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Clinical outcomes of quadrant root planing *versus* full-mouth root planing

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Abstract

Objectives: To determine the clinical effects of full mouth compared with quadrant wise scaling and root planing.

Method: Twenty patients with chronic periodontitis ($\geqslant 2$ teeth per quadrant with probing pocket depths (PPD) $\geqslant 5$ mm and bleeding on probing (BOP) were randomized into a test group treated in two sessions with subgingival scaling and root planing within 24 h (full-mouth root planing (FMRP)) and a control group treated quadrant by quadrant in four sessions in intervals of 1 week (quadrant root planing (QRP)). PPD, relative attachment level (RAL) and BOP were recorded at baseline, 3 and 6 months.

Results: Analysing first quadrant data, in moderately deep pockets ($5\text{ mm} \leqslant \text{PPD} < 7\text{ mm}$) there was no evidence for a difference (FMRP–QRP) between both groups for PPD reduction (mean: -0.128 mm; CI: [-0.949, 0.693]; $p = 0.747$), RAL gain (mean: 0.118 mm; CI: [-0.763, 1.000]; $p = 0.781$), and BOP reduction (mean: -20.1%; CI: [-44.3, 4.2]; $p = 0.099$). Likewise, no significant differences between treatments were found for initially deep pockets ($\text{PPD} \geqslant 7$ mm), neither for first quadrant nor for whole mouth data.

Conclusion: The results of the present study demonstrated equally favourable clinical results following both treatment modalities.

Key words: chronic periodontitis; dental calculus; dental plaque; full-mouth root planing; non-surgical therapy; periodontal therapy; quadrant wise root planing

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The outcome of periodontal treatment is based on supra- and subgingival plaque control. This is assured by thorough oral hygiene to remove supragingival plaque deposits and by meticulous scaling and root planing during subgingival debridement (Petersilka et al. 2002). With subgingival debridement it is possible to reduce total viable bacterial counts (Petersilka et al. 2002), reduce pocket depths and improve clinical attachment levels (Van der Weijden & Timmerman 2002), which assures effective treatment of chronic periodontitis and long-term stability.

Consequently, if periodontopathogenic bacteria are only partly eliminated from the periodontal pocket, recolonisation of periodontal pockets and re-inflammation can occur. Not only bacteria from treated periodontal sites, but also bacteria from untreated pockets may jeopardise treatment outcomes. Dorsum of the tongue, tonsils and other oral niches function as sources of reinfection during healing (Koshy et al. 2004).

An alternative treatment method to conventional quadrant wise scaling and root planing has been described. Quirynen et al. (1995) compared full-mouth and partial mouth disinfection. In a treatment model of full-mouth disinfection they completed all scaling and root planing within 24 h supplemented with supra- and subgingival use of chlorhexidine. This pilot study showed that full-mouth disinfection yielded better periodontal treatment results, when compared with conventional quadrant wise scaling and root planing. In the following studies from the same group (Vandekerckhove et al. 1996, Bollen et al. 1998) results were confirmed with respect to clinical and microbiological data. In the group of patients treated with full-mouth disinfection significantly higher reductions in bleeding on probing (BOP) were shown. The reduction of probing depths for moderately deep (5–6 mm) and deep pockets ($\geqslant 7$ mm) was more pronounced in this group. Attachment level gain was also significantly higher in the full-mouth disinfection group for deep and moderately deep pockets. They concluded that benefits of full-mouth disinfection depended on the intensive intervention on all niches in the oral cavity within a short time and on the use of chlorhexidine.

The role of chlorhexidine in the treatment model of full-mouth disinfection was investigated by Quirynen et al. (2000). In this study three groups of patients with advanced adult periodontitis were treated with three different strategies over a period of 8 months. One group was treated quadrant by quadrant with scaling and root planing with two weeks intervals, the second group was treated with full-mouth disinfection using chlorhexidine as an adjunct. Data from these two groups were derived from Mongardini et al. (1999). Quirynen et al. (2000) added an additional test group without the use of chlorhexidine, which was described as full-mouth root planing. Only negligible differences were found between the two full-mouth treatment strategies. Still, better clinical and microbiological results were reached with full-mouth disinfection or full-mouth root planing (FMRP) then with quadrant wise scaling and root planing.

Lately, another group has tested the hypothesis of an improved periodontal response after FMRP in comparison with quadrant wise treatment at 2 weeks intervals over a period of 6 months (Apatzidou & Kinane 2004). Both therapies improved periodontal status with respect to clinical parameters, however, with the exception of very few deep sites, the authors failed to find any greater improvement in the group treated with FMRP in contrast to the patients treated with quadrant wise root planing with respect to reduction of bleeding on probing, probing pocket depths (PPD) and attachment level gain.

Very recently, Koshy et al. (2005) reported the results of ultrasonic treatment in three patient groups: a control group treated with quadrant wise ultrasonic scaling with 1 week intervals and two test groups. In both test groups patients were treated with full-mouth ultrasonic scaling in one session; one group with water, the other with povidone iodine as coolant. They concluded, that single visit full-mouth mechanical debridement may have limited additional benefits over quadrant wise therapy, but can be completed in shorter time. This led Kinane (2005) to the assumption that a single-visit, full-mouth ultrasonic debridement might constitute a paradigm shift in periodontal therapy. Wennström et al. (2005) compared full-mouth subgingival debridement with ultrasonic instruments in one session and quadrant scaling/root planing with hand instruments at intervals of 1 week. No statistically significant differences were found for bleeding on probing, probing depths and relative attachment level (RAL) at the various examination intervals.

Thus, at present there are conflicting results reported in the literature and data from other centres are needed to further explore the utility of FMRP in the treatment of chronic periodontitis.

Therefore, the aim of this study was to determine the clinical effects after 3 and 6 months of FMRP compared with conventional quadrant wise root planing.

Material and Methods

Patients

A total of 20 adult patients (all caucasians, 53.1 ± 10.2 years of age, nine females and 11 males) with chronic periodontitis volunteered in the present study. All patients were in good general health, no pregnant females were allowed to participate in this study. None of the patients had received any periodontal or antibiotic treatment during the last six months. Patients had more than 20 teeth, with at least two teeth per quadrant with a probing depth of 5 mm or more and bleeding on probing. According to the study from Quirynen et al. (2000) patients were considered as smokers if they were smoking more than 10 cigarettes a day for more than 5 years (Kinane & Radvar 1997).

Study design

All patients who fulfilled the inclusion criteria and agreed to participate in the study signed an informed consent. The study had been approved by an international ethics committee (IRB/IEC, Freiburg, Germany).

At a baseline visit clinical measurements were performed. Patients were randomized into two groups according to a computer generated list provided by an external agent. Patient characteristics are presented in Table 1, the time schedule of the study is shown in Fig. 1.

Clinical parameters

Clinical parameters were assessed prior to the first session of scaling and root planing, 3 and 6 months later. All measurements were performed by one blinded examiner.

Full mouth PPD were recorded with a computerized constant force probe (Florida Probe®, Gainesville, FL, USA) at six sites per tooth. Using an individual stent trimmed to follow the gingival margin in about a distance of 1 mm, the RAL was also recorded at the same six sites per tooth. Both PPD and RAL were measured to the nearest whole millimeter. Bleeding on probing

Table 1. Patient characteristics at baseline

	QRP ($n = 10$)	FMRP ($n = 10$)
Age	49.1 ± 8.6	56.3 ± 11.1
Male/female	4/6	5/5
Smoker	1	1
Plaque index (O'Leary)(%)	16.1 ± 8.8	14.9 ± 6.8
Bleeding on probing (BOP)(%)	22.1 ± 12.4	16.9 ± 13.7

FMRP, Full-mouth root planing; QRP, quadrant root planing.

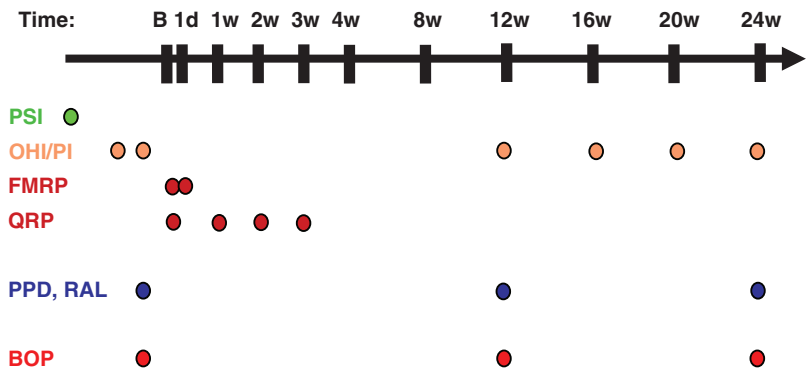

Fig. 1. Study design.

(BOP) was also recorded concomitantly with PPD and RAL. The presence or absence of plaque was determined and calculated in percent on the basis of total measurement points of the patient.

Treatment

Each patient was given repeated oral hygiene training until a low plaque score (<20%) was obtained. Oral hygiene was reinforced at 3, 4, 5 and 6 months.

In the test group 10 patients were treated in two sessions with subgingival scaling and root planing within 24 h (FMRP) without use of any antibiotics or antiseptics. In the control group the other 10 patients were also treated with subgingival scaling and root planing without use of any antibiotics or antiseptics, quadrant by quadrant clockwise in four sessions in intervals of 1 week (quadrant root planing (QRP)). In both groups treatment always started in the right maxillary quadrant.

Scaling and root planing was performed under local anaesthesia using periodontal hand instruments (Gracey curettes, Hu-Friedy, Chicago, IL, USA) and sonic scalers (Sonicflex, KaVo, Biberach, Germany). All patients were asked to abstain from mouthwashes, they were all asked to use the same type of toothbrush (Meridol®, Gaba International, Münchenstein, Switzerland), inter-dental brushes (TePe®, Munhygienprodukte AB, Malmö, Sweden) and toothpaste (Meridol®, Gaba International).

Treatment was continued in one week intervals in a clockwise mode. In the test group (FMRP) treatment was always provided in two sessions within 24 h on 2 consecutive days, starting with the right maxillary and mandibulary quadrants. The reason for starting in the same quadrant in both QRP and FMRP was to allow the same time for healing in the right maxillary quadrant until re-evaluation to facilitate the comparison between the groups.

Duration of scaling and root planing was about 1 hour per quadrant in both groups, so that total time spent for each patient averaged 4 hours, independent of group affiliation.

Statistical analysis

As basis for all statistical computations mean PPD, RAL and BOP values for each patient were calculated, summarising the values of moderately deep and deep pockets respectively at baseline, after 3 and 6 months. Changes from baseline were compared between both treatment groups (FMRP − QRP) by two-sided two sample *t*-tests. A level of 5% was pre-specified for the test of the primary hypothesis of equal changes in mean PPD in both groups. All other comparisons were primarily descriptive, though statistical tests were applied and *p*-values are given. The comparisons of values after 3 and 6 months with baseline values are based on one-sample *t*-tests comparing the mean changes to zero.

A χ^2 test was used to test for differences in proportions of numbers of sites with PPD ⩽ 4 mm between QRP and FMRP treatment groups.

Results

Maxillary right quadrant

The clinical changes observed in the moderately deep pockets (5 mm ⩽ PPD < 7 mm) are displayed in Table 2. After 3 and 6 months, a reduction of PPD and BOP and gain in RAL in the moderately deep pockets could be recorded following both treatments ($p < 0.01$; $p < 0.001$; $p < 0.05$), There was no evidence for a difference between test and control groups comparing baseline and 6 months data for PPD reduction (mean: − 0.128 mm; CI: [− 0.949, 0.693]; $p = 0.747$), RAL gain (mean: 0.118 mm; CI: [− 0.763, 1.000]; $p = 0.781$), and BOP reduction (mean: − 20.1%; CI: [− 44.3, 4.2]; $p = 0.099$). The relative change of BOP (relBOP) was calculated in relation to the baseline value and showed a comparable reduction for the percentage of bleeding sites following both treatments.

In initially deep pockets (PPD ⩾ 7 mm), there was no significant difference between test and control groups comparing baseline and 6 months data for PPD reduction (mean: − 0.126 mm; CI: [− 3.319, 3.067]; $p = 0.933$), RAL

Table 2. Clinical findings of the maxillary right quadrant (mean ± SD), moderately deep pockets (5 mm ⩽ PPD < 7 mm)

	baseline	3 months	6 months	baseline − 3 months	baseline − 6 months	mean difference (baseline − 6 months) Confidence interval
PPD (mm)						
QRP	5.5 ± 0.16	3.8 ± 0.49	4.0 ± 0.90	1.8 ± 0.55***	1.6 ± 0.95***	− 0.128
FMRP	5.3 ± 0.22	4.1 ± 0.79	3.9 ± 0.73	1.3 ± 0.89**	1.5 ± 0.79***	[− 0.949, 0.693]
RAL (mm)						
QRP	6.5 ± 1.14	5.5 ± 0.67	5.6 ± 1.37	1.0 ± 0.91**	1.0 ± 0.97**	0.118
FMRP	6.3 ± 0.92	5.6 ± 1.19	5.3 ± 1.17	0.7 ± 0.92*	1.1 ± 0.91**	[− 0.763, 1.000]
BOP (%)						
QRP	88.0 ± 17.6	15.3 ± 18.7	27.1 ± 18.9	72.7 ± 25***,#	60.8 ± 21***	− 20.1
FMRP	56.2 ± 25.2	24.2 ± 18.2	15.5 ± 18.3	32.0 ± 20***,#	40.8 ± 30***	[− 44.3, 4.2]
relBOP (%)						
QRP	88.0 ± 17.6	15.3 ± 18.7	27.1 ± 18.9	81.6 ± 22.1	68.8 ± 20.2	
FMRP	56.2 ± 25.2	24.2 ± 18.2	15.5 ± 18.3	60.4 ± 29.6	71.5 ± 36.3	

$N_{(QRP)} = 10$ patients, $N_{(FMRP)} = 10$ patients.
*$p < 0.05$,
**$p < 0.01$,
***$p < 0.001$; *p*-values represent longitudinal changes from baseline within QRP and FMRP groups
#$p < 0.001$; p-values represent differences between QRP and FMRP.
BOP, bleeding on probe; PPD, probing pocket depth; FMRP, Full mouth root planing; QRP, quadrant root planing; RAL, relative attachment level; relBOP, relative change of BOP.

Table 3. Clinical findings of the maxillary right quadrant (mean ± SD), deep pockets (PPD ⩾ 7 mm)

	baseline	3 months	6 months	baseline – 3 months	baseline – 6 months	mean difference (baseline – 6 months) Confidence interval
PPD (mm)						
QRP	7.3 ± 0.52	5.3 ± 1.21	5.8 ± 0.99	2.0 ± 0.78***	1.5 ± 1.01**	– 0.126
FMRP	7.2 ± 0.37	5.5 ± 1.69	5.8 ± 3.80	1.6 ± 1.60*	1.4 ± 3.74	[– 3.319, 3.067]
RAL (mm)						
QRP	7.7 ± 1.00	6.2 ± 1.40	6.8 ± 1.43	1.6 ± 1.19**	0.9 ± 1.49	– 0.840
FMRP	7.8 ± 0.70	7.0 ± 1.45	7.7 ± 2.48	0.8 ± 1.05	0.1 ± 2.19	[– 3.026, 1.345]
BOP (%)						
QRP	92.4 ± 13.6	44.3 ± 36.3	81.4 ± 28.0	48.1 ± 43*	11.0 ± 35	11.2
FMRP	84.3 ± 27.0	38.6 ± 45.6	62.1 ± 45.1	45.7 ± 51	22.2 ± 54	[– 41.8, 64.2]
relBOP (%)						
QRP	92.4 ± 13.6	44.3 ± 36.3	81.4 ± 28.0	48.9 ± 42.6	8.4 ± 38.7	
FMRP	84.3 ± 27.0	38.6 ± 45.6	62.1 ± 45.1	50.0 ± 50.0	14.3 ± 62.7	

$N_{(QRP)} = 10$ patients, $N_{(FMRP)} = 10$ patients.
*$p < 0.05$,
**$p < 0.01$,
***$p < 0.001$; p-values represent longitudinal changes from baseline within QRP and FMRP groups.
BOP, bleeding on probe; PPD, probing pocket depth; FMRP, Full mouth root planing; QRP, quadrant root planing; RAL, relative attachment level; relBOP, relative change of BOP.

Table 4. Whole-mouth clinical findings (mean ± SD), moderately deep pockets (5 mm ⩽ PPD < 7 mm)

	baseline	3 months	6 months	baseline–3 months	baseline – 6 months	mean difference (baseline – 6 months) Confidence interval
PPD (mm)						
QRP	5.4 ± 0.19	3.7 ± 0.44	3.5 ± 0.59	1.7 ± 0.48***	1.8 ± 0.54***	– 0.205
FMRP	5.4 ± 0.14	3.9 ± 0.74	3.7 ± 0.55	1.5 ± 0.77***	1.6 ± 0.56***	[– 0.723, 0.313]
RAL (mm)						
QRP	6.3 ± 0.68	5.3 ± 0.65	5.4 ± 1.07	1.0 ± 0.57***	0.9 ± 0.70**	0.205
FMRP	6.0 ± 0.41	5.1 ± 0.75	4.9 ± 0.68	0.9 ± 0.83**	1.1 ± 0.61***	[– 0.412, 0.821]
BOP (%)						
QRP	72.6 ± 16.2	17.0 ± 8.7	23.4 ± 13.4	55.6 ± 20***,#	49.3 ± 22***	– 6.0
FMRP	57.6 ± 20.7	22.7 ± 15.1	14.4 ± 12.1	34.9 ± 20***,#	43.2 ± 19**	[– 25.7, 13.6]
relBOP (%)						
QRP	72.6 ± 16.2	17.0 ± 8.7	23.4 ± 13.4	75.1 ± 12.7	66.6 ± 20.4	
FMRP	57.6 ± 20.7	22.7 ± 15.1	14.4 ± 12.1	59.8 ± 28.3	75.0 ± 23.0	

$N_{(QRP)} = 10$ patients, $N_{(FMRP)} = 10$ patients.
*$p < 0.05$,
**$p < 0.01$,
***$p < 0.001$; p-values represent longitudinal changes from baseline within QRP and FMRP groups.
#$p < 0.05$, p-values represent differences between QRP and FMRP.
BOP, bleeding on probe; PPD, probing pocket depth; FMRP, Full mouth root planing; QRP, quadrant root planing; RAL, relative attachment level; relBOP, relative change of BOP.

gain (mean: – 0.840 mm; CI: [– 3.026, 1.345]; $p = 0.418$), and BOP reduction (mean: 11.2%; CI: [– 41.8, 64.2]; $p = 0.654$) (Table 3).

Whole mouth

The clinical changes observed in the moderately deep pockets (5 mm ⩽ PPD < 7 mm) are shown in Table 4. Significant reductions of PPD were found after 3 and 6 months in both groups ($p < 0.001$). Improvements for RAL and BOP after 3 and 6 months were also found in both groups ($p < 0.01$). There was no evidence for a difference between test and control groups comparing baseline and 6 months data for PPD reduction (mean: – 0.205 mm; CI: [– 0.723, 0.313]; $p = 0.417$), RAL gain (mean: 0.205 mm; CI: [– 0.412, 0.821]; $p = 0.494$), and BOP reduction (mean: – 6.0%; CI: [– 25.7, 13.6]; $p = 0.528$).

In initially deep pockets (PPD ⩾ 7 mm), there was no significant difference between test and control groups comparing baseline and 6 months data for PPD reduction (mean: – 0.392 mm; CI: [– 1.919, 1.136]; $p = 0.594$), RAL gain (mean: – 0.682 mm; CI: [– 2.067, 0.703]; $p = 0.312$), and BOP reduction (mean: 11.6%; CI: [– 21.8, 44.9]; $p = 0.472$) (Table 5).

The number of sites with PPD of 4 mm or less was elevated after 3 and 6 months (Table 6). A slightly higher proportion of pockets with PPD ⩽ 4 mm was found in the FMRP group compared with the QRP group at all times.

For the calculation of the proportion of sites with a clinically significant

Table 5. Whole-mouth clinical findings (mean ± SD), deep pockets (PPD ⩾ 7 mm)

	baseline	3 months	6 months	baseline – 3 months	baseline – 6 months	mean difference (baseline – 6 months) Confidence interval
PPD (mm)						
QRP	7.5 ± 0.34	5.4 ± 0.95	5.4 ± 1.06	2.2 ± 0.99**	2.1 ± 1.35***	– 0.392
FMRP	7.3 ± 0.42	4.7 ± 1.44	5.6 ± 1.68	2.6 ± 1.17***	1.7 ± 1.69**	[– 1.919, 1.136]
RAL (mm)						
QRP	8.1 ± 0.76	6.5 ± 0.78	6.7 ± 1.16	1.6 ± 1.18**	1.4 ± 1.69*	– 0.682
FMRP	7.6 ± 0.50	6.0 ± 1.42	6.9 ± 1.09	1.6 ± 1.05**	0.7 ± 0.99	[– 2.067, 0.703]
BOP (%)						
QRP	85.1 ± 14.2	40.9 ± 24.8	60.2 ± 21.5	44.2 ± 34**	24.8 ± 23**	11.6
FMRP	84.8 ± 19.0	31.6 ± 36.5	48.4 ± 32.2	53.2 ± 41**	36.4 ± 41*	[– 21.8, 44.9]
relBOP (%)						
QRP	85.1 ± 14.2	40.9 ± 24.8	60.2 ± 21.5	48.8 ± 31.3	28.3 ± 23.2	
FMRP	84.8 ± 19.0	31.6 ± 36.5	48.4 ± 32.2	61.0 ± 42.2	38.1 ± 40.1	

$N_{(QRP)} = 10$ patients, $N_{(FMRP)} = 10$ patients.
*$p < 0.05$,
**$p < 0.01$,
***$p < 0.001$; p-values represent longitudinal changes from baseline within QRP and FMRP groups.
BOP, bleeding on probe; PPD, probing pocket depth; FMRP, Full mouth root planing; QRP, quadrant root planing; RAL, relative attachment level; relBOP, relative change of BOP.

Table 6. Changes in numbers (%) of sites with PPD ⩽ 4 mm

	Baseline	3 months	6 months
Whole mouth			
QRP	1136 (77.2)	1299 (88.4)	1200 (83.2)
FMRP	1323 (84.1)	1422 (90.3)	1440 (91.4)
Upper right quadrant			
QRP	279 (77.9)	313 (88.1)	310 (87.4)
FMRP	325 (77.8)	366 (87.9)	372 (89.1)

$N_{(QRP)} = 1470$ Sites, $N_{(FMRP)} = 1572$ Sites (whole mouth).
$N_{(QRP)} = 354$ Sites, $N_{(FMRP)} = 414$ Sites (upper right quadrant).
No statistically significant differences were noted between QRP and FMRP treatment groups ($p > 0.05$).
PPD, probing pocket depth; FMRP, Full mouth root planing; QRP, quadrant root planing.

Table 7. Number (%) of sites with a change of attachment ⩾ 2 mm

	Baseline – 3 months	Baseline – 6 months
Attachment loss ⩾ 2 mm		
QRP	160 (11.5)	184 (12.8)
FMRP	171 (11.2)	171 (11.0)
Attachment gain ⩾ 2 mm		
QRP	213 (14.6)	194 (13.5)
FMRP	203 (13.2)	184 (11.8)

$N_{(QRP)} = 1470$ sites, $N_{(FMRP)} = 1572$ sites (whole mouth).
FMRP, Full mouth root planing; QRP, quadrant root planing.

change of attachment (gain or loss), a threshold level of 2 mm of change was chosen. The comparison of both groups after 3 and 6 months showed a similar frequency of such sites following both treatment modalities (Table 7).

Discussion

Noticeable improvements were found in the present study after both treatment modalities with respect to all clinical parameters. To facilitate a comparison of the present results with the findings of previous studies (Badersten et al. 1981, 1984, Cobb 1996, Quirynen et al. 2000, Apatzidou & Kinane 2004), sites were classified according to their initial probing depth in moderately deep and deep pockets.

Earlier studies have reported data on the outcome of quadrant wise root planing. The reduction of 1.8 mm for PPD following QRP in the present study is comparable with the findings of Badersten et al. (1981), who reported a PPD reduction of 1.3–1.7 mm in moderately deep pockets. In deep pockets Badersten et al. (1984) found a reduction of PPD between 2.3 and 3.0 mm, whereas in the present study mean reductions in deep pockets of 2.1 mm were achieved. However, the studies of Badersten et al. included only single rooted teeth. It is well known that molar furcation sites respond less favourably to non-surgical periodontal therapy (Nordland et al. 1987, Loos et al. 1989). Marked gains of attachment levels and reductions in BOP were also demonstrated in the studies of Badersten et al. (1981, 1984), equal to the findings in both groups in the present study.

In a meta-analysis of studies on non-surgical pocket therapy Cobb (1996) found a mean reduction of PPD in deep pockets of 2.16 mm, and in moderately deep pockets a reduction of 1.29 mm. The present study showed concordant reductions in deep pockets and comparatively higher reductions in moderately deep pockets following QRP. Cobb (1996) also reported a gain of attachment in deep (1.19 mm) as well as in moderately deep pockets (0.55 mm). In the present study slightly higher gains of clinical attachment were found for both pocket categories. Thus, the results for the control group (QRP) in the present study are in good agreement with reported data in the literature.

The present study was designed to facilitate a comparison between this conventional treatment approach and a novel procedure (FMRP). The sample size of 20 patients randomized into the two treatment groups was initially chosen to be able to detect a difference in reduction of PPD from baseline to 6 months of at least 1 mm with a power of 80%, assuming a standard deviation of the change from baseline of 0.75 mm.As an empirical standard deviation of 0.55 mm for the difference between 6 months and baseline was found, the present study would have been able to detect a difference of 0.73 mm and more with a power of 80%.

In moderately deep pockets, FMRP led to similar pocket reductions as QRP, 3 and 6 months results showed no significant difference between both groups. In deep pockets, a greater reduction of PPD was found for FMRP as for QRP after 3 months, after 6 months there was an opposite trend, however, differences between groups failed to reach statistical significance. These findings are in accordance with the results reported by Apatzidou & Kinane (2004), who also failed to find statistically significant differences between both treatment modalities.

With respect to attachment levels Apatzidou & Kinane (2004) reported a significant greater attachment gain in the FMRP compared with the QRP group in a few selected deep sites after 25 weeks. In the present study more advantageous results were obtained with QRP in deep pockets after 3 and 6 months, however these differences were not found to be significant.

For BOP a slight difference between both groups was found at baseline. To compensate for this we calculated the relative change of bleeding on probing (relBOP) and found no significant differences between both treatment approaches at 6 months, what is in agreement with the results of Apatzidou & Kinane (2004).

In both studies, the conventional treatment group exhibited a good response, comparable with the full-mouth-treated groups, despite slight differences in study design: 1 week intervals *versus* 2 weeks intervals for the QRP group, treatment within 24 *versus* 12 h in the FMRP group.

In contrast, a series of clinical trials reported that a protocol of one-stage full-mouth disinfection led consistently to superior outcomes when compared with conventional QRP at 2 weeks intervals (Quirynen et al. 1995, 2000, Vandekerckhove et al. 1996, Bollen et al. 1998, Mongardini et al. 1999). Only one study evaluated the benefits of FMRP without the use of chlorhexidine (Quirynen et al. 2000) and compared those with the results of Mongardini et al. (1999), all data derived from first quadrant.

In the present study analysing first quadrant data for moderately deep pockets, greater PPD reductions of 1.6 mm were achieved following QRP, in comparison with the study of Quirynen et al. (2000) who found PPD reductions of 1.0 mm for single-rooted teeth and 0.7 mm for multi-rooted teeth, respectively. In deep pockets Quirynen et al. (2000) reported slightly greater PPD reductions of 1.9 mm for single-rooted and 1.6 mm for multi-rooted teeth *versus* mean reductions of 1.5 mm in this study. The corresponding values for gains of attachment levels for moderate and deep pockets were greater in the present study than those reported by Quirynen.

With the full-mouth approach higher reductions of PPD were achieved by Quirynen et al. (2000) for moderately deep and deep pockets *versus* the FMRP group in the present study (2.2/2.0 mm and 3.3/2.9 mm for single-rooted/multi-rooted teeth *versus* 1.5 mm and 1.4 mm). Also, for changes in attachment and BOP more advantageous results were reported by Quirynen et al. (2000).

In summary, the comparison with data by Quirynen et al. (2000) demonstrates less favourable outcomes for the test group (FMRP) in the present study but superior outcomes for the control group (QRP). However, as stated above the results for the control group (QRP) in the present study are in good agreement with reported data in the literature.

The discrepancies between the results of both studies might be because of differences in diagnostic techniques and study design such as: probing time point (before *versus* after root instrumentation), type of probe (computerized constant force probe and a stent *versus* manual probe), supragingival plaque control (high standard of oral hygiene *versus* lack of oral hygiene instruction at baseline), differing intervals between treatments in the QRP group (1 *versus* 2 weeks) and re-evaluation time points (3 and 6 *versus* 4 and 8 months), severity of the disease, and the use of a parallel *versus* a historic control group.

Very recently Koshy et al. (2005) reported limited additional benefits of FMRP in comparison with quadrant wise treatment at 1 week intervals. They observed a significant greater reduction in number of pockets $\geqslant 5$ mm in the full-mouth-treated group. Even though in the present study similar trends were observed, this reduction failed to reach statistical significance. However, Koshy et al. (2005) found similar reductions in probing depths and gains of attachment for both treatments, with no evidence of any difference between groups. Thus, their findings, the data by Apatzidou & Kinane (2004) and the outcomes of the present study are in good agreement.

In summary, based on the present findings we conclude that both treatment modalities, quadrant wise and full-mouth root planing, have been able to show comparable beneficial changes in the periodontal status, and should both be considered as valid treatment approaches in the treatment of patients with chronic periodontitis.

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Clinical Relevance

Scientific rationale for the study: In an attempt to enhance treatment outcomes, alternative protocols for subgingival scaling and root planing have been proposed. Various studies have suggested superior results of full-mouth disinfection and FMRP *versus* the standard quadrant wise approach.

Principal findings: This study could not confirm the benefits of scaling and root planing within 24 h compared with treatment over several sessions.

Practical implications: Both modalities improved the periodontal status and should be considered as valid alternative treatment approaches. Thus, the choice of treatment should be made with respect to patient and operator preference.