

Improving Scaling and Root Planing Over the Past 40 Years: A Meta-Analysis

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Abstract

Aim: To screen whether or not classical non-surgical periodontal therapy improved over the last four decades and how adjunctive local or systemic measures influenced its clinical outcome.

Methodology: Starting from the year 1970, the entire annual sets of publications of every 5th year of the "Journal of Clinical Periodontology" and the "Journal of Periodontology" were hand searched for articles dealing with non-surgical periodontal therapy, i.e. scaling and root planing either alone (SRP) or in combination with adjunctive local (SRPloc) or systemic (SRPsyst) treatment. Mean pocket reduction was computed for each of the three treatment modalities. Where applicable, a meta-analysis and a meta-regression as well as linear regression were performed.

Results: A total of 52 articles were found. Twenty-six thereof were randomized clinical trials. The meta-analysis revealed a standardized mean difference of pocket reduction of 0.77 mm (95% CI=0.283; 1.255) and 0.90 mm (95% CI 0.210; 1.593 for SRPloc–SRP and SRPsyst–SRP, respectively ($P<0.0001$). Meta regression showed significantly more mean pocket reduction for SRPloc ($p=0.011$) and SRPsyst ($p=0.001$) than for SRP. In addition, a negative correlation between time to re-evaluation and mean pocket reduction could be found ($p=0.015$). None of the treatment modalities improved over the past 40 years.

Conclusion: Adjunctive local or systemic measures seem to improve the classic non-surgical periodontitis therapy, i.e. scaling and root planing. None of the three analyzed treatment modalities improved over the past 40 years.

Keywords: Periodontitis; Scaling; Debridement; Non-surgical; Review

Introduction

Periodontitis is a complex infective disease modulated by several host and environmental factors, leading to tissue inflammation and bone resorption [1,2]. As a clinical consequence, pocket formation and loss of attachment may occur. Bacteria are considered to be the primary etiological factor [3].

Since the early 1980s effective reduction of supra- and subgingival pathogenic flora by mechanical means i.e. scaling and root planing in combination with a meticulous oral hygiene is considered the gold standard in non-surgical periodontal therapy [4]. However, a complete removal of subgingival deposits and an effective and reliable control of the subgingival vital flora has been shown to be unrealistic and a difficult goal to achieve [5].

In order to overcome these limitations, a large variety of adjunctive measures to improve the outcome of mechanical debridement was tested and published subsequently. Concerning the removal of calculus and biofilm a considerable number of different instruments such as curettes, ultrasonic devices, air scalers, powder jet devices and lasers as well as different protocols have been described [6]. Antibiotics and antiseptics have been introduced as a systemic and local adjunct to mechanical therapy [7]. The use of systemic antibiotics has been widely assessed and contradictorily discussed [8]. Particularly the combination of amoxicillin and metronidazole is warranted in advanced chronic and aggressive periodontitis [9]. On the other hand the use of systemically administered antibiotics is associated with certain risks, notably the development of antibiotic resistance in various bacterial species or allergies and some considerable clinical side-effects like nausea, headaches, diarrhea etc. [10]. In contrast, topical administration of antibiotics and antiseptics supporting mechanical periodontal debridement seems worth consideration [11]. Several antimicrobial chemotherapeutics, varying in concentrations

and galenic formulations have been used. They are a quick and potentially less expensive method, and can be applied in the pockets [12]. In most cases, subgingival irrigation with different antiseptic and antibiotic formulations has still not shown clinically significant effectiveness beyond that of conventional mechanical debridement [13]. On the other hand, several local drug delivery devices have become commercially available. The claimed benefit of these more sophisticated systems includes their ability to deliver drugs even within deep pockets at bactericidal or bacteriostatic concentrations for a longer period of time. A systematic review has assessed the local adjunctive anti-infective therapy using a variety of pharmacological agents and found that these agents in a sustained-release vehicle alone could reduce PD and bleeding on probing (BOP), but equivalent to that achieved by SRP alone [14]. Overall, there is still a lack of information regarding the clinical effectiveness of most of these agents. To sum up adjunctive measures as described above can basically be divided in two main groups: First local and second systemic adjunctive measures. Local measures range from simple irrigation of a periodontal pocket with a disinfectant to considerably more sophisticated therapies such as laser treatment or photodynamic therapy. On the other hand systemic adjunctive treatment is in the main composed of peroral administration

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of different antibiotics, particularly the combination of amoxicillin and metronidazole.

Looking back on 40 years of research and the persistent struggle to improve decontamination by the mentioned means, one should be allowed to ask an almost heretic question: "With what result?"

Therefore, the aim of the study was to screen, whether or not non-surgical periodontal therapy improved over the last four decades and how adjunctive local or systemic measures influenced its outcome so far. We hypothesized that technical and pharmaceutical developments in the last four decades and an overall therapeutic learning curve led to more pocket depth reduction.

Materials and Methods

Starting from the year 1970 the entire annual sets of publications of every 5th year of the "Journal of Clinical Periodontology" as well as the "Journal of Periodontology" were hand searched for articles concerning non-surgical periodontal therapy. Every type of publication exploring the classic non-surgical periodontal therapy, i. e. scaling and root planing either alone or in combination with adjunctive local or systemic treatment such as local drug delivering devices or systemic antibiotics, other drugs or nutritional supplements was included. For inclusion, the study population of the included articles had to suffer from localized or generalized periodontitis. The mean reduction of the clinical pocket (dPD) and its standard deviation (SD) as well as the time span between baseline and the first re-evaluation (tTR) had to be included. As dPD was calculated by subtracting the pocket depth (PD) at re-evaluation from the PD at baseline. A positive value represented a reduction of the clinical PD. Some publications did not provide dPD in numeric values. In order to raise the number of includable articles, dPD numeric data was extracted from graphs where possible. For further missing information - for example SD - the approximations from Sachs (Sachs 1991) were applied. Each publication meeting the inclusion criteria was assigned to one of three treatment modalities:

1. SRP: Classic scaling and root planing executed with currettes and/or ultrasonic or air scalers respectively. Any kind of protocol such as full-mouth, quadrant wise or others was included.
2. SRPloc: SRP in combination with adjunctive local treatment such as irrigation of the pockets or application of local drug delivering devices or local laser treatment.
3. SRPsyst: SRP in combination with adjunctive systemic treatment such as antibiotics, other drugs or nutritional supplements.

When performing the meta-analysis, the SRP-groups of respective RCTs served as control-group.

Data were coded in Excel and analyzed with both Medcalc 12.4.0 and SPSS Version 20. For randomized clinical trials meta-analysis together with heterogeneity test and appropriate forest plots were provided. Apart from that a meta-regression was considered. It consisted of a multiple linear weighted regression and contained all studies, which have been found. The association between mean pocket reduction and the year of publication was assessed by means of Spearman correlation. Results of statistical analyses with p-values smaller than 0.05 were considered as significant.

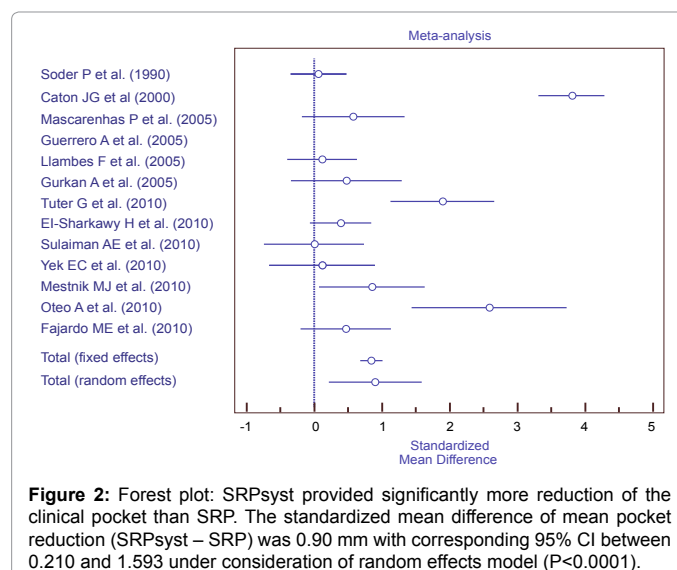
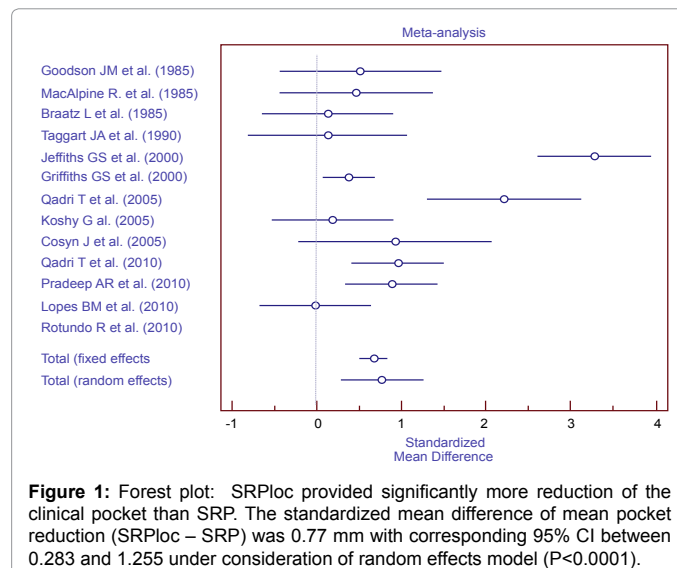
Results

A total of 52 publications were found [15-66]. Twenty-six studies represented randomized controlled clinical trials (RCT; Figures 1 and 2).

Regarding adjunctive local (SRPloc) therapy, irrigation of the pockets with disinfectants, application of local drug delivering devices [17-22] or local laser treatment [23-26] were identified. Pocket irrigation and mouth rinses in most of the studies were performed with chlorhexidine [27-29,66]. Another study used povidone iodine instead [67].

Regarding systemic (SRPsyst) treatment, amoxicillin and metronidazole or metronidazole alone was used in most studies [33-38]. Several studies tested doxycycline in subantimicrobial [39,40,68] or antibacterial doses [42]. Two studies assayed azithromycin [43,44] and one further publication evaluated clindamycin [45]. Other drugs like atorvastatin [31] or nutritional supplements such as vitamin C, omega-3 fatty acids and low-dose aspirin [15,32] were also screened.

The meta-analysis of the RCTs revealed that combining SRP with adjunctive local or systemic measures respectively provided more mean pocket reduction than the classic treatment i.e. SRP alone (Figures 1 and 2), when the random effects model had been considered. When comparing SRP with SRPloc, the additional standardized mean pocket



reduction of local treatment was 0.77 mm, whereas when comparing the classic (SRP) with the adjunctive systemic treatment (SRPsyst) the additional standardized mean pocket reduction accounted for 0.90 mm. For both comparisons, the zero value was not contained in the 95% CI which implied, that these results were highly significant.

The meta-regression of all 52 studies showed that both predictors, type of treatment ($p < 0.001$) as well as time to re-evaluation ($p = 0.015$) had an influence on mean pocket reduction (Figure 3). In conformity with the meta-analysis, SRP achieved minor results than SRPloc and SRPsyst respectively when the calculation was adjusted for time to re-evaluation. In addition, there was no statistically significant difference between SRPloc and SRPsyst ($p = 0.566$).

The time span between baseline and re-evaluation (tTR) differed between 1.5 and 12 months and had a significant influence on the outcome of the studies under investigation. The longer the tTR, the

smaller was the achieved mean pocket reduction ($\beta = -0.043$, $p = 0.015$, 95% CI (β) = (-0.078, -0.009)).

Spearman correlation looking at the three treatment modalities separately, revealed no significance (Figure 4), i.e. none of them improved over the past 40 years (SRP $p = 0.548$; SRPloc $p = 0.565$; SRPsyst $p = 0.450$). Moreover, - when pooling all treatment modalities - the probing pocket depth reduction after non-surgical periodontal treatment did not improve over time neither ($p = 0.913$).

Discussion

Within the limitations of this study it could be shown by meta-analysis as well as meta-regression that the introduction of adjunctive local or systemic treatment had a beneficial effect on classic scaling and root planning indeed.

Considering the fact that only a selection of volumes of just two journals were searched as well as the fact that treatment options have been reduced to only three treatment modalities - these statements cannot be conclusive nor definitive.

Most evidence seems to exist for the beneficial effect of adjunctive systemic antibiotics and particularly for the combination of amoxicillin and metronidazole to non-surgical periodontal therapy [8,9,69-72]. It has to be underlined that the systemic administration of antibiotics is only recommended in combination with mechanical debridement of the root surfaces i.e. scaling and root planning [8].

Among the included studies in the present meta-analysis, primarily tetracycline, metronidazole and chlorhexidine were used as locally administered antimicrobials. Another systematic review corroborated our findings and showed that the most positive results occurred for exactly these substances and that their local administration generally reduced PD levels significantly [73]. However, when compared to SRP alone, the benefit in this study seemed to be rather small (0.1-0.5 mm).

We only analyzed data from studies reporting classical SRP. In the last few years, the significance of laser in non-surgical periodontal therapy either alone or as an adjunct to SRP has been widely discussed and numerous reviews of the literature have been published. Most authors concluded that there is still insufficient evidence to suggest that any specific wavelength of laser or treatment protocol is superior to the traditional modalities of therapy and that further research is needed [74-76].

Observing the mean pocket reduction over time, it seems as if there was no substantial improvement in non-surgical periodontal therapy over the past 40 years neither when looking at the three assessed treatment modalities separately nor when combining all the different treatment approaches to one group. However, the heterogeneity of the included studies was remarkable. Some publications dealt only with the deepest site in every patient, while others calculated with full mouth PD [54,77]. In that way "mean pocket reduction" could simply be the wrong parameter to base such a statement on.

Finally we could show that time span between baseline and re-evaluation (tTR) stands in inverse ratio to dPD. This can easily be explained by the fact that the re-establishment of a disease-associated, subgingival microbiota may take several months [78]. Furthermore, with growing distance to the initial therapy, the role of supportive periodontal treatment in maintaining successful results becomes more and more important [79].

Two studies assessing local antibiotic/antiseptic treatment (Figure 1) [20,24] as well as three studies with a systemic antimicrobial approach

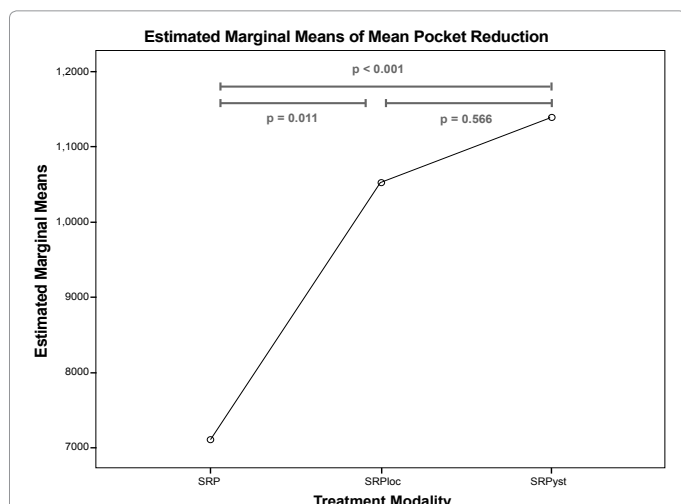


Figure 3: Estimated marginal means of mean pocket reduction in the model adjusted for time to reevaluation for the three different treatment modalities. SRPloc as well as SRPsyst provided significantly more reduction of the clinical pocket than SRP.

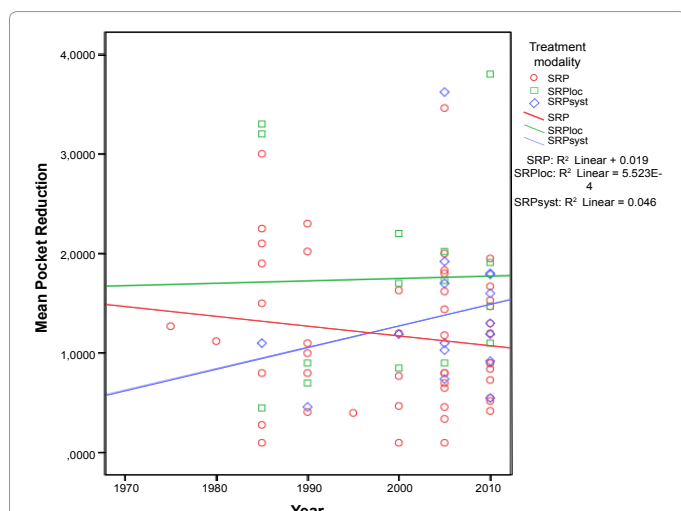


Figure 4: Linear regression lines for mean pocket reduction on the year of publication for the three different treatment modalities. The Spearman correlation together with coefficients of determination couldn't reveal any improvement in any of the searched treatment modalities over the past 40 years ($p > 0.45$).

(Figure 2) [40,41,43] showed relatively high values for standardized mean differences in pocket reduction. This can be explained as follows: some of these studies included high numbers (up to 190) of participants [68] and/or had a small spread i.e. standard deviation (SD) of their data [20], which gives them a higher weight in the meta-analysis. On the other hand, study design plays a crucial role. For example, one study included only four sites per patient with probing depths between 5 and 8 mm [20]. Other studies just referred to single-rooted teeth [40] or sites with PD deeper than 3 mm [41], which of course also results in a higher mean pocket reduction compared to publications who dealt with full-mouth measurements.

Conclusion

It can be concluded - despite some methodological drawbacks of this screening study - that the combination of scaling and root planing and adjunctive local or systemic treatment provides more mean pocket reduction than SRP alone, which is corroborated by the modern literature. However, in contrast to the hypothesis, there is no trend that non-surgical periodontal therapy significantly improved over the last 40 years with regard to better pocket depth reduction potential - neither in general nor when looking at any of the three assessed treatment modalities separately.

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