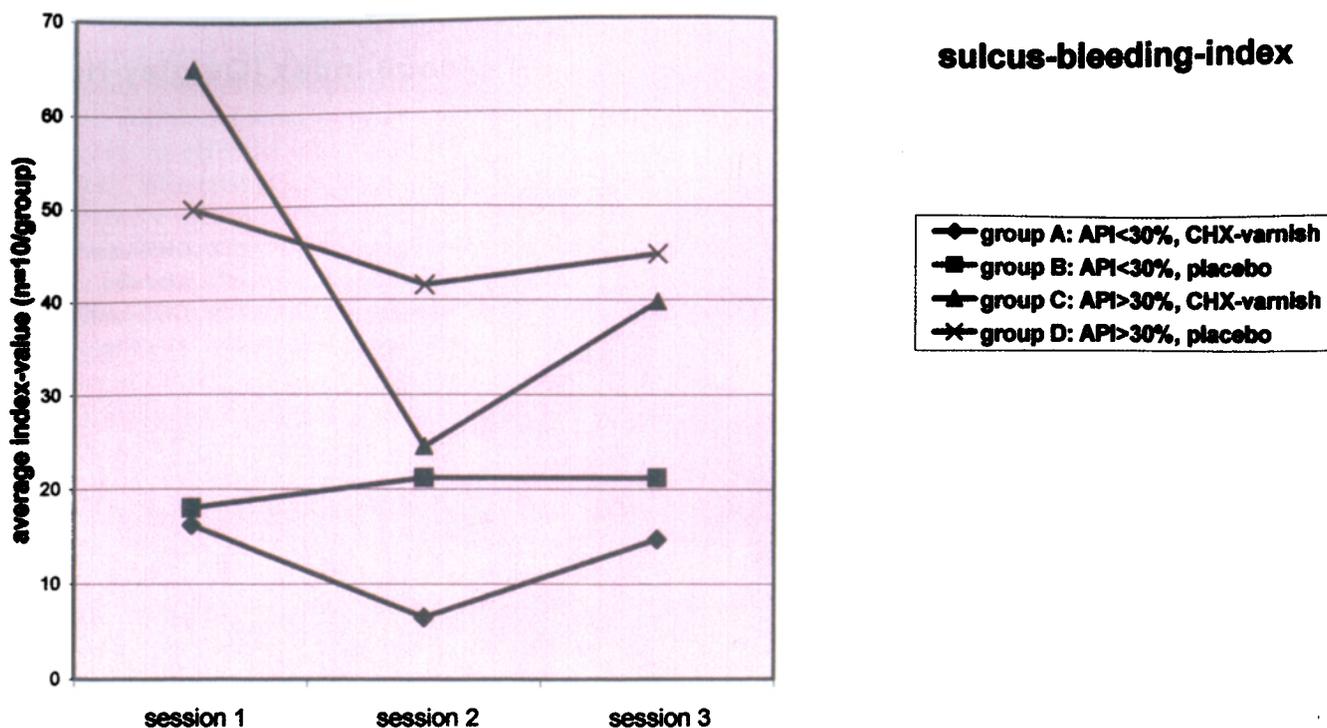


Figure 2. Effects of a CHX varnish on the sulcus-bleeding index. A considerable decrease was noted in group C, while group A displayed only a minor decrease.

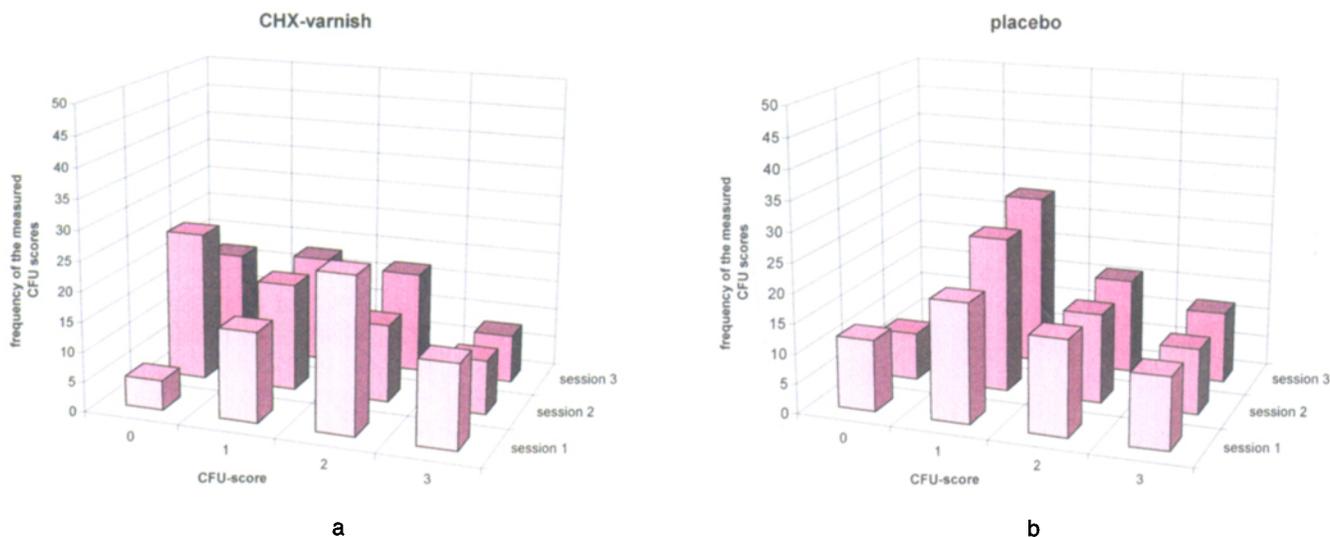


Figure 3. Distribution of CFU scores in group C (a) and group D (b). CHX application reduced the frequency of high CFU scores. As a control, no changes were observed in the placebo-group.

distribution of the CFU-scores were apparent from one session to another. On the whole, the results in the placebo-group remained the same. After application of the chlorhexidine-varnish in the group of volunteers with unsatisfactory oral hygiene (C), a clear shift to more favorable values was observed. The results of the placebo-group (D) remained mostly unchanged

(Figures 3a and 3b). Side-effects of the application of CHX-varnish were not reported by the participants in this study.

Discussion

The evaluation of the results showed that in subjects with low plaque-accumulation the plaque-index could only be slightly

lowered following the application of CHX. In the test-group with high plaque-accumulation, which underwent CHX application, a considerable reduction of the plaque-index was determined. In the course of the experiment, the antimicrobial effect of the chlorhexidine varnish decreased according to records of Twetman *et al.*²³.

The results from this study confirm that the application of a chlorhexidine-varnish under clinical conditions in patients with low plaque-accumulation, i.e. with good dental hygiene, is not required in the repertoire of preventive measures. However, in patients with high plaque-accumulation, the application of a chlorhexidine-varnish is a very effective method to reduce the main risk-factor for the emergence of caries³. Since this reduction of plaque can be maintained over a time period of six weeks at least, the described procedure could successfully be used within the framework of prophylaxis programmes with high-risk-patients². For long-term reduction of *S. mutans* levels a recall system is needed to repeat the varnish application. Therefore, compliance is required primarily to reduce the caries incidence of high-risk subjects²⁴.

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