Surgical and Non-surgical Therapy in Patients with Chronic Periodontitis. MWF and SRP in Comparison with the VECTOR Ultrasonic Instrument. A Pilot Study.

Arndt Guentsch, Tina Seltmann, Bernd W. Sigusch, Gisela Klinger, Eike Glockmann

Background: Disruption and/or removal of the subgingival biofilm remain the cornerstone of periodontal therapy. A great variety of instruments can be used in order to perform scaling and root planing. A pilot study was undertaken to investigate clinical outcomes following surgical and non-surgical periodontal treatment including investigation of the efficacy of the new ultrasonic instrument VECTOR™ (Fa. Dürr-Dental, Bietigheim-Bissingen, Germany).
Methods: 30 patients with generalised chronic periodontitis were recruited and randomly allocated to three different treatment methods (n=10 in each group). The treatment modalities included scaling and root planing (SRP), modified Widman-flap (MWF) surgery, and non-surgical therapy with the new ultrasonic instrument VECTOR™. Clinical parameters (PPD, BoP and CAL) were recorded at baseline (i.e. before treatment) and at six months after therapy.
Results: At six months following therapy, significant improvements in all clinical parameters were identified in all three groups. PPD, BoP and CAL were significantly reduced in all groups, with no statistically significant differences between the different treatment procedures.
Conclusion: Notwithstanding the limitations of this pilot study, periodontal therapy outcomes with the new ultrasonic instrument VECTOR™ were comparable to the results obtained following SRP and MWF surgery. No differences were observed between surgical and non-surgical therapy in any clinical parameter after six months.

Key words: periodontal treatment, non-surgical therapy, surgical therapy, ultrasonic therapy, VECTOR™

INTRODUCTION

Periodontal diseases are infections, initiated by the subgingival bacterial biofilm, in which the chronic inflammatory response to the presence of plaque bacteria does not result in the complete elimination of bacteria but instead results in local tissue destruction (Genco, 1996; Page, 1999). The primary goal of periodontal therapy is to arrest the progression of disease and create an environment favourable for wound healing (Magnusson et al, 1994). Periodontal treatment focuses on reducing the bacterial challenge by the removal of supra- and subgingival plaque. In order to achieve this goal, a great number of instruments (manual curettes, rotating and ultrasonic instruments) can be used for the removal of supra- and subgingival plaque and calculus.

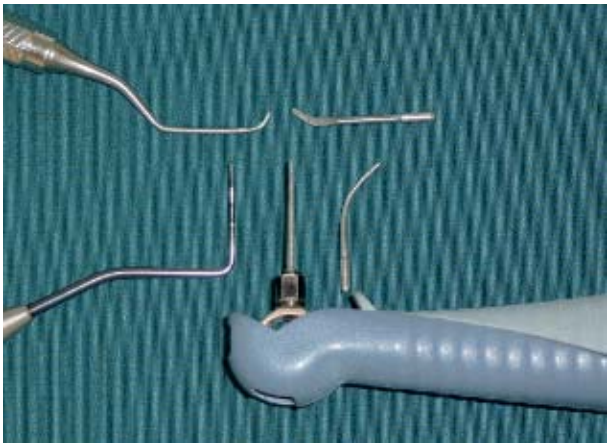

Fig 1 The tips of the VECTOR™ ultrasonic instrument are comparable with the perio-probe and curettes.

Complete elimination of all subgingival bacteria and calculus can neither be achieved by manual or by ultrasonic instruments (Baehni et al, 1992; Dragoo, 1992; Bollen et al, 1996), although a partial elimination is able to reduce clinical signs of infection such as bleeding and probing depths (Waerhaug, 1978; Badersten et al, 1984; Nyman et al, 1986; Smart et al, 1990). This can be explained by the concept of 'critical mass' (World Workshop in Periodontics, 1989), which means that the therapy reduces the quantity of plaque to a level resulting in equilibrium between residual bacteria and the host response.

Subgingival root debridement with manual instruments can be accomplished either as a "closed" procedure (non-surgical periodontal therapy) or following exposure of the contaminated root surface by various surgical techniques (surgical periodontal therapy) (Rosling et al, 2001). The effects of both surgical and non-surgical therapy have been reported in many papers (Badersten, et al, 1984; Lindhe et al, 1984; Isidor et al, 1986; Ali et al, 1992; Kaldahl et al, 1993; Cobb, 1996; Sigusch et al, 1999; Cugini et al, 2000; Hung et al, 2002). Kaldahl and co-workers (1993) described in a review that there were no differences between the results of non-surgical (scaling and root planing = SRP) and surgical (modified Widman-Flap = MWF) therapy. Lindhe et al (1984) and Isidor and Karring (1986) showed that both treatment procedures had nearly the same influence on long-term outcomes. On a short-term basis, surgical therapy showed better results than SRP, but this advantage was lost after two years (for review see Hung and Douglas, 2002). Ultrasonic instruments were introduced nearly 50 years ago, at first for removing supragingival calculus (Cobb, 1999). The tips were subsequently modified and now have diameters similar to those of periodontal probes. Numerous studies have reported the comparative efficacy of sonic and/or ultrasonic *versus* manual instrumentation (Badersten et al, 1984; Loos et al, 1987; Dragoo, 1992; Kocher et al, 1998; Cobb, 2002). Cobb (2002) described no specific or significant difference between manual and sonic/ultrasonic instrumentation in clinical end-points.

In 1999, Dürr (Bietigheim-Bissingen) developed a new generation of ultrasonic instruments, named VECTOR™. This instrument comprises a ring-shaped resonant body vibrated by an ultrasonic drive and attached to the working end at an angle of 90°. The resultant purely directed movement eliminates ellipsoid vibrations. Hydroxyl apatite particles with a grain size of 10 µm are added to the liquid film adhering to the surface of the instrument. The working tips allow minimally invasive instrumentation and are comparable in dimensions with the manual probe or the working tips of Gracey-Curettes (Fig 1). A recently published study showed the effect of calculus reduction in vitro with this instrument (Braun et al, 2005). Furthermore, the use of VECTOR™ caused less pain during the treatment of periodontal lesions in comparison with hand instrumentation or a conventional ultrasonic system (Braun et al, 2003). The first clinical comparator study of the VECTOR system observed no differences in the clinical outcomes whether using VECTOR™ or conventional SRP (Sculean et al, 2004).

The aim of this pilot study was to compare clinical outcomes following manual instrumentation with Gracey-Curettes (SRP group), open debridement (MWF surgery) and ultrasonic instrumentation using VECTOR™ in patients with severely advanced chronic periodontitis.

METHODS

Study population

Thirty patients with generalized advanced chronic periodontitis characterised by a minimum of 12 teeth with pockets deeper than 5 mm were recruited. None of the patients had received any peri-

odontal therapy nor had used antibiotics or immunosuppressive agents in the preceding six months. Subjects who were smokers or former smokers were excluded, as were patients with significant systemic disease, and pregnant or lactating females.
Patients were randomly assigned to one of three treatment groups (single-blind for patients). (I) non-surgical therapy by conventional scaling and root planing (SRP group), (II) surgical therapy by modified Widman flap surgery (MWF group) and (III) a new treatment method using the ultrasonic instrument VECTOR™. There were no drop-outs in the six-month study period.

At baseline, the following clinical parameters were recorded.
Number of teeth
Bleeding on probing (BoP). BOP was recorded at six surfaces per tooth and the percentage of BoP positive teeth was calculated.
Probing pocket depth (PPD). PPD was measured from the gingival margin using the manual probe PCP 12 (Hu Friedy). Measurements were made to the nearest 1 mm. PPD measurement was performed at six surfaces per tooth.
Gingival recession (REC). REC was measured from cemento-enamel junction to the gingival margin.
Clinical attachment level (CAL) was measured from cemento-enamel junction.
PPD, REC and BoP were measured directly before therapy and six months after therapy by two periodontists. Periodontal treatment and clinical measurements were performed by different operators. Before the study commented, the two examiners were calibrated in order to minimise methodical error. The calibration procedure included measurement of PPD and CAL in 5 patients who were not participating in this study and involved both intra- and inter-examiner calibration. PPD and REC were measured in duplicate at a randomly chosen tooth in each quadrant and calibration was accepted if measurements were identical to the millimetre at > 90% of occasions.

Treatment

At the beginning of the treatment, all patients received detailed information about their disease, including motivation to improve oral hygiene by using interdental brushes. During the hygiene phase, a plaque score (Lange, 1978) was recorded. Using the Approximal-plaque-index (API), the score 0 means no plaque interdentally and the score 1 was measured if plaque was visible. The plaque score must be reduced to a low level (API < 20%). This was the condition that had to be met before commencing periodontal treatment, and the API was not recorded further in this study. After initial therapy, baseline data were recorded.
Ten patients were in the SRP group, 10 in the MWF group and 10 in the VECTOR™ group. Treatment procedures were performed in accordance with full-mouth treatment concepts, and the non-surgical therapy was completed within 24–42 hours. The surgical therapy (MWF) was completed during either one or two sessions, and was undertaken only at sites with pockets > 5 mm. After treatment a periodontal dressing (Voco-pac, Fa. Voco GmbH, Germany) was applied for two to five days. Patients were enrolled in a post-therapeutic maintenance programme with maintenance appointments at four, eight, 12 and 24 weeks.
Six months after treatment re-examination was undertaken and involved the same measurements as were performed at baseline.

Statistical analysis

Individual mean values and standard deviation were calculated. Differences between the treatment groups (SRP, MWF and VECTOR) were analysed using ANCOVA. Differences within the groups were analysed using a paired *t*-test. A *p*-value of < 0.05 was considered to be statistically significant. The re-examination results are presented with the 95% confidence intervals (CI). SPSS 11.5.1 was used as statistical programme.

RESULTS

The mean (range) age of the patients was 49 (41–61) years. The mean (± sd) number of teeth was 26.2 (± 2.9), and in each group 1572 (± 47) probing sites were measured at baseline and six months. BoP, PPD and CAL data at each timepoint are presented in Table 1.
Following treatment, the number of sites with positive BoP was significantly reduced in all groups. There were no significant differences at baseline and at re-examination between the groups.
Mean probing depths were significantly reduced in all treatment groups as a result of treatment

Table 1 Mean (± sd) % bleeding on probing scores (BoP), probing pocket depth (PPD) (mm) and clinical attachment level (CAL) (mm) at each timepoint.

	BoP Baseline	BoP post treatment	PPD Baseline	PPD post treatment	CAL Baseline	CAL post treatment
SRP	86.3 % (± 18.7)	13.8 % (± 14.5)*	5.05 mm (± 0.54)	2.64 mm (±0.49)*	5.94 mm (± 0.41)	3.77 mm (± 0.35)*
MWF	86.3 % (± 13.2)	20.8 % (± 18.9)*	5.43 mm (± 0.65)	3.10 mm (±1.06)*	6.28 mm (± 0.48)	4.63 mm (± 0.61)*
VECTOR™	81.2 % (± 11.8)	19.6 % (± 13.9)*	4.48 mm (± 0.58)	2.99 mm (±0.60)*	5.26 mm (± 0.45)	3.86 mm (± 0.35)*

** Significant decrease from baseline ($p < 0.001$). No significant differences were observed between SRP, MWF or VECTOR™.*

($p < 0.001$). From baseline to month six, PPD measurements fell from 5.05 ± 0.54 mm to 2.64 ± 0.49 mm (95% CI of change 2.19–3.09 mm) in the SRP group, from 5.43 ± 0.65 mm to 3.10 ± 1.06 mm (95% CI of change 2.34–3.33 mm) in the MWF group, and from 4.48 ± 0.58 mm to 2.99 ± 0.60 mm (95% CI of change 2.78–3.79 mm) in the VECTOR group.

The ANCOVA procedure was used to compare treatment outcomes between the three groups, accounting for any pre-existing differences between the groups at baseline. No statistically significant differences in treatment outcomes were identified between the three groups, nor were there any statistically significant differences between the open (surgical) and closed (non-surgical) procedures ($p > 0.05$). Probing depths recorded at re-examination were similar in all groups.

Similar to probing depth changes, the mean clinical attachment level data revealed statistically significant differences before and after therapy within each group ($p < 0.05$) but not between treatment groups (ANCOVA $p > 0.05$). When comparing the observed gains in attachment level in the three groups, there were no statistically significant differences between SRP (mean gain 2.66 ± 0.74 mm), MWF (mean gain 1.66 ± 1.05mm) and the Vector™ instrumentation (mean gain 1.85 ± 0.99 mm) ($p > 0.05$).

In all groups there was a significant increase in the proportion of shallow sites (< 4 mm) and a significant decrease in the proportion of deep pockets (≥ 6 mm) ($p < 0.05$) as a result of treatment (Fig 2). When considering all treatment groups, 40–50% of probing sites were > 4 mm before therapy. Overall, this proportion was reduced to approximately 10% following treatment. Sites with ≥ 6 mm pockets were few following treatment. 2.3% of sites in the SRP-group, 2.4% in the MWF-group, and 0.75% in the VECTOR™-group.

Gingival recession at baseline and re-examination is illustrated in Fig 3. At baseline, similar gingival recession data were recorded in all groups. The lowest increase of gingival recession at the re-examination appointment was seen in those patients treated with VECTOR™-therapy, which is consistent with the least attachment gain in this group. However, none of these differences reached statistical significance.

DISCUSSION

Notwithstanding the limitations of this pilot study, the data support that manual open/closed therapy (SRP/MWF) and ultrasonic (VECTOR™) instrumentation are successful treatment methods in patients with chronic periodontitis. A significant reduction of probing pocket depths, % BoP and clinical attachment levels were recorded in the patients treated by SRP, MWF and VECTOR™. Furthermore, all three procedures resulted in a significant reduction in the proportion of deep pockets (> 6 mm) and in an increase in the proportion of shallow pockets (< 4 mm) following treatment. Reduction of pocket depth was found to be slightly (though non-significantly) higher in the SRP- and MWF-groups than in the VECTOR™-group. It is

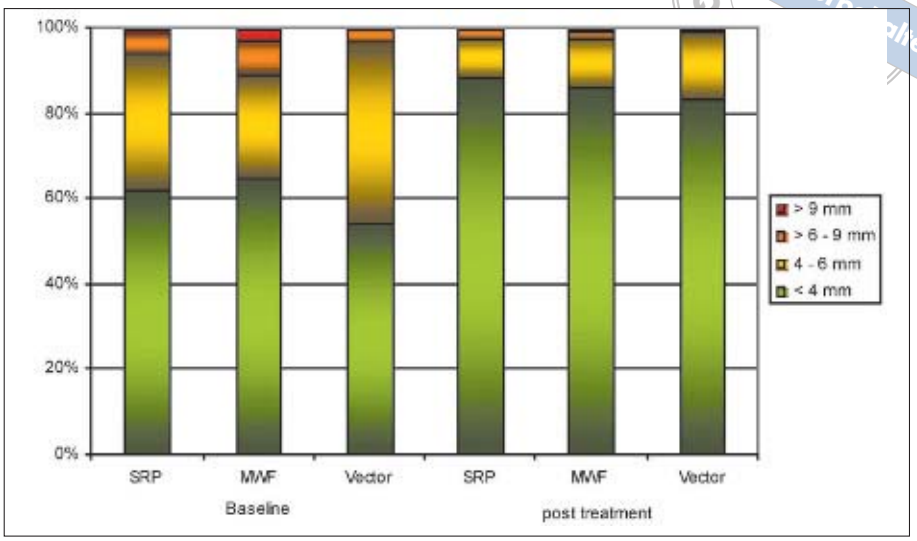

Fig 2 The measured sites were subdivided into categories. shallow (< 4 mm), moderate (4–6 mm) and deep pockets (> 6 mm; with subclasses > 6–9 mm and > 9 mm). Sites with moderate and deep pockets were reduced from 40–50% to nearly 10% in all treatment groups.

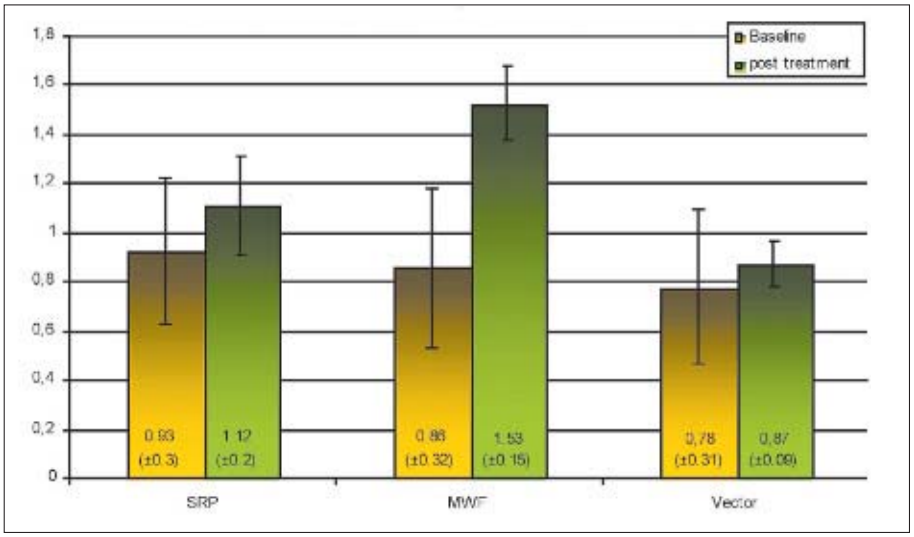

Fig 3 Mean (sd) gingival recession measurements (mm) at baseline and after treatment. There were no significant differences in gingival recession between the three treatment groups at baseline. Six months after therapy, there was a (non-significantly) lesser increase of recession in the VECTOR™ group compared to the MWF and SRP groups.

noteworthy that VECTOR™ therapy resulted in a (non-significantly) lower increase in gingival recession compared to SRP or MWF.

In previous clinical trials (Knowles et al, 1979; Lindhe, et al, 1984; Isidor, et al, 1986; Ramfjord et al, 1987; Kaldahl, et al, 1993; Shiloah et al, 1998), the effects of surgical and non-surgical treatment procedures were compared. Knowles et al (1979) compared three treatment modalities during an eight-year follow-up. The reduction of probing depth following curettage (CUR) was slightly less than that observed for MWF and pocket elimination (PEL) surgery. The MWF open debridement seemed to result in more gain of probing attachment level than the other procedures. In a five-year study of the effect of surgical (MWF) or non-surgical (root planing) periodontal treatment, Lindhe et al (1984) reported that pockets deeper than 3 mm responded equally well to both treatment procedures, an observation that is in agreement with our findings comparing surgical and non-surgical debridement after six months. Isidor and Karring (1986) compared three treatment procedures (including SRP and MWF surgery) during a five-year follow-up in 17 patients. They detected similar results for all treatment modalities. Ramfjord et al (1987) compared CUR, SRP, MWF and PEL over five years in 72 subjects. They concluded, that SRP was the treatment of choice for periodontal pockets ≤ 6 mm. For pockets ≥ 7 mm, the results were similar for all of the four methods of treatment studied, and there was no additional benefit from MWF over SRP. These conclusions are also in agreement with the results

(comparing SRP and MWF) in the present study. The relationship between clinical outcomes of different treatment modalities and the prevalence of selected periodontal pathogens were examined by Shiloah et al (1998). The choice of treatment procedure did not affect the prevalence of the target species and the different treatments showed similar clinical outcome one year post-treatment. Hung and Douglas (2002) compared in their meta-analysis changes in periodontal probing depth and attachment level following non-surgical (SRP) and surgical (MWF) treatment. They concluded that surgical treatment is more effective for reduction of probing depth but the differences between SRP and MWF tend to become smaller over time. Some authors (Pihlstrom et al, 1981; Pihlstrom et al, 1983) have favoured SRP for shallow pockets and others (Kaldahl et al, 1988) favoured SRP also for medium and deep pockets, a suggestion which is, again, in agreement with the current findings.

Subgingival debridement by SRP is the traditional method for controlling the subgingival microflora. Several studies have compared the efficiency of sonic/ultrasonic versus manual instrumentation (Torfason et al, 1979; Badersten et al, 1981; Badersten, et al, 1984; Dragoo, 1992; Takacs et al, 1993; Kocher, et al, 1998).

Badersten et al (1984) studied the effect of supra- and subgingival instrumentation in patients with advanced periodontitis. After the use of hand and ultrasonic instruments, similar improvements occurred. This confirms previous studies by Torfason et al (1979) and Badersten et al (1981) which showed that root debridement can apparently be accomplished equally well by ultrasonic and hand instrumentation. Manual instruments appeared slightly more effective but required more effort, time and expertise. Newly designed inserts appear to overcome this discrepancy (Dragoo, 1992; Takacs, et al, 1993; Kocher, et al, 1998). Cobb (2002) did not find any significant differences between manual and sonic/ultrasonic instrumentation in clinical end-points. Results from the present investigation and those reported earlier (Klinger et al, 2000) are in agreement with this conclusion in that VECTOR™ -therapy showed no significant differences to SRP and MWF in reducing pocket depths, BOP and clinical attachment level. It is also noteworthy that no differences were identified between surgical and non-surgical therapy in any clinical parameter after six months.

Sculean et al (2004) compared the clinical outcome of hand instrumentation and VECTOR™ -ultrasonic-therapy (VUS) in 38 patients. Both treatment procedures resulted in statistically significant reductions in PD and gains in CAL. No statistically significant differences between SRP and VUS were observed. These results are comparable with the results of the present study.

CONCLUSIONS

The present data indicate that non-surgical periodontal therapy with VECTORTM may lead to comparable results to those obtained following SRP and MWF surgery. Further studies with a higher number of subjects are needed to confirm these findings.

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Reprint requests
Dr Arndt Güntsch
Department of Restorative Dentistry
School of Dental Sciences
Friedrich-Schiller-University Jena
An der alten Post 4,
D-07743 Jena, Germany
Email: Arndt.Guentsch@med.uni-jena.de
Tel: +49 3641 934595