The effect of chlorhexidine supplementation in a periodontal dressing

Salah Othman, Ellen Haugen and Per Gjermo
Department of Periodontology, Dental Faculty, University of Oslo, Oslo, Norway

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Most commercial periodontal dressings claiming antibacterial activity lose this activity shortly after application. Chlorhexidine (CH) is an antibacterial agent with long-term activity in the oral cavity owing to its substantiveness and slow-release properties. In a double-blind split-mouth-designed clinical trial the effect of incorporating CH acetate in periodontal dressing was tested on wound healing after gingivectomy. Eleven patients, each needing at least two gingivectomies, constituted the test panel. Wound healing, as assessed by bleeding tendency after removal of dressing 7 days postoperatively was significantly delayed when control dressings were applied as compared with test dressings. Variables with regard to patient comfort also yielded results in favor of the test pack. Incorporation of antibacterial agents with high retention and slow release properties in the mouth in surgical dressings seems advantageous. □ *Antibacterial agents; clinical trial; wound healing*

Per Gjermo, Department of Periodontology, Dental Faculty, University of Oslo, Geitmyrsvn. 71, 0445 Oslo 4, Norway

The assumption that mechanical, thermal, chemical, and microbial influences are unavoidable in the oral cavity in man has initiated the use of periodontal wound dressings after periodontal surgery. Such dressings have been applied to reduce patient discomfort and to protect the wound from mechanical injury during the first phases of healing (1, 2) and to hold a flap in position after suturing or to immobilize a gingival graft by diminishing the pull from the cheek and lip (3). Furthermore, it has been claimed that periodontal dressings protect the healing wounds from saliva, prevent formation of granulation tissue, control hemorrhage, and inhibit bacterial growth on the wound surface (4). Whereas a close adaptation of the periodontal dressing to the wound surface is considered to contribute to optimal healing conditions (5–7), most studies have focused on bacterial products as the main reason for delayed healing and discomfort after periodontal surgery (8–12). Thus several commercial periodontal packs have been marketed with the emphasis on their antibacterial properties. However, it seems that in most cases this antibacterial activity is of short duration when the dressings are exposed to water or saliva (12).

Therefore, several attempts have been made to incorporate antimicrobial drugs with a high substantiveness, such as chlorhexidine (CH), in experimental dressings (10), in commercial packs (11), or in additional mouth rinses (11, 13), all with a certain success.

In a clinical trial comparing three commercially available periodontal dressings Haugen & Gjermo (14) concluded that Coe-pak® seems to possess good physical properties and show good initial antibacterial activity against salivary bacteria in vitro but that this activity was lost after 24 h in water. The effect of CH as a plaque inhibitor has been ascribed to its ability to be retained in the oral cavity and to be released slowly over an extended period of time, thus creating a bacteriostatic milieu in the mouth (15–17). If these properties of the drug can be maintained in a periodontal dressing of good physical quality, the wound healing might be improved.

The purpose of the present study was to test the hypothesis that incorporation of CH in the dressing would promote the healing of gingivectomy wounds as compared with dressing without any additions and would also reduce postoperative discomfort.

Materials and methods

Clinical procedures

Eleven patients, each needing gingivectomies in at least two contralateral segments of the mouth, volunteered for the study. The panel consisted of 4 men and 7 women ranging from 33 to 65 years of age, with a mean age of 47 years. All operations were performed by undergraduate dental students under surveillance of clinical teachers other than the authors.

Independent variables

As a standard periodontal dressing Coe-pak® (Coe Laboratorium, Inc., Chicago, Ill., USA) was used. The test dressing was Coe-pak with added CH acetate powder (0.8% w/w). Each patient had one surgical site with the test and one with the standard pack. The packs were left in place for 1 week after surgery. There was an interval of at least 3 weeks between the two operations. Both packs were applied in a randomized sequence, which was unknown both to the operator and to the patient and the examiner.

Dependent variables

Degree of healing. The degree of healing was operationalized as percentage bleeding units of all units tested in each patient after a blast of air only (standardized pressure (2 kg) and distance from tissue surface (10 mm)) and after standardized probing applying a force of 14 *g* with a probe (Dontrix, E.T.M. Corp., Monrovia, Calif., USA) designed for measurement of orthodontic forces (10, 14). The mesial, buccal, and distal aspects of all teeth in the operated areas were regarded as observational units and tested for bleeding as described immediately after removal of the pack. Thus the number of observational units behind each analytical unit varied from 3 to 12.

State of the pack. The state of the pack was assessed before removal as acceptable, with cracks, loose, or fully or partly lost. When removed, the pack was judged for evidence of foul scent.

Information about subjective symptoms with regard to pain, swelling, and fever was collected by interviewing the patients. The degree of postoperative pain was operationalized by recording the number of analgesic tablets used. All patients received eight tablets (Paralgin forte®, Weifa Farmasøytiske A/S, Norway) immediately after surgery for use when needed. They were instructed to return those not used. In addition, the time the tablets were taken was recorded, to estimate the most frequent time lapse between the operation and the occurrence of pain.

Laboratory procedures

To test the antibacterial activity of CH when incorporated in the periodontal dressing, two control experiments were performed.

Control experiment 1. Standard and test dressings were prepared as described by the manufacturers, and portions of 180 mg were placed in sterile plastic syringes (2.5 ml). Circular thin discs with standardized diameter (8 mm) were produced by pressing the dressing material through the syringe against a flat surface (12).

The specimens were stored in distilled water, which was changed every 24 h.

Blood agar in Petri dishes was flooded with 0.5 ml whole saliva in 5 ml 1% glucose broth, and excess fluid drained off. The specimens were placed on the dishes after 1, 2, 3, 4, 5, and 6 days in distilled water and incubated for 48 h at 37°C. Freshly made specimens from test and standard dressing were placed in the center of each plate (Fig. 1).

The antibacterial activity of the specimens was assessed by recording presence or absence of a zone of inhibition of bacterial growth adjacent to the specimens.

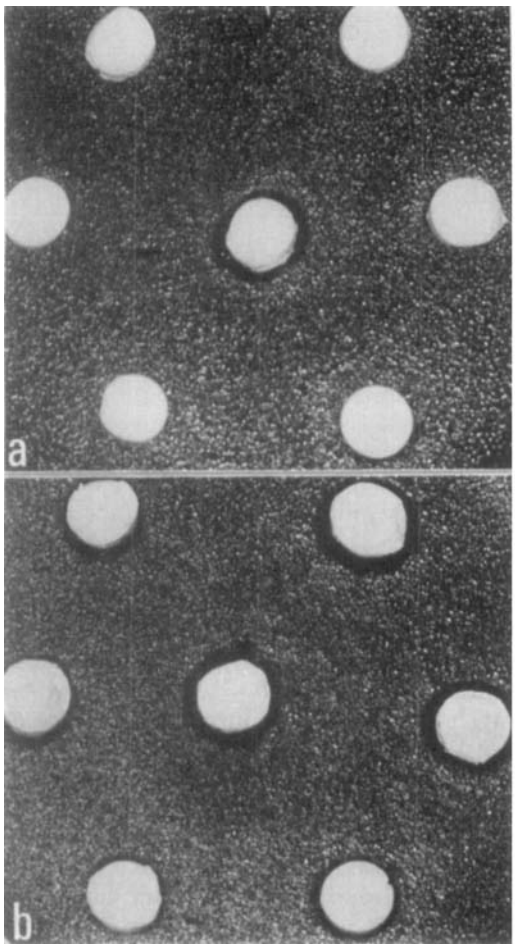

Fig. 1. Freshly made specimens from standard (a) and test (b) dressings were placed in the center of each plate, and after 1, 2, 3, 4, 5, and 6 days in distilled water the specimens were distributed in a clockwise direction, starting from the upper midpoint of the plate. Inhibition of bacterial growth is seen only around the freshly made specimen of standard dressing (a). Inhibition is evident also around test specimens that had been stored in water up to 6 days (b).

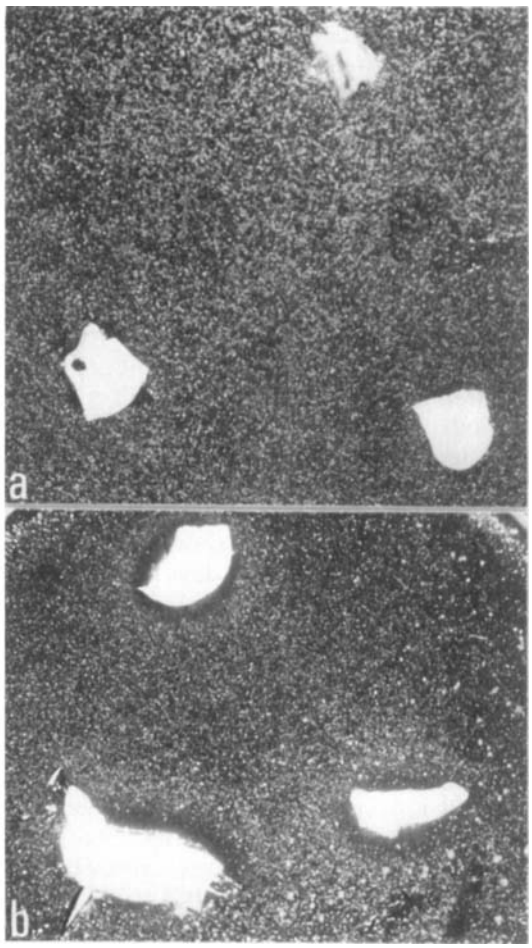

Fig. 2. After 4 days in the mouth pieces of dressing material were collected from the patients. No inhibition zone can be seen around the standard dressing (a). Around the test dressing inhibition of growth is evident (b).

Control experiment 2. Pieces of the dressing material were also collected from the patients after 4 and 7 days in the mouth, and the antibacterial activity assessed as described above (Fig. 2).

The results are shown in Table 1. Coe-pak showed a zone of inhibition only when freshly made. Antibacterial activity could not be detected after storage for 24 h in

Table 1. Presence (+) and absence (−) of antibacterial activity against salivary bacteria on blood agar of Coe-pak® and Coe-pak with added chlorhexidine (CH) (0.8% w/w) after storage in distilled water and application in the mouth

	Days in distilled water							Days in the mouth	
Dressing	0	1	2	3	4	5	6	4	7
Coe-pak	+	−	−	−	−	−	−	−	−
Coe-pak + CH	+	+	+	+	+	+	+	+	−

Table 2. Mean percentage bleeding units provoked by air blast and probing after removal of periodontal dressings ($n = 11$)

Provocation	Dressing: Coe-pak, $\bar{x}$ (SD)	Dressing: Coe-pak + CH†, $\bar{x}$ (SD)	Difference $\bar{x}$ (SD)
Air blast	6.5 (14.8)	1.0 (3.4)	5.5 (15.5)
Probing	31.9 (29.0)	7.0 (10.5)	24.9 (28.4)*

* Significantly different from zero ($p < 0.05$).
† Chlorhexidine.

distilled water. Coe-pak with added CH showed inhibition zones after all storage periods.

After 7 days in the mouth of the patients none of the dressings showed antibacterial activity in the present test system, and only the pack containing CH showed inhibition of bacterial growth after 4 days in the mouth (Table 1).

Statistical analyses

The *t* test for dependent observations was used to assess statistically significant differences in degree of wound healing and use of pain relievers. The level of significance chosen was $p < 0.05$. The strength of associations between variables was expressed by the contingency coefficient (C).

Results

Very little bleeding was observed from the operation wounds after 7 days when the only provocation was a blast of air. The difference between areas that had been covered with control and experimental wound dressings was negligible (Table 2). When a standardized pressure was applied to the wounds, on an average 31.9% of the tested units bled after the use of Coe-Pak (control), whereas bleeding occurred in 7.0% after the use of the chlorhexidine-containing test dressing (Table 2). The mean difference between test and control sites derived from the 11 test subjects appeared to be significantly different from zero ($p < 0.05$).

The incorporation of CH in the commercially available Coe-Pak did not seem to affect its physical properties. Only minor cracks were observed after 1 week, and there was no difference between test and control.

The mean number of tablets consumed after the operations was 1.8 and 1.1 for control and test dressings, respectively. The mean difference was not significantly different from zero. However, fewer patients had used tablets after the use of the test pack than after the use of the control pack. Moreover, those using pain relievers after the test pack used them on the day of operation only, in contrast to those using tablets after Coe-pak without CH. Subjective reports from the patients showed that eight of them had experienced pain after the control dressing, whereas the corresponding figure after the test pack was four.

Foul scent was recorded for 8 of a total of 11 control packs at time of removal. Similar findings were recorded for only two of the test packs. Foul scent from the surgical pack on removal after 7 days in the mouth and reported postoperative pain during these 7 days showed significant association ($C = 0.57$, $p < 0.01$) (Table 3).

None of the patients reported incidents of postoperative swelling regardless of surgical

Table 3. Contingency table showing number of cases with reported pain after gingivectomy and observed foul scent from periodontal dressings

Foul scent	Pain: +	Pain: −	Total
+	9	1	10
−	3	9	12
Total	12	10	22

Coefficient C = 0.57.

pack used. After the use of the control pack one patient experienced spontaneous postoperative bleeding, and another had a slight and transient increase in body temperature.

Discussion

Since several conditions, including bacterial colonization of periodontal surgical wounds and packs, have been implicated in delayed healing (8, 9, 11, 12) and patient discomfort (18), antibacterial activity against oral bacteria of the wound dressings would be expected to counteract these effects. However, most periodontal dressings claiming such activity lose the activity after a short time in the mouth (12) and thus enable unfavorable conditions to develop during the early phases of healing.

In the present study an antibacterial agent with a well-established substantiveness and slow-release property in the oral cavity was added to the experimental dressing with the intention of extending the duration of its antibacterial activity. The in vitro control experiments indicated that this was possible but also showed that the antibacterial activity was more rapidly lost in the mouth than when stored in water under laboratory conditions.

The weight of the periodontal pack used to cover the wounds in the present study varied from 2 to 5 g. The corresponding amount of chlorhexidine applied in each pack ranged from 16 to 40 mg. In a standard mouth-rinsing of 10 ml 0.2% aqueous solution, 20 mg is applied. Accordingly, the concentration in the pack (0.8% w/w) seems to be moderate, since it is regarded as a depot supposed to last for several days.

Assuming that the tendency of the wound to bleed on provocation reflects the degree of healing, the results from the in vivo study indicated that healing was more rapid when CH was added to the pack and also that the occurrence of postoperative discomfort was reduced. Thus the test hypothesis was supported. However, using a gentle blast of air seemed to be too weak a provocation of 7-day-old wounds.

When the degree of pain experienced was quantitated by the number of tablets consumed, no difference was observed between the groups. This may reflect a lack of linearity between experienced pain and number of tablets used or that in fact very few tablets were consumed.

Reported occurrence of pain and observed foul scent were associated, and both have been regarded as a consequence of accumulation of bacteria (19). However, pain and foul scent occurred also in some of the experimental cases. One explanation might be that most of the CH is lost, and the antibacterial activity of the pack strongly reduced during the last few days of the study period.

In concord with previous studies (11, 12, 14) we may conclude that bacterial growth on gingivectomy wounds and/or packs delays healing and increases patient discomfort. Furthermore, the present study indicates that these effects may be counteracted if an extended duration of the antibacterial activity of the periodontal dressing can be obtained.

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