

Full-mouth Disinfection vs. Scaling and Root Planing for the Treatment of Periodontitis: A review of the current literature

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Before new treatment concepts can be used in daily practice, a critical analysis of the present scientific literature is necessary. The concept of full-mouth disinfection (FMD) was introduced as a new alternative treatment for the non-surgical therapy of inflammatory periodontal diseases, and is becoming more and more popular in dental practice. The following article provides a short survey and evaluation of the present scientific evidence about full-mouth disinfection. The concept of full-mouth disinfection includes scaling and root planing within 24 hours combined with an adjunctive chlorhexidine chemotherapy aimed to eliminate bacterial reservoirs in periodontal pockets and in all oral niches. Scaling and root planing within 24 hours but without the adjunctive chemotherapy - called full-mouth scaling (FMS) - is another newly introduced strategy for the treatment of periodontitis. For the present review, 9 original publications of clinical studies were analyzed, in which a total of 118 patients with chronic or aggressive periodontitis were treated. Bleeding upon probing, the reduction of probing depths, changes of attachment level, and analysis of the bacterial microflora were used as markers to compare the different treatment modalities.

Based on the present review, no evidence was found that full-mouth disinfection or full-mouth scaling could improve the clinical results of periodontal treatment compared to conventional scaling and root planing. Currently there exists no evidence for a change in a paradigm in periodontal treatment from conventional non-surgical therapy to full-mouth disinfection.

Key words: periodontal treatment, adjunctive chemotherapy, chlorhexidine, full-mouth approach

INTRODUCTION

Before new treatment methods are introduced into daily dental practice, it is indispensable to compare the new therapeutic approaches with existing and proven treatment methods by means of the present scientific literature. The critical analysis of new methods is essential for ethical reasons and permits effective and evidence-based medical treatment.

The concept of "full-mouth disinfection" (FMD) has been recently introduced as a new and alternative method for the non-surgical therapy of inflammatory periodontal diseases and was first specified in 1995 (Quirynen, 2000). That article and other

subsequent studies demonstrated that full-mouth disinfection improved the success of periodontal treatment compared to conventional non-surgical scaling and root planing. If adequate scientific evidence for an improvement of the therapeutic endpoints in the treatment of periodontitis by full-mouth disinfection compared to scaling and root planing (SRP) could be demonstrated, a change of the paradigm for the treatment of inflammatory periodontal diseases would become necessary. A critical analysis of this topic is essential, because the method is becoming more and more popular in dental practice. The following contribution presents a survey and evaluation of the current scientific evidence about full-mouth disinfection.

THE HYPOTHESIS BEHIND FULL-MOUTH DISINFECTION

Numerous investigations demonstrated that periodontitis could be regarded as a specific infection (Slots, 1991) which is associated with specific key pathogens (Sokransky, 1992). The origin of these pathogenic bacteria is from endogenous or exogenous sources. If their origin is exogenous, the goal of periodontal treatment must be the elimination of all bacteria located in the oral cavity. To achieve this goal, mechanical treatment of inflamed periodontal pockets is not sufficient to eliminate all pathogenic bacteria from the oral cavity because most periodontal pathogens colonize additional oral niches such as the oral mucosa, tongue, all oral hard surfaces, and the tonsils. (Danser 1994; Van Winkelhoff 1986) Bacteria in these oral niches that are not eliminated by conventional periodontal treatment may be able to re-colonize treated periodontal pockets and contribute to a re-infection, which may jeopardize the success (Figure 1). Due to these considerations, the complete and simultaneous elimination of all exogenous pathogens from periodontal pockets and all oral niches is the therapeutic goal of full-mouth disinfection.

WHAT DOES "FULL-MOUTH DISINFECTION" MEAN?

The concept of full-mouth disinfection (FMD) is a modification of the non-surgical treatment of periodontitis by scaling and root planing (SRP). Full-mouth disinfection comprises the mechanical instrumentation of the inflamed pockets in a maximum of two sessions within 24 hours and adjunctive chlorhexidine chemotherapy of all oral niches during the periodontal treatment and a period of up to two months after the completion of the non-surgical therapy (Figure 2 and Table 1). A modification of this method is to treat the infected root surfaces within 24 hours but without the adjunctive chlorhexidine chemotherapy. This method is designated in the literature as "partial-mouth disinfection" or "full-mouth root planing". In the following article, this method is designated as "full-mouth scaling" (FMS) because this name best describes the treatment procedure. In the studies reviewed,

the indications for a full-mouth disinfection approach were periodontal pockets of 4-6 mm and pockets deeper than 7 mm on single- and multi-rooted teeth. Patients with advanced chronic periodontitis and with early-onset periodontitis (aggressive periodontitis) were included in these studies.

STUDY DESIGN AND RESULTS

Scientists from the University of Leuven, Belgium, developed the concept of full-mouth disinfection and published numerous clinical studies to establish the best possible scientific evidence for the method. (Bollen 1996, 1998; De Soete 2001; Mongardini 1999; Quirynen 1999, 2000; Vandekerckhove 1996) In addition, a clinical study from a group of the University of Glasgow, Scotland, comparing full-mouth scaling with scaling and root planing has been published recently (Apatzidou).

University of Leuven

- Quirynen et al. 1995: A 2-month pilot study with 10 patients compared the efficiency of conventional non-surgical therapy with full-mouth disinfection. Clinical results and microbiological data were evaluated.
- Vandekerckhove et al. 1996: The pilot study was extended to an observation period of 8 months.
- Bollen et al. 1996: The microbiological results of the pilot study were evaluated 8 months after the end of therapy.
- Bollen et al. 1998: A second study with 16 patients was conducted and the clinical parameters were compared between conventional therapy and full-mouth disinfection after 4 months.
- Mongardini et al. 1999 and Quirynen et al. 1999: Forty patients were examined, 24 with severe adult periodontitis (chronic periodontitis) and 16 with early-onset periodontitis (aggressive periodontitis). The clinical results and the microbiological data were published in two articles.
- Quirynen et al. 2000: Twelve patients were examined who were treated with full-mouth scaling (FMS). The data were combined with previous studies.
- De Soete et al. 2001: The microbiological results of a study from 1999 were complemented by DNA hybridization techniques.

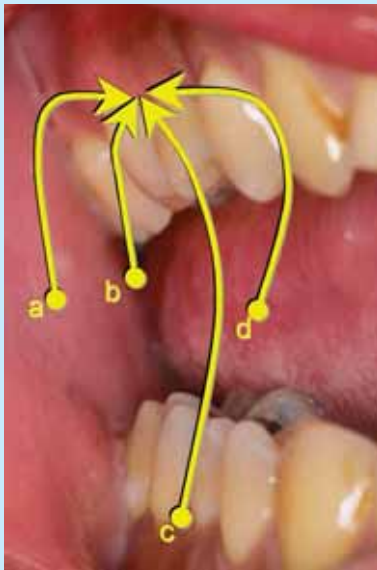


Fig. 1 The idea of full-mouth disinfection: the oral mucosa (a), the tonsil area (b), non-treated pockets (c) and the mucosa of the tongue (d) are oral niches for periodontal pathogens. From these reservoirs, transmission of bacteria to healthy and treated pockets can occur and re-infect these pockets. Therefore, a complete and simultaneous elimination of exogenous pathogens from all periodontal pockets and oral niches is the goal of a full-mouth disinfection approach.

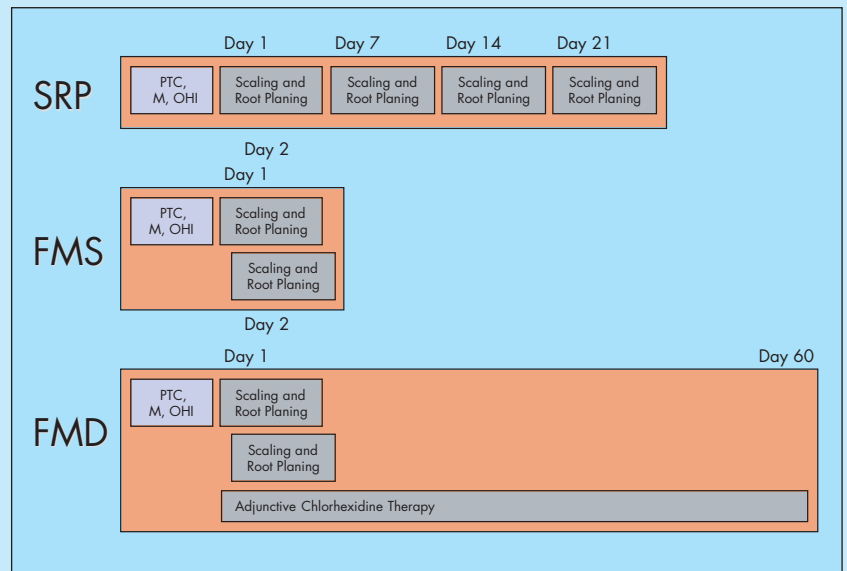


Fig. 2 An overview of the practical procedure and the chronological course of conventional scaling and root planing (SRP), full-mouth scaling (FMS), full-mouth disinfection (FMD), professional tooth cleaning (PTC) and motivation oral hygiene instruction (M, OHI).

Table 1 The adjunctive chlorhexidine (CHX) chemotherapy and the modifications in the course of Full-mouth Disinfection

Treatment	Quirynen et al. 1995	Mongardini et al. 1999, Quirynen et al. 2000
First session (Day 0)	Brushing the tongue (1x 1% CHX gel, 60 sec) Mouth rinsing (2x 0.2% CHX, 60 sec) Subgingival irrigation (3x in 10 minutes, 1% CHX Gel)	Brushing the tongue (1x 1% CHX gel, 60 sec) Mouth rinsing (2x 0.2% CHX, 60 sec) Subgingival irrigation (3x in 10 minutes, 1% CHX Gel) Spray the tonsil area (0.2% CHX)
Second session (24 hours later)	Brushing the tongue (1x 1% CHX gel, 60 sec) Mouth rinsing (2x 0.2% CHX, 60 sec) Subgingival irrigation (3x in 10 minutes, 1% CHX Gel)	Brushing the tongue (1x 1% CHX gel, 60 sec) Mouth rinsing (2x 0.2% CHX, 60 sec) Subgingival irrigation (3x in 10 minutes, 1% CHX Gel) Spray the tonsil area (0.2% Chx)
Third session (Day 8)	Subgingival irrigation (3x in 10 minutes, 1% CHX Gel)	Subgingival irrigation (3x in 10 minutes, 1% CHX Gel)
For a period of 14 days	Mouth rinsing (2x 0.2% CHX, 60 sec)	Mouth rinsing (2x 0.2% CHX, 60 sec)
For a period of two months		Spray the tonsil area (0.2% CHX)

Table 2 The reduction of the bleeding frequency (%) after gentle probing and the assessed significant (SS) and non-significant (NS) differences between the treatment methods.

Study	N	Study period (Month)	SRP	FMD	FMS	Difference
Quirynen et al. 1995						
single-rooted	10	2	40	40		0 NS
multi-rooted			20	30		10 NS
Vandekerckhove et al. 1996	10	8	30	30		0 NS
Bollen et al. 1998	16	4	9	60		51 SS
Mongardini et al. 1999						
CAP	24	8	36	64		28 SS
EOP	16		39	43		4 NS
Quirynen et al. 2000	36	8	36	64	65	^a 28 SS ^b 29 SS ^c 1 NS
Apatzidou & Kinane 2004	40	6	58		57	1 NS

SRP= Conventional Scaling and Root planing
FMS= Scaling and Root planing within 24 hours
FMD= Full-mouth Disinfection
^a SRP vs. FMD
^b SRP vs. FMS
^c FMS vs. FMD

Glasgow Dental Hospital and School

- Apatzidou & Kinane 2004: Forty patients with chronic periodontitis were examined over a period of six months. Subjects were randomized into two groups and received either conventional therapy (SRP) or a full-mouth scaling (FMS).

Up to now, nine clinical studies (8 University of Leuven, 1 University of Glasgow) have been conducted in which the clinical success of local treatment by full-mouth disinfection (FMD) or full-mouth scaling (FMS) was compared to the conventional non-surgical therapy (SRP). A total of 118 patients (78 University of Leuven, 40 University of Glasgow) with chronic or aggressive periodontitis were treated. The results of the different treatment methods were analyzed by the markers bleeding on probing, reduction of probing pocket depth, and changes of attachment level. The bacterial microflora was analyzed by differential phase contrast microscopy, culturing methods, or DNA hybridization techniques. The data of the following tables were taken from the original studies as accurately as possible.

Bleeding Index

The status of the bleeding frequency after gentle probing before and after periodontal therapy was reported in 6 studies (Table 2). Except for the early investigations with small numbers of patients (Quirynen 1995; Vandekerckhove 1996), the following studies demonstrated that full-mouth disinfection was able to reduce the bleeding frequency to a significantly greater extent than a treatment by the conventional therapy. In one study published by Bollen et al. (1996, 1998), the observed difference between the reduction of bleeding frequency after full-mouth disinfection and after conventional therapy was about 51%. That study reported that four months after completion of the periodontal therapy by scaling and root planing, 47% (mean value) of the periodontal pockets were still bleeding after gentle probing. No statistically significant difference for the parameter "bleeding frequency" was observed between full-mouth disinfection and full-mouth scaling (Quirynen, 2000). This result is in agreement with the study published by the Glasgow group (Apatzidou, 2004).

Reduction of probing depth

The findings for moderate (4-6 mm) and deep (>7 mm) periodontal pockets and between single- and multi-rooted teeth were evaluated separately.

Table 3 Reduction of probing depth in mm and the assessed significant (SS) and non-significant (NS) differences between the different treatment methods.

Study	N	Study period (Month)	single-rooted teeth				multi-rooted teeth			
			SRP	FMD	FMS	Difference	SRP	FMD	FMS	Difference
Quirynen et al. 1995										
5–6mm	10	2	2.0	2.2		0.2 NS	1.9	2.1		0.1 NS
≥7mm			2.5	3.3		0.8 SS				
Bollen et al. 1996										
5–6mm	10	8	1.9	2.6		0.7 NS	1.8	2.2		0.4 NS
≥7mm			3.2	4.1		0.9 SS		2.6	3.9	1.3 SS
Vanderkerckhove et al. 1996										
5–6mm	10	8	1.9	2.6		0.7 NS	1.8	2.2		0.4 NS
≥7mm			3.3	4.1		0.8 SS	2.7	3.9		1.2 SS
Bollen et al. 1998										
5–6mm	16	4	1.1	2.0		0.9 SS	0.9	1.6		0.7 SS
≥7mm			1.0	3.3		2.3 SS	1.0	2.4		1.4 SS
Mongardini et al. 1999										
CAP 4.5-6.5mm	24	8	1.2	1.9		0.7 SS	0.6	1.7		1.1 SS
CAP ≥7mm			1.9	3.7		1.8 SS	1.5	2.9		1.4 SS
EOP 4.5–6.5mm	16	8	1.2	1.7		0.5 NS	1.3	1.6		0.3 NS
EOP ≥7mm			2.1	2.7		0.6 NS	1.9	2.2		0.3 NS
Quirynen et al. 2000										
5–6mm	36	8	1.0	1.7	2.1	^a 0.7 SS ^b 1.1 SS ^c 0.4 NS	0.7	1.4	1.9	^a 0.7 SS ^b 1.2 SS ^c 0.5 NS
≥7mm			1.9	3.7	3.3	^a 1.8 SS ^b 1.4 SS ^c 0.4 NS	1.6	3.0	2.9	^a 1.4 SS ^b 1.3 SS ^c 0.1 NS
Apatzidou & Kinane 2004	40	6	1.8*		1.7*	0.1 NS				
SRP= Conventional Scaling and Root planing FMS= Full-mouth Scaling and Root planing FMD= Full-mouth Disinfection ^a SRP vs. FMD ^b SRP vs. FMS ^c FMS vs. FMD * no differences between single- and multi-rooted teeth										

The reduction of probing depth in deep periodontal pockets by full-mouth disinfection was significantly higher than the reduction achieved by the conventional therapy (Table 3). The difference between both methods varied from 0.8 to 0.2 mm for single-rooted teeth and between 0.7 to 1.9 mm for multi-rooted teeth. No significant differences were observed between full-mouth disinfection or scaling and root planing for the marker pocket depth reduction in middle or deep pockets after the treatment of patients with generalized early-onset periodontitis (aggressive periodontitis) (Mongardini, 1999). The probing depth reduction achieved by full-mouth disinfection compared to full-mouth scaling was about the same size. The

significant difference in probing depth reduction between full-mouth scaling and the conventional treatment was 2 mm in favor of the full-mouth approach. In contrast to these results, no difference between full-mouth scaling and conventional therapy was shown for the pocket depth reduction in the study conducted at the University Hospital Glasgow (Apatzidou, 2004).

Attachment level

The changes of attachment levels during the different treatment procedures tend to be comparable with the results of the pocket depth reduction (Table 4). The treatment of moderate and deep

Table 4 Changes of attachment level in mm and the assessed significant (SS) and non-significant (NS) differences between the different treatment methods

Study	N	Study period (Month)	single-rooted teeth			Difference	multi-rooted teeth			Difference
			SRP	FMD	FMS		SRP	FMD	FMS	
Vanderkerckhove et al. 1996										
5–6mm	10	8	1.47	1.78		0.21 NS				
≥7mm			1.88	3.74		1.86 NS				
Bollen et al. 1998										
5–6mm	16	4	0.0	0.9		0.9 SS	–0.1	0.6		0.7 SS
≥7mm			0.4	1.7		1.3 SS	0.1	1.3		1.2 SS
Mongardini et al. 1999										
CAP 4.5–6.5mm	24	8	0.3	1.1		0.8 SS	–0.1	1.8		1.9 SS
CAP ≥7mm			0.6	2.3		1.7 SS	0.5	2.0		1.5 SS
EOP 4.5–6.5mm	16		0.8	1.3		0.5 NS	0.3	1.0		0.7 SS
EOP ≥7mm			0.3	1.2		0.9 SS	0.8	1.0		0.2 NS
Quirynen et al. 2000										
≥7mm	36	8	0.6	2.3	2.6	^a 1.7 SS ^b 2.0 SS ^c 0.3 NS	0.5	2.0	2.3	^a 1.5 SS ^b 1.8 SS ^c 0.3 NS
Apatzidou & Kinane 2004										
	40	6	1.1*		1.1*	0.0 NS				
* no differences between single and multi-rooted teeth										
SRP=conventional Scaling and Root planing										
FMS= Scaling and Root planing within 24 hours										
FMD= Full-mouth Disinfection										
^a SRP vs. FMD										
^b SRP vs. FMS										
^c FMS vs. FMD										

Study	Study period	Culture methods			
		DPCM	CFU	Specific Pathogens	DNA
Quirynen et al. 1995	2	NS	SS		
Bollen et al. 1996					
single-rooted	8	NS	NS	SS	
multi-rooted		SS	NS	SS	
Bollen et al. 1998					
single-rooted	4	SS	SS		
multi-rooted		SS	NS		
Quirynen et al. 1999					
CAP	8	SS	SS	SS	
EOP		NS	NS	NS	
Quirynen et al. 2000					
	8	^a SS ^b SS ^c NS		^a * ^b * ^c *	
De Soete et al. 2001					

DPCM= Differential phase contrast microscopy
 *= no statistical analysis, but denoted as additional reduction in the group of FMD
^a SRP vs. FMD
^b SRP vs. FMS
^c FMS vs. FMD

Table 5 The assessed significant (SS) and non-significant (NS) differences for the bacterial analysis between the treatment methods.

periodontal pockets by full-mouth disinfection led to statistically significantly greater attachment gain than that achieved with scaling and root planing. The statistically significant differences in favor of full-mouth disinfection were 0.9 to 1.7 mm for single- and multi-rooted teeth. In comparison to scaling and root planing, the attachment levels were additionally improved by 2 mm with full-mouth scaling. However, no significant differences in the attachment level changes were found between full-mouth disinfection and full-mouth scaling. The Glasgow study group did not confirm the more favorable gain of attachment levels caused by full-mouth scaling vs. conventional therapy indicated by the Leuven study group.

Bacterial verification

The analysis of the bacterial microflora was performed by differential phase contrast microscopy, culturing methods, or DNA hybridization techniques. Table 5 indicates that in the majority of studies, the elimination of bacteria in periodontal pockets by full-mouth disinfection was more effective than by scaling and root planing. The same results were verified for the elimination of specific periodontal pathogens. Between full-mouth disinfection and full-mouth scaling, no difference of the bacterial colonization was verified after treatment.

Adverse reactions

In the present studies, the intensity of pain (scale from 0-10), the number of analgesics taken (0 to 6), the rise in body temperature, and the occurrence of herpes labialis were recorded as adverse reactions. The survey of these parameters showed that conventional therapy was not as painful for the patients as any treatment conducted within 24 hours (full-mouth disinfection or full-mouth scaling). Different studies reported different incidences of elevated body temperature after a full-mouth approach compared to conventional therapy. Some studies showed an increase in body temperature induced by the full-mouth disinfection treatment (Vandekerckhove), while other studies did not observe this (Apatzidou, 2004). While the information about changes in body temperature varied between different studies, it was obvious that any periodontal treatment within 24 hours increased the need for analgesics and the risk of developing a herpes labialis infection (Apatzidou, 2004; Vandekerckhove, 1996).

DISCUSSION AND CONCLUSION

The concept of full-mouth disinfection is based on the assumption that an inflammatory periodontal disease is an exogenous infection and that the intraoral transmission of bacteria from oral niches could lead to a re-infection of already treated pockets, which may jeopardize the success of the periodontal treatment. However, these assumptions are a contentious issue in the scientific community. The detection of the periodontal pathogens *Actinobacillus actinomycetemcomitans* and *Porphyromonas gingivalis* in a healthy population and in patients with periodontitis demonstrated that periodontitis is not an exogenous infection (Dahlen 1992; Wilson 1993). In addition, the transmission of oral pathogens from different oral niches and the possibility of a subsequent infection of periodontal pockets are also discussed critically (Christersson, 1985).

Besides the evaluation of the full-mouth disinfection approach, a critical review of the scientific methods employed is necessary to estimate the scientific and clinical relevance of the studies. In this context, it is interesting to investigate the methods used for the measurement of the pocket depths, the design of the studies, and the results of the control treatments in the present studies.

In order to determine the magnitude of the reduction of periodontal pockets, it is necessary to measure the depth of the pockets before the treatment starts. The researchers at the University of Leuven chose another permissible, although not frequently used procedure. Probing depth was measured after the non-surgical treatment of the root surfaces to avoid any interference with calculus deposits. This procedure led to higher values of pocket depth reduction than in fact existed. This complicates the estimation of the clinical relevancy of the results and the comparability with other studies.

Another important issue of the full-mouth disinfection concept is to determine the effect of the adjunctive chlorhexidine chemotherapy for the outcome measurements of the periodontal treatment. To answer this question, the University of Leuven authors brought a third group into an ongoing investigation, a procedure that is scientifically not correct. However, they showed that the adjunctive chlorhexidine therapy did not have any additional effect on the outcome of the full-mouth treatment.

The clinical results of the control scaling and root planing should also be included in this critical

review. In one study (Bollen, 1996), a bleeding index of more than 40% was recorded after completion of the therapy and a pocket depth reduction of less than 1 mm was achieved in deep periodontal pockets (>7 mm). These results are lower than the values reported in the standard literature on the effectiveness of periodontal treatment (Badersten 1984a, 1984b).

These remarks are not intended to negate the studies in general, but they should point to the limited value of the results and, consequently, the necessity of discussing potentially limited clinical significance.

The present analysis illustrates the immense effort that has been and must continue to be made at the Universities to evaluate the best evidence for new periodontal treatment concepts, as well as for any other new medical treatment procedure. The present survey does not supply the scientific exactness of a systematic review, but it is adequate for drawing the following conclusions about the effectiveness of full-mouth disinfection or full-mouth scaling compared to the conventional therapy of scaling and root planing:

- The studies did not provide the basis for verification that one of the new treatment strategies (full-mouth disinfection or full-mouth scaling) significantly improved the clinical results of local treatment compared to conventional scaling and root planing. In spite of the positive results published by the University of Leuven group, other university-based centers did not reproduce the results, and further studies are necessary as a consequence.
- The conditions for a change in paradigm in periodontal treatment from conventional non-surgical therapy to a full-mouth disinfection approach are not met at this time.
- Including the results of the study in 2000 (Quirynen 2000) conducted at the University of Leuven, irrespective of the methodological limitations and the small number of patients, the adjunctive therapy with chlorhexidine has no verified positive influence outcomes. The question of a possible positive effect of the adjunctive chlorhexidine chemotherapy still remains.
- In contrast to the easy treatment schedule of conventional therapy, the need for additional analgesics and the increased risk of a herpes labialis infection must be taken into account if a full-mouth approach is planned. The possible rise in body temperature should also be carefully examined when applying this therapy.

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