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Full-mouth treatment concepts for chronic periodontitis: a systematic review

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Abstract

Objectives: To systematically review the effectiveness of full-mouth treatment concepts for chronic periodontitis.

Material and Methods: A search was conducted for randomized, controlled clinical trials including full-mouth scaling with (FMD) or without (FMS) the use of antiseptics and quadrant scaling (control). Data sources included COHG, CENTRAL, MEDLINE and EMBASE. Reviewers independently conducted data abstraction and quality assessment. The primary outcome was tooth loss; secondary outcomes were the reductions of PPD and BOP and a gain of CAL.

Results: Of 216 identified abstracts, seven trials were included. Meta-analysis revealed a weighted mean difference (WMD) for the reduction of PPD between FMD and control of 0.53 mm [95% confidence interval (CI) (0.28, 0.77), $p<0.0001$] in moderately deep pockets of single-rooted teeth. The WMD for gain in CAL was 0.33 mm [95% CI (0.04, 0.63), $p = 0.03$] in moderately deep pockets of single- and multi-rooted teeth. Comparing FMD and FMS, the WMD for the reduction of CAL amounted to 0.74 mm [95% CI (0.17, 1.31), $p = 0.01$] in deep pockets of multi-rooted teeth in favour of FMS. For BOP a WMD –18.0% [95% CI (− 34.30, − 1.70), $p = 0.03$] was calculated in deep pockets of single-rooted teeth in favour of FMD.

Conclusions: In adults with chronic periodontitis only minor differences in treatment effects were observed between the treatment strategies.

Key words: chlorhexidine; disinfection; periodontal treatment; periodontitis; systematic review

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Some 5–15% of the population suffer from severe, generalized periodontitis, although mild to moderate periodontitis affects the majority of adults (Burt 2005). Periodontitis is seen as resulting from a complex interplay of bacterial infection and host response, modified by behavioural and systemic risk factors. The therapy of chronic periodontitis is principally based on the mechanical removal of subgingival biofilms from colonized root surfaces in order to arrest and control inflammatory processes (Van der Weijden & Timmerman 2002). There is considerable evidence to support scaling and root planing (SRP) as one of the most effective procedures for the treatment of infectious periodontal diseases (Heitz-Mayfield et al. 2002).

In patients with periodontitis, key pathogens such as *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis* and *Prevotella intermedia* were found to colonize nearly all niches in the oral cavity, such as the tongue, the mucosa, the saliva or the tonsils (Beikler et al. 2004). These findings confirmed the results of earlier studies, where black-pigmented Bacteroides species were found not only subgingival in the periodontal pocket, but also at various sites in the oral cavity such as tonsils, dorsum of the tongue and saliva (Zambon et al. 1981, Van Winkelhoff et al. 1988). A translocation of these pathogens may occur rapidly and a recently root-planed deep pocket might be re-colonized from the remaining untreated pockets or from other intra-oral niches, before a less pathogenic ecosystem can be established (Van Winkelhoff et al. 1988).

Conflict of interest and source of funding statement

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Based on this hypothesis, a full-mouth disinfection (FMD) approach consisting of scaling and root planing of all pockets in two visits within 24 h in combination with adjunctive chlorhexidine treatments of all oral niches has been proposed (Quirynen et al. 1995), which was subsequently evaluated in a series of studies by the same research group (Vandekerckhove et al. 1996, Bollen et al. 1998, Mongardini et al. 1999). A later report indicated that this full-mouth treatment approach resulted in superior clinical outcomes and microbiological effects than clockwise quadrant scaling and root planing (control), irrespective of the adjunctive use of chlorhexidine (Quirynen et al. 2000). More recent studies from other research centres, however, failed to demonstrate an advantage of full-mouth scaling (FMS) within 24 h *versus* quadrant scaling (Apatzidou & Kinane 2004, Koshy et al. 2005, Wennström et al. 2005, Jervøe-Storm et al. 2006, Quirynen et al. 2006a, Zanatta et al. 2006).

To date, no systematic review has been conducted to address the issue of full-mouth treatment concepts, which may have great impact on clinical practice. The purpose of this systematic review was to evaluate the clinical effects of FMD or FMS compared with conventional quadrant scaling and root planing for the treatment of chronic periodontitis. This paper is based on a Cochrane review published in *The Cochrane Library* 2008, Issue 1 (see www.thecochranelibrary.com for information). Cochrane Reviews are regularly updated as new evidence emerges and in response to feedback, and *The Cochrane Library* should be consulted for the most recent version of the review.

Material and Methods

Study selection

Randomized, controlled clinical trials (RCT) of at least 3 months follow-up were considered for this review. The participants of the included studies had a clinical diagnosis of chronic periodontitis based on the international classification of periodontal diseases (Armitage 1999). Data from studies on patients with aggressive periodontitis were not included. Types of interventions were as follows: (1) FMD comprising scaling and root planing of all quadrants within 24 h with the additional use of an anti-infective agent. Adjunctive treatments could include rinsing, pocket irrigation, spraying of the tonsils and tongue brushing with an anti-infective agent or the use of an anti-infective coolant instead of water during ultrasonic instrumentation. (2) FMS. All FMS approaches were included as long as the treatment was completed within 24 h. (3) Quadrant scaling and root planing (control) was carried out in four sessions separated by intervals of at least 1 week.

Outcome variables

The primary outcome variable was tooth loss. Secondary outcomes were changes in probing depth, changes in clinical attachment levels and changes in bleeding on probing. Factors that were recorded to assess the heterogeneity of outcome across studies were plaque levels, time allowed for treatment, age of patients, initial probing depth, smoking status and study quality.

Search strategy

The Cochrane Oral Health Group Trials Register (1965 to December 2006), the Cochrane Central Register of Controlled Trials (1965 to December 2006), MEDLINE (1966 to December 2006) and EMBASE (1980 to December 2006) were searched. The searches attempted to identify all relevant trials irrespective of language. Members of The Cochrane Collaboration translated papers that were not in English. Sensitive search strategies were developed for each database using a combination of free text and MeSH terms (Table 1).

Incomplete information and ambiguous data were researched further by contacting the author and/or researcher responsible for the study directly. For unpublished material the conference proceedings of the International Association for Dental Research, the American Academy of Periodontology and the European Federation of Periodontology were searched. Relevant 'in press' manuscripts were sought from *Journal of Clinical Periodontology*, *Journal of Periodontology*, *Journal of Dental Research* and *Journal of Periodontal Research* and by contact with the journal editors. The following journals have been identified as being important for this review to be hand searched by the reviewers (J. E. and S. J.) for the period 1980 to present: *Journal of Periodontology*, *Journal of Clinical Periodontology* and *Journal of Periodontal Research*.

Table 1. Searches

Database	Search strategy
CENTRAL	#1 Exp PERIODONTAL DISEASES #2 periodont* #3 ((dental near scaling) or (tooth near scaling) or (tooth near scale*) or (teeth near scaling) or (teeth near scaled) or (supragingival next scaling) or (subgingival next scaling)) #4 Exp DENTAL PROPHYLAXIS #5 ((dental near prophylaxis) or (oral next prophylaxis)) #6 ((root near plane*) or (root near planning)) #7 ((mechanical* near debride*) or (periodontal next debridement)) #8 (subgingival near curettage) #9 Exp SUBGINGIVAL CURRETTAGE #10 (pocket near irrigat*) #11 CHLORHEXIDINE #12 chlorhexidine #13 (eludril or chlorohex or corsodyl) #14 #1 or #2 #15 (#3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13) #16 ((full-mouth near disinfection) or ((full next mouth) near disinfection) or ((full next mouth) near scaling) or (full-mouth near scaling) or (full-mouth near root-planing) or ((full next mouth) near (root next planing)) or (full-mouth near debridement) or ((full next mouth) near debridement)) #17 #14 AND #15 AND #16
MEDLINE search strategy for OVID	1. exp Periodontal Diseases/ 2. periodont$.mp. [mp = title, original title, abstract, name of substance, mesh subject heading]

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Table 1. (Contd.)

Database	Search strategy
	3. ((dental adj6 scaling) or (tooth adj6 scaling) or (tooth adj6 scale$) or (teeth adj6 scaling) or (teeth adj6 scale$) or (supragingival$ adj (scaling or scale$)) or (subgingival$ adj (scaling or scale$))).mp. [mp = title, original title, abstract, name of substance, mesh subject heading] 4. exp Dental Prophylaxis/ 5. (dental prophylaxis or oral prophylaxis).mp. [mp = title, original title, abstract, name of substance, mesh subject heading] 6. ((root adj plane$) or (root adj6 planing)).mp. [mp = title, original title, abstract, name of substance, mesh subject heading] 7. ((mechanical$ adj6 debride$) or periodontal asj debridem$).mp. [mp = title, original title, abstract, name of substance, mesh subject heading] 8. (subgingival adj curettage).mp. [mp = title, original title, abstract, name of substance, mesh subject heading] 9. exp Subgingival Curettage/ 10. (pocket adj6 irrigat$).mp. [mp = title, original title, abstract, name of substance, mesh subject heading] 11. CHLORHEXIDINE/ 12. chlorhexidine.mp. [mp = title, original title, abstract, name of substance, mesh subject heading] 13. (Eludril or Chlorohex or corsodyl).mp. [mp = title, original title, abstract, name of substance, mesh subject heading] 14. or/1-2 15. or/3-13 16. ((full-mouth adj6 disinfection) or (full mouth adj6 disinfection) or (full mouth adj6 debridement) or (full mouth adj6 debridement) or full mouth scaling or full-mouth scaling).mp. [mp = title, original title, abstract, name of substance, mesh subject heading] 17. 14 and 15
CINAHL – via OVID search strategy	1. exp Periodontal Diseases/ 2. periodont$.mp. [mp = title, cinahl subject headings, abstract, instrumentation] 3. ((dental adj6 scaling) or (tooth adj6 scaling) or (tooth adj6 scale$) or (teeth adj6 scaling) or (teeth adj6 scale$) or (supragingival$ adj (scaling or scale$)) or (subgingival$ adj (scaling or scale$))).mp. [mp = title, cinahl subject headings, abstract, instrumentation] 4. exp Dental Prophylaxis/ 5. (dental prophylaxis or oral prophylaxis).mp. [mp = title, cinahl subject headings, abstract, instrumentation] 6. ((root adj plane$) or (root adj6 planing)).mp. [mp = title, cinahl subject headings, abstract, instrumentation] 7. ((mechanical$ adj6 debride$) or periodontal asj debridem$).mp. [mp = title, cinahl subject headings, abstract, instrumentation] 8. (subgingival adj curettage).mp. [mp = title, cinahl subject headings, abstract, instrumentation] 9. exp Subgingival Curettage/ 10. (pocket adj6 irrigat$).mp. [mp = title, cinahl subject headings, abstract, instrumentation] 11. CHLORHEXIDINE/ 12. chlorhexidine.mp. [mp = title, cinahl subject headings, abstract, instrumentation] 13. (Eludril or Chlorohex or corsodyl).mp. [mp = title, cinahl subject headings, abstract, instrumentation] 14. or/1-2 15. or/3-13 16. ((full-mouth adj6 disinfection) or (full mouth adj6 disinfection) or (full mouth adj6 debridement) or (full mouth adj6 debridement) or full mouth scaling or full-mouth scaling).mp. [mp = title, cinahl subject headings, abstract, instrumentation] 17. 14 and 15 and 16
EMBASE (as MEDLINE)	

Validity assessment

Titles and abstracts were managed by downloading to EndNote 9.0.1 software. The selection of papers, the decision about eligibility and data extraction was carried out independently, in duplicate, by two reviewers (J. E. and S. J.). Any disagreements were resolved by discussion among the reviewers. A screening form was used to evaluate the selected papers. Authors were contacted to provide additional information wherever possible. κ scores were used to assess agreement between reviewers based on a 2×2 contingency table. Agreement was assessed both for study eligibility and for quality assessment items. A κ score of >0.81 was regarded as equating to almost complete agreement. Studies meeting the inclusion criteria underwent validity criteria and data extraction. The full text of the included studies was evaluated by two reviewers (J. E. and S. J.). Data entry to a computer and data extraction were carried out by two review authors (P. S. and H. W.). Studies rejected were recorded in a table of excluded studies and reasons for exclusion were recorded for all studies rejected at the full-text stage.

The following data were extracted:

- General study characteristics: year of the study, country of origin, authors, funding and university/private practice-based.
- Specific trial characteristics: population, gender, age and severity of periodontal disease.
- Primary outcomes: number of teeth before and after treatments.
- Secondary outcomes: probing depth, attachment level, bleeding on probing before and after different treatment modalities.

The methodological quality of included studies was assessed mainly using components shown to affect study outcomes including method of randomization, allocation concealment and blinding of examiners and therapists. In addition, completeness of follow-up was examined. Methodological quality was used in sensitivity analyses to test the robustness of the conclusions but was not used to exclude studies qualifying for the review on the basis of their inclusion criteria. The definitions of categories from the Cochrane Handbook

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(Version 4.2.6, http://www.cochrane.org/resources/handbook/) were used.

The method of randomization was classified as:

- adequate, when random number generation was used such as computer-generated schemes;
- inadequate, when other methods of randomization were used (such as alternate assignment and hospital number);
- unclear, when method of randomization was not reported or explained.

Allocation concealment (i.e., how the randomization sequence was hidden from the examiners) was classified as follows:

- adequate, when examiners were kept unaware of randomization sequence (e.g., by means of central randomization, sequentially numbered, opaque envelopes);
- inadequate, when other methods of allocation concealment were used (such as alternate assignment and hospital number);
- unclear, when method of allocation concealment was not reported or explained.

Blindness of examiners:

- Blindness of examiners, with regard to treatment alternatives used in the trial, was determined as yes/no/uncertain.

Completeness of follow-up was assessed dichotomously (yes/no) by answering the following questions:

- Was the number of patients at baseline and at completion of the follow-up reported for both groups?
- Were all the patients who entered the trial properly accounted for at completion of the study?
- Did the analysis take into account the drop-outs/losses to follow-up or the excluded patients?

Data analysis

Patient means were the basis for data analysis. For dichotomous outcomes, the estimates of effect of an intervention were expressed as relative risks together with 95% confidence intervals (CI). For continuous outcomes, mean differences (MD) and 95% CI were used to summarize the data for each group. The analysis for the continuous outcome variables was conducted using the generic inverse variance statistical method where the MD and standard errors were entered. Where there were studies of similar comparisons reporting the same outcome measures, a meta-analysis was performed. Relative risks were combined for dichotomous data, and weighted mean differences (WMDs) for continuous data, using random effects models.

Heterogeneity was assessed by inspection of a graphical display of the estimated treatment effects from trials along with Cochran's test for heterogeneity undertaken before each meta-analysis, and I^2 statistics. Statistical heterogeneity is the degree of variation in the effect estimates from a set of studies and can be used to indicate the presence of variability among the studies beyond the amount expected solely due to the play of chance. Heterogeneity was planned to be investigated for aspects of study quality and for potential sources of heterogeneity specified a priori. However, the limited number of trials prevented such analysis.

Results

Description of studies

The literature search provided 216 titles and abstracts to be screened. Twelve full papers were selected by the two reviewers (J. E. and S. J.) to read, and from these nine RCTs could be identified. Seven papers were found to be eligible (Fig. 1). There was complete agreement between the two reviewers regarding the selection of eligible papers.

The remaining seven studies were all randomized clinical trials with at least one full-mouth treatment modality compared with standard quadrant scaling and root planing (Table 2). Excluded articles and the reasons for exclusion are presented in Table 3.

Methodological quality of included studies

Seven trials were included in this systematic review (Mongardini et al. 1999, Apatzidou & Kinane 2004, Koshy et al. 2005, Wennström et al. 2005, Jervøe-Storm et al. 2006, Quirynen et al. 2006a, Zanatta et al. 2006). One set of data was reported in two articles, and one of these reports included a third group (described as FRp group) that was not randomized (Mongardini et al. 1999, Quirynen et al. 2000). In consequence only one paper was included in this review (Mongardini et al. 1999).

Of all seven trials, four described the method of randomization, which was performed with the aid of a computer (Koshy et al. 2005, Wennström et al.

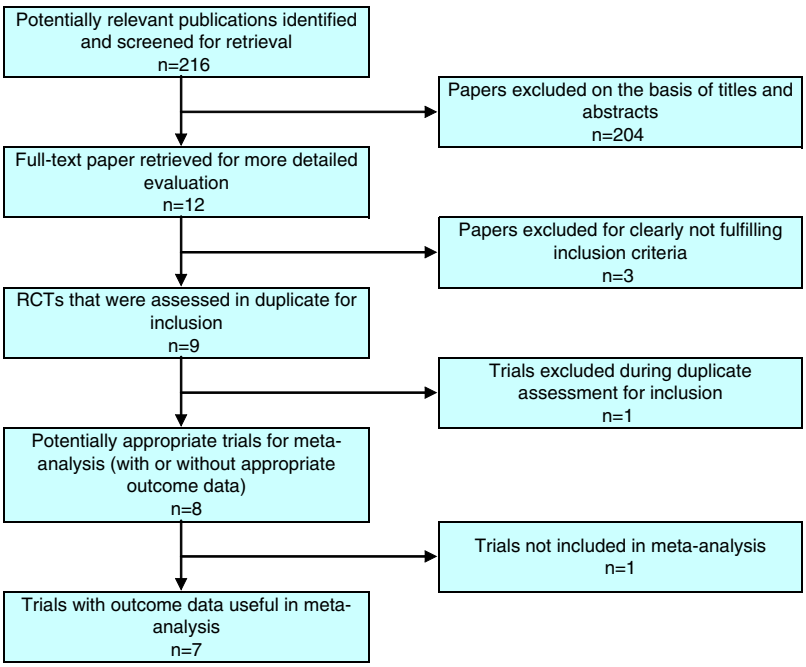

Fig. 1. Flow chart for inclusion of RCTs in review and meta-analysis. RCT, randomized, controlled clinical trial.

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Table 2. Characteristics of included studies

Study	Methods	Participants	Interventions	Outcomes
Apatzidou & Kinane (2004)	RCT, parallel, 2 treatment groups, 25 weeks duration, examiner unblinded, university (Glasgow, UK)-based, no details on funding	40 individuals, [2 asian (one in each group), 38 caucasian] 20 individuals in each group. 17 female, aged 31–70, 15 smokers. Chronic periodontitis	Test group (FM-SRP): FMS 2 sessions same day. Control group (Q-SRP): QRP 4 sessions − 2-week intervals. Oral hygiene reinforcement before study start unknown. Hand- and ultrasonic instruments. Time spent for scaling each quadrant 1 h. Maintenance at 7 weeks (FMS) or 13 weeks (QRP) and 6 months from baseline (both groups).	Whole-mouth recordings [baseline, 6-week reassessment after last instrumentation (FM-SRP: 7 weeks; Q-SRP: 13 weeks from baseline), 6 months]. PPD, CAL, BOP (6 sites per tooth), manual probe, computer-assisted disk probe for selected sites. MGI, PI, BOP, SUP, PPS, RAL (selected site clinical analysis = 1 deepest pocket per quadrant). Average pain VAS score (0–10), body temperature, number of analgesics, cold sores or oral ulcers.
Jervøe-Storm et al. (2006)	RCT, parallel, 2 treatment groups, 6 months duration, examiner blinded, university (Bonn, Germany) based, no details on funding	20 individuals, all caucasian, 10 individuals in each group. Nine females, age 53.1 ± 10.2; 2 smokers (1 in each group). Chronic periodontitis	Test group (FMRP): FMS 2 sessions within 24 h on 2 consecutive days. Control group (QRP): QRP 4 sessions –1 week intervals. Before randomization repeated oral hygiene reinforcements. Hand- and ultrasonic instruments. Time spent for scaling each quadrant 1 h. Maintenance at 1, 3, 4, 5 and 6 months (both groups)	Whole-mouth recordings (baseline, 3 and 6 months), data split in 1 quadrant and whole mouth and initial moderate (PPD 5–6 mm) and deep pockets (PPD >6 mm). PPD, RAL, BOP (6 sites per tooth), BOP whole mouth recordings only for PPD >4 mm. Computer-assisted probe with stent for all measurements
Koshy et al. (2005)	RCT, parallel, 3 treatment groups, 6 month duration, examiner blinded, university (Tokyo, Japan) based, funding: yes	36 individuals, all japanese, 12 individuals in each group. 23 female, age 34–66, nonsmokers. Chronic periodontitis	Test group 1 (FMD+water): FMS 1 session ultrasonic scaling with water (duration 2–2 1/2 h). Test group 2 (FMD+povidone): FMS 1 session ultrasonic scaling with 1% povidone iodine (duration 2–2 1/2 h), patients rinsing with 0.05% CHX twice a day for 1 month, tonguebrushing. Control group (QMD): QRP 4 sessions ultrasonic scaling with water − 1 week intervalls (duration 40–50 min. each), before randomization repeated oral hygiene interventions. Ultrasonic instruments. Maintenance every month from baseline (both groups).	Whole-mouth recordings (baseline, 1, 3 and 6 months). Data split in single-/multi-rooted teeth and initial moderate (PPD 5–6 mm) and deep pockets (PPD >6 mm). PI, PPD, PAL, BOP (6 sites per tooth), manual probe with stent for all measurements. Average pain VAS score (0–10), body temperature, number of analgesics.
Mongardini et al. (1999)	RCT, 2 treatment groups, double-blind, parallel, 8-months, university (Leuven, Belgium) based, funding: yes	40 individuals, Control group: 8 AgrP: 6 females; 12 ChrP: 2 females. Test group: 8 AgrP: 3 females; 12 ChrP: 7 females. 4 sites per quadrant PPD >7 mm.	Test group (Fdis): FMS 2 sessions scaling within 24 h, after instrumentation: brushing the tongue with 1% CHX-gel, rinsing twice with 0.2% CHX, spraying pharynx with 0.2% CHX, subg. irrigation 3 times with 1% CHX-gel. Patients rinsing, brushing the tongue and spraying the tonsils with	PPD, CAL

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Table 2. (Contd.)

Study	Methods	Participants	Interventions	Outcomes
			0.2% CHX twice a day for 2 months. Control group (control): QRP 4 sessions scaling − 2 week intervals, no antiseptics. First oral hygiene after first scaling session (all groups). Hand instruments, maintenance after 1, 2 and 4 months from baseline	
Quirynen et al. (2006a)	RCT, parallel, 8 months duration, examiner blinded. 5 treatment groups, university (Leuven, Belgium) based, funding: yes	71 individuals, all caucasian, neg. control group: 15, FMS: 14, 3 × FMD: 14 per group, 31 female, aged 30–75, 18 smokers. Chronic periodontitis	Control group (FRp): FMS 2 sessions scaling within 24 h. Test group 1 (FMCHX): FM 2 sessions scaling within 24 h, after instrumentation: brushing the tongue with 1% CHX-gel, rinsing twice with 0.2% CHX, spraying pharynx with 0.2% CHX, subg. irrigation three times with 1% CHX-gel. Patients brushing the tongue and spraying the tonsils with 0.2% CHX twice a day for 2 months. Patients rinsing twice a day with 0.2% CHX for 2 months. Test group 2 (FMF): FMS 2 sessions scaling within 24 h, after instrumentation: brushing the tongue with 1% CHX-gel, rinsing twice with 0.2% CHX, spraying pharynx with 0.2% CHX, subg. irrigation three times with 1% CHX-gel. Patients brushing the tongue and spraying the tonsils with 0.2% CHX twice a day for 2 months. Patients rinsing twice a day with AmF/SnF2. Test group 3 (FMCHX+F): FMD 2 sessions scaling within 24 h, after instrumentation: brushing the tongue with 1% CHX-gel, rinsing twice with 0.2% CHX, spraying pharynx with 0.2% CHX, subg. irrigation three times with 1% CHX-gel. Patients brushing the tongue and spraying the tonsils with 0.2% CHX twice a day for 2 months. Patients rinsing twice a day with 0.2% CHX for 2 months and AmF/SnF2 for another 6 months. Negative control group (NC): QRP 4 sessions scaling − 2-week intervals, no antiseptics. First oral hygiene after first scaling session (all groups), handinstruments.	First quadrant recordings (baseline, 2, 4 and 8 months), data split in single/multi-rooted teeth and initial medium (PPD 4–5.5 mm) and deep pockets (PPD >5 mm). SBI, PI, PPD, GR, CAL (as sum of PPD and ging. recession), BOP (6 sites per tooth). Manual probe.

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Table 2. (Contd.)

Study	Methods	Participants	Interventions	Outcomes
			Oral hygiene controls and re-instructions after 1, 2 and 4 months from baseline.	
Wennström et al. (2005)	RCT, multicenter: university (Göteborg, Sweden) & private dental office (Trento, Italy), parallel, 2 treatment groups, 6 months duration, examiner blinded, funding: yes	41 individuals, 20 individuals in test group, 21 individuals in control group, 19 female, aged 25–75. Twenty smokers. Chronic periodontitis	Test group (FM-UD-test): FMS 1 h session ultrasonic scaling with water, re-instrumentation after 3 months in PPD >4 mm. Control group (Q-SRP-control): QRP four sessions handinstrumentation − 1 week intervalls (time recorded, no time restriction), re-instrumentation after 3 months in PPD >4 mm. Before randomization repeated oral hygiene reinforcements, ultrasonic *versus* hand instruments, maintenance 1 month following completion of instrumentation (both groups)	Whole mouth recordings (baseline, 3 and 6 months), data split in initial moderate (PPD 5–6 mm) and deep pockets (PPD >6 mm). PI, PPD, PAL, BOP (6 sites per tooth), manual probe. Average pain VAS score (100 mm scale)
Zanatta et al. (2006)	RCT, parallel, 3 treatment groups, 3 month duration, examiner blinded, university (Campinas, Brazil) based, no details on funding	36 individuals, 13 individuals in control group, 12 in test group 1, 15 in test group 2. Eighteen females, age 27–72. Chronic periodontitis	Test group 1 (PDG): FMS 1 session ultrasonic scaling with 0.9% NaCl (duration 45 min.). Test group 2 (PD-PIG): FMS 1 session ultrasonic scaling with 0.5% povidone iodine (duration 45 min.). Control group (CG): QRP four sessions ultrasonic scaling with water − 1-week intervals (duration unclear). Before randomization oral hygiene interventions, ultrasonic instruments, maintenance twice weekly from baseline	Whole mouth recordings (baseline, 1 and 3 months), data split initial moderate (PPD 5–6 mm) and deep pockets (PPD >6 mm). PI, PPD, GR, CAL, BOP (6 sites per tooth), computerized probe with stent for all measurements

FMS, full-mouth subgingival scaling and root planing; QRP, quadrantwise subgingival scaling and root planing, clockwise in four sessions; PPD, probing pocket depth; CAL, clinical attachment level; BOP, bleeding on probing; MGI, modified gingival index; PI, plaque index; SUP, suppuration; RAL, relative attachment level; VAS, visual analogue scale; FMD, (full-mouth disinfection) full-mouth subgingival scaling and root planing with use of antiseptics; CHX, chlorhexidine gluconate; SBI, sulcus bleeding index; GR, gingival recession; AgrP, aggressive Periodontitis; ChrP, chronic Periodontitis.

Table 3. Reasons for exclusion of full-text articles

Author	Reason for exclusion
Bollen et al. (1998)	Six out of 16 patients suffering from aggressive periodontitis
Eren et al. (2002)	Patients received FMS for 4 consecutive days
Quirynen et al. (1995)	2 month data only
Vandekerckhove et al. (1996)	Complete data not available

2005, Jervøe-Storm et al. 2006, Quirynen et al. 2006a). In two papers, the method of randomization was uncertain or not stated (Apatzidou & Kinane 2004, Zanatta et al. 2006). Five papers provided adequate information about allocation concealment (Mongardini et al. 1999, Koshy et al. 2005, Wennström et al. 2005, Jervøe-Storm et al. 2006, Quirynen et al. 2006a). Two papers provide unclear information about allocation concealment (Apatzidou & Kinane 2004, Zanatta et al. 2006). The completeness of follow-up, as described by the number of subjects that were entered into the study and subsequently finished, was described adequately in five of the cases (Apatzidou & Kinane 2004, Jervøe-Storm et al. 2006, Koshy et al. 2005, Mongardini et al. 1999, Wennström et al. 2005). In two studies it was unclear if the analysis took into account the drop-outs/losses to follow-up or the excluded patients (Quirynen et al. 2006a, Zanatta et al. 2006). An overview of the quality assessments of the included studies is presented in Table 4. The summarized risk of bias of the included studies was categorized as ''low'', ''moderate'' or ''high''

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Table 4. Quality assessment of the included studies

Study	Randomization	Allocation concealment	Blinding	Withdrawals clear	Risk of bias
Apatzidou & Kinane (2004)	Unclear	Unclear	No	Yes	High
Jervøe-Storm et al. (2006)	Adequate	Adequate	Yes	Yes	Low
Koshy et al. 2005	Adequate	Adequate	Yes	Yes	Low
Mongardini et al. 1999	Adequate	Adequate	Uncertain	Yes	Moderate
Quirynen et al. (2006a)	Adequate	Adequate	Yes	Unclear	Moderate
Wennström et al. (2005)	Adequate	Adequate	Yes	Yes	Low
Zanatta et al. (2006)	Unclear	Unclear	Yes	Unclear	Moderate

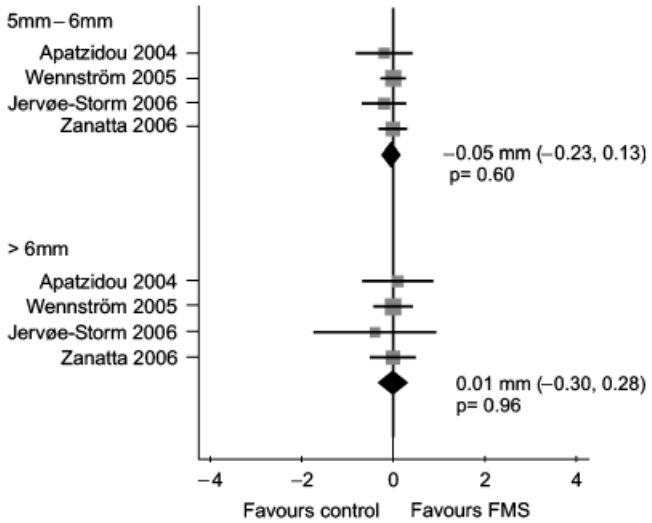

Fig. 2. Weighted mean difference in PPD change between FMS and quadrant scaling at single- and multi-rooted teeth with initial PPD 5–6 mm and PPD >6 mm. Random effects Forest plots. FMS, full-mouth scaling.

according to the Cochrane Reviewers Handbook (Higgins & Green 2006).

Study design

Four studies provided data for the comparison of FMS and quadrant scaling in single- and multi-rooted teeth over a period of 6 months from baseline (Apatzidou & Kinane 2004, Koshy et al. 2005, Wennström et al. 2005, Jervøe-Storm et al. 2006). One study observed the clinical effects of FMS, FMD and quadrant scaling over a period of 3 months (Zanatta et al. 2006). One study provided data for the comparison of FMD and quadrant scaling with a follow-up of 6 months after baseline (Koshy et al. 2005). One study evaluated the effect of FMD compared with quadrant scaling after 8 months (Mongardini et al. 1999) and one study analysed the clinical outcomes of the three different treatment modalities after 8 months (Quirynen et al. 2006a).

Three studies categorized outcome data of PPD for ''single-'' and ''multi-rooted'' teeth (Mongardini et al. 1999, Koshy et al. 2005, Quirynen et al. 2006a). One study classified pocket depths in moderate pockets of 4–5.5 mm and in deep pockets of >6 mm (Quirynen et al. 2006a). The other six studies classified pocket depths in moderate pockets of 5–6 mm and in deep pockets of $1 \geqslant 6$ mm. Two studies provided data for the first quadrant only (Mongardini et al. 1999, Quirynen et al. 2006a), whereas the other five studies generated whole-mouth data.

Primary outcome

No data were available for the primary outcome tooth survival.

Secondary outcomes

FMS versus quadrant scaling, PPD

Four studies were included in the meta-analysis analysing moderate and deep pockets of single- and multi-rooted teeth (Apatzidou & Kinane 2004, Wennström et al. 2005, Jervøe-Storm et al. 2006, Zanatta et al. 2006). No statistically significant differences were found for moderate (5–6 mm) and deep (>6 mm) pockets (Fig. 2, Table 5a).

Two studies were included in the meta-analysis for single-rooted teeth alone (Koshy et al. 2005, Quirynen et al. 2006a). No statistically significant differences were found for moderate and deep pockets. A subgroup analysis of PPD changes in multi-rooted teeth revealed no statistically significant differences (Table 5a); however, there was a significant heterogeneity between the two trials for moderate pockets, with both effect estimates going in the same direction.

FMS versus quadrant scaling, CAL

Five studies were included in the meta-analysis of moderate and deep pockets in single- and multi-rooted teeth (Apatzidou & Kinane 2004, Wennström et al. 2005, Jervøe-Storm et al. 2006, Quirynen et al. 2006a, Zanatta et al. 2006). No statistically significant differences were found for moderate and deep pockets (Fig. 3). No evidence of heterogeneity for moderate pockets and some evidence for deep pockets were observed. One study (Koshy et al. 2005) provided separate data for single- and multi-rooted teeth. No statistically significant differences were found for this analysis (Table 5a).

FMS versus quadrant scaling, BOP

Five studies were included in the meta-analysis of single- and multi-rooted teeth combined (Apatzidou & Kinane 2004, Koshy et al. 2005, Wennström et al. 2005, Jervøe-Storm et al. 2006, Zanatta et al. 2006). No statistically significant differences between FMS and quadrant scaling were found for this full-mouth evaluation (Fig. 4). Little evidence of heterogeneity was found between the trials. One trial analysed changes of BOP for single- and multi-rooted teeth separately (Quirynen et al. 2006a); however, no statistically significant differences were found (Table 5a).

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Table 5a. Summary of meta-analyses for clinical outcomes regarding comparison of FMS *versus* control

Outcome	Initial PPD category (mm)	No. of studies	WMD weighted mean difference (mm) 95%	95% CI	*p*-value for WMD	Heterogeneity	
						p-value	method
Single- and multi-rooted teeth							
PPD reduction	Full mouth		Not estimable				
CAL gain	Full mouth		Not estimable				
BOP reduction	Full mouth	5	0.17	− 6.21, 6.55	0.96	0.26	Random
PPD reduction	5–6 mm	4	− 0.05	− 0.23, 0.13	0.60	0.85	Random
CAL gain	5–6 mm	5	0.13	− 0.05, 0.30	0.17	0.84	Random
BOP reduction	5–6 mm		Not estimable				
PPD reduction	>6 mm	4	− 0.01	− 0.30, 0.28	0.96	0.94	Random
CAL gain	>6 mm	5	0.28	− 0.08, 0.64	0.13	0.11	Random
BOP reduction	>6 mm		Not estimable				
Single-rooted teeth							
PPD reduction	Full mouth		Not estimable				
CAL gain	Full mouth		Not estimable				
BOP reduction	Full mouth		Not estimable				
PPD reduction	5–6 mm	2	0.11	− 0.19, 0.41	0.48	0.95	Random
CAL gain	5–6 mm	1	0.19	− 0.29, 0.67	0.44	Not applicable	
BOP reduction	5–6 mm	1	− 10.00	− 30.39, 10.39	0.34	Not applicable	
PPD reduction	>6 mm	2	0.29	− 0.27, 0.85	0.31	0.67	Random
CAL gain	>6 mm	1	0.47	− 0.37, 1.31	0.27	Not applicable	
BOP reduction	>6 mm	1	− 4.00	− 25.56, 17.56	0.72	Not applicable	
Multi-rooted teeth							
PPD reduction	Full mouth		Not estimable				
CAL gain	Full mouth		Not estimable				
BOP reduction	Full mouth		Not estimable				
PPD reduction	5–6 mm	2	0.83	− 0.51, 2.16	0.22	<0.0001	Random
CAL gain	5–6 mm	1	0.18	− 0.20, 0.56	0.35	Not applicable	
BOP reduction	5–6 mm	1	11.00	− 25.65, 47.65	0.56	Not applicable	
PPD reduction	>6 mm	2	0.12	− 0.42, 0.65	0.66	0.48	Random
CAL gain	>6 mm	1	0.38	− 0.28, 1.04	0.26	Not applicable	
BOP reduction	>6 mm	1	− 4.00	− 30.22, 22.22	0.76	Not applicable	

FMS, full-mouth subgingival scaling and root planing; PPD, probing pocket depth; CAL, clinical attachment level; BOP, bleeding on probing; CI, confidence intervals.

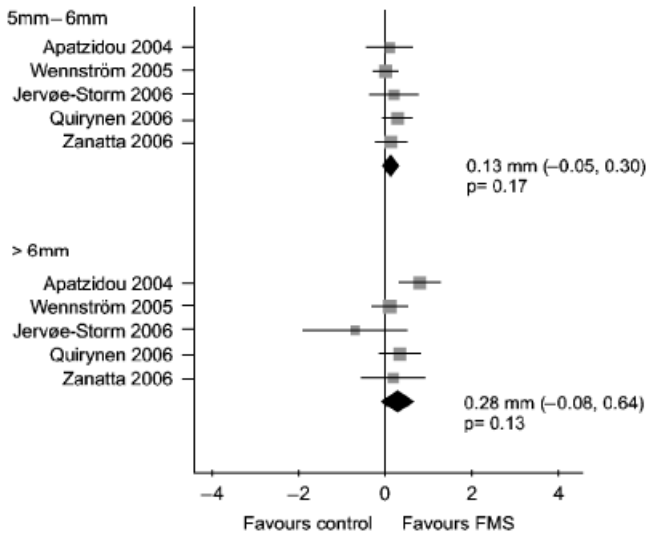

Fig. 3. Weighted mean difference in CAL change between FMS and quadrant scaling at single- and multi-rooted teeth with initial PPD 5–6 mm and PPD >6 mm. Random effects Forest plots. FMS, full-mouth scaling.

Full-mouth data evaluation was carried out based on measurements of all pockets in four studies (Apatzidou & Kinane 2004, Koshy et al. 2005, Wennström et al. 2005, Zanatta et al. 2006). One study evaluated full-mouth BOP data in pockets of initially $1 \geqslant 5$ mm (Jervøe-Storm et al. 2006) and one study analysed the data for single- and multi-rooted teeth separately (Quirynen et al. 2006a).

FMD versus quadrant scaling, PPD

One study reported the data for single- and multi-rooted teeth (Zanatta et al. 2006) and no statistically significant differences were found for this comparison. Three studies (Mongardini et al. 1999, Koshy et al. 2005, Quirynen et al. 2006a) compared changes of PPD in single-rooted teeth. A statistically significant difference in favour of the FMD treatment was found for moderate pockets [WMD = 0.53 mm (95% CI 0.28–0.77 mm), $\chi^2 = 0.26$, 2 df, $p = 0.88$, $I^2 = 0\%$, $p < 0.0001$] with no evidence of any heterogeneity (Fig. 5). This significant difference between the treatment modalities was based on two studies with a moderate risk of bias (Mongardini et al. 1999, Quirynen et al. 2006a) and one study with a low risk of bias (Koshy et al. 2005). No statistically significant difference

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Table 5b. Summary of meta-analyses for clinical outcomes regarding comparison of FMD *versus* control

Outcome	Initial PPD category (mm)	No. of studies	WMD weighted mean difference (mm) 95%	95% CI	*p*-value for WMD	Heterogeneity	
						p-value	method
Single- and multi-rooted teeth							
PPD reduction	Full mouth		Not estimable				
CAL gain	Full mouth		Not estimable				
BOP reduction	Full mouth	3	9.99	– 5.60, 25.59	0.21	0.03	Random
PPD reduction	5–6 mm	1	0.12	– 0.19, 0.43	0.45	Not applicable	
CAL gain	5–6 mm	2	0.33	0.04, 0.63	0.03	0.29	Random
BOP reduction	5–6 mm		Not estimable				
PPD reduction	>6 mm	1	– 0.35	– 0.89, 0.19	0.20	Not applicable	
CAL gain	>6 mm	2	0.48	– 0.13, 1.09	0.12	0.19	Random
BOP reduction	>6 mm		Not estimable				
Single-rooted teeth							
PPD reduction	Full mouth		Not estimable				
CAL gain	Full mouth		Not estimable				
BOP reduction	Full mouth		Not estimable				
PPD reduction	5–6 mm	3	0.53	0.28, 0.77	<0.0001	0.88	Random
CAL gain	5–6 mm	2	0.33	– 0.28, 0.93	0.29	0.20	Random
BOP reduction	5–6 mm	1	1.00	– 19.39, 21.39	0.92	Not applicable	
PPD reduction	>6 mm	3	0.68	– 0.20, 1.57	0.13	0.09	
CAL gain	>6 mm	2	0.73	– 0.97, 2.44	0.40	0.03	Random
BOP reduction	>6 mm	1	14.00	– 7.56, 35.56	0.20	Not applicable	
Multi-rooted teeth							
PPD reduction	Full mouth		Not estimable				
CAL gain	Full mouth		Not estimable				
BOP reduction	Full mouth		Not estimable				
PPD reduction	5–6 mm	3	0.28	– 0.34, 0.91	0.37	0.15	Random
CAL gain	5–6 mm	2	0.39	– 0.66, 1.45	0.47	0.02	Random
BOP reduction	5–6 mm	1	21.00	– 10.74, 52.74	0.19	Not applicable	
PPD reduction	>6 mm	3	0.32	– 0.34, 0.98	0.34	0.08	Random
CAL gain	>6 mm	2	0.53	– 1.29, 2.35	0.57	0.004	Random
BOP reduction	>6 mm	1	– 8.00	– 31.39, 15.39	0.50	Not applicable	

FMD, full-mouth disinfection; PPD, probing pocket depth; CAL, clinical attachment level; BOP, bleeding on probing; CI, confidence intervals; WMD, weighted mean difference.

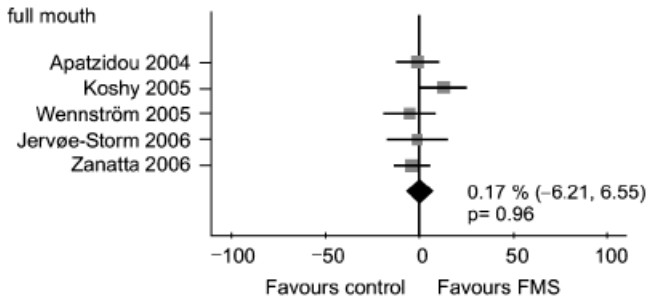

Fig. 4. Weighted mean difference in BOP change between FMS and quadrant scaling at single- and multi-rooted teeth. Random effects Forest plots. FMS, full-mouth scaling.

was observed for deep pockets (Table 5b); however, there was significant heterogeneity between the three studies, with the effect estimates all going in the same direction. The same three studies were included in a meta-analysis of multi-rooted teeth. No statistically significant differences were found (Table 5b); however once again there was significant heterogeneity between the three included trials, with effect estimates ranging from –0.07 to 1.37.

FMD versus quadrant scaling, CAL

Two studies (Quirynen et al. 2006a, Zanatta et al. 2006) compared changes of CAL for single- and multi-rooted teeth combined. A statistically significant difference in favour of the FMD treatment for moderate pockets of WMD = 0.33 mm [$p = 0.03$ (95% CI 0.04–0.63 mm), $\chi^2 = 1.13$, 1 df, $p = 0.29$, $I^2 = 11.4\%$] with no evidence of heterogeneity was found (Fig. 6). This result is based on two studies with a moderate risk of bias. No statistically significant difference was calculated for deep pockets.

Two studies (Mongardini et al. 1999, Koshy et al. 2005) compared changes of CAL for single- and multi-rooted teeth separately. No statistically significant differences between the FMD and the quadrant scaling groups for moderate or deep pockets were observed (Table 5b). However, there was evidence of heterogeneity between the two trials with the effect estimates going in both directions.

FMD versus quadrant scaling, BOP

Four trials provided data for BOP (Mongardini et al. 1999, Koshy et al. 2005, Quirynen et al. 2006a, Zanatta et al. 2006). There were no statistically significant differences for changes of BOP between the test and control groups in terms of single-rooted teeth for moderate or deep pockets, and multi-rooted teeth for moderate or deep pockets; however, there was a significant heterogeneity among the three trials

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Table 5c. Summary of meta-analyses for clinical outcomes regarding comparison of FMS *versus* FMD

Outcome	Initial PPD category (mm)	No. of studies	WMD weighted mean difference (mm) 95%	95% CI	*p*-value for WMD	Heterogeneity	
						p-value	method
Single- and multi-rooted teeth							
PPD reduction	Full mouth		Not estimable				
CAL gain	Full mouth		Not estimable				
BOP reduction	Full mouth	2	2.38	− 5.75, 10.51	0.57	0.37	Random
PPD reduction	5–6 mm	1	− 0.13	− 0.46, 0.20	0.44	Not applicable	
CAL gain	5–6 mm	2	− 0.14	− 0.42, 0.13	0.30	0.60	Random
BOP reduction	5–6 mm		Not estimable				
PPD reduction	> 6 mm	1	0.34	− 0.14, 0.82	0.16	Not applicable	
CAL gain	> 6 mm	2	− 0.21	− 0.68, 0.25	0.36	0.26	Random
BOP reduction	> 6 mm		Not estimable				
Single-rooted teeth							
PPD reduction	Full mouth		Not estimable				
CAL gain	Full mouth		Not estimable				
BOP reduction	Full mouth		Not estimable				
PPD reduction	5–6 mm	2	− 0.20	− 0.56, 0.15	0.26	0.15	Random
CAL gain	5–6 mm	1	0.08	− 0.40, 0.56	0.74	Not applicable	
BOP reduction	5–6 mm	1	− 11.00	− 31.74, 9.74	0.30	Not applicable	
PPD reduction	> 6 mm	2	0.00	− 0.54, 0.53	0.99	0.58	Random
CAL gain	> 6 mm	1	0.56	− 0.37, 1.49	0.24	Not applicable	
BOP reduction	> 6 mm	1	− 18.00	− 34.30, − 1.70	0.03	Not applicable	
Multi-rooted teeth							
PPD reduction	Full mouth		Not estimable				
CAL gain	Full mouth		Not estimable				
BOP reduction	Full mouth		Not estimable				
PPD reduction	5–6 mm	2	0.11	− 1.67, 1.89	0.90	< 0.0001	Random
CAL gain	5–6 mm	1	0.25	− 0.16, 0.66	0.23	Not applicable	
BOP reduction	5–6 mm	1	− 10.00	− 48.04, − 28.04	0.61	Not applicable	
PPD reduction	> 6 mm	2	1.12	− 1.25, 3.49	0.35	< 0.00001	Random
CAL gain	> 6 mm	1	0.74	0.17, 1.31	0.01	Not applicable	
BOP reduction	> 6 mm	1	4.00	− 19.89, 27.89	0.74	Not applicable	

FMS, full-mouth subgingival scaling and root planing; FMD, full-mouth disinfection; PPD, probing pocket depth; CAL, clinical attachment level; BOP, bleeding on probing; CI, confidence intervals; WMD, weighted mean difference.

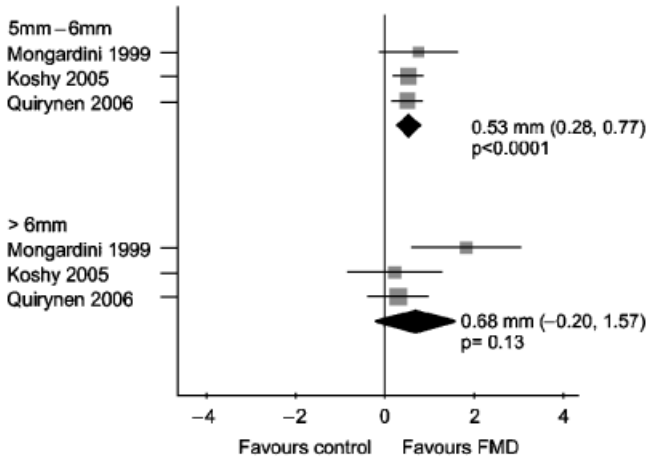

Fig. 5. Weighted mean difference in PPD change between FMD and quadrant scaling at single-rooted teeth with initial PPD 5–6 mm and PPD > 6 mm. Random effects Forest plots. FMD, full-mouth disinfection

providing data for full mouth, single- and multi-rooted teeth, with effect estimates ranging from –2 to 28.

FMS versus FMD, PPD

One study reported combined data for single- and multi-rooted teeth (Zanatta et al. 2006). No statistically significant differences were found for moderate and deep pockets.

Two trials (Koshy et al. 2005, Quirynen et al. 2006a) compared changes of PPD for single- and muti-rooted teeth separately, and no statistically significant differences were observed for moderate and deep pockets (Table 5c). There was significant heterogeneity between the two trials for multi-rooted teeth with effect estimates going in both directions.

FMS versus FMD, CAL

Two studies (Koshy et al. 2005, Quirynen et al. 2006a) compared changes of CAL for single- and multi-rooted teeth combined. No statistically significant differences were found neither for moderate nor for deep pockets.

One trial (Koshy et al. 2005) provided individual data relevant to the changes of CAL between FMS and FMD for single- and multi-rooted teeth. No statistically significant differences were found for moderate and deep pockets of single-rooted teeth and for moderate pockets of multi-rooted teeth. However, a WMD of 0.74 mm [$p = 0.01$ (95% CI 0.17–1.31 mm)] was found for deep pockets of multi-rooted teeth, which is a statistically significant difference in favour of FMS compared with FMD (Fig. 7, Table 5c). The observed statistically significant

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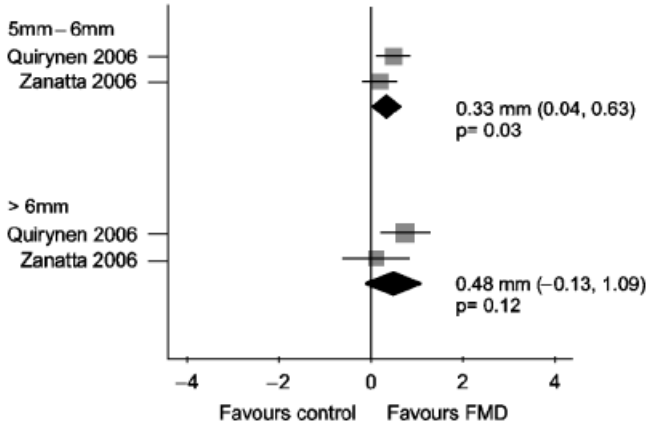

Fig. 6. Weighted mean difference in CAL change between FMD and quadrant scaling at single- and multi-rooted teeth with initial PPD 5–6 mm and PPD >6 mm. Random effects Forest plots. FMD, full-mouth disinfection

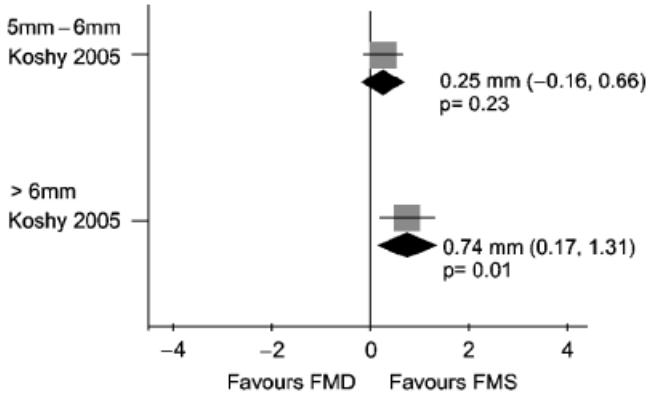

Fig. 7. Weighted mean difference in CAL change between FMD and FMS at multi-rooted teeth with initial PPD 5–6 mm and PPD >6 mm. Random effects Forest plots. FMD, full-mouth disinfection; FMS, full-mouth scaling.

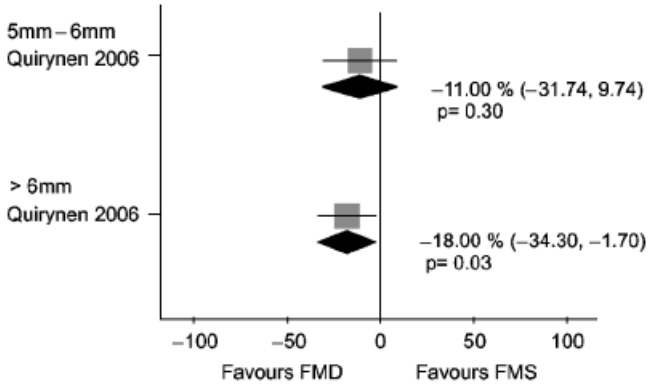

Fig. 8. Weighted mean difference in BOP change between FMD and FMS at single-rooted teeth with initial PPD 5–6 mm and PPD >6 mm. Random effects Forest plots. FMD, full-mouth disinfection; FMS, full-mouth scaling.

difference was based on one study with a low risk of bias (Koshy et al. 2005).

FMS versus FMD, BOP

No statistically significant differences in BOP between FMS and FMD were observed for a combination of single- and multi-rooted teeth. One trial evaluated BOP of single-rooted teeth separately (Quirynen et al. 2006a). No statistically significant difference was found for moderate pockets; however, a statistically significant difference in favour of FMD for the deep pockets was found [$p = 0.03$, MD -18.00% (95% CI -34.30% to -1.70%)] (Fig. 8). This study was rated with a moderate risk of bias. The same study presented data for multi-rooted teeth; however, no statistically significant differences were found for moderate or deep pockets (Table 5c).

There were insufficient trials in the meta-analyses to undertake sensitivity analysis for quality components. There were insufficient studies to investigate the heterogeneity, which was present in a few occasions as indicated. Generally there was little heterogeneity and none found where there were significant differences between study groups.

Discussion

The present systematic review addressed the question of evidence for periodontitis therapy by full-mouth strategies within 24 h with or without adjunctive antiseptics or by a conventional quadrant approach over a treatment period of up to 6 weeks.

This systematic review found an overall WMD of 0.53 mm (95% CI 0.28–0.77 mm) for PPD reduction for FMD over conventional quadrant scaling in single-rooted teeth with an initial PPD of 5–6 mm. This finding was based on three studies including 77 patients, with low to moderate risk of bias. For single- and multi-rooted teeth combined with an initial PPD of 5–6 mm the FMD approach showed an overall increase of CAL gain of 0.33 mm (95% CI 0.04–0.63 mm) in comparison to quadrant scaling. This finding was based on two studies with 57 patients. The studies were assessed with a moderate risk of bias. For multi-rooted teeth with initially deep pockets, the CAL gain following FMS was superior compared with FMD (WMD 0.74 mm, 95% CI 0.17–1.31 mm). The reduction of BOP was greater following FMD than following FMS for single-rooted teeth in one study of 28 patients. Each of these latter two findings was based on one study that was assessed with a low risk of bias. For all the other comparisons presented in Tables 5a–c, the meta-analyses did not reveal statistically significant differences between the three treatment strategies FMS, FMD or quadrant scaling.

For the inclusion of studies in this systematic review, appropriate criteria were used resulting in the inclusion of

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seven RCTs relevant for meta-analysis. Because tooth survival is of tangible benefit to the subject, it would have been desirable to evaluate which therapy was superior in preventing tooth loss. However, it is recognized that tooth loss is difficult to assess due to the low incidence and extended time to event. Thus, no study reported tooth survival rates and clinical parameters were used as surrogate variables. The selected articles included only studies of at least 3 months follow-up and studies presenting clinical data. A follow-up of 3 months after baseline was selected, because complete healing could be expected after this time period. As a consequence, an early study on FMD could not be included in this systematic review (Quirynen et al. 1995).

The results of the seven RCTs included in this review show a substantial variability in their results. Differences in study design and methods could have affected the outcomes. The studies included several clinical differences that we hypothesized could affect heterogeneity. This included the time point of probing in relation to subgingival instrumentation and the type of probe used. For example, probing was performed after root instrumentation by one set of studies (Mongardini et al. 1999) and before root instrumentation in the other included studies (Apatzidou & Kinane 2004, Koshy et al. 2005, Wennström et al. 2005, Jervøe-Storm et al. 2006, Quirynen et al. 2006a, Zanatta et al. 2006). Although probing after root instrumentation may be a reasonable procedure if large amounts of calculus interfere with probing accuracy, the values for probing depth reduction and attachment gain are higher compared with measurements performed before instrumentation (Claffey et al. 1988). In addition, some studies used computerized constant force probes and a stent for the measurement of probing depth and clinical attachment, in contrast to studies that used manual probes. Another aspect that influenced the treatment results could have been the instruments used for root treatment, manual or powered or a combination of both, even though recent reviews reported no differences in the efficacy in the root instrumentation when manual or ultrasonic instruments were compared (Drisko et al. 2000, Tunkel et al. 2002, Hallmon & Rees 2003). Differences may result from different concentrations and application regimes of antiseptics and the time schedule for full-mouth approaches ranging from 12 to 24 h (Table 2).

More discrepancies might have resulted from the fact that one research group did not include any oral hygiene instructions at baseline; all patients received standard oral hygiene instructions only after the first session of scaling and root planing (Mongardini et al. 1999, Quirynen et al. 2006a). In contrast, for all other studies the patients showed a high level of oral hygiene already before baseline. In this context it should be recognized that studies from the Leuven research group were designed as ''proof of principle'', aimed to increase the chance of cross-contamination in the control group (Quirynen et al. 2006a, b). Furthermore, even though all studies included minimal observation periods of 3 months, re-evaluation was conducted at varying time points 3–8 months after treatment.

Pockets of varying depth may respond differently to therapy. Therefore, sites are usually analysed in three categories of initial probing depth: 1–3, 4–6 and >6 mm. This approach of presenting results based on these three categories was performed by most studies included in the present systematic review, with the exception of one study using a range of 4–5.5 mm (Quirynen et al. 2006a). With respect to this subgroup analysis, it is interesting to see that FMD improved the clinical outcomes in moderate pockets, but not in deep pockets. This phenomenon may be related to the relatively low number of deep as compared with moderate sites that had been studied. The practice of analysing by initial pocket depth has been criticized due to the potential for statistical artefacts such as regression to the mean and mathematical coupling. Therefore, the results of such analyses should be viewed with extreme caution (Tu et al. 2002).

This systematic review aimed to compare the clinical effects of conventional mechanical treatment and FMD and FMS approaches for the treatment of chronic periodontitis. It has been demonstrated that the FMD approach resulted in a modest additional reduction of probing depth compared with the conventional treatment for sites with an initial probing depth of 5–6 mm in single-rooted teeth. It may be questioned whether this small difference in outcome can justify the extensive use of chlorhexidine over a period of several months. All three interventions can result in improvements in clinical measures of periodontitis. Additional improvements from FMD are inconsistent across tooth types and initial pocket depths. Therefore, no recommendations regarding additional benefits can be made on the basis of the clinical data to date. A decision, to select one non-surgical periodontal therapy over another, needs to include patient preferences and convenience of the treatment schedule.

In order to combine studies for a meta-analysis, which can support and strengthen the findings of individual studies and produce an overall pooled estimate of effect, a mean measure of the effect and the standard error of the mean is necessary, and without these data it is impossible to perform any analysis. Reporting of standard deviation or standard error provides a more precise description of the data profile and should be therefore a mandatory piece of information in scientific reports.

The treatment effects of FMD compared with conventional scaling and root planing are modest and the implications for periodontal care are not profound.

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Clinical Relevance

Scientific rationale for the study: In an attempt to enhance treatment outcomes, alternative protocols for anti-infective periodontal therapy have been introduced. However, controversial results have been reported for the clinical effects of FMD and full-mouth root planing *versus* the standard quadrant-wise approach.

Principal findings: The treatment effects of FMD compared with conventional scaling are minimal and the implications for periodontal care are not profound.

Practical implications: No recommendations regarding additional benefits can be made on the basis of the clinical data to date. The decision to select one approach to anti-infective periodontal therapy over another needs to include patient preferences and convenience of the treatment schedule.

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