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ORIGINAL ARTICLE

Pain and morbidity after non-surgical and surgical treatment of peri-implantitis

Thomas Åge Norum, Anne Merete Aass and Odd Carsten Koldsland

Department of Periodontology, Faculty of Dentistry, Institute of Clinical Dentistry, University of Oslo, Oslo, Norway

ABSTRACT

Objective: Not much information exists on post-treatment pain related to peri-implantitis. The purpose of this study was to evaluate intensity and quality of pain after non-surgical and surgical treatment of peri-implantitis.

Material and methods: A total of 30 patients with a diagnosis of peri-implantitis were included in the study. The patients registered pain using a VAS scale after non-surgical and surgical treatment of peri-implantitis. The data were registered for one week after each treatment. The patients also recorded quality of pain and if analgesics were taken. Factors included in the study were number of implants, severity of peri-implantitis (millimetre bone loss at most severely affected implant), implant localization, smoking and gender.

Results: Statistically significant difference in intensity of pain was found between day zero and day one for both non-surgical and surgical treatment of peri-implantitis ($p < .05$). Number of implants, severity of peri-implantitis, implant localization, smoking and gender were not statistically significant related to intensity of pain post-treatment. The most frequently reported quality of pain was throbbing/soreness and numbness for both non-surgical and surgical treatment.

Conclusion: Levels of pain are found to be low to moderate for most patients after treatment of peri-implantitis. The pain was most pronounced on the first two days post-treatment. Throbbing/soreness and numbness were the most frequently reported quality of pain.

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Introduction

Pain is often considered a feature caused by tissue damage or pathophysiological reasons. However, pain is a complex phenomenon and is influenced by psychological, physiological, cultural and social components [1,p.210,2,p.11,3,p.22–50]. The international Association for the Study of Pain (IASP) has made the following definition: 'An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage'. This implies that pain is subjective and independent of the underlying illness and possibly is a result of tissue damage [1,p.210]. The definition was supported by McCaffery and was originally proposed in 1968: 'Pain is whatever the experiencing person say it is, existing whenever the experiencing person says it does' [4,p.7]. Thus, it seems impossible for health team members to accurately know how much pain a patient might experience, and adequate communication and consideration of the patients' needs is therefore of great importance [3,p.22–50,5,p.6–8].

Pain can be classified in many different ways. Measuring pain is useful because it provides information on how patients feel and it increases the understanding of what to expect after treatment. Assessment of pain can contribute to more information about the aetiology and make it easier for both patient and operator to handle the pain [3,p.22-50].

There are different tools for identifying pain systematically, and the methods can be divided into one-dimensional and multidimensional scales. A one-dimensional tool usually measures the intensity of pain and morbidity, while a multidimensional tool measure different aspects of the patients experience of the treatment, for example quality of life, sleeping, functionality, etc. Tools most often used in identification of pain intensity are the visual analogue scale (VAS), the numeric rating scale (NRS) and the verbal rating scale (VRS) [6,p.51–69]. Peri-implant disease itself is usually asymptomatic, but patients are often affected by discomfort during probing and treatment, and some will also experience pain after treatment [7]. Clinicians have experienced that the level of pain and discomfort can differ dramatically between patients.

Dental implant treatment has become an accepted treatment option in patients having lost one or more teeth. As a result of this, more implant related infections occur. Peri-implantitis was defined as an inflammatory reaction associated with loss of bone around a functioning implant [8]. Data from publications have shown a prevalence of peri-implantitis about 20% at patient level and approximately 10% at implant level [9,10]. It is recommended that non-surgical treatment precede surgical peri-implantitis treatment [11].

There is currently no information or literature on post-operative pain and discomfort caused by treatment of

CONTACT Thomas Åge Norum thnorum@gmail.com Department of Periodontology, Institute of Clinical Dentistry, Faculty of Dentistry, University of Oslo, Postboks 1142, Blindern, Oslo 0318, Norway

peri-implantitis. However, several studies have evaluated patients' experience after treatment of periodontitis and post-operative pain related to the use of local anaesthesia, periodontal dressings, analgesia, duration and type of surgery, healing and postoperative morbidity [12–20].

Improved knowledge of pain and discomfort after peri-implant treatment will provide patients and operators with valuable information. The aim of the present study was to register experience of pain (intensity and quality) related to non-surgical and surgical treatment of peri-implantitis.

Material and methods

This trial was part of a clinical study, approved by the Regional Committee for Research Ethics (2012/2257). All the participants were given written information about the trial and signed an informed consent. The treatments were performed at the Department of Periodontology, Faculty of Dentistry, University of Oslo. Data collection took place between November 2012 and May 2015 [21]. The diagnosis of peri-implantitis was based on the consensus from the VIII European Workshop on Periodontology; changes in the level of crestal bone, the presence of BoP and/or suppuration; with or without concomitant deepening of PPD [22,23]. Hence, only implants with baseline radiographs available to assure progressive bone loss (PBL) $\geq$2.0 mm (mesial and/or distal site) and BoP/suppuration registered at the same site/sites were considered for inclusion [21].

Thirty patients registered pain and filled out a VAS scale after both non-surgical and surgical treatment of peri-implantitis. The recordings started on the day of the non-surgical treatment (day zero) and ended seven days after the surgical treatment, 14 days in total (Figure 1). The patients were asked to do the registrations in the evening directly before bedtime. The treatments were performed between 09.00 am and 16.00 pm. Patients were also asked to give information about the quality of pain and if analgesics were taken post treatment. The patients were given ibuprofen (400mg $\times$ 2) and paracetamol (500mg $\times$ 2) post-surgery. For ethical reasons, there was no fixed regimen for analgesics, and the patients used analgesics according to their own needs. If analgesics were taken, brand and dosage were recorded. The factors assessed in this study were severity of peri-implantitis (millimeter bone loss at most severely affected implant), implant localizations (maxilla/mandible), number of implants treated, smoking and gender.

Study population

The study population is described in detail previously [21]. The inclusion criteria were peri-implantitis with bone loss exceeding 2 mm and inflammation at one or several dental implants. The exclusion criteria were acute conditions of gingivitis and periodontitis, medical reasons and/or insufficient oral hygiene (total plaque score $\geq$20%) [24]. All subjects included were interviewed concerning their health and oral hygiene routines [21]. A total of 116 implants treated for peri-implantitis were included in the study. The patients were grouped according to number of implants treated; 1–2 implants, 3–4 implants or 5–7 implants. They were also grouped and analysed according to bone loss at the most severely affected implant. Group one included patients with a severity of 2.1–8.0 mm bone loss at implants and group two included patients with a severity of 8.1–13.0 mm bone loss.

Study outline is described in Figure 1.

Assessment and non-surgical treatment

Prior to treatment, clinical measurements were recorded and standardized intra-oral radiographs were obtained. Supraconstructions were removed if possible, and cleaned in an ultrasonic bath before repositioning. The implants and pocket walls were treated with curettage and scaling, using titanium curettes and ultrasonic instruments with stainless steel tip (EMS Piezon scaler EN-041 Perio Slim, EMS, Nyon, Switzerland). Chlorhexidine (CHX) gel (Corsodyl®1%, GlaxoSmithKline Consumer Healthcare A/S, Brøndby, Denmark) was applied in the pockets surrounding the implants. The subjects rinsed with 0.2% CHX mouthwash (Corsodyl® 2mg/ml mouthwash; Smithkline Beecham Ltd.) twice a day after non-surgical treatment. This was continued for two weeks after surgical treatment.

Surgical procedure

Surgery was performed one week after non-surgical treatment [11]. The surgical procedure included full-thickness mucoperiosteal flaps, removal of infected tissue, cleaning of the implants and if necessary, slight osteoplastic was performed. The participants were given antibiotics for 10 days, amoxicillin (500mg $\times$ 3) in combination with metronidazole (500mg $\times$ 3), starting the evening before surgery. Sutures were removed after 2 weeks.

Registration of pain intensity, quality and morbidity

VAS is a 10 cm wide scale that consists of two endpoints; one endpoint means 'no pain' and the other endpoint means 'worst possible pain'. Patients registered pain intensity daily by placing a vertical mark on the scale between the two endpoints, in the position that best described their perception of pain that day. 'No pain' was defined as

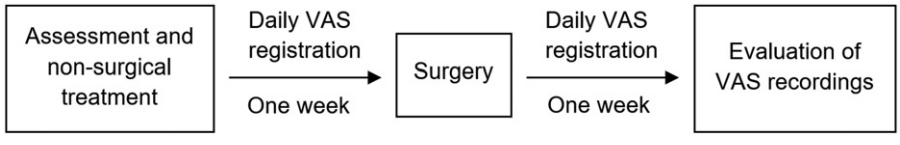

Figure 1. Study flowchart.

VAS-score $\leq$1.0 for the purpose of descriptive statistics. The patients were asked to report different kinds of pain quality and morbidity daily. The different categories were: No pain, stinging, itching, throbbing/soreness, icing sensation, numbness, pain while occluding, pain while eating, pain while ingesting cold food/drinks, pain while ingesting hot food/drinks, fever, taste disturbance, nausea, headache, tiredness, swelling, bruising, diarrhoea and rash.

Statistical analyses

Descriptive statistical analysis was performed, showing percentage distribution, mean and standard deviation (SD). Normality of the continuous variables was tested on a Q-Q-plot and using the Shapiro–Wilk and/or Kolmogorov–Smirnov test. Since the assumption of the one-way ANOVA with repeated measures was not met, Friedman test was used to detect the differences of the pain level measured at several different time points. Wilcoxon signed-rank test was used to detect the differences between pain levels measured at two time points. Mann–Whitney and Kruskal–Wallis ANOVA were applied to determine statistically significant differences between two or several groups. Significance level was set at $p < .05$. The statistical analysis was performed using IBM SPSS statistics 25 for Windows version 7 Enterprise (IBM, New York, NY, USA). Sample size calculations were performed according to the original study [21].

Results

The study population consisted initially of 45 patients, but 15 failed to register a daily VAS score after both non-surgical and surgical treatment. The remaining 30 participants consisted of 18 women and 12 men. The study population had a mean age of 63.4 years (range 45–76 years). In the present study, low pain was described as VAS-score 1–3, moderate pain as VAS-score 4–6, and substantial pain was described as VAS-score 7–10. Mean, standard deviation and maximum intensity of pain after non-surgical and surgical treatment of peri-implantitis is presented in Figure 2(A,B). Minimum intensity of pain was zero for each day for both treatments.

The pain was most pronounced the first two days after both non-surgical and surgical treatment. There was statistically significant more pain on day zero compared to day one, and average and maximum intensity of pain decreased day

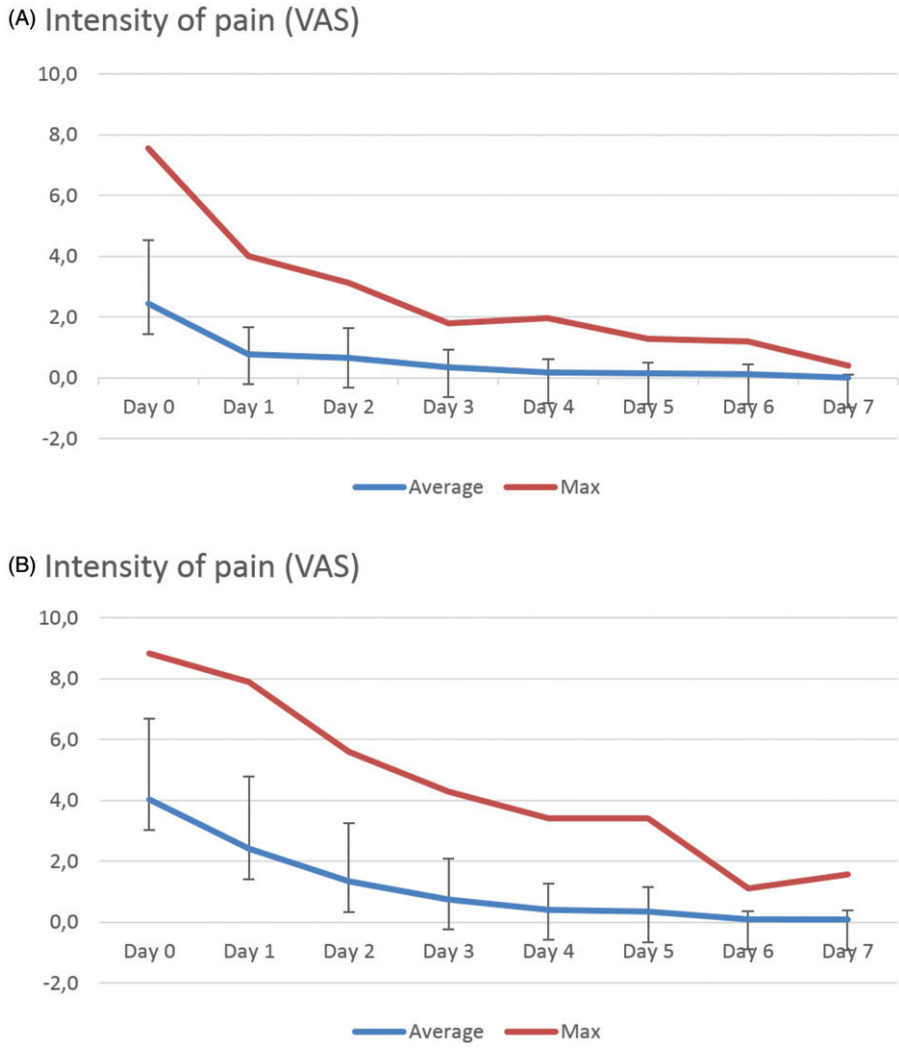

Figure 2. (A) Post-treatment pain after non-surgical treatment. (B) Post-treatment pain after surgical treatment.

Table 1. Patients reporting to have no pain (VAS $\leq$ 1.0) after non-surgical and surgical treatment at different days.

Day	0	1	2	3	4	5	6	7
n (%) non-surgical treatment	7 (23%)	17 (57%)	23 (77%)	24 (80%)	28 (93%)	28 (93%)	29 (97%)	30 (100%)
n (%) surgical treatment	5 (17%)	12 (40%)	20 (67%)	23 (77%)	25 (83%)	27 (90%)	29 (97%)	29 (97%)

n = number of patients.

Table 2. Recorded pain after non-surgical and surgical treatment according to number of implants treated.

Intensity of pain (VAS score)				
	Day 0		Day 1	
Number of implants	Non-surgical	Surgical	Non-surgical	Surgical
1–2 (*n* = 9) (mean ± SD)	2.5 ± 2.4	2.7 ± 2.8	0.7 ± 0.8	1.8 ± 2.4
3–4 (*n* = 6) (mean ± SD)	2.6 ± 1.7	5.4 ± 2.0	0.9 ± 0.7	3.8 ± 2.9
5–7 (*n* = 15) (mean ± SD)	2.4 ± 2.2	4.3 ± 2.6	1.0 ± 1.3	2.2 ± 2.1

n = number; SD = standard deviation.

Table 3. Recorded pain after non-surgical and surgical treatment according to severity of peri-implantitis.

Intensity of pain (VAS score)				
	Day 0		Day 1	
Bone loss in mm	Non-surgical	Surgical	Non-surgical	Surgical
2.1–8.0 (*n* = 16) (mean ± SD)	2.9 ± 1.9	4.4 ± 2.6	0.7 ± 0.9	2.4 ± 2.7
8.1–13.0 (*n* = 14) (mean ± SD)	1.9 ± 2.3	3.6 ± 2.8	1.1 ± 1.2	2.4 ± 2.1

n = number; SD = S.

by day throughout the week after the treatments. Three patients reported pain intensity of $\geq$5 after non-surgical treatment, and two of these patients were among the 12 patients reporting pain intensity of $\geq$5 after surgical treatment at day zero (data not shown).

The average intensity of pain was reported higher after surgical treatment compared to non-surgical treatment. This was statistically significant at day zero and day one (Friedman test). Patients reporting no pain after treatment are shown in Table 1.

Post treatment pain related to number of implants, severity of peri-implantitis and implant localization

Table 2 shows recorded pain at day zero and day one after non-surgical and surgical treatment according to number of implants. There was no statistically significant difference in pain intensity at day zero or day one when comparing the different groups. Table 3 shows recorded pain at day zero and day one after non-surgical and surgical treatment according to severity of peri-implantitis. There was no statistically significant difference in pain intensity between the two groups (Kruskal–Wallis Test). Two patients reported pain intensity of $\geq$5 after both non-surgical and surgical treatment at day zero. Both of these patients had bone loss exceeding 7mm at implant level. Five patients reported pain intensity of $\geq$5 after surgical treatment on both day zero and day one. Four of these patients had four or more implants and all had bone loss exceeding 7mm at implant level (data not shown).

According to implant-localization, the mean recorded intensity of pain after non-surgical treatment was 2.6 (SD = 2.3) in the maxilla and 2.2 (SD = 1.6) in the mandible at day zero. After surgical treatment, the mean recorded intensity of pain was 4.1 (SD = 2.6) in the maxilla and 3.9 (SD = 2.9) in the mandible at day zero. The differences were not statistically significant (Mann–Whitney test).

Post-treatment pain related to smoking and gender

The study population consisted of 15 smokers and 15 non-smokers. The mean recorded intensity of pain among smokers was 2.7 (SD = 2.4) after non-surgical treatment and 4.3 (SD = 3.0) after surgical treatment at day zero. For non-smokers, mean recorded intensity of pain was 2.3 (SD = 1.8) after non-surgical and 3.7 (SD = 2.4) after surgical treatment. No statistically significant difference was found between smokers and non-smokers (Mann–Whitney test).

For women, mean recorded intensity of pain after non-surgical treatment was 2.3 (SD = 2.3) and 4.1 (SD = 3.0) after surgical treatment at day zero. For men, mean recorded intensity of pain was 2.7 (SD = 1.8) after non-surgical and 3.9 (SD = 2.2) after surgical treatment. No statistically significant difference was found between genders (Mann–Whitney test).

Use of analgesics and quality of pain

The results show that patients took more analgesics at day zero for both treatments compared to the rest of the days, and the use was reduced during the week (data not shown). More patients used analgesics after surgical treatment compared to non-surgical treatment. Twenty patients took analgesics after both non-surgical and surgical treatment at day zero, while only 8 patients took analgesics after both non-surgical and surgical treatment at day one. Throbbing/soreness and numbness were the most commonly recorded qualities of pain for both non-surgical and surgical treatment (data not shown).

Discussion

The main finding of this study was that the post-operative pain after both non-surgical and surgical treatment of peri-implantitis was low to moderate. The highest score was recorded the day the treatments were performed. Quality of pain did not differ between the treatments. It was one week between the non-surgical and surgical treatment, and therefore, the time frame may affect the threshold of pain; patients being more or less sensitive after the first treatment.

Patients were given antibiotics after surgical treatment only. It might be expected that patients perceived less pain, experienced less swelling and had enhanced wound healing when antibiotics were administered [25–27]. Measurement of pain and discomfort is difficult because of individual aspects such as physique, psychology, social conditions and culture. In addition, the Hawthorne effect must be considered as the patients might have had more than usual attention to their pain [28]. Patients also tend to report symptoms in a way they think is expected and may therefore exaggerate the pain reported after surgical treatment. In the present study, the patients were given a list of different qualities of pain and asked to register pain daily. This may have increased the number of patients reporting pain. Patient blinding was not considered because it would not be possible. The patients could easily differ between the two treatments.

Patient anxiety may result in increased levels of pain [29]. It was therefore important that each treatment was performed under similar procedures and conditions. In the present study, the same specialists treated all patients. The patients and operators met several times and were well acquainted prior to surgery.

The study population consisted of only 30 participants and could preferably have been larger. Sample size calculation was not carried out related to the aspect of pain, before the start of the study. When using a self-reporting system, it is important to be aware of the possibility of bias in registration of the intensity and quality of pain at the correct time. In this study, the participants were asked to register the pain in the evening. Some patients might find the self-reporting system to be time-consuming and experience it as stressful [6,p.51–69]. This might imply that participants would be inaccurate in their reporting of pain.

In the present study, throbbing/soreness and numbness were the most recorded quality of pain for both non-surgical and surgical treatment. Some patients did not register intensity of pain but recorded only quality of pain. Quality of pain depends on different factors like mechanical trauma and inflammation [3,p.22–50,30,p.1–30]. When nociceptors are stimulated the response will be highest immediately after the stimulus. Tissue exposed to mechanical trauma generally perceive greater response from A-fibres than C-fibres [30,p.1-30,31]. When inflammatory mediators activate nociceptors, it is called inflammatory pain. Pain from such mediators is present in tissue damage after surgery. This kind of pain is linked to unmyelinated C-fibres and gives a prolonged pain. Pain perceived as throbbing/soreness and numbness comes from C-fibres [3,p.22–50, 30,p.1–30], and in the present study, the experience of pain was most pronounced during the same day as treatment was performed.

Surgical treatment of peri-implantitis was reported as more painful than non-surgical treatment. This was as expected, although it was probably less inflammation in the tissue before the surgical treatment compared to the non-surgical treatment, due to the curettage and administration of antibiotics with the surgical treatment. This might also be attributed to the fact that the surgical treatment is more invasive and gives a greater mechanical trauma with exposed bone margins, longer operating time, and suturing that can subsequently give more discomfort. These findings are in accordance with findings in other studies of pain, comparing non-surgical and surgical periodontal treatment [32–35]. For practical reasons, surgery was performed one week after non-surgical treatment. The patients' perception and assessment of pain after surgical treatment might have been influenced by the pain experienced after the non-surgical treatment.

In the present study, there was no statistically significant difference in intensity of pain after treatment of peri-implantitis related to severity, number of implants or smoking. To the best of our knowledge, no other studies have investigated these factors in relation to treatment of peri-implantitis. The reason for not finding statistically significant differences could be attributed to the small sample size and that most patients reported low pain intensity after treatment. In relation to gender, there was no statistically significant difference in intensity of pain. Some reports related to the treatment of periodontitis are in accordance with the present study [32,36], while other studies show that women experience greater levels of pain after surgical treatment of teeth compared to men, as well as other orofacial pain conditions [37,38].

When comparing intensity of pain and implant localization, no statistically significant difference was found for either treatment. This is not in accordance with other reports related to treatment of periodontitis [13,36], and might be a result of not dividing into more specific areas, for example anterior/posterior. This was not done due to extensive treatments, where both anterior and posterior areas was included in the same session.

More patients took analgesics at day zero of both treatments compared to the rest of the study period. Use of analgesics was reduced during the week. Because there was no standardized regiment for the use of analgesics, this might have influenced the perception of pain and the use of analgesics. A potential carryover effect on the next day must be considered. As expected, more analgesics were taken after surgical treatment compared to non-surgical treatment. This is in accordance with a study related to treatment of periodontitis, reporting that patients treated non-surgically used significantly less analgesics than patients treated surgically [33].

Conclusion

Intensity of pain after both non-surgical and surgical treatment of peri-implantitis was most pronounced at day zero but was in general low to moderate. There was statistically significant more pain at day zero compared to day one for both non-surgical and surgical treatment. The results showed individual differences in experienced intensity of pain. None of the included variables showed any statistically significant difference in intensity of pain. The quality of pain was mostly recorded as throbbing/soreness and numbness for most patients.

Disclosure statement

None of the authors declare a conflict of interest.

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