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Full-mouth ultrasonic debridement and risk of disease recurrence: a 1-year follow-up

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Abstract

Aim: To evaluate the incidence of disease recurrence following a full-mouth pocket/root debridement approach with ultrasonic instrumentation *versus* that following a traditional approach of quadrant-wise scaling and root planing (Q-SRP) performed with hand instrumentation.

Methods: Thirty-seven patients were re-examined 1 year after the completion of a 6-month clinical trial comparing two different treatment protocols: a 1-h session of full-mouth ultrasonic debridement (UD – 19 patients) or four sessions of Q-SRP with hand instruments (Q-SRP – 18 patients). At 3 months, re-instrumentation was performed of pockets showing a remaining probing pocket depth (PPD) of $\geqslant 5$ mm using the same type of instruments as used during the initial treatment phase. The clinical examinations comprised assessments of plaque, bleeding on probing (BoP) and PPD. The primary outcome variable was the incidence of recurrent diseased sites (i.e., sites showing PPD $\geqslant 5$ mm and BoP+) between the post-treatment and 1-year follow-up examinations. All sites that were healed (PPD $\leqslant 4$ mm and BoP−) at the post-treatment examination were included in the study sample, with a mean number of sites per patient of 23.5.

Results: In the UD group, 29 (7%) out of 430 initially healed sites showed disease recurrence at the 1-year follow-up examination compared with 47 (11%) of 440 sites in the Q-SRP group ($p > 0.05$). Twelve patients (63%) in the UD group presented recurrent diseased pockets, compared with 14 patients (78%) in the Q-SRP group. Two or more recurrent, diseased pockets were observed in nine patients in the UD group *versus* 11 in the Q-SRP group. All but one of the smokers belonged to the group of patients presenting recurrences. A tendency towards a higher mean plaque score was observed for the patients with recurrent sites.

Conclusion: The study revealed no significant difference in the incidence of recurrence of diseased periodontal pockets between the full-mouth UD approach and the traditional approach of Q-SRP.

Key words: clinical; debridement; periodontitis; randomized controlled trial; recurrence; scaling and root planing; ultrasonic

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The main objective in the treatment of periodontitis is to establish adequate infection control, i.e., to reduce the bacterial load below the individual threshold level for disease. Hence, basic periodontal treatment is aiming at an effective pocket/root debridement (scaling and root planing (SRP)) and the establishment of a proper self-performed supragingival plaque control. A shallow probing pocket depth (PPD) without bleeding following probing manifests the successful outcome of the therapy.

In a recent publication (Wennström et al. 2005), we evaluated the clinical efficacy of a single session of full-mouth ultrasonic debridement (UD) as an initial periodontal treatment approach compared with quadrant-wise scaling/root planing with hand instruments (Q-SRP). At 3 months, all sites with remaining PPD $\geqslant 5$ mm were subjected to repeated debridement using the same type of instruments. The final evaluation at 6 months revealed no statistically significant differences between the two treatment approaches in pertinent clinical outcome variables. In fact, several recent systematic reviews (Tunkel et al. 2002, van der Weijden & Timmerman 2002, Hallmon & Rees 2003) concluded that in terms of pocket reduction and

gain in clinical attachment there is no major difference in the efficacy of pocket/root debridement techniques using hand or power-driven instruments. However, the overall time spent in our study for subgingival instrumentation was markedly lower for UD than for Q-SRP (106 *versus* 214 min.). The positive treatment outcome of the UD approach, despite the markedly reduced time for pocket/root instrumentation, may partly be explained by observations made in an in vitro study by Busslinger et al. (2001) showing that less treatment time is required for root debridement with the use of a piezoelectric ultrasonic instrument compared with hand instruments. On the other hand, it has also been demonstrated that the amount of removal of subgingival deposits is positively correlated to the time employed for instrumentation (Braun et al. 2005). Furthermore, a number of in vitro (Breininger et al. 1987, Rateitschak-Pluss et al. 1992) and in vivo studies (e.g., Waerhaug 1978, Eaton et al. 1985, Caffesse et al. 1986, Brayer et al. 1989, Sherman et al. 1990, Wylam et al. 1993) have shown that a complete removal of hard and soft deposits is a non-feasible objective of closed pocket/root instrumentation. Hence, the positive clinical outcome observed at the short-term evaluation in our previous study (Wennström et al. 2005) may rather be ascribed to a marked reduction in the amount of subgingival deposits than to the complete removal of calculus and biofilms. Because of the apparent difference in time spent for ultrasonic and hand instrumentation of the pockets, and thereby a potential variation in the amount of residual deposits after instrumentation (Braun et al. 2005), it could be argued however that the risk for recurrence of disease might differ between the two approaches.

The aim of this study was therefore to evaluate the incidence of disease recurrence following a full-mouth pocket/root debridement approach with ultrasonic instrumentation *versus* that following a traditional approach of Q-SRP performed with hand instrumentation.

Material and Methods

The data analysed in this report derived from a 1-year follow-up examination of patients who had been enrolled in a 6-month study (Wennström et al. 2005) with the objective of evaluating the outcome of two different approaches to non-surgical periodontal treatment; Q-SRP and full-mouth UD. The study was conducted at two centres (Department of Periodontology, the Sahlgrenska Academy at Göteborg University, Sweden and a private dental office in Trento, Italy). Approval of the study protocol by the Ethics Committee at Göteborg University was obtained and all participating subjects provided informed consent before the start of the study.

Forty-one patients with moderately advanced chronic periodontitis were randomly assigned to be treated either with a 1-h session of full-mouth debridement (UD) using an ultrasonic instrument (EMS Piezon Master 400 with A+PerioSlim tips, water coolant and power setting to 75%; EMS, Nyon, Switzerland) or with four sessions of Q-SRP with hand instruments (LM-dental, Turku, Finland). At 3 months, re-instrumentation was performed of pockets showing a remaining PPD of $\geqslant 5$ mm using the same type of instruments as used during the initial treatment phase. In addition, supragingival polishing of all teeth with the use of a rubber cup and a low abrasive paste was performed. The outcome of the active periodontal treatment was evaluated after a further 3 months (post-treatment examination). Subsequent treatment decisions were left to the dentist in charge of the patient. All patients were recalled for a clinical re-examination 1 year after the post-treatment examination.

Current study sample

Out of the 41 patients involved in the original study, 37 agreed to participate in the follow-up examination. Two patients were unable to attend the examination because of geographic relocation and two subjects declined to participate.

As the main outcome variable to be evaluated in the current study was the incidence of recurrent diseased periodontal sites, the target sample was represented by all initially deepened pockets that had healed after treatment, i.e. had a PPD $\leqslant 4$ mm and were bleeding on probing (BoP) − . Out of a total of 1249 sites with a pre-treatment PPD of $\geqslant 5$ mm, 941 (75%) sites were resolved at the 6-month examination. During the subsequent 1 year, seven of these sites were lost because of tooth extractions. An additional 64 sites were deleted from the study sample because of location adjacent to sites subjected to surgical treatment. Thus, the final study sample to be evaluated comprised 870 sites, with a mean number of sites per patient of 23.5 (range 7–48).

Clinical assessments

The clinical data collected at examinations performed before treatment (pre-treatment), at 6 months (post-treatment) and at 18 months (1-year follow-up) included the following variables assessed at the mesial, buccal, distal and lingual surfaces of each tooth.

Plaque score: presence/absence of plaque at the cervical part of the tooth scored by running a probe along the tooth surface.

PPD: measured with a manual Hu-Friedy PCP15 periodontal probe (Hu-Friedy Inc., Leimen, Germany) to the closest lower millimetre.

BoP: presence/absence of bleeding within 15 s following pocket probing.

In addition, the patients' charts were evaluated to determine the number of recall visits for supportive care that had been given during the 1 year of follow-up.

Data analysis

The primary outcome variable was the incidence of recurrent sites (i.e., sites showing PPD $\geqslant 5$ mm and BoP+) between the post-treatment and 1-year follow-up examinations.

Patient mean values were calculated as a basis for the statistical analysis. Mean values, standard deviations and proportions of sites within various categories of scoring units were calculated for data description. For descriptive purposes, analysis of the data was also performed on a site level.

The distribution of continuous variables was initially analysed with the Kolmogorov–Smirnov test. Differences between mean values were statistically analysed by the use of repeated measurements analysis of variance and differences in proportions with the use of 2×2 tables and the Fisher's exact test. The χ^2 test was used to determine the differences in dichotomous variables. A p-value of <0.05 was considered as statistically significant. All data handling and statistical testing were performed with the use of the SPSS 12.0 software package (SPSS Inc., Chicago, IL, USA).

Table 1. Treatment group characteristics (subject level); mean values (95% CI)

	Q-SRP	UD
Number of subjects	18	19
Mean age	53 (48–57)	47 (42–52)
Gender (F/M)	10/8	8/11
Smokers	8	8
Mean number of recall visits	2.0 (1.4–2.6)	2.2 (1.6–2.8)
Plaque score		
Pre-treatment	26% (18–34)	27% (16–38)
Post-treatment	15% (8–23)	25% (15–36)
1-year follow-up	36% (23–49)	32% (17–48)
BoP score		
Pre-treatment	92% (81–101)	94% (90–98)
Post-treatment	26% (19–35)	22% (14–31)
1-year follow-up	40% (31–50)	35% (23–47)
Mean PPD (mm)		
Pre-treatment	5.7 (5.5–6.0)	5.8 (5.6–6.0)
Post-treatment	3.1 (2.9–3.3)	3.1 (3.0–3.3)
1-year follow-up	3.3 (3.0–3.5)	3.2 (2.9–3.5)

Q-SRP, quadrant-wise scaling and root planning; BoP, bleeding on probing; PPD, probing pocket depth; UD, ultrasonic debridement.

Table 2. Treatment group characteristics (site level)

	Q-SRP	UD
Number of sites	440	430
Sites located at molars	23%	22%
Pre-treatment PPD $\geqslant$ 7 mm	18%	19%
Presence of angular bone defect	5 (1%)	5 (1%)

PPD, probing pocket depth; Q-SRP, quadrant-wise scaling and root planning; UD, ultrasonic debridement.

Table 3. Distribution of patients with recurrent sites (PPD $\geqslant$ 5 mm and BoP+) and total number of recurrent sites according to treatment group

	Q-SRP	UD
No. of patients with recurrent sites	14 (78%)	12 (63%)
1 site	3	3
2 sites	4	3
3 sites	3	5
$\geqslant$4 sites	4	1
No. of recurrent sites	47 (11%)	29 (7%)

Q-SRP, quadrant-wise scaling and root planning; BoP, bleeding on probing; PPD, probing pocket depth; UD, ultrasonic debridement.

Results

Patient and site characteristics

The characteristics of the patients included in the study are reported in Table 1. Eight patients in each group were smokers. On average the patients in both treatment groups had been recalled twice for supportive care during 1 year of follow-up. The individual mean plaque score for the study sites was similar for the two treatment groups before treatment and at the 1-year follow-up, but was somewhat higher for the UD compared with the Q-SRP group at the post-treatment examination (25% *versus* 15%; $p = 0.076$). The mean BoP score and the mean PPD were markedly reduced following both treatment protocols. At the 1-year follow-up, a tendency towards an increase in BoP was observed in both groups, while the mean PPD remained more or less unchanged. No statistically significant differences were detected for the evaluated characteristics between the two treatment groups.

Some baseline characteristics of the 870 sites included in the study are given in Table 2, according to treatment group. No statistically significant differences were found between the two treatment groups with regard to total number of sites or proportion of sites (i) located at molars, (ii) with pre-treatment PPD $\geqslant$ 7 mm or (iii) associated with angular bone defects.

Recurrence of diseased periodontal pockets

Twelve patients (63%) in the UD group presented recurrent diseased pockets (i.e., PPD $\geqslant$ 5 mm and BoP+) at the 1-year follow-up examination, compared with 14 patients (78%) in the Q-SRP group (Table 3). Out of these patients, nine patients in the UD treatment group presented two or more sites with recurrent pockets *versus* 11 in the Q-SRP group.

In total, 29 pockets (7%) in the UD group and 47 pockets (11%) in the Q-SRP group showed recurrence of clinical signs of disease at the 1-year follow-up examination (Table 3), out of which 15 sites (52%) in the UD group and 31 (66%) in the Q-SRP group revealed an increase in probing depth of $\geqslant$ 2 mm. A PPD of $\geqslant$ 6 mm at 1 year was observed at eight sites (2%) in the UD group and 10 (2%) in the Q-SRP group. The difference in terms of number of patients or sites with recurrence of disease between the two treatment groups was not found to be statistically significant.

Table 4 describes characteristics of the patient sample according to the absence or presence of recurrent sites. All but one of the 16 smokers included in the study belonged to the group of patients that showed recurrent sites at the 1-year follow-up examination. While no significant differences in clinical parameters were detected at the pre-treatment examination, patients with recurrent sites showed a significantly higher bleeding score at the post-treatment examination than patients with no recurrent site (28% *versus* 16%; $p < 0.05$). At the 1-year follow-up examination, patients with recurrent sites also presented a somewhat higher plaque score than patients without recurrent sites (40% *versus* 21%; $p = 0.066$) and a significantly higher bleeding score (46% *versus* 17%; $p < 0.05$).

In Table 5 the baseline characteristics of recurrent and ''stable'' sites are compared. The proportions of pockets located at molars were higher for recurrent sites than for ''stable'' sites ($p < 0.01$). Furthermore, recurrent sites showed a tendency for higher prevalence of sites with an initial PPD of $\geqslant$ 7 mm compared with ''stable'' sites ($p = 0.053$).

Discussion

The results of the current study revealed no significant difference with regard to

Table 4. Characteristics of patients with and without recurrent sites (PPD ⩾5 mm and BoP+); mean values (95% CI)

	No of recurrent sites		⩾1 recurrent site
Number of subjects	11		26
Mean age	49 (41–57)		50 (47–54)
Gender (F/M)	5/6		13/13
Smokers	1	$p<0.05$	15
Mean number recall visits	2.4 (1.5–3.2)		2 (1.5–2.5)
Plaque score			
Pre-treatment	28% (9–47)		27% (20–32)
Post-treatment	17% (7–27)		22% (14–30)
1-year follow-up	21% (3–39)		40% (28–52)
BoP score			
Pre-treatment	91% (78–104)		94% (89–98)
Post-treatment	16% (12–20)	$p<0.05$	28% (20–34)
1-year follow-up	17% (9–26)	$p<0.05$	46% (35–53)
Mean PPD (mm)			
Pre-treatment	5.9 (5.6–6.3)		5.7 (5.5–5.8)
Post-treatment	3.0 (2.8–3.1)		3.2 (3.0–3.3)
1-year follow-up	2.7 (2.5–2.9)	$p<0.05$	3.4 (3.3–3.6)

BoP, bleeding on probing; PPD, probing pocket depth.

Table 5. Characteristics of recurrent and stable sites

	Recurrent		Stable
Number of sites	76		794
Molar location	40%	$p<0.01$	21%
Pre-treatment PPD⩾7 mm	26%		18%
Presence of angular bone defect	1 (1%)		9 (1%)

PPD, probing pocket depth.

the risk for recurrence of diseased periodontal pockets between the full-mouth UD approach and the traditional approach of Q-SRP. Hence, the incidence of recurrent sites in the studied period (1 year) was 7% for the UD and 11% for the Q-SRP group, which lends support to the concept that the ultrasonic approach to pocket/root debridement is as effective as Q-SRP.

Recurrence of diseased periodontal sites may occur as a result of a microbial re-colonization because of failure in maintaining proper oral hygiene (Magnusson et al. 1984, Hellstrom et al. 1996) and/or as a result inadequate pocket/root debridement (Wennström et al. 1987, Westfelt et al. 1998). In the present study, the individual mean plaque score for the study sites was similar for the two treatment groups at the 1-year follow-up. On the other hand, patients presenting disease recurrences showed a tendency towards a higher mean plaque score (40% *versus* 21%) than patients without recurrences despite a similar frequency of recalls for supportive care. In addition, sites showing disease recurrence were frequently located at molars where cleaning manoeuvres may be more difficult. Thus, it cannot be ruled out that re-colonization from the supragingival environment may be a cause for the recurrence of diseased pockets independent of treatment approach for pocket/root debridement. This consideration is supported by data from a recent study by Brochut et al. (2005) who evaluated the predictive value of clinical parameters for the treatment outcome of SRP. The authors demonstrated a significant correlation between the proportion of sites with visible plaque after the hygienic phase and the prevalence of diseased sites at the re-evaluation at 6 months.

Several studies have demonstrated that SRP rarely renders a root completely free from microbial deposits and calculus (e.g., Waerhaug 1978, Eaton et al. 1985, Caffesse et al. 1986, Brayer et al. 1989, Sherman et al. 1990, Wylam et al. 1993). Furthermore, results from an in vitro study (Braun et al. 2005) showed that the efficacy of mechanical instrumentation in removal of subgingival deposits is related to the time employed for instrumentation and that the use of hand instruments requires less time than ultrasonic devices to achieve the same degree of calculus removal. On the other hand, the fact that the type of ultrasonic device used may be a factor to consider is based on observations made in an in vitro study by Busslinger et al. (2001) showing that markedly less treatment time is required for root debridement with the use of a piezoelectric ultrasonic instrument compared with hand instruments. Also the design of the tip of the instrument is a factor that influences the efficacy of subgingival UD (Dragoo 1992, Clifford et al. 1999). Nevertheless, as the total time used for ultrasonic instrumentation in the current study was less than 50% of that spent for SRP with hand instruments, one might anticipate a higher risk of recurrence of diseased sites in the UD group because of remaining deposits after instrumentation (Braun et al. 2005). However, the lack of a significant difference in the incidence of disease recurrences during the follow-up period indicates that the UD approach was not inferior to the Q-SRP approach in terms of removal of subgingival soft and hard deposits. This finding is supported by data from a recently reported clinical trial (Koshy et al. 2005) demonstrating that UD performed as a single-visit full-mouth procedure resulted in a comparable healing outcome 6 months post-treatment as that presented by UD performed in a quadrant-wise manner at weekly intervals, even though the time spent to complete the treatment was significantly shorter. Hence, taken together these observations indicate that adequate removal of subgingival deposits and biofilms is attainable with ultrasonic instrumentation in a markedly shorter treatment time than is traditionally employed for non-surgical pocket/root debridement. Obviously, there is a threshold level of bacterial load following pocket/root instrumentation, below which the individual host can cope with the remaining infection (Cobb 2002). Besides the quantity and quality of the remaining subgingival microbiota, the individual threshold level might be influenced by various host related and modifying factors. In this respect it is noteworthy that all but one of the smokers presented recurrent pockets. Other authors (MacFarlane et al. 1992, Loesche et al. 2002, Kamma & Baehni 2003) also reported a higher incidence of disease recurrence among smokers than non-smokers. MacFarlane et al. (1992) found in their study that 90% of the patients poorly responding to repeated periodontal treatment were smokers. One explanation could be that smokers present a higher number of remaining pockets, with a higher

possibility for re-infection of healed sites (Quirynen et al. 2006). In our sample, smokers at the post-treatment examination presented a prevalence of 13% of diseased pockets compared with 5% in non-smokers. Other possible explanations are that smokers may show a lower reduction of the subgingival microbial load following pocket instrumentation (van Winkelhoff et al. 2001, Van der Velden et al. 2003) and an impaired host response (Labriola et al. 2005, Palmer et al. 2005).

In conclusion, the results of the present study indicate that, despite a considerably shorter time employed for instrumentation, adequate removal of the subgingival deposits and biofilm can be obtained with the application of the evaluated ultrasonic approach to pocket/root debridement.

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Clinical Relevance

Scientific rationale for the study:- Short-term evaluations of a full-mouth UD approach and Q-SRP have revealed comparable clinical outcomes, despite a marked difference in time spent for pocket/root debridement. However, a pertinent question to address is whether the risk for recurrence of disease might differ between the two approaches.

*Principal findings:*This 1-year follow-up study revealed no differences with regard to incidence of recurrent diseased sites, or number of patients with pockets re-presenting signs of disease, between the two treatment approaches. Recurrent sites were most frequent among smokers.

*Practical implication:*A full-mouth UD approach can be considered as a rational alternative to Q-SRP.