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ORIGINAL ARTICLE

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Topical application of 1% chlorhexidine gel versus 0.2% mouthwash in the treatment of peri-implant mucositis. An observational study

Abstract: *Objective:* The aim of this study was to compare the use of two chlorhexidine-based antimicrobial agents as an adjunct to mechanical therapy for the treatment of peri-implant mucositis. *Materials and methods:* Thirty patients with peri-implant mucositis were included in the study and randomized in two groups. In addition to mechanical therapy, group A was treated with chlorhexidine 0.2% mouthwash, while group B was treated with chlorhexidine 1% gel. Probing depth, plaque index and bleeding index were recorded at each scheduled follow-up visit: ten days, 1 month and 3 months after giving the patients the assigned formulation. Patients had to fill in a questionnaire investigating their satisfaction and ease of use of the product. *Results:* A total of 23 patients (13 in group A and 10 in group B) attended all the follow-up visits. Chlorhexidine 0.2% mouthwash and chlorhexidine 1% gel were equally useful in the treatment of peri-implant mucositis leading to the reduction in inflammatory parameters. Probing depth decreased over time in both groups. Patients showed preference for gel formulation even if they found it more difficult to use. *Conclusions:* Adjunctive treatment with different chlorhexidine formulations was beneficial to the treatment of peri-implant mucositis. Besides, no differences could be found between 0.2% mouthwash and 1% gel.

Key words: bleeding index; chlorhexidine gel; chlorhexidine mouthwashes; peri-implant mucositis; plaque index

Introduction

Implant-supported rehabilitations are considered a viable treatment option for partial or complete maxillary or mandibular edentulism, and this is supported also by long-term studies (1–3). However, implant failure can compromise the success of rehabilitation.

Implant failures are divided into early failures, which follow the surgical intervention and which are usually caused by post-surgical early infections (4, 5), and late failures, which are caused either by an excessive occlusal overload (6, 7) or by peri-implant late infections caused by plaque accumulation (4).

Peri-implant mucositis is the reversible infection of marginal tissues without bone loss and is characterized by bleeding and signs of inflammation localized at the peri-implant soft tissues (8). Non-treated peri-implant

mucositis can evolve in irreversible peri-implantitis that causes marginal bone loss and implant mobility and failure (8).

Peri-implant infections are caused by bacterial plaque accumulation around implant–abutment structure, which generates an inflammatory response by surrounding tissues (8).

While there is still no gold standard treatment for peri-implantitis, scientific literature did not demonstrate clearly the success of any treatment option for peri-implantitis (9, 10), many studies have shown that non-surgical treatment, with or without the aid of antimicrobial agents, can successfully heal peri-implant mucositis (11, 12).

Chlorhexidine (CHX) is the most used agent in chemical plaque control and is effective in reducing plaque accumulation because of its bactericidal and bacteriostatic activity (13–16). Chlorhexidine has shown an antibacterial activity against both gram-positive and gram-negative bacteria, and it is particularly suitable for the treatment and prevention of oral infections because of its substantivity (14).

Several studies described the use of CHX as an adjunctive treatment for peri-implant mucositis and peri-implantitis (12, 17–19). In these studies, 0.12% CHX was used for local irrigation and for twice a day rinses over ten days in one study (12), 0.06% CHX and 0.12% CHX were used for irrigations in one study (17), while 1% CHX gel was tested in two studies, comparing it to minocycline (18, 19).

The aim of this study was to compare the use of CHX gel 1% and CHX 0.2% mouthwash for the treatment of peri-implant mucositis.

Study population and methodology

The study protocol was approved by the Research Committee of the Centre of Research of Oral Health of the University of Milan. This study was conducted following the principles embodied in the Helsinki Declaration of 1975 for biomedical research involving human subjects as revised in 2000 (20). All patients were informed about the study protocol and signed an informed consent form before beginning the study.

Sample size and randomization

Patients were selected from those attending the Dental Clinic of the IRCCS Istituto Ortopedico Galeazzi in Milan. All patients had a full-arch reconstruction supported by four implants placed in intraforaminal region in the mandible or in anterior maxilla with distal cantilever extensions. All prostheses were resin made, with a titanium structure, and were screwed to implant abutments.

Inclusion criteria for the study were as follows:

1 Bleeding on probing or spontaneous bleeding with local swelling [code 1, 2 or 3 as described in previously published report (21)]: 0) no bleeding; 1) bleeding on probing without redness and swelling; 2) bleeding on probing, redness and swelling; and 3) spontaneous bleeding.

2 Plaque accumulation at the implant–abutment level [code 1, 2 or 3 as described in previously published report (21)]: 0) no plaque accumulation; 1) plaque accumulation only detectable using a probe; 2) moderate accumulation of visible plaque/calculus; 3) high accumulation of visible plaque/calculus.

3 Peri-implant bone resorption <3 mm evaluated through the use of periapical radiographs.

Exclusion criteria were as follows:

1 Antibiotic treatment within 6 months before the beginning of the study.

2 Topical antimicrobial treatment within 4 weeks before the beginning of the study.

3 Presence of active infection with suppuration.

4 Presence of peri-implant bone loss $\geq$3 mm (calculated since definitive prosthesis placement) evaluated through the use of periapical radiographs with individualized holder.

5 Uncontrolled diabetes mellitus.

Based on sample size calculation, it was decided to include a total of 30 implants in 30 patients. If one patient had more than one implant affected by peri-implant mucositis, only one site randomly chosen was considered for the study.

Through computer-aided randomization, patients were assigned to two groups of same size:

1 Treatment group A: CHX 1% gel twice a day for 10 days.

2 Treatment group B: CHX 0.2% mouthwash twice a day for 10 days.

Several parameters were balanced by the use of computer worksheets that were programmed *ad hoc*, between the two groups: patient's age; patient's gender; presence/absence of diabetes mellitus; number of smokers; smoking (number of cigarettes a day); alcohol consumption (number of glasses a day); absence/presence of periodontitis; full-mouth bleeding score (FMBS%); and full-mouth plaque score (FMPS%).

Treatment protocols and timing

After the inclusion in the study and assignment, baseline data were recorded. Professional oral hygiene was performed by a single experienced dental hygienist for all patients. A periapical radiograph was taken by a medical operator to assess marginal bone resorption. After giving oral hygiene instructions, an external operator gave to the patient the assigned product with an anonymous packaging:

1 Group A: CHX 0.2% mouthwash (Curasept^{TM}; Curaden Healthcare srl, Saronno, Italy) with antidiscoloration system (ADS).

2 Group B: CHX 1% gel with tips for self-administration in the pockets (Curasept^{TM}) with ADS.

Patients were instructed to use the assigned products twice a day for ten days. One-minute mouthwash with 10 ml of chlorhexidine 0.2% was recommended to patients belonging to group A. Patients were also advised not to modify their usual oral hygiene manoeuvres during the test period.

Control visits were scheduled at 10 days, at 1 month and after 3 months from the beginning of the study. At each visit, clinical parameters were recorded.

Parameters evaluation

1 Plaque index (21).
2 Bleeding index (21).
3 Probing depth was measured with a plastic probe (Periowise®; Premier Products Co., Plymouth Meeting, PA, USA) and with a force not exceeding 0.25 N (22, 23). One experienced operator performed all measurements (author FDS). The calibration was made through comparison between repeated measures by the same and other operators being made before the beginning of the study.
4 Presence of suppuration.
5 Patient's perception regarding ease in using the given product (Visual Analogue Scale (VAS) for which 0 = easy and 10 = maximum difficulty).
6 Patient's general appreciation of the product (VAS scale for which 0 = not appreciated and 10 = maximum appreciation).
7 Presence of discoloration or pigmentation of teeth or prosthetic surfaces.

Statistical analysis

A frequency table was prepared for a descriptive analysis of results regarding bleeding and plaque indexes. Fisher's exact test was used to analyse differences between the two groups and between different time frames.

Student's *t*-test was used to evaluate differences in probing depth between groups and between different follow-up visits.

A significance threshold of $P = 0.05$ was considered for both tests to accept or refuse the null hypothesis that both products were equally useful in the treatment of peri-implant mucositis.

Results

A total of 30 patients were initially included in the study. Seven dropouts were recorded and a total of 23 patients attended the last follow-up visit, 13 in group A and 10 in group B. Patient's mean age was 62.3 ± 9.9 standard deviation (SD) years (range, 43–87), and 15 were females, while 8 patients were males. Eight patients were moderate smokers (<10 cigarettes a day), while four were former smokers. None of the patients suffered from diabetes. No significant differences between group A and group B at baseline were found regarding mean age, gender, smoking status, concomitant periodontitis and alcohol consumption (Table 1).

Figure 1 shows one patient treated with CHX mouthwashes, while Fig. 2 shows one patient treated with CHX gel application.

Plaque and bleeding index evaluation outcomes, at baseline and in follow-up visits, were presented in Tables 2 and 3.

At baseline, plaque index was generally high, not significantly different between the two groups ($P = 0.097$). After ten days, a significant reduction in plaque index was observed in both groups ($P = 0.004$ for group A and $P = 0.008$ for group B). In this visit, more than 50% of the sites in both groups had no plaque accumulation and another 30% had only small deposits (code 1). After 1 month and 3 months from baseline, no further significant reduction in plaque accumulation was observed if compared with the first follow-up visit. No significant difference could be observed between the two groups at baseline and after 10 days. In the last two follow-up visits, plaque accumulation was significantly different between the two groups (with less plaque accumulation in group B) with a relatively high level of significance ($P = 0.039$ at 1 month and $P = 0.028$ at 3 months).

Table 1. **Baseline sample characteristics**

Characteristic	Group A *n* = 13	Group B *n* = 10	Total *n* = 23	Difference
Gender (M/F)	8/5	7/3	15/8	NS
Age (Mean ± SD) (years)	65.5 ± 9	58.2 ± 10.4	62.3 ± 9.9	NS
Diabetes (*n*)	0	0	0	NS
Smokers (*n*)	4	4	8	NS
Smoking (*n* cigarettes)	6 ± 7.1	5.6 ± 4.9	5.8 ± 6.3	NS
Periodontitis	1 (mild)	0	1 (mild)	NS
Alcohol consumption (*n* glasses)	0.6 ± 0.9	0.6 ± 0.8	0.6 ± 0.8	NS
Full-mouth plaque score (%)	36 ± 16	28 ± 18	32 ± 18	NS
Full-mouth bleeding score (%)	9.6 ± 8.1	5 ± 7.1	7.5 ± 7.8	NS
Plaque index (median)	1	1	1	NS
Bleeding index (median)	1	1	1	NS
Probing depth (mm)	3.1 ± 0.2	3.1 ± 0.3	3.1 ± 0.3	NS

Bleeding index was not significantly different between the two groups in each follow-up visit ($P = 1$ at baseline, $P = 0.25$ after 10 days, $P = 0.49$ after 1 month and after 3 months). After 10 days, a significant reduction in bleeding scores was observed for both groups. In this visit, almost 70% of sites in group A and 90% of sites in group B were healed and did not show any sign of inflammation. Results remained stable also at the 1-month and 3-month follow-up visit.

Mean probing depth decreased in each visit with the exception of the last follow-up control. The decrease was statistically significant in the first time frame for group A (Fig. 3).

Patients' appreciation for the product was higher in group B [mean VAS = 5.5 ± 2.1 (SD)] than in group A (4.8 ± 2.0) without statistical significant difference ($P = 0.45$). Patients reported more difficulties in using gel formulation (3.5 ± 2.1) than mouthwashes (1.2 ± 1.6), and this difference was statistically significant ($P = 0.006$) (Fig. 4).

No complications were recorded, and no pigmentation of teeth or prosthetic surfaces was observed in the study period.

Discussion

In this study, both CHX formulations (1% gel and 0.2% mouthwashes) proved useful to decrease the inflammatory

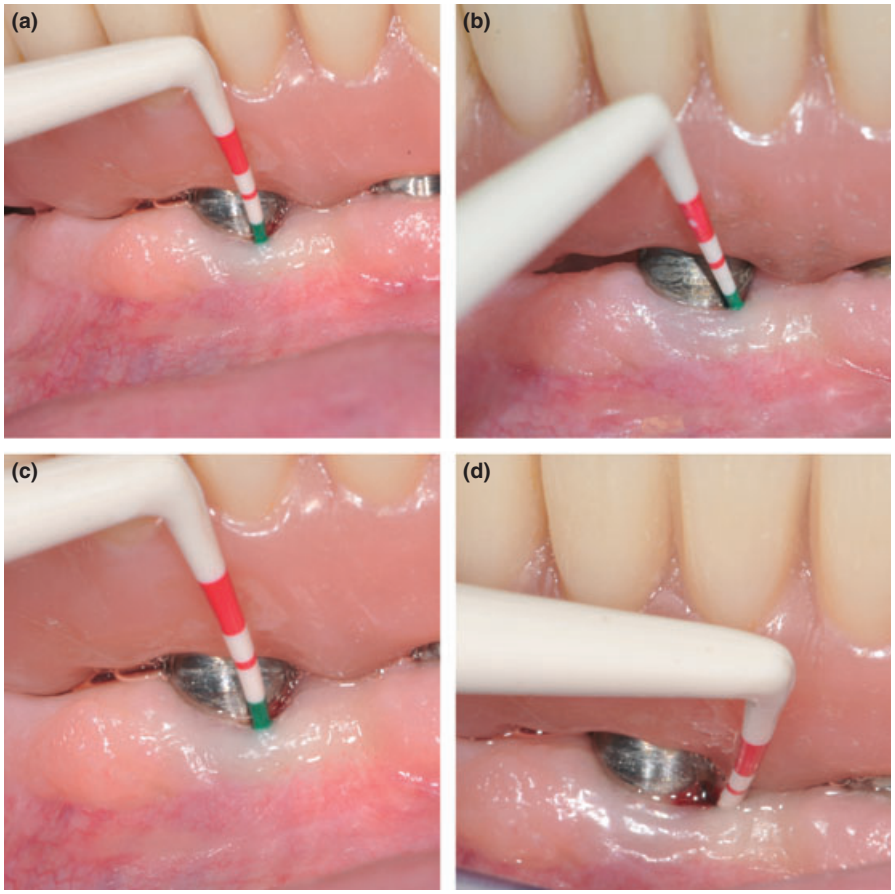

Fig. 1. Patient in Group A. (a) baseline; (b) 10 days follow-up; (c) 1 month follow-up; (d) 3 months follow-up. After 3 months probing depth changed from 2 to 4 mm.

status of peri-implant mucosa in the short term (10 days). This reduction is associated with a decrease in plaque accumulation at the abutment level in first time frame, but in the following follow-up, an increase in plaque accumulation was observed. However, this increase appeared unable to induce a significant progression of the inflammatory status in the later follow-up visits (after 1 month and after 3 months).

It was demonstrated that bacterial plaque accumulation at implant and prosthetic surfaces could cause peri-implant inflammation (8, 24–26) and several species were mainly associated to the initiation and progression of this pathology (27–29).

In a previous report, it was demonstrated that a strict implant maintenance protocol can prevent the development of peri-implantitis, and that peri-implant mucositis can be successfully treated through professional oral hygiene combined with the use of CHX as an antimicrobial agent (21). Other authors shown that CHX 1% gel can be useful in reducing the contamination of implant surfaces also in healthy sites (30).

Many studies described the use of different formulations of CHX for the treatment of peri-implant inflammation.

An experimental study on monkeys published in 2006 demonstrated that the adjunctive application of 0.2% CHX gel and 0.12% CHX mouthwash significantly reduces clinical parameters of peri-implant infection in comparison with mechanical debridement alone (31).

Irrigation with CHX was also demonstrated to be more effective than self-administration in the treatment of peri-implant mucositis, although both treatments were shown to successfully treat the disease (17).

Submucosal application with CHX 0.2% gel performed by a dental practitioner was described to be effective for the reduction in clinical parameters as gingival index and probing depth in affected implant site (32).

It has to be also reported that Porras in 2002 did not demonstrate any significant advantage in the use of 0.12% CHX gel and mouthwash as an adjunct to mechanical treatment in comparison with mechanical cleansing alone for the treatment of peri-implant mucositis (12) but this may be due to the relatively lower concentrations used.

Another recent study did not demonstrate an adjunctive beneficial effect of 0.5% CHX gel, used for one month, with respect to professional oral hygiene alone (14 patients in test group and 15 patients in control group), also reporting 38% of implants with at least one bleeding-on-probing positive site after 3 months (33). However, the authors recommended the use of CHX gel in all cases of peri-implant mucositis (33). Also, other authors did not found a significantly beneficial effect of adjunctive use of 0.12 CHX in comparison with mechanical debridement alone in 13 patients (34).

However, in the previously cited articles, the differences in concentrations used can be a major confounding factor in

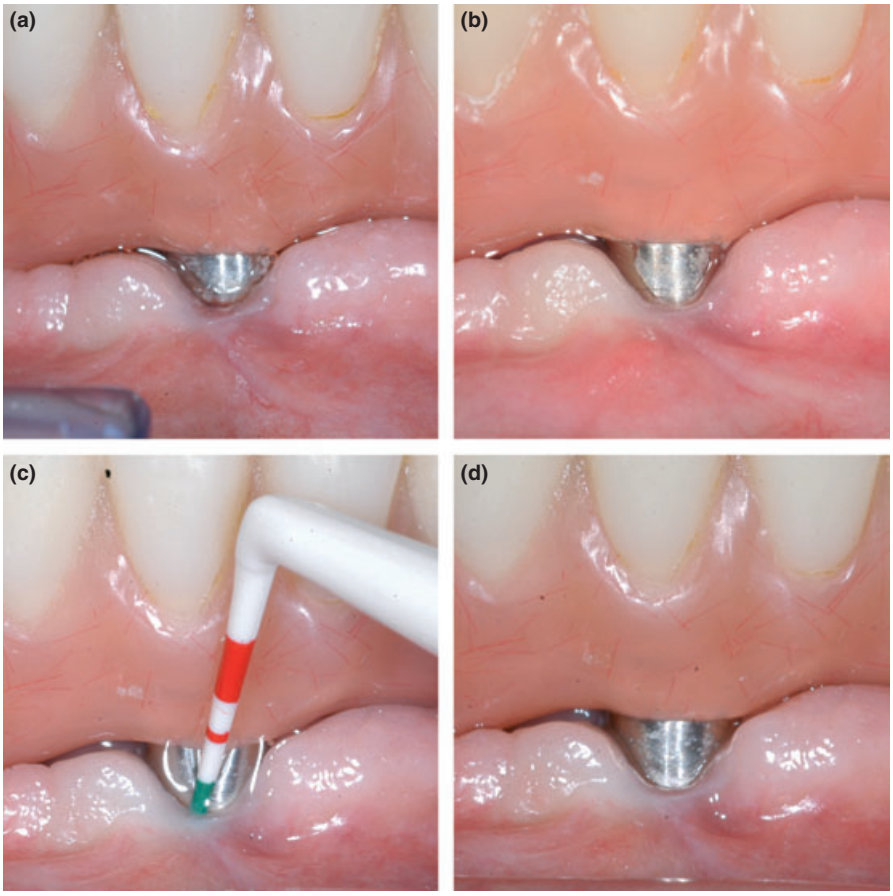

Fig. 2. Patient in Group B. (a) baseline; (b) 10 days follow-up; (c) 1 month follow-up; (d) 3 months follow-up.

Table 2. **Plaque index frequencies. In brackets the relative proportion for each value**

	Baseline		10 days		1 month		3 months	
Value	Group A (%)	Group B (%)	Group A (%)	Group B (%)	Group A (%)	Group B (%)	Group A (%)	Group B (%)
0	1 (7.6)	1 (10)	7 (53.8)	6 (60)	6 (46.1)	4 (40)	5 (38.5)	1 (10)
1	7 (53.9)	5 (50)	4 (30.8)	3 (30)	4 (30.8)	6 (60)	6 (46.1)	9 (90)
2	4 (30.8)	3 (30)	2 (15.4)	1 (10)	3 (23.1)	0 (0)	2 (15.4)	0 (0)
3	1 (7.7)	1 (10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 3. **Bleeding index frequencies. In brackets the relative proportion for each value**

	Baseline		10 days		1 month		3 months	
Value	Group A (%)	Group B (%)	Group A (%)	Group B (%)	Group A (%)	Group B (%)	Group A (%)	Group B (%)
0	0 (0)	0 (0)	9 (69.2)	9 (90)	9 (69.2)	6 (60)	9 (69.2)	6 (60)
1	13 (100)	10 (100)	4 (30.8)	1 (10)	4 (30.8)	4 (40)	4 (30.8)	4 (40)
2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
3	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

interpreting the results. The present study compared two different CHX for the treatment of peri-implant mucositis.

No statistical significant differences were found in clinical efficacy between the two tested products even if both were useful in reducing implant soft-tissue inflammation and plaque accumulation when associated with professional oral hygiene and adequate oral instructions. The differences observed for plaque index in the 1-month and 3-month follow-up could not be linked to the use of the products and did not cause differences in peri-implant mucosa inflammation. In one group, an increase in number of patients with mild local inflammation can be observed between 10 days and 1 month, even if it was

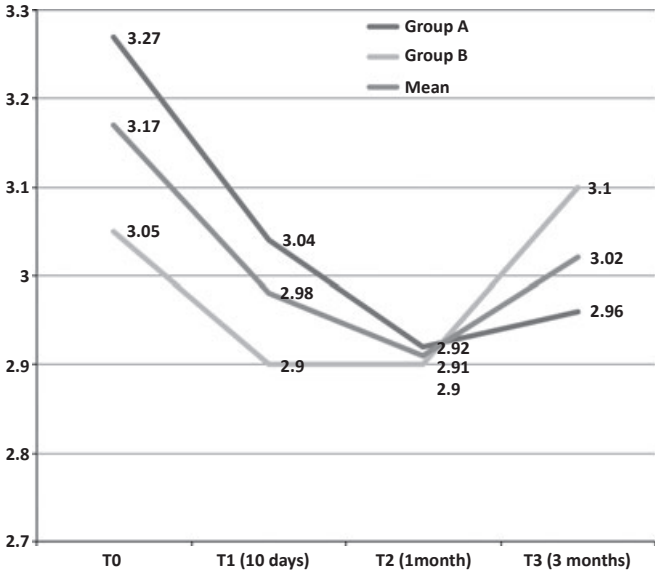

Fig. 3. Probing depth (mm).

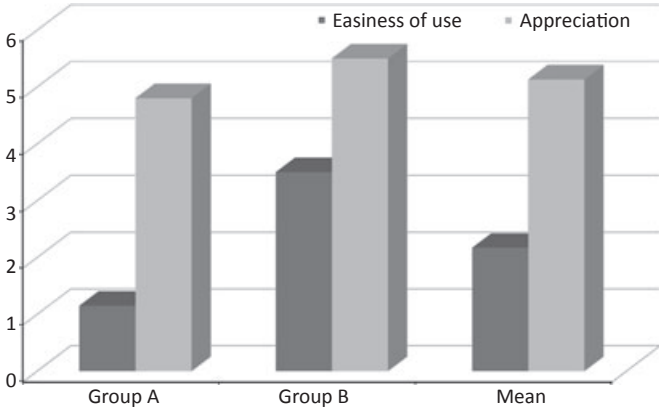

Fig. 4. Patient's appreciation of the product and patients' perception of easiness of use. The mean VAS values are indicated for each group.

not statistically significant. It can be hypothesized that this increase was attributed to oral hygiene manoeuvres. Furthermore, most of the sites with peri-implant mucositis were completely healed after 10 days and did not necessitate any further treatment.

The present short-term results (10 days and one month) can be compared with those from a recent randomized trial (33).

Probing depth decreased during the first time frame, and this is probably due to the tissue retraction while healing from an inflammation status.

As expected, patients reported that CHX use through mouthwashes was easier than CHX gel application. More interestingly, even if statistically significant, the mean difference in patients' perception of ease of use, calculated through the VAS, was low (1.1 ± 1.6 for group A and 3.5 ± 2 for group B on a scale of 10) showing that the use of a tip may facilitate gel application. Patients referred to prefer gel if compared to mouthwashes considering the general satisfaction index, although this difference was not statistically significant. This is probably due to the fact that gel application could be located essentially to the site with inflammation and, consequently, taste alteration caused by CHX is limited.

Some limitations could be highlighted in this study. First, the absence of a negative control did not allow an evaluation of the adjunctive effect of antimicrobial treatment. Then, therapeutic concentrations of CHX could have masked the difference between the two formulations, both equally useful in the treatment of peri-implant mucositis. Finally, in spite of the limited observation time, a nearly 20% dropout was recorded, reducing the power of the statistical analysis.

Conclusion

Despite the limitations of the study, this report shows that peri-implant mucositis can be successfully treated with mechanical therapy in association with the use of CHX as an antimicrobial agent. The use of CHX 1% gel can be effective because it can be limited to the affected site and self-administered by the patients if provided with adequate tips.

Further randomized clinical trials with larger sample size and a negative control group can be useful to discriminate the effect of CHX in the treatment of peri-implant disease.

Conflict of interest

All authors declare no financial support. Curaden Healthcare Srl, Saronno, Italy, provided the products for the study.

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