Dentistry
ISSN: 2161-1122

Eskandari et al., Dentistry 2012, 2:2
DOI: 10.4172/2161-1122.1000118

Research Article Open Access

Comparing the Effect of One Stage Full Mouth Disinfection Versus Quadrant-Wise Scaling and Root Planing on Clinical Parameters and Salivary Inflammatory Biomarkers in Chronic Periodontitis Patients

Eskandari A[1], Babaloo Z[2], Shirmohammadi A[3]* and Khashabi E[4]

[1]Assistant Professor of Periodontics, Tabriz University of Medical Sciences, Iran
[2]Sciences Assistant Professor of Immunology, Tabriz University of Medical Sciences, Iran
[3]Associate professor of Periodontics, Tabriz University of Medical, Iran
[4]Associate professor of Periodontics, Urmia University of Medical Sciences, Iran

Abstract

Background: We aimed to compare the efficacy of one stage full mouth disinfection versus the quadrant-wise scaling and root planing in terms of clinical parameters and inflammatory biomarkers screening.

Methods: Forty patients, with generalized moderate to severe chronic periodontitis, participated in the study. The test group received one stage full mouth disinfection (FMD). Quadrant wise scaling and root planing (Q-SRP) was performed for the control group. At baseline, 2 months and 4 months, Clinical parameters and salivary IL-1β and MMP-8 were measured.

Results: Both procedures resulted in statistically significant improvement in all of the measured parameters between the baseline and the 2 and 4 months ($p<0.05\%$). No meaningful improvement was seen between the 2 and 4 months ($p<0.05\%$) in both of the FMD and Q-SRP groups. There was no significantly difference between the study groups except for the MGI ($P<0.05$).

Conclusion: No statistically significant differences were found between FMD and Q-SRP.

Keywords: Periodontitis; One stage full mouth disinfection; Scaling; Root Planing; IL-1β; MMP-8

Introduction

Periodontal diseases are among the most prevalent oral pathologies [1]. The elimination or reduction of periodontopathogens is the fundus principal in the prevention and treatment of periodontal diseases that is traditionally performed by the conventional quadrant wise scaling and root planing (Q-SRP). Unfortunately, treatment failure and disease recurrence may occur. Among different causes, cross contamination through the intra oral bacterial translocation has been suspected. Numerous studies show that the presence of the periodontal pathogens, residues from the previous inadequate treatment or recolonization, is associated with poor treatment results [2]. It has been shown that after mechanical debridement, the subgingival microbial load is reduced to its 0.1% of original volume [3], but will return to its original bulk, just within a week although with a lesser pathogenic bacteria residing in it [4]. The possible concept is that the putative periodontal pathogens such as *Aggregatibacter actinomycetemcomitans* (A.a), *Tannerella forsythia* (T.f) and *Porphyromonas gingivalis* (P.g) [5,6] not only are found within the periodontal pocket, but also colonize other oral niches such as tonsils, buccal mucosa and tongue [6-8]. To overcome this problem Quirynen et al. [9] have proposed a treatment regimen that claims to be clinically and microbiologically promising in treatment of severe chronic periodontitis by the author . In their treatment protocol, the aim was to eradicate or reduce the amount of periodontal pathogens and to prevent their re-colonization [9]. Since its introduction, some studies have endorsed the relation in terms of clinical and microbiological parameters [5,10,11], but others have not found any priority to the conventional treatment [12,13]. In 2008, Eberhard et al. [14] tried to make a conclusion from the studies about the one stage full mouth disinfection (FMD). They concluded that the treatment had modest effect on periodontal care and the difference with the quadrant wise scaling and root planing (Q-SRP) was modest. Results are still conflicting. Previous studies about the FMD used clinical parameters to monitor the treatment outcomes. Although the application of these parameters is acceptable and routine, they carry considerable limitations with them. They are unable to predict or monitor different stages of periodontal disease, accurately [15]. Their possible invasiveness, cost and time consuming nature limit them further for patient monitoring. To overcome the above drawbacks, cytokine monitoring has shown to be very promising in periodontal research. Positive and direct relationship has been documented between the salivary inflammatory cytokines such as IL-1β and MMP-8 and the presence of periodontitis [16]. Interestingly, they also may predict the risk for periodontal disease [16]. The cytokine monitoring is very advantageous in that it can show subtle destructive periodontal processes before they are too large to turn into clinical lesion [17]. Since the accuracy and ability in revealing different treatments' outcomes are crucial for comparing their performance, salivary inflammatory cytokine monitoring seems to be very beneficial in this regard. The aim of the present study was to compare clinical periodontal and gingival

***Corresponding author:** Shirmohammadi A, Department of Periodontics, Dental Faculty, Tabriz University of Medical Sciences, Tabriz 51666-14711, Iran, Tel: +98 411 335 59 65 Fax: +98 411 334 69 77; Cell: +98 914 411 2272; E-mail: shirmohamadia@yahoo.com

Received December 07, 2011; **Accepted** January 24, 2012; **Published** January 26, 2012

Citation: Eskandari A, Babaloo Z, Shirmohammadi A, Khashabi E (2012) Comparing the Effect of One Stage Full Mouth Disinfection Versus Quadrant-Wise Scaling and Root Planing on Clinical Parameters and Salivary Inflammatory Biomarkers in Chronic Periodontitis Patients. Dentistry 2:118. doi:10.4172/2161-1122.1000118

parameters along with salivary inflammatory cytokines between the one stage full mouth disinfection and conventional quadrant wise scaling and root planing.

Method and Population

40 patients (21 male and 19 female), with age ranging from 25 to 62 years old referring to the department of Periodontics of Tabriz University of Medical Sciences were randomly allocated to test (one stage full mouth disinfection) and control (quadrant-wise scaling and root planing) groups. The inclusion criteria were: patients with age ranging from 25 to 70 years old, presence of at least 12 teeth in mouth (with exception of third molars, crown and bridges, teeth with orthodontic appliances and dental implants), moderate to severe chronic periodontitis, clinical probing depth (CPD) of 4mm or more and clinical attachment loss of 3mm or more in at least 4 teeth and signs of radiographic bone loss. The patients were excluded from the study if they had any of the following: systemic diseases (including but not limited to diabetes mellitus, cancer, AIDS, systemic metabolic diseases, diseases that modify the wound healing and inflammation process, auto-immune diseases, history of radiotherapy and/or chemotherapy, treatment with immunosuppressive agents and infectious disease other than periodontitis). Pregnant or lactating women were also excluded from the study. The target patients should not have had a history of taking systemic antibiotics or non-steroidal anti-inflammatory drugs (NSAIDS) in the last two months. In the test group (FMD), all of the periodontal sites were debrided using an ultrasonic device (VARIOS ULTRASONIC SCALER, NSK, JAPAN) in two consecutive visits within the 24 hours to reduce the chance of intra-oral cross-contamination. Subgingival irrigation of all periodontal pockets (3 times within 10 minutes) with a blunted tip insulin syringe (SUPA medical devices, Tehran, Iran) with 0.2% Chlorhexidine (CHX) along with tongue brushing (for one minute) and oral rinsing and gargling (for twenty seconds) with 0.2% solution of CHX to eliminate/reduce the remaining pathogens in pockets, saliva and tonsils was also performed. Subgingival irrigation (3 times within 10 minutes) was repeated 8 days after the first session. The patients were instructed to rinse with CHX twice daily for two months. In the control group (Q-SRP), quadrant wise ultrasonic debridement was performed in four proceeding sessions with a two week interval. The baseline sampling of saliva was performed before any treatment and oral hygiene instruction in both groups. Patients were prohibited from teeth brushing in the last 12 hours and eating and drinking or gum chewing in the last 1.5 hours. Patients were requested to spit in a test tube for at least a 10 ml of saliva. All samples were stored frozen in minus 80 centigrade Nitrogen for analysis day. The samples were analyzed with an Enzyme-Linked Immunosorbent Assay (ELISA) kit (Komabiotech, Seoul, Korea) for detection and quantifying the IL-1β and MMP-8 content.

At baseline, 2 months and 4 months after the initiation of the treatments, periodontitis and gingivitis clinical parameters including: attachment level (CAL), plaque index (PI) [18], Bleeding on probing (BOP), clinical probing depth (CPD), modified gingival index (MGI) [19] and inflammatory salivary cytokines including: IL-1β and MMP-8 were measured. Periodontal examinations were performed with a William's periodontal probe (HU-FRIEDY, Chicago, Illinois, USA. All clinical parameters were measured in 4 locations of all teeth. The CAL was measured as distance between CEJ and bottom of pocket. BOP was positive if after 30 seconds of probing with a periodontal probe, bleeding was initiated. CPD was defined as the distance from gingival margin to the bottom of pocket. All numbers were rounded to the nearest millimeters.

All the measurements were performed by one calibrated periodontist that was blind to the treatment groups.

The data were analyzed using SPSS version 16. Prior to this, Kolmogorov-Smirnov test was utilized to examine the homogeneity of the samples. A chi square (X2) test was used to investigate whether distributions of categorical variables differ from one another. Paired sample t- Test was used in order to compare the mean scores of case and control groups. Analyze of variance was applied to discover any probable differences within tested groups that proceeded Shceffe test to reveal any statistically significant difference between the study's timelines. A 5% statistically significance level was set to determine the meaningful differences.

Results

40 patients (21 male and 19 female) participated in the study. The average age of FMD group was 43 ± 12.47 years old and the average age of Q-SRP group was 47.7 ± 9.42 years old that was not statistically significantly different from FMD group ($p<0.05\%$). Statistical analysis showed that there was not a statistically significant sexual difference among the participants and the sexual distribution between the groups ($p<0.05\%$). The Kolmogorov-Smirnov test showed that all data in the study had a normal distribution ($p>0.05\%$).

For all measurements, there was a statistically significant improvement between baseline and the later 2 and 4 months measurements in each group ($p<0.05\%$). But the difference between 2 and 4 months was not statistically significant ($p>0.05\%$). In the FMD group, the baseline reading of the salivary IL-1β was 273.7 picogram per milliliter (pg/ml) that reduced to 155.6 pg/ml in two months and reached to 149.7 pg/ml in 4 months. MMP-8 also showed a marked improvement in that its baseline value that was 385.75 Nano gram per milliliter (ng/ml) was reached to 175.9 ng/ml and 149.9 ng/ml in 2 and 4 moths respectively.

In the Q-SRP group, the baseline reading of the salivary IL-1β was 290.2 pg/dl that reduced to 135 pg/dl in two months and reached to 129.4 pg/ml in 4 months. MMP-8 also showed a marked reduction in that its baseline value (365.6 ng/ml) was reached to 130.4 ng/ml and 129.6 ng/ml in 2 and 4 months respectively.

The average CPD at baseline was 4.1mm in the FMD group which reduced to 2.7mm and 2.6mm at 2 and 4 months respectively. The average CPD at baseline was 4.1mm in the Q-SRP group which reduced to 2.7mm and 2.5mm at 2 and 4 months respectively (Figure 1).

The average CAL at baseline (4.2mm) in the FMD group reduced to 3.04mm and 2.7mm at 2 and 4 months respectively. The average CAL at baseline (4.2mm) in the Q-SRP group reduced to 3.02mm and 2.7mm at 2 and 4 months respectively (Figure 1).

The average positive BOP at baseline (72.70%) in the Q-SRP group reduced to 15.7% and 6.6% at 2 and 4 months respectively. The average positive BOP at baseline (73.8%) in the FMD group reduced to 17.9% and 12.7% at 2 and 4 months respectively (Figure 2).

The average PI at baseline (76.7%) in the Q-SRP group reduced to 10.8% and 5.5% at 2 and 4 months respectively. The average PI at

baseline (69.4%) in the FMD group reduced to 12.2% and 5.4% at 2 and 4 months respectively (Figure 2).

Prior to treatment the most prevalent MGI grade was 3 with 55% in Q-SRP. This grade turned to grade 2 with 80% prevalence and at the third session the MGI was grade 2 with a 70% prevalence.

In the FMD group at baseline, the most prevalent MGI grade was 3 with 70% in Q-SRP. This grade turned to grade 2 and grade 1, each with 40% prevalence and at the third session the MGI was grade 1 with a 50% prevalence.

There was no statistically significant difference in all of the measured parameters, except for the MGI, in none of the assessment sessions ($p>0.05$) between FMD and Q-SRP groups (Table 1-3).

In contrast to other variables, the MGI was statistically significantly different between our treated groups in 2 and 4 months measurements ($P<0.05$) despite their similar values at the baseline ($p>0.05$). The MGI values are presented in Table 3.

Discussion

Many researches clearly show the signs of intra oral translocation between the niches other than the periodontal pockets [7, 20-23]. Despite the fact that these niches are well documented, their significance in the pathogenesis of the periodontal diseases, still needs

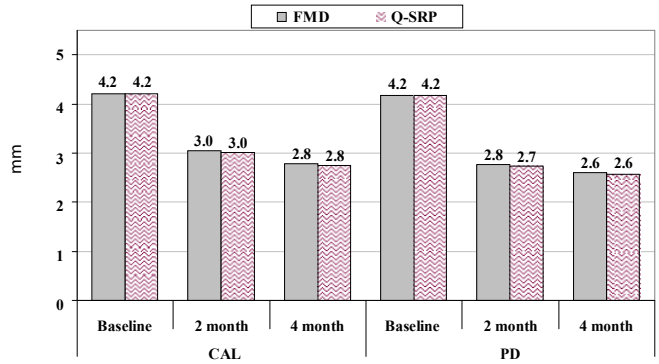

Figure 1: Comparison of clinical attachment level (CAL) and probing depth (CPD) between one stage full mouth disinfection (FMD) and Quadrant wise debridement (Q-SRP).

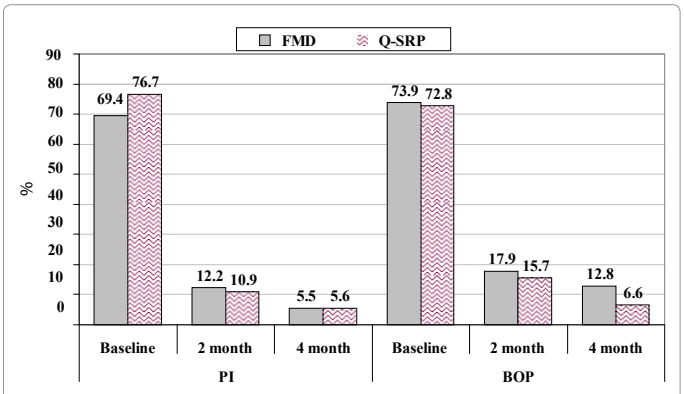

Figure 2: Comparing the percentage of bleeding on probing (BOP) and plaque index (PI) between one stage full mouth disinfection (FMD) and Quadrant wise debridement (Q-SRP).

	Time	Treatment modality	Mean (pg/dl)	Standard deviation	t value	P Value
salivary IL-1β	Baseline	FMD	273.70	88.42	-0.59	0.56
		Q-SRP	290.20	89.65		
	2 month	FMD	155.64	61.34	1.37	0.18
		Q-SRP	135.00	27.93		
	4 month	FMD	149.75	67.76	1.23	0.23
		Q-SRP	129.40	30.27		
Salivary MMp-8	Baseline	FMD	358.75	88.00	-0.23	0.82
		Q-SRP	365.65	104.13		
	2 month	FMD	157.90	61.53	1.369	0.18
		Q-SRP	130.40	65.48		
	4 month	FMD	149.95	58.35	1.03	0.31
		Q-SRP	129.6	66.50		

Table1: Salivary biomarker outcomes and their comparison between the treatment groups.

	Time	Treatment modality	Mean	Standard deviation	t value	P Value
CPD	Baseline	FMD	4.18	0.59	0.010	0.992
		Q-SRP	4.18	0.66		
	2 month	FMD	2.76	0.57	0.09	0.93
		Q-SRP	2.74	0.63		
	4 month	FMD	2.60	0.52	0.20	0.84
		Q-SRP	2.57	0.56		
CAL	Baseline	FMD	4.20	0.57	0.010	0.992
		Q-SRP	4.20	0.67		
	2 month	FMD	3.04	0.59	0.09	0.93
		Q-SRP	3.02	0.62		
	4 month	FMD	2.78	0.54	0.20	0.84
		Q-SRP	2.75	0.56		
PI	Baseline	FMD	69.40	24.20	-1.084	0.285
		Q-SRP	76.70	17.91		
	2 month	FMD	12.20	19.32	0.28	0.78
		Q-SRP	10.85	10.10		
	4 month	FMD	5.45	3.25	-0.10	0.92
		Q-SRP	5.55	2.93		
BOP	Baseline	FMD	73.85	15.20	0.160	0.874
		Q-SRP	72.75	26.77		
	2 month	FMD	17.90	9.32	0.75	0.46
		Q-SRP	15.70	9.29		
	4 month	FMD	12.75	13.69	1.87	0.07
		Q-SRP	6.6	5.39		

Table 2: Clinical treatment outcomes and their comparison between the treatment groups.

to be clarified. Different suspects in this regard may contribute to cross-contamination between niches, ranging from iatrogenic vehicles like periodontal probe [24] and caries explorers [25] to physiologic media like saliva [26]. The one stage full mouth disinfection was introduced to overcome the above mentioned conventional treatment's drawbacks. This treatment completes full mouth scaling and root planing within

24 hours period and combines CHX disinfection hoping to reduce the chance of cross-contamination [9]. It fulfills the criteria of a successful periodontal treatment in that it should result in elimination or reduction of the exogenous pathogens and changes in the endogenous flora [26].

In the present study, the FMD group was treated by ultrasonic tooth debridement in two visits within 24 hours in combination with irrigation of all pockets rinsing with a 0.2% Chlorhexidine solution. Quadrant wise scaling and root planing (Q-SRP) was performed in the control group with 2 weeks intervals. At baseline, 2 months and 4 months after the initiation of the treatments, clinical parameters and salivary IL-1β and MMP-8 were measured.

The clinical findings in our study are in agreement with some studies [12,13,27,28]. For example, wennstrom et al. [28] observed improvements in the CPD that were similar to our results. In our study the PI improved in each session. This might be due to the oral hygiene re-instruction in our study for all patients especially for those in the Q-SRP group as they needed more visits to complete the Q-SRP and within these sessions oral hygiene was reinforced. Unlike other variables, the MGI was significantly different between the FMD and Q-SRP groups in 2 and 4 months although the PI did not change significantly ($P>0.05$). A reason might be that MGI is more a subjective variable and is less sensitive compared to the GI as the periodontal probe has been eliminated from this index [19]. In our study, we found mean increase of CAL and reduction of CPD in both groups that is in agreement with other similar studies [10,27,29,30]. Unlike our study, Quirynen et al. [9] reported that the FMD treatment resulted in statistically significant additional CPD reduction of 0.8mm in deep pockets (≥7mm) in single rooted teeth compared to the Q-SRP, although the benefit could not be observed for the multi rooted teeth. The results of Vandekerchhove et al. [11] study, also agreed with the study of Quirynen et al. [9] but they showed the FMD treatment reduced the CPD of multi rooted teeth statistically significant as well as the single rooted teeth compared to Q-SRP. The CPD reduction in both of the mentioned studies was not statistically different for less than the 6 mm pockets. In our research

CHI²		Q-SRP		FMD			
P Value	Value	%	Number of patients	%	Number of patients	**MGI grade**	
0.44	1.64					**1**	**Baseline**
		5	17			**2**	
		55	11	70	14	**3**	
		40	8	30	6	**4**	
0.03	6.73	15	3	40	8	**1**	**2 month**
		80	16	40	8	**2**	
		5	1	20	4	**3**	
						4	
0.04	6.66	25	5	50	10	**1**	**4 month**
		70	14	30	6	**2**	
		5	1	20	4	**3**	
						4	

Table 3: Modified gingival index (MGI) outcomes and their comparison between the treatment groups.

moderate cases of chronic periodontitis were incorporated in the study as well as the severe cases. This might explain why no statistically significant results were found when comparing the two treatments as it seems that FMD works better for deeper pockets. A hypotheses might be that deeper pockets are more favorable niches for bacterial colonization and therefore more vulnerable to recolonization. FMD prevents or at least reduces the chance of intra oral translocation but the Q-SRP gives the opportunity for the cross-contamination.

In contrast to our study, Mongardini et al. [5] found significant differences between FMD and Q-SRP in CAL gain ranging from 0.8mm to 1.9mm.

As stated earlier, since the FMD's introduction, for and against opinions have emerged about the concept. Some studies have confirmed the proposed advantages of FMD in terms of clinical and microbiological parameters [10, 31], but others have questioned any priority to the conventional treatment [12,13,27,32]. Results are still conflicting. In 2008, Eberhard et al. [23] tried to make a conclusion from the studies about the one stage full mouth disinfection (FMD). They concluded that the treatment had modest effect on periodontal care and the difference with the conventional standard treatment was not significantly different. The role of CHX is probably the most debated one [33]. Quirynen et al. [29] did not found any superiority of the results in the group that CHX was added to the protocol but they recommended its use for a faster healing and in patient lacking an acceptable oral hygiene. A systematic review by Lang et al. [34] also failed to show any statistically significant benefit in treatment outcomes for combining the CHX to the full mouth scaling and root planing. CHX might be considered a probable factor for getting similar results between the FMD and Q-SRP groups in some studies, as the patients in the Q-SRP group were not prohibited from rinsing their mouth with Chlorhexidine solution. The dosage of applied CHX is also different in the studies that may be responsible for the result diversity [35] although the effect of this different dosage on treatment outcomes is unclear [35].

Oral hygiene instruction strategy among different studies is said to influence the treatment outcome and be responsible for different studies variable results. Good oral hygiene prior to study initiation in the quadrant wise debridement will result in lower chance of intra oral translocation chance for bacteria and will lessen the difference between the Q-SRP and the FMD groups [36]. We used 0.2% CHX solution instead of 1% CHX gel for subgingival irrigation and tongue scrubbing. Gargling with 0.2% CHX was also performed instead of spraying for tonsilar disinfection. We do not know exactly that how this modification might affect the treatment results although since the effect of CHX dosage on the treatment outcome is unknown [35]. The effect of CHX vehicle might influence the treatment result as one might argue that the gel form will last longer than the solution form although for the CXH it has been shown that once absorbed to the mucosa, CHX shows bacteriostatic activity for more than 12 hours [37]. So the persistent antimicrobial activity of CHX seems independent from the carrying medium.

This research measured some of the (pro) inflammatory salivary biomarkers. The conventional method for periodontal disease screening is by measuring the clinical parameters. Although these methods are successfully used today, the time and expense limit them

for screening patients in the epidemiologic studies. On the other hand, the clinical methods have many other limitations. Clinical methods are limited in predicting or monitoring the initiation, progression and/or exacerbation of periodontal diseases like their inability in detecting the subclinical states of periodontal diseases [15]. Also, they might be invasive in nature that might reduce the patient's cooperation in the treatment process.

In an article by Miller et al. [16], a clear relationship between salivary IL-1β and MMP-8 and periodontitis was documented They found that patients with simultaneous elevation of salivary IL-1β and MMP-8 had a 45 fold increased risk for periodontal disease. Since our study is the first study to measure salivary MMP-8 and IL-1β in FMD, the comparison with similar studies is not possible. Because some biomarkers are also active osteoclastic cytokines, minute changes in bone modeling will be reflected in their salivary profile [17]. Indeed the salivary biomarkers might be more accurate in detection of periodontitis at least in the initial stages of periodontal disease since there is no need for clinical manifestation of the increased cytokines enabling the clinician for disease detection. Laboratory detection technique's specificity and sensitivity and also the individual's responsiveness phenotype are very important and should not be overlooked. For instance, In contrast to many articles that relate the amount of MMP-8 to periodontitis [38,39], it has been stated that the presence of only active form of MMP-8 is related to periodontitis and inactive MMP-8 is related to gingivitis [39,40]. Recently, timed resolved immunofluorometric Assay (IMFA) has been introduced for MMP-8 that is enables the practitioner (unlike ELISA) not only to detect the active and inactive forms of the MMP-8 but also distinguish between the different host sources and exogenous sources (e.g. bacteria) of MMP-8 [41]. As a result, this method seems to be more suitable for the detection of MMP-8 in periodontal research.

Conclusion

Within the limits of this study, the one stage full mouth disinfection improves the gingivitis and periodontitis parameters meaningfully but no statistically significant differences were found between this procedure and the conventional quadrant wise scaling and root planing. Long-term studies with simultaneous bacteriologic investigations and more sensitive/specific immunologic methods are recommended.

References

1. Ryan ME (2005) Nonsurgical approaches for the treatment of periodontal diseases. Dent Clin North Am 49: 611-636.
2. Cugini MA, Haffajee AD, Smith C, Kent RL Jr, Socransky SS (2000) The effect of scaling and root planing on the clinical and microbiological parameters of periodontal diseases: 12-month results. J Clin Periodontol 27: 30-36.
3. Maiden MF, Tanner A, McArdle S, Najpauer K, Goodson JM (1991) Tetracycline fiber therapy monitored by DNA probe and cultural methods. J Periodontal Res 26: 452-459.
4. Wade WG, Moran J, Morgan JR, Newcombe R, Addy M (1992) The effects of antimicrobial acrylic strips on the subgingival microflora in chronic periodontitis. J Clin Periodontol 19: 127-134.
5. Mongardini C, van Steenberghe D, Dekeyser C, Quirynen M (1999) One stage full- versus partial-mouth disinfection in the treatment of chronic adult or generalized early-onset periodontitis. I. Long-term clinical observations. J Periodontol 70: 632-645.
6. Beikler T, Abdeen G, Schnitzer S, Sälzer S, Ehmke B, et al. (2004) Microbiological shifts in intra- and extraoral habitats following mechanical periodontal therapy. J Clin Periodontol 31: 777-783.
7. Danser MM, van Winkelhoff AJ, de Graaff J, Loos BG, van der Velden U (1994) Short-term effect of full-mouth extraction on periodontal pathogens colonizing the oral mucous membranes. J Clin Periodontol 21: 484-489.
8. von Troil-Lindén B, Saarela M, Mättö J, Alaluusua S, Jousimies-Somer H, et al. (1996) Source of suspected periodontal pathogens re-emerging after periodontal treatment. J Clin Periodontol 23: 601-607.
9. Quirynen M, Bollen CM, Vandekerckhove BN, Dekeyser C, Papaioannou W, et al. (1995) Full- vs. partial-mouth disinfection in the treatment of periodontal infections: short-term clinical and microbiological observations. J Dent Res 74: 1459-1467.
10. Bollen CM, Mongardini C, Papaioannou W, Van Steenberghe D, Quirynen M (1998) The effect of a one-stage full-mouth disinfection on different intra-oral niches. Clinical and microbiological observations. J Clin Periodontol 25: 56-66.
11. Vandekerckhove BN, Bollen CM, Dekeyser C, Darius P, Quirynen M (1996) Full- versus partial-mouth disinfection in the treatment of periodontal infections. Long-term clinical observations of a pilot study. J Periodontol 67: 1251-1259.
12. Apatzidou DA, Kinane DF (2004) Quadrant root planing versus same-day full-mouth root planing. I. Clinical findings. J Clin Periodontol 31: 132-140.
13. Apatzidou DA, Riggio MP, Kinane DF (2004) Quadrant root planing versus same-day full-mouth root planing. II. Microbiological findings. J Clin Periodontol 31: 141-148.
14. Eberhard J, Jervøe-Storm PM, Needleman I, Worthington H, Jepsen S (2008) Full-mouth treatment concepts for chronic periodontitis: a systematic review. J Clin Periodontol 35: 591-604.
15. Taba M Jr, Kinney J, Kim AS, Giannobile WV (2005) Diagnostic biomarkers for oral and periodontal diseases. Dent Clin North Am 49: 551-571, vi.
16. Miller CS, King CP Jr, Langub MC, Kryscio RJ, Thomas MV (2006) Salivary biomarkers of existing periodontal disease: a cross-sectional study. J Am Dent Assoc 137: 322-329.
17. Frodge BD, Ebersole JL, Kryscio RJ, Thomas MV, Miller CS (2008) Bone remodeling biomarkers of periodontal disease in saliva. J Periodontol 79: 1913-1919.
18. O'Leary TJ, Drake RB, Naylor JE (1972) The plaque control record. J Periodontol 43: 38.
19. Lobene RR, Weatherford T, Ross NM, Lamm RA, Menaker L (1986) A modified gingival index for use in clinical trials. Clin Prev Dent 8: 3-6.
20. Quirynen M, Listgarten MA (1990) Distribution of bacterial morphotypes around natural teeth and titanium implants ad modum Brånemark. Clin Oral Implants Res 1: 8-12.
21. Van Winkelhoff AJ, Van der Velden U, Winkel EG, de Graaff J (1986) Black-pigmented Bacteroides and motile organisms on oral mucosal surfaces in individuals with and without periodontal breakdown. J Periodontal Res 21: 434-439.
22. Quirynen M, Papaioannou W, van Steenberghe D (1996) Intraoral transmission and the colonization of oral hard surfaces. J Periodontol 67: 986-993.
23. Papaioannou W, Quirynen M, Van Steenberghe D (1996) The influence of periodontitis on the subgingival flora around implants in partially edentulous patients. Clin Oral Implants Res 7: 405-409.
24. Christersson LA, Slots J, Zambon JJ, Genco RJ (1985) Transmission and colonization of Actinobacillus actinomycetemcomitans in localized juvenile periodontitis patients. J Periodontol 56: 127-131.
25. Papaioannou W, Bollen CM, Van Eldere J, Quirynen M (1996) The adherence of periodontopathogens to periodontal probes. A possible factor in intra-oral transmission? J Periodontol 67: 1164-1169.
26. van Winkelhoff AJ, van der Velden U, de Graaff J (1988) Microbial succession in recolonizing deep periodontal pockets after a single course of supra- and subgingival debridement. J Clin Periodontol 15: 116-122.
27. Swierkot K, Nonnenmacher CI, Mutters R, Flores-de-Jacoby L, Mengel R (2009) One-stage full-mouth disinfection versus quadrant and full-mouth root planing. J Clin Periodontol 36: 240-249.

28. Wennström JL, Tomasi C, Bertelle A, Dellasega E (2005) Full-mouth ultrasonic debridement versus quadrant scaling and root planing as an initial approach in the treatment of chronic periodontitis. J Clin Periodontol 32: 851-859.

29. Quirynen M, Mongardini C, de Soete M, Pauwels M, Coucke W, et al. (2000) The rôle of chlorhexidine in the one-stage full-mouth disinfection treatment of patients with advanced adult periodontitis. Long-term clinical and microbiological observations. J Clin Periodontol 27: 578-589.

30. Cionca N, Giannopoulou C, Ugolotti G, Mombelli A (2009) Amoxicillin and metronidazole as an adjunct to full-mouth scaling and root planing of chronic periodontitis. J Periodontol 80: 364-371.

31. Koshy G, Kawashima Y, Kiji M, Nitta H, Umeda M, et al. (2005) Effects of single-visit full-mouth ultrasonic debridement versus quadrant-wise ultrasonic debridement. J Clin Periodontol 32: 734-743.

32. Farman M, Joshi RI (2008) Full-mouth treatment versus quadrant root surface debridement in the treatment of chronic periodontitis: a systematic review. Br Dent J 205: E18.

33. Jenkins S, Addy M, Newcombe R (1990) The effect of triclosan, stannous fluoride and chlorhexidine products on: (II) Salivary bacterial counts. J Clin Periodontol 17: 698-701.

34. Lang NP, Tan WC, Krähenmann MA, Zwahlen M (2008) A systematic review of the effects of full-mouth debridement with and without antiseptics in patients with chronic periodontitis. J Clin Periodontol 35: 8-21.

35. Thöne-Mühling M, Swierkot K, Nonnenmacher C, Mutters R, Flores-de-Jacoby L, et al. (2010) Comparison of two full-mouth approaches in the treatment of peri-implant mucositis: a pilot study. Clin Oral Implants Res 21: 504-512.

36. Teughels W, Dekeyser C, Van Essche M, Quirynen M (2009) One-stage, full-mouth disinfection: fiction or reality? Periodontol 2000 50: 39-51.

37. Schiott CR, Löe H, Jensen SB, Kilian M, Davies RM, et al. (1970) The effect of chlorhexidine mouthrinses on the human oral flora. J Periodontal Res 5: 84-89.

38. Scannapieco FA, Ng P, Hovey K, Hausmann E, Hutson A, et al. (2007) Salivary biomarkers associated with alveolar bone loss. Ann N Y Acad Sci 1098: 496-497.

39. Teles RP, Likhari V, Socransky SS, Haffajee AD (2009) Salivary cytokine levels in subjects with chronic periodontitis and in periodontally healthy individuals: a cross-sectional study. J Periodontal Res 44: 411-417.

40. Sorsa T, Hernández M, Leppilahti J, Munjal S, Netuschil L, et al. (2010) Detection of gingival crevicular fluid MMP-8 levels with different laboratory and chair-side methods. Oral Dis 16: 39-45.

41. Gursoy UK, Könönen E, Pradhan-Palikhe P, Tervahartiala T, Pussinen PJ, et al. (2010) Salivary MMP-8, TIMP-1, and ICTP as markers of advanced periodontitis. J Clin Periodontol 37: 487-493.