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Review article

A systematic review of the effect of surgical debridement vs. non-surgical debridement for the treatment of chronic periodontitis

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Abstract

Objective: To systematically review the evidence of effectiveness of surgical vs. non-surgical therapy for the treatment of chronic periodontal disease.

Methods: A search was conducted for randomized controlled trials of at least 12 months duration comparing surgical with non-surgical treatment of chronic periodontal disease. Data sources included the National Library of Medicine computerised bibliographic database MEDLINE, and the Cochrane Oral Health Group (COHG) Specialist Trials Register. Screening, data abstraction and quality assessment were conducted independently by multiple reviewers (L.H., F.H., L.T.). The primary outcome measures evaluated were gain in clinical attachment level (CAL) and reduction in probing pocket depth (PPD).

Results: The search provided 589 abstracts of which six randomized controlled trials were included. Meta-analysis evaluation of these studies indicated that 12 months following treatment, surgical therapy resulted in 0.6 mm more PPD reduction (WMD 0.58 mm; 95% CI 0.38, 0.79) and 0.2 mm more CAL gain (WMD 0.19 mm; 95% CI 0.04, 0.35) than non-surgical therapy in deep pockets (>6 mm). In 4–6 mm pockets scaling and root planing resulted in 0.4 mm more attachment gain (WMD −0.37 mm; 95% CI −0.49, −0.26) and 0.4 mm less probing depth reduction (WMD 0.35 mm; 95% CI 0.23, 0.47) than surgical therapy. In shallow pockets (1–3 mm) non-surgical therapy resulted in 0.5 mm less attachment loss (WMD −0.51 mm; 95% CI −0.74, −0.29) than surgical therapy.

Conclusions: Both scaling and root planing alone and scaling and root planing combined with flap procedure are effective methods for the treatment of chronic periodontitis in terms of attachment level gain and reduction in gingival inflammation. In the treatment of deep pockets open flap debridement results in greater PPD reduction and clinical attachment gain.

Key words: non-surgical therapy; periodontal diseases/ therapy; surgical therapy; systematic review

Chronic periodontitis is defined as an inflammatory disease of the supporting tissues of the teeth caused by groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession or both (1999 International Workshop for a Classification of Periodontal Diseases). Chronic perio dontitis affects most of the adult population and may be further classified on the basis of extent and severity. Furthermore, chronic periodontitis may be associated with modifying factors such as systemic diseases, cigarette smoking, and local factors.

Cross-sectional epidemiological studies indicate that about 10–15% of the adult population have 'advanced periodontitis', while about 80% have 'moderate periodontitis', and 10% of the

population are periodontally healthy (Löe et al. 1978, Baelum et al. 1986, Okamoto et al. 1988, Papapanou et al. 1988, Hugoson et al. 1998).

The primary goal of periodontal therapy is to arrest the inflammatory disease process. Treatment involves mechanical removal of the subgingival biofilm, and the establishment of a local environment and microflora compatible with periodontal health. Parameters including clinical attachment level (CAL) and probing pocket depth (PPD) measurements, and the presence of bleeding on probing (BOP) are commonly used to assess and monitor the periodontal status. To improve periodontal health, treatment aims to reduce probing pocket depths (PPD), maintain or improve clinical attachment levels (CAL) and reduce the incidence of BOP.

Chronic periodontal disease can be successfully treated by non-surgical or surgical mechanical therapy provided adequate plaque control is maintained during the supportive phase of treatment (Lindhe & Nyman 1975, Nyman et al. 1977, Axelsson & Lindhe 1981). The objective of this review is to evaluate the effect of surgical debridement versus non-surgical debridement in terms of changes in clinical attachment level, probing pocket depth and bleeding on probing for patients with chronic periodontitis.

Material and Methods

Study selection

To be eligible for inclusion in this review, studies had to be randomized controlled trials of at least 12 months duration. Studies were considered for inclusion if they included patients with a clinical diagnosis of chronic periodontitis who were at least 20 years of age. The lower age limit was selected in order to be as inclusive of studies as possible. However, studies specifically treating aggressive forms of periodontitis were excluded.

A patient-based analysis was required for inclusion. Studies were excluded if site-based data was presented without a patient-based analysis.

Outcome variables

The primary outcome variables assessed were clinical attachment level change (ΔCAL), probing pocket depth change (ΔPPD) and change in incidence of bleeding on probing (ΔBOP). Other outcome variables of interest were adverse reactions to treatment, and long-term outcome measures of disease recurrence and tooth loss.

Literature search

A search of MEDLINE (1965 to April 2001) and the Cochrane Oral Health Group specialist trials (1965 to April 2001) was made. Only papers written in the English language were considered. In addition, reference lists from review articles and books were searched.

The search strategy applied for the MEDLINE search was a combination of non-surgical therapy AND surgical therapy AND types of studies.

Non-surgical therapy

- MeSH terms: periodontics OR periodontal diseases OR dental scaling OR root planing OR dental prophylaxis OR;
- Text words: initial therapy OR debridement OR non-surgical.

Surgical therapy

- MeSH terms: surgical flaps OR gingivectomy OR periodontal-pocket-surgery OR;
- Text words: modified widman flap OR access OR kirkland OR osseous surgery OR apically repositioned OR coronally.

Types of studies

- MeSH terms: longitudinal study OR randomised controlled study OR comparative study OR clinical trial.

The search strategy applied for the Cochrane search was ((Periodontics OR periodontal-disease OR 'periodontal disease* OR dental-scaling OR "dental scaling" OR root-planing OR 'root planing' OR dental-prophylaxis OR 'dental prophylaxis' OR 'oral prophylaxis' OR 'initial therap' OR debridement OR ((non-surgical OR 'non surgical') AND perio*)) AND ('surgical flap*' OR gingivectom* OR 'periodontal pocket surgery' OR 'modified Widman flap' OR access OR Kirkland OR 'osseous surgery' OR apical* OR reposition* OR coronally)).

Validity assessment

Two reviewers (L.H. & F.H.) independently screened titles and abstracts of the search results for possible inclusion. The full text of all studies of possible relevance was obtained for independent assessment against the stated inclusion criteria. Any disagreement was resolved by discussion amongst the reviewers. Authors were contacted to provide additional information where possible.

The methodological quality assessment, and data abstraction for included studies was independently conducted by two reviewers (L.H. & L.T.). Methodological quality was assessed focusing on individual components shown to affect study outcomes including the randomization method, allocation concealment (concealment of the randomization code from those recruiting patients to avoid selection bias), and completeness of follow-up. Agreement concerning study inclusion, and quality assessment was determined by Kappa statistics.

Quantitative data analysis

Studies were combined in meta-analyses to evaluate the treatment effect of surgical (open flap debridement, OFD) and non-surgical (scaling and root planing, SRP) procedures. The meta-analyses were performed using the statistical software package Stata version 6 (STATA version 6. Texas: Stata Corporation 1999). Results were expressed as weighted mean differences (WMD and 95% CI). A fixed effects model was used where appropriate and a random effects model was used when studies showed statistically significant heterogeneity. Variance imputation methods were used to estimate appropriate variance estimates in some studies, where the appropriate standard deviation of the differences was not included in study reports (Follmann et al. 1992).

Analyses were planned to investigate the treatment effects of non-surgical therapy and open flap debridement. Subgroup analyses were planned to investigate the treatment effects for non-molar and molar teeth.

Results

Study characteristics

The search resulted in the identification of 589 studies. Independent initial screening of the titles and abstracts by

two reviewers (L.H. & F.H.) resulted in further consideration of 14 randomized controlled trials for possible inclusion. Of these studies, seven met the defined inclusion criteria (Fig. 1). The Kappa value for interreviewer agreement for study inclusion was 0.93, 95% CI: 0.80, 1.06, indicating strong agreement. Disagreement concerning one paper was resolved by discussion. A further study, Sigurdsson et al. (1994), was excluded from the review following discussions during the workshop group session. This study included patients who were described as having recurrent disease and the consensus of the group was that this study was at variance with other studies and should be excluded from the review.

The remaining six randomized controlled trials were all of split mouth design with a non-surgical and surgical procedure performed within each patient. There was, however, considerable variation in study design and data presentation among the studies. Table 1 describes the characteristics of the included studies. The eight excluded publications and reasons for exclusion are presented in Table 2.

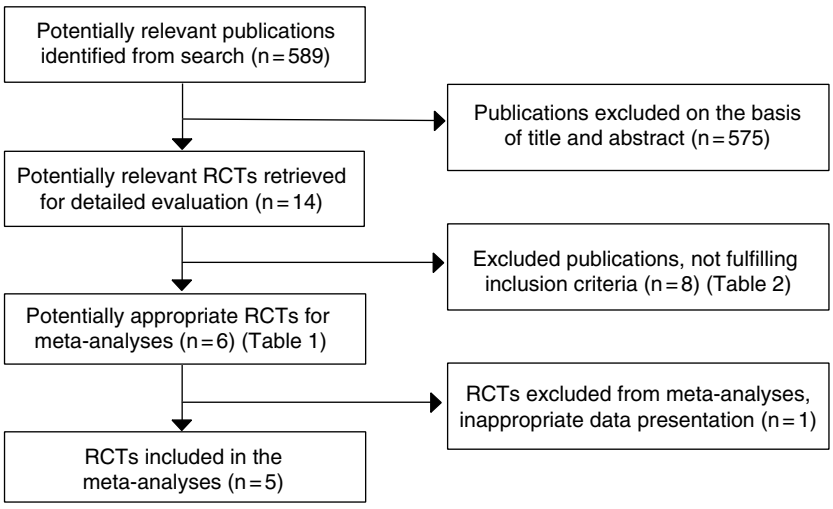

Fig. 1. Flow chart for inclusion in review and meta-analyses.

Methodological quality of included studies

Two studies described the randomization method (Isidor et al. 1984, Kaldahl et al. 1996), while allocation concealment was not reported in any of the studies.

Completeness of follow-up: A number of studies were based on a decreasing number of subjects. Data from these patients were included until the time of exit from the study.

There was 100% agreement between reviewers concerning study quality issues.

Study design – Initial therapy

Initial therapy varied among studies with three different study designs identified within the papers. The first involved no presurgical scaling (Lindhe et al. 1982, Lindhe & Nyman 1985). The second reported by Pihlstrom et al. (1983) incorporated initial scaling and root planing with no further treatment in the control group. Thus the control group received scaling and root planing once, while the test group received scaling and root planing at initial therapy and again during surgery. The third group of studies incorporated scaling and root planing during initial therapy with repeated scaling and root planing in the SRP and OFD groups (Ramfjord et al. 1987, Isidor et al. 1984, Kaldahl et al. 1996).

Studies of all three designs categories were included in the meta-analyses for treatment effect for sites with initial PPD of 4–6 mm, and greater then 6 mm. The analyses, however, showed no statistically significant heterogeneity between the studies.

Change in clinical attachment level (CAL)

One study presented data for the clinical attachment level change and probing depth change (mm) for all initial probing depths combined (Lindhe et al. 1982). All other studies presented data in relation to initial probing depth severity. Four studies presented data using the initial probing depth categories 1–3 mm, 4–6 mm and >6 mm (Lindhe et al. 1982, Lindhe & Nyman 1985, Pihlstrom et al. 1983, Ramfjord et al. 1987). Kaldahl et al. (1996) presented data using an alternative initial probing depth classification of 1–4 mm, 5–6 mm, and >6 mm.

Thus for the initial probing depth categories 1–3 mm and 4–6 mm there were four studies available for meta-analysis evaluation and for deep pockets (>6 mm), five studies were available. In the Lindhe et al. (1982) paper, the standard error was estimated from a figure.

In shallow pockets (1–3 mm) there was 0.5 mm less attachment loss following scaling and root planing (Table 3, Fig. 2). The weighted mean difference between surgical and non-surgical therapy was −0.51 mm (95% CI: [−0.74, −0.29], $P < 0.001$).

In pockets of initial probing depth 4–6 mm there was 0.4 mm more attachment gain following non-surgical therapy. The difference between the treatment modalities was highly statistically significant (Table 3, Fig. 3). The weighted mean difference between surgical and non-surgical therapy was −0.37 mm (95% CI: [−0.49, −0.26], $P = 0.000$).

In deep pockets (PPD > 6 mm), there was 0.2 mm more attachment gain following access flap surgery (Table 3, Fig. 4). The weighted mean difference between surgical and non-surgical therapy was 0.19 mm (95% CI [0.04, 0.35], $P = 0.017$).

Probing pocket depth reduction

When initial probing depth severity was considered, differences in treatment effect could be observed between surgical and non-surgical therapy. In shallow pockets (1–3 mm), no statistically significant difference in pocket depth reduction between treatment procedures was observed (Table 3, Fig. 5).

When the initial probing depth was 4–6 mm, there was 0.4 mm more pocket reduction following open flap debridement (Table 3, Fig. 6). The weighted mean difference between surgical and non-surgical therapy was 0.35 mm (95% CI: [0.23, 0.47], $P < 0.001$).

In deep pockets (>6 mm) the open flap debridement resulted in 0.6 mm more pocket reduction than scaling and root planing (Table 3, Fig. 7). The weighted mean difference between surgical and non-surgical therapy was 0.58 mm (95% CI [0.38, 0.79], $P < 0.001$).

Table 1. Characteristics of included studies

Study	Methods	Participants	Interventions	Outcomes	Location and funding	Comments
Lindhe et al. (1982, 1984) (5-year follow-up)	RCT Split-mouth 2 treatment groups 2–5 years' duration	15 individuals, 11 completed the study 6 females Age 32–57 years	Initial therapy: OHI Control: SRP. Test: MWF Maintenance intervals: every 2 weeks for first 6 months, 3-monthly from 6 to 24 months, 4–6-monthly supragingival cleaning from 24 to 60 months	Δ CAL Δ PPD GI PLI	University	Tooth loss not reported Data: Overall data Initial PPD 1–3 mm Initial PPD 4–6 mm Initial PPD >6 mm non-molars molars 5-year data: frequency distribution of ΔCAL in patients with Plaque score $\leqslant$10% and $\geq$50%
Lindhe & Nyman (1985)	RCT Split-mouth 3 treatment groups 12 months' duration	15 individuals Age 42–59 years	Initial therapy: OHI Control: SRP Test 1: MWF Test 2: modified Kirkland flap Maintenance intervals: every 2 weeks for first 3 months supragingival cleaning, 3-monthly from 3 to 12 months (supra- and subgingival debridement)	ΔCAL ΔPPD PLI GI BOP	University	Data: Initial PPD 1–3 mm Initial PPD 4–6 mm Initial PPD >6 mm
Pihlstrom et al. (1981, 1983, 1984)	RCT Split-mouth 2 treatment groups 6.5 years' duration	17 individuals, 10 completed the study, 13 females Age 22–59 years	Initial therapy: OHI + SRP (+LA) Control: no further treatment Test: MWF Maintenance intervals: 3–4-monthly supra- and subgingival debridement	ΔCAL ΔPPD GI PLI	University	Results based on a decreasing number of subjects Data: Initial PPD 1–3 mm Initial PPD 4–6 mm Initial PPD > 6 mm non-molars molars
Isidor & Karring (1986) Isidor et al. (1984)	RCT Split-mouth 3 treatment groups 5 years' duration	16 individuals Age 28–52 years	Initial therapy: OHI + SRP(-LA) Control: SRP Test 1: MWF (OFD) Test 2: Reverse Bevel Flap Maintenance intervals: every 2 weeks year 1, professional prophylaxis 3-monthly year 2, 6-monthly years 3, 4 & 5 – subgingival debridement	ΔCAL ΔPPD PLI GI BOP	University	Non-molar teeth only angular defects evaluated
Ramfjord et al. (1987)	RCT Split-mouth 4 treatment groups 5 years' duration	90 Individuals, 72 completed the study; 37 females Age 24–68 years	Initial therapy: OHI + SRP Control: SRP Test 1: MWF Test 2: Pocket elimination surgery. Test 3: subgingival curettage Maintenance intervals: weekly for 1 month, 3-monthly for 5 years (supra- and subgingival debridement)	ΔCAL ΔPPD	University	Recordings obtained both prior to and 1 month following completion of initial therapy Results based on a decreasing number of subjects Detailed data for plaque and bleeding scores not presented Data: Initial PPD 1–3 mm Initial PPD 4–6 mm Initial PPD >6 mm
Kaldahl et al. (1988, 1996) Kalkwarf et al. (1988) (Molar furcations) Kalkwarf et al. (1989)	RCT Split-mouth 4 treatment groups 7 years' duration	82 individuals, 51 completed the study 52 females Mean age 43.5 years	Initial therapy: OHI + SRP Control: additional SRP Test 1: MWF Test 2: Osseous surgery Test 3: Coronal scaling Maintenance intervals: subgingival debridement)	ΔCAL ΔPPD	University	Analysis of coronal scaling group discontinued Results based on a decreasing number of subjects Detailed data for plaque and bleeding scores not presented Data: Initial PPD 1–4 mm Initial PPD 5–6 mm Initial PPD >6 mm

RCT: randomized control trial; LA: local anaesthesia; OHI: oral hygiene instruction; BOP: bleeding on probing; CAL: clinical attachment level; OFD: open flap debridement; PPD: probing pocket depth; PLI: plaque index; GI: gingival index; MWF: modified Widman flap (OFD); SRP: scaling and root planing.

Table 2. Characteristics of excluded studies

Study	Reason for exclusion	Methods	Participants	Interventions	Outcomes	Location and funding
Westfelt et al. (1985)	6 months' duration	RCT Split-mouth 5 treatment groups 6 months' duration	16 individuals Age 35–65 years	Initial therapy: OHI Control: SRP Test 1: MWF Test 2: Gingivectomy Test 3: Apically repositioned flap Test 4: Apically repositioned flap + bone recontouring Maintenance intervals: 2-weekly for 6 months	ΔCAL ΔPPD	University
Becker et al. (1988)	Antibiotics prescribed for 4 days after treatment Anterior teeth not included	RCT Split-mouth 3 treatment groups 12 months' duration	16 individuals Age 30–57 years	Initial therapy: OHI Control: SRP Test 1: MWF Test 2: Apically repositioned flap + osseous surgery Maintenance intervals: 3-monthly	ΔCAL ΔPPD	University
Renvert et al. (1985)	Citric acid root surface conditioning as an adjunct to OFD	RCT Split-mouth 2 treatment groups 5 years' duration	14 individuals, 12 completed the study Age 32–67 years	Initial therapy: OHI + SRP Control: SRP Test: Access flap + citric acid Maintenance intervals: every 6 weeks for first year, then every 6 months	ΔCAL ΔPPD	University
Knowles et al. (1979)	No SRP group Subgingival curettage (Root planing and soft tissue curettage)	RCT Split-mouth 3 treatment groups 8 years' duration	78 individuals, 43 completed the study Age 19–61 years	Initial therapy: OHI + SRP(-LA) Control: subgingival curettage Test 1: MWF Test 2: pocket elimination Maintenance intervals: 3-monthly	ΔCAL ΔPPD	University
Waite et al. (1976)	No SRP group, supragingival scaling and polishing only	RCT Split-mouth 2 treatment groups 2 years' duration	28 individuals Age 21–49 years	Initial therapy: OHI + SRP Control: supragingival scaling and polishing Test: gingivectomy Maintenance intervals: 3-monthly	ΔCAL ΔPPD	University
Schroer et al. (1991)	Not randomized, teeth selectively assigned to treatment groups Grade II molar furcations	CCT Split-mouth 2 treatment groups 12 months' duration	11 individuals, 10 completed the study Age 32–69 years	Initial therapy: OHI +SRP Control: SRP Test: OFD Maintenance intervals: 3-monthly	ΔCAL ΔPPD	University
Forabosco et al. (1996)	SRP with betadine 0.5% irrigation Site-based analysis	RCT Split-mouth 2 treatment groups 12 months' duration	8 individuals Age 35–50 years	Initial therapy: OHI +supragingival scaling Control: SRP + Betadine 0.5% Test: MWF Maintenance intervals:every 2 weeks	ΔCAL ΔPPD	University
Sigurdsson et al. (1994)	Patients described as having recurrent periodontitis excluded during group discussion	RCT Split-mouth 2 treatment groups 12 months' duration	11 individuals 7 females Age 34–57 years	Initial therapy: OHI Control: SRP Test: MWF Maintenance intervals: 3-monthly, subgingival debridement avoided	ΔCAL ΔPPD	Private practice

CCT: controlled clinical trial.

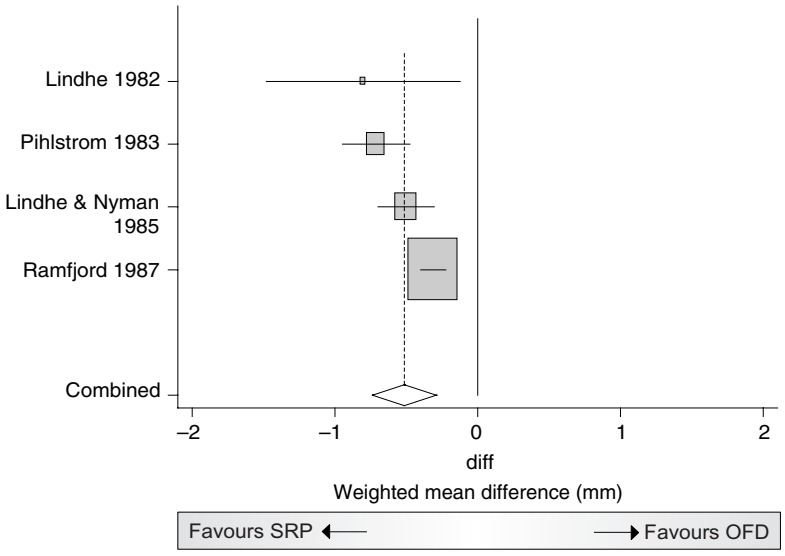

Fig. 2. Difference in the CAL change between OFD and SRP at sites with initial PPD 1–3 mm. Random effects Forest plot.

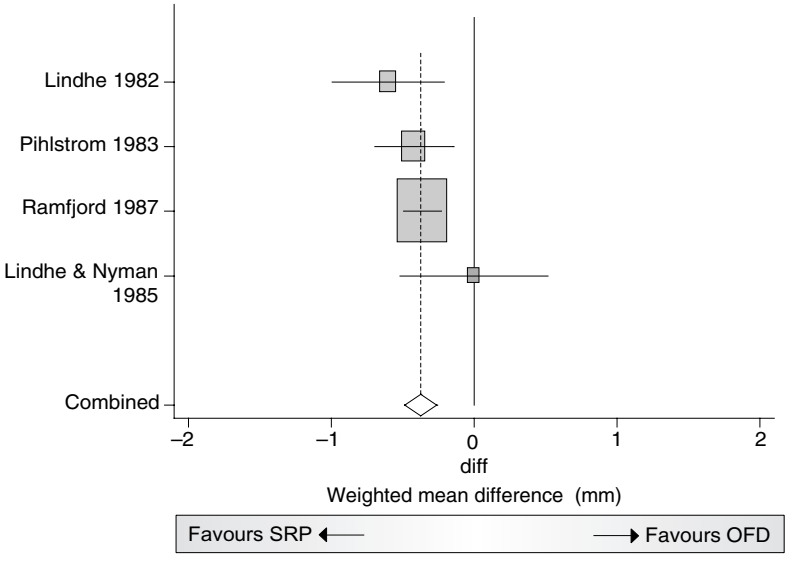

Fig. 3. Difference in the CAL change between OFD and SRP at sites with initial PPD 4–6 mm. Fixed effects Forest plot.

Molar and non-molar teeth (Tables 4a, b, c, d)

Two studies evaluated the treatment outcome in both molar and non-molar teeth (Lindhe et al. 1982, Pihlstrom et al. 1984). A meta-analysis was not performed, as it was not possible to derive the standard error in the paper by Pihlstrom et al. (1984). Both studies reported that deep sites (PPD > 6 mm) showed more probing pocket depth reduction following open flap debridement for non-molar teeth. Mean attachment level changes, however, showed little variation between tooth types and treatment modalities.

Isidor & Karring (1986) evaluated non-molar teeth over a period of 5 years. Similar results in probing depth reduction and attachment gain were achieved following non-surgical and surgical procedures. An analysis of angular defects was also included, and indicated no difference in outcome between treatment modalities. Data were not presented in relation to the initial probing depth severity in this paper, and therefore could not be combined in a meta-analysis with data from Lindhe et al. (1982).

Molar furcations

Kalkwarf et al. (1988) evaluated furcation areas of molar teeth 2 years after non-surgical and surgical therapy. Similar treatment effects were observed following both procedures (Table 5).

Incidence of bleeding on probing (BOP)

The incidence of bleeding on probing was inconsistently reported and a meta-analysis was therefore not possible for this outcome variable. Table 6 shows a similar reduction in the percentage of sites with presence of BOP following non-surgical and surgical treatment modalities.

Long-term treatment outcomes

A number of studies presented long-term treatment outcomes after 5 years (Isidor & Karring 1986, Ramfjord et al. 1987, Lindhe et al. 1984), 6.5 years (Pihlstrom et al. 1983) and 7 years (Kaldahl et al. 1996). The long-term results of these studies were based on a decreasing number

Table 3. Summary of meta-analyses for clinical outcomes

Outcome	Initial PPD category (mm)	No. of studies	WMD weighted mean difference (mm) 95%	95% CI	*P*-value for WMD	Heterogenity *P*-value	Heterogenity Method
CAL gain	1–3 mm	4	−0.513	−0.737, −0.290	0.000	0.005	random
PPD reduction	1–3 mm	2	0.101	−0.036, 0.239	0.147	0.008	random
CAL gain	4–6 mm	4	−0.373	−0.485, −0.261	0.000	0.331	fixed
PPD reduction	4–6 mm	2	0.351	0.234, 0.467	0.000	0.108	fixed
CAL gain	>6 mm	5	0.191	0.035, 0.347	0.017	0.897	fixed
PPD reduction	>6 mm	3	0.584	0.383, 0.785	0.000	0.687	fixed

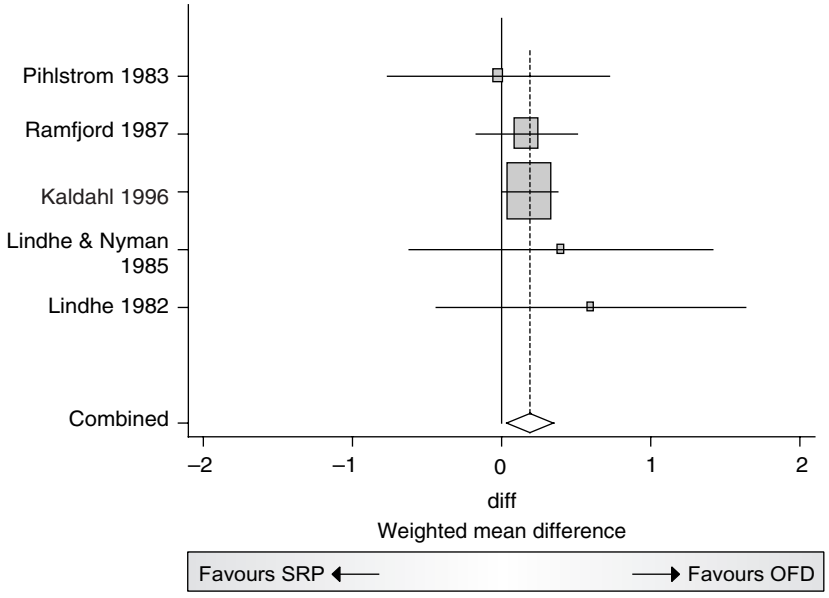

Fig. 4. Difference in the CAL change between OFD and SRP at sites with initial PPD >6 mm. Fixed effects Forest plot.

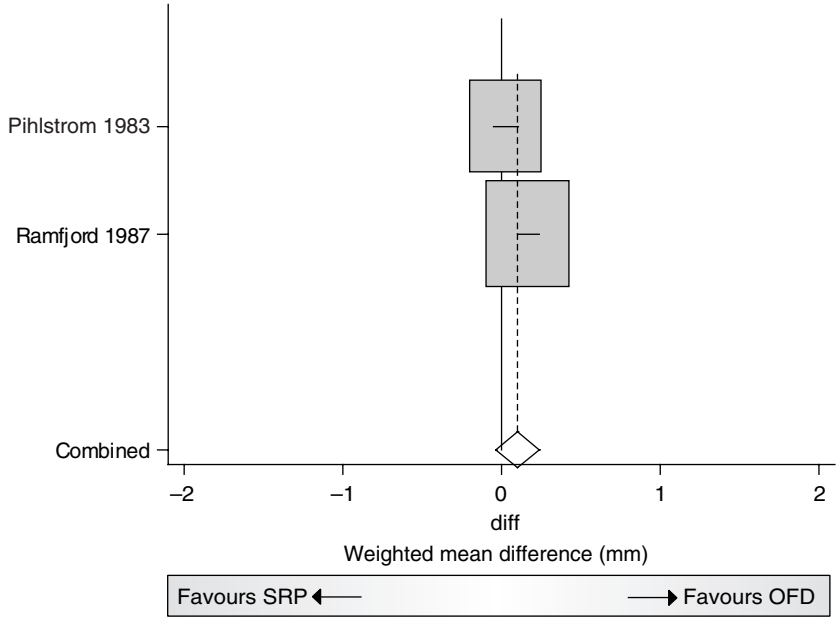

Fig. 5. Difference in the PPD change between OFD and SRP at sites with initial PPD 1–3 mm. Random effects Forest plot.

of subjects compared with baseline (Lindhe et al. 1982, Pihlstrom et al. 1983, Ramfjord et al. 1987, Kaldahl et al. 1996). In these studies, data were included in the analyses up until the time of dropout.

Re-treatment of sites and tooth loss was reported in several studies. Ramfjord et al. (1987) reported a total of 101 teeth in 24 patients requiring re-treatment due to persistent inflammation; 44 teeth required re-treatment in the non-surgical treatment group, while about 20 teeth for the surgical groups were re-treated. However, the long-term results of scaling and root planing were equivalent to those of the surgical procedures with regard to maintenance of attachment and prevention of loss of teeth.

Similarly, Kaldahl et al. (1996) reported that breakdown sites (attachment loss $\geq$3 mm/year) were more frequently found in deep sites treated by scaling and root planing. They also observed that similar numbers of teeth were extracted due to progressive periodontal disease following non-surgical treatment (21 teeth) and modified Widman flap (21 teeth).

Pihlstrom et al. (1983) also reported a similar incidence of tooth loss following surgical (five teeth) and non-surgical (six teeth) therapy over a 5-year observation period.

Overall, the long-term data suggests that non-surgical and surgical therapy were equally effective in establishing gingival health, and preventing further loss of attachment.

Discussion

This systematic review illustrates the heterogeneity of study design within the literature. While individual studies may offer valuable information, only six randomized, controlled trials met the inclusion criteria for this systematic review. Due to the limited number of studies in the analyses, formal testing for publication bias was not possible.

Regarding the quality of the included studies, some reports were incomplete in their presentation of methods or results. Allocation concealment was not reported, and randomization method was described in only two studies. Furthermore, some studies did not report standard deviation or standard error. Data for the meta-analyses were frequently obtained by estimation from figures in the papers.

It is recommended that authors of randomized controlled trials (RCTs) should follow the CONSORT statement (http://www.consort-statement.org/) for reporting of trials (Needleman 1999). This report provides concise guidelines on presentation of trial reports and may facilitate future systematic reviewing of the literature.

While all included studies were of split mouth design there were differences in a number of aspects between studies. Firstly, there was a range of terminology used to describe the study population and disease severity among studies. The age range also varied from 22 to 68 years and this suggests that participants may have varied in their susceptibility to periodontitis.

Secondly, the initial therapy provided varied among studies. In two studies initial therapy consisted of

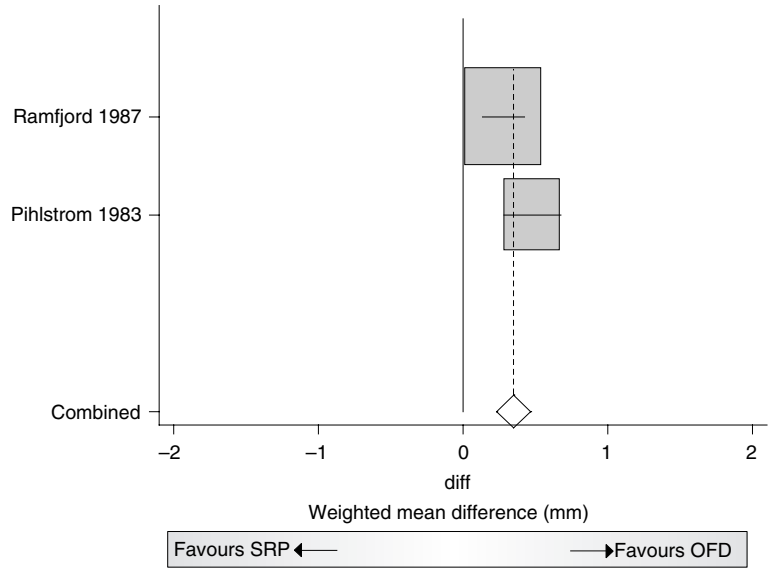

Fig. 6. Difference in the PPD change between OFD and SRP at sites with Initial PPD 4–6 mm. Fixed effects Forest plot.

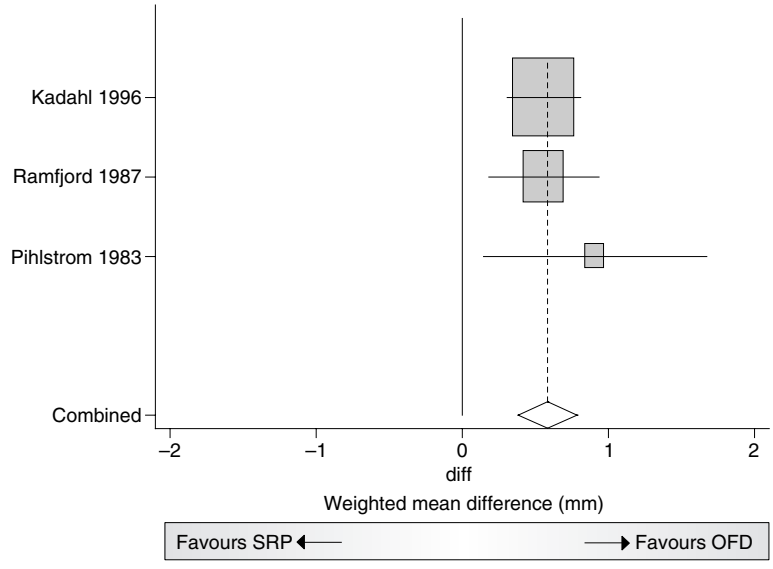

Fig. 7. Difference in the PPD change between OFD and SRP at sites with Initial PPD >6 mm. Fixed effects Forest plot

Table 4a. Non-molar teeth ΔCAL

		ΔCAL mm (12 months)	
	n	SRP mean ± SD/SE*	OFD mean ± SD/SE*
Lindhe et al. (1982)			
PPD 1–3 mm	15	−0.9 ± 0.4*	−0.2 ± 0.2*
PPD 4–6 mm	15	0.7 ± 0.4*	0.3 ± 0.2*
PPD >6 mm	15	0.9 ± 0.9*	1.5 ± 0.6*
Pihlstrom et al. (1984)			
PPD 4–6 mm	14	0.34	0.06
PPD >6 mm	10	0.41	1.19
Isidor & Karring (1986)			
All initial PPD	16	0.6 ± 0.2*	0.2 ± 0.3*
Angular defects	16	1.6 ± 0.3*	0.9 ± 0.5*

OFD: open flap debridement. SRP: scaling and root planing.

oral hygiene instruction alone (Lindhe et al. 1984, Lindhe & Nyman 1985). In contrast, Ramfjord et al. (1987), Isidor et al. (1984) and Kaldahl et al. (1996) performed scaling and root planing as part of initial therapy and this was repeated during the definitive phase of treatment. In one study the control group received a single session of scaling and root planing while the test group received scaling and root planing at initial therapy, and again during the flap procedure (Pihlstrom et al. 1983).

Furthermore, supportive periodontal therapy (SPT), or professionally supervised maintenance care, also varied considerably among studies. In a number of studies, patients followed a programme of professional prophylaxis at 2-weekly intervals, as described by Axelsson & Lindhe (1974), for a period of up to 1 year following treatment (Lindhe et al. 1984, Lindhe & Nyman 1985, Isidor & Karring 1986). In other studies, supra- and subgingival debridement at 3–4-monthly intervals was the standard of care (Pihlstrom et al. 1983, Ramfjord et al. 1987, Kaldahl et al. 1996).

While SPT intervals differed among studies, all studies incorporated regular supervised maintenance care in their protocols and interpretation of the results should be made with this in mind.

The importance of supportive periodontal therapy (SPT) was emphasized in the 5-year report by Lindhe et al. (1984). In this study a strict programme of professional supragingival plaque removal at 2-weekly intervals was provided for 6 months following treatment. The maintenance care programme was then extended to 3-monthly visits including subgingival scaling as required. Frequency distribution of attachment level changes for patients with excellent plaque control (PLI $\leq$ 10%), and poor oral hygiene (PLI $\geq$ 50%) at each re-examination were described. Reduction of probing depth, and gain of clinical attachment occurred predominantly in the group of patients with a high standard of oral hygiene.

Overall, studies showed a substantial reduction in the percentage of BOP positive sites following both treatment modalities, reflecting the systematic approach to plaque control incorporated in the included studies.

Table 4b. Non-molar teeth ΔPPD

	ΔPPD mm (12 months)		
	n	SRP mean ± SD/SE*	OFD mean ± SD/SE*
Lindhe et al. (1982)			
PPD 1–3 mm	15	0.4 ± 0.2*	0.6 ± 0.2*
PPD 4–6 mm	15	2.0 ± 0.4*	2.3 ± 0.4*
PPD >6 mm	15	2.6 ± 1.0*	3.4 ± 0.8*
Pihlstrom et al. (1984)			
PPD 4–6 mm	14	0.80	1.45
PPD >6 mm	10	1.71	3.14
Isidor & Karring (1986)			
All initial PD	16	2.3 ± 0.3*	2.5 ± 0.4*
Angular defects	16	3.7 ± 0.3*	3.5 ± 0.3*

OFD: open flap debridement. SRP: scaling and root planing.

Table 4c. Molar teeth ΔCAL

	ΔCAL mm (12 months)		
	n	SRP mean ± SD/SE*	OFD mean ± SD/SE*
Lindhe et al. (1982)			
PPD 1–3 mm	15	−0.3 ± 0.2*	−1.0 ± 0.6*
PPD 4–6 mm	15	0.3 ± 0.4*	−0.1 ± 0.2*
PPD > 6 mm	15	0.9 ± 0.6*	0.7 ± 0.6*
Pihlstrom et al. (1984)			
PPD 4–6 mm	14	0.50	0.07
PPD > 6 mm	10	0.64	1.21

OFD: open flap debridement. SRP: scaling and root planing.

Table 4d. Molar teeth ΔPPD

	ΔPPD mm (12 months)		
	n	SRP mean ± SD/SE*	OFD mean ± SD/SE*
Lindhe et al. (1982)			
PPD 1–3 mm	15	0.2 ± 0.2*	0.5 ± 0.4*
PPD 4–6 mm	15	1.2 ± 0.4*	1.4 ± 0.4*
PPD > 6 mm	15	2.0 ± 1.0*	2.0 ± 1.2*
Pihlstrom et al. (1984)			
PPD 4–6 mm	14	0.67	1.26
PPD > 6 mm	10	0.94	2.28

OFD: open flap debridement. SRP: scaling and root planing.

Table 5. Molar furcation sites: data from Kalkwarf et al. (1988) (all values estimated from Figures: no SD/SE given). 12-month results

	SRP		OFD	
	n	mean	*n*	mean
ΔCAL vertical (mm)	78	0.8	74	0.6
ΔCAL horizontal (mm)	78	0.2	74	−0.4
ΔPPD (mm)	78	1.2	74	1.5

OFD: open flap debridement. SRP: scaling and root planing.

Subject dropout, re-treatment of teeth and tooth loss were reported in several studies. In these studies the data were included in the analysis until the time of exit. It is not clear, however, how this subject dropout and tooth loss affects the results and conclusions within these studies.

All studies were university-based, which may have influenced the results of comparison of treatment modalities in that conditions were 'ideal' for research with no time constraints during treatment and maintenance. Operator experience was inconsistently reported and this may also have influenced the outcome of treatment modalities.

Despite these differences, the outcomes of the seven studies included in this review show similar results 1 year after surgical and non-surgical periodontal therapy. In deep pockets (>6 mm), surgical therapy resulted in more probing pocket depth reduction and more attachment gain than the non-surgical therapy, whereas in shallow pockets (1–3 mm) there was more attachment loss following surgery than scaling and root planing. Long-term results suggest that the two treatment modalities are equally effective in PPD reduction, CAL gain and reduction in incidence of BOP.

Insufficient studies are available to evaluate the various treatment procedures in furcation regions and angular defects.

At the time when most of the studies were conducted, subject characteristics and their possible effect on treatment outcome were not addressed.

Patient preference and patient-based outcomes were not reported in any of the studies and this area should be addressed in future research.

Conclusions

- When sites with initial PPD 1–3 mm were involved in treatment by open flap debridement, there was significantly more CAL loss than with treatment by scaling and root planing (WMD –0.51 mm; 95% CI –0.74, –0.29).
- When sites with initial PPD 4–6 mm were treated by open flap debridement, there was significantly less CAL gain than with the scaling and root planing procedure (WMD

Table 6. Bleeding on Probing BOP%

		SRP		OFD	
Lindhe & Nyman (1985)	*n*	baseline M ± SD/SE*	12 months M ± SD/SE*	baseline M ± SD/SE*	12 months M ± SD/SE*
	15	79 ± 9*	8 ± 5*	78 ± 10*	5 ± 4*
		SRP		OFD	
Kalkwarf et al. (1989)	*n*	baseline	12 months	baseline	12 months
1–4 mm initial PPD	78	70	32	70	38
5–6 mm initial PPD	78	90	45	90	55
>6 mm initial PPD	78	90	58	90	55

OFD: open flap debridement. SRP: scaling and root planing.

–0.37 mm; 95% CI –0.49, –0.26). The PPD reduction was significantly greater following the open flap debridement procedure (WMD 0.35 mm; 95% CI 0.23, 0.47).

- When sites with initial PPD >6 mm were treated with open flap debridement, there was significantly more CAL gain than with scaling and root planing (WMD 0.19 mm; 95% CI 0.04, 0.35). Open flap debridement resulted in significantly more PPD reduction than did scaling and root planing in these deep pockets (WMD 0.58 mm; 95% CI 0.38, 0.79).
- No data exist to address the important issue of patient-centred evaluation of treatment outcomes or adverse effects.

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