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Isabella Karina Gutiérrez-de la Garza
Graduate Periodontics Program, School of Dentistry, Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México

Gloria Martínez-Sandoval
Graduate Periodontics Program, School of Dentistry, Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México

Norma Idalia Rodríguez-Franco
Graduate Periodontics Program, School of Dentistry, Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México

María Gabriela Chapa-Arizpe
Graduate Periodontics Program, School of Dentistry, Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México

Jesús Israel Rodríguez-Pulido
Graduate Periodontics Program, School of Dentistry, Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México

Correspondence
Isabella Karina Gutiérrez-de la Garza
Graduate Periodontics Program, School of Dentistry, Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México

Full-mouth disinfection protocol: Applications, techniques and variables in non-surgical periodontal treatment literature review

Isabella Karina Gutiérrez-de la Garza, Gloria Martínez-Sandoval, Norma Idalia Rodríguez-Franco, María Gabriela Chapa-Arizpe and Jesús Israel Rodríguez-Pulido

Abstract
The non-surgical periodontal treatment is focused on scaling and root planning, and in an attempt to get better results, the Full-Mouth Disinfection protocol (FMD) is introduced with the aim to perform scaling and root planning within 24 hours, with chlorhexidine solutions and gels. The aim of this investigation is to review the literature that exists about FMD, specifically the technique variations, clinic and microbiologic results in chronic periodontitis and clinic and microbiologic results in aggressive periodontitis. Different techniques are applied to this protocol, being the use of manual instruments with an adjunct chlorhexidine therapy for two weeks. The results in chronic periodontitis are similar to those found in the quadrant-based scaling and root planning. The clinical results in aggressive periodontitis show an improvement in pocket depth, bleeding and clinical attachment level, in comparison with the traditional treatment method, when used in conjunction with antibiotic therapy. Microbiologic results in chronic periodontitis show a reduction in pathogen levels the first months post-treatment, but there isn't a long-term significant difference. Microbiological results in aggressive periodontitis show an signigificant reduction in levels of pathogens.

Keywords: scaling and root planning, aggressive periodontitis, chronic periodontitis, full-mouth disinfection

1. Introduction
Periodontal disease is an inflammatory condition caused by several factors, like the proliferation of subgingival bacteria, which is present in 46% of the adult population in United States. Periodontitis is the result of a combination of factors like microbial infection and the host response to it, modified by the systemic risk factors and the patient's habits [1]. The periodontopathogenic microorganisms are the principal etiological agents, finding a close relationship with *Porphyromonas gingivalis*, *Bacteroides forsythus* y *Aggregatibacter actinomycetemcomitans* [2-4].
According to The American Academy of Periodontology (AAP) periodontal disease classification in 1999, periodontitis can be classified as chronic, aggressive and as a manifestation of systemic diseases. Chronic periodontitis is identified being prevalent in adults, though it can be present in young patients; the observed destruction is consistent with the local factors (Dental plaque and calculus), and it has a slow to moderate rate of destruction. In the other hand, on aggressive periodontitis, the patient is healthy in all aspects, and the observed destruction is inconsistent with the quantity of bacterial deposits and there's a rapid loss of attachment and bone loss [5].
In the European Workshop of Periodontology in 2017 by the European Federation of Periodontology (EFP) and AAP, a new classification of periodontal diseases was proposed, dividing the periodontitis in four stages depending on severity of the condition; and grades depending on the extent of the disease, taking into consideration the patient's susceptibility to disease and risk factors [6].
The main objective of periodontal treatment consists on the reduction or elimination of microbial load, the removal of dental plaque and calculus.

The most effective treatment for this is the mechanic debridement through non-surgical methods [7]. The traditional non-surgical treatment for periodontitis is the scaling and root planing by quadrants (SRP-Q) in a range of one or two weeks between each [2]. However, microorganisms exist in other oral niches, like saliva, tongue, cheeks and tonsils, and these can migrate from these sites back to the subgingival space, contaminating the already treated quadrants [2].

To avoid this cross contamination, Quirynen proposed the Full-Mouth Disinfection technique (FMD), which varies from the traditional SRP-Q in that the scaling and root planning are done in two appointments within 24 hours, and the use of chlorhexidine rinses for two weeks are implemented. The purpose of this is to lower bacteria counts and avoid cross-contamination [8].

The aim of the present study is to realize a literature review about the applications and variations of the FMD technique, clinic and microbiological results in chronic and aggressive periodontitis.

2. Materials and Methods

A search of literature was made, including original articles, narrative and systemic reviews, and case reports in the database of PubMed and Google Scholar, with the keywords "periodontitis", "Full-Mouth disinfection" and "FMD".

3. Results & Discussion

3.1 Periodontal disease

Armitage has classified the periodontal disease in two general categories: those induce by dental plaque, being these most frequent ones worldwide; and those not induced by plaque. Plaque induced periodontal disease can divide in three categories: health, gingivitis and periodontitis. Health can be defined as the absence of periodontal disease; gingivitis is the presence of gingival inflammation without attachment loss of the connective tissue, whereas, when there's a clinical attachment loss and bone loss, it is categorized as periodontitis [9].

Regarding periodontitis, three subdivisions can be found: chronic periodontitis, aggressive periodontitis and periodontitis as a manifestation of systemic disease. Chronic periodontitis is characterized by occurring mainly in adults, finding attachment and bone tissue destruction consistent with the amount of plaque and subgingival calculus present. In general, the progress of the disease is slow, but there may be periods of the destruction's exacerbation. Local factors, systemic diseases and extrinsic factors such as smoking can modify the disease's progression. Chronic periodontitis is classified as localized (<30%) or generalized (>30%) depending on the sites involved; and it is classified as mild (1-2mm), moderate (3-4mm) or severe (> 5mm) depending on the clinical attachment loss.

Aggressive periodontitis is characterized as one that shows a rapid loss of clinical attachment levels and bone destruction, as well as a possible family relationship of the disease. Aside periodontal disease, patients are usually systemically healthy. One of the important characteristics of this type of periodontitis is an amount of destruction greater than what would be expected by the presence of the local factor; in addition to high levels of *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis* [10].

Currently, the new classification of periodontal disease described in the Global Workshop of EFP and AAP of 2017 is used. The classification of periodontal disease takes a stage approach, as is normally used in oncology to describe the severity of the disease; and degrees to describe the progression of the disease and the manner in which each patient responds depending on his or her general or systemic health status. This with the purpose of simplify and standardizing the diagnosis and optimizing the treatment [11].

Periodontitis is divided into four stages:

- Stage I: is the incipient disease, represented by the early signs of clinical attachment loss.
- Stage II: previously considered as mild or moderate, is the disease whose treatment can be carried out relatively easily by applying the principles periodontal treatment.
- Stage III: is one in which there has been a significant clinical attachment loss, and if left without treatment, it can lead to the loss of teeth.
- Stage IV: is what was previously considered severe, due to the large amount of attachment and teeth, therefore masticatory function loss.

The grades of periodontitis are divided in three: grade A with a low progression, grade B with a moderate progression, and grade C with a rapid progression of the disease [6].

3.2 Non-surgical periodontal treatment

The role of bacterial plaque in the progression of periodontal disease is already known. For this reason, treatments aimed at controlling the biofilm are essential for the management of periodontitis. The scaling and root planning allows the removal of plaque and supra and subgingival calculus, in addition to the toxified cement [12]. The scaling and root planning are usually done by quadrants [13].

There is a positive response to scaling and root planning. The literature reports a reduction of inflammation, as well as a reduction of bleeding on probing, and gingival indexes [14]. A reduction in tooth loss up to 58% with time is also observed [15].

However, microorganisms are not found only in supra and subgingival spaces, but are present in other oral niches, such as saliva, tongue, cheeks and tonsils. This could cause a recontamination of the already treated pockets by the untreated quadrants [2]. For this reason, Quirynen proposes the FMD protocol, a technique that differs from the traditional SRP-Q in that the scaling and root planning of all surfaces are done in two appointments within 24 hours; in addition, rinses with chlorhexidine are indicated to eliminate the greatest amount of microorganisms in the oral cavity and thus avoid cross-contamination [8].

3.3 Full mouth disinfection

FMD technique was described by Quirynen in 1995, with the intention of performing the scaling and root planning in one or two visits in a 24-hour range. This with the goal of avoiding the possibility of cross contamination between treated and untreated quadrants.

FMD is performed with manual instruments, taking approximately one hour in each quadrant. After instrumentation, optimal disinfection is sought by first brushing the back of the tongue for 60 seconds with a 1% chlorhexidine gel. Afterwards, two rinses are made with a 0.2% chlorhexidine solution for one minute (gargling during the last 10 seconds to reach the tonsils). Subsequently, subgingival irrigation of all periodontal pockets is performed for 10 minutes in 3 intervals with a 1% chlorhexidine gel. This step is repeated eight days after the intervention. Additionally, patients are instructed to use 0.2% chlorhexidine mouthwash twice daily for two weeks. Indications of oral hygiene are given, including interdental

plaque control with interdental brushes or toothpicks, and brushing the back of the tongue twice a day [8, 16-18].

3.4 Technique and variations of FMD

3.4.1 Full-mouth scaling

In 2000, Quirynen *et al*, proposed full-mouth scaling (FMS), a variation of the FMD protocol without chlorhexidine. This was then compared with the traditional treatment by quadrants, using manual instruments [19].

Benefits were found in both groups (FMS and FMD) in terms of periodontal pocket reduction and clinical attachment gain compared to SRP-Q. However, no significant difference was observed between the two test groups. A decrease in motile microorganisms and spirochetes in the FMD group was also found, but without differences after 2 months postoperatively [19-22].

3.4.2 Use of antiseptics

In 2006, Quirynen considered the use of Amine Fluoride/stannous fluoride in the FMD protocol instead of chlorhexidine [17]. Similarly, Wang studied the possibility of using povidone-iodine in the FMD protocol, finding that there is a reduction of antibodies against *P. gingivalis* and *anti-actinomyctemcomitans*. It is suggested that povidone-iodine can be a reliable alternative to chlorhexidine [23].

3.4.3 Use of antibiotics

The additional benefit of an antibiotic in conjunction with FMD has been discussed in various studies [5, 24, 25]. Azithromycin, Metronidazole and Amoxicillin have been the most used. Gomi *et al.*, compared a control group of SRP-Q and a FMD protocol with Azithromycin test group. Microbiological parameters were lower in the test group for the first two postoperative months [26]. Cionca *et al* investigated the use of a combination of Amoxicillin with Metronidazole alongside the FMD protocol. They concluded that the test group with antibiotic had better results in clinical parameters, such as pocket depth reduction and elimination of bleeding. They also observed that there was a reduced need for complementary surgical treatment. Regarding microbiological effects, they observed the elimination of *Aggregatibacter actinomycetemcomitans* in the experimental group three months after treatment. They also observed lower levels of *Porphyromonas gingivalis* and *Tannerella forsythia* [27]. In a similar study, it was found that the effects of Amoxicillin and Metronidazole were maintained for six months [5]. Preus in his studies using monotherapy of Metronidazole, he finds that the results showed significant differences, however, the-analyzes are not enough to recommend the use of metronidazole in patients with severe chronic periodontitis, due to the risks to adverse effects for the patient [24, 25].

3.4.4 Use of ultrasonic scalers

The use of ultrasonic scalers instead of manual instruments has also been studied in the literature. The benefits are limited compared to conventional treatment, though it is completed in a significantly shorter time [28, 29].

3.4.5 Clinical outcomes in chronic and aggressive periodontits

Some authors prefer the FMD protocol over the traditional SRP-Q because they found a clinical improvement in terms of pocket depth, clinical attachment levels and bleeding on probing, arguing that part of the therapy's success is the use of antiseptics, such as chlorhexidine, and reduced chair time [8, 16, 17, 30].

Currently, most authors agree that the results regarding clinical attachment level, pocket depth and bleeding on probing are better after periodontal treatment, finding improvements in moderate pockets (4-6mm) using the FMD, though there's not a significant difference between the use of the FMD protocol and the traditional SRP-Q treatment in deeper pockets (> 6mm) [1, 2, 25, 31].

Patients with aggressive periodontitis have a lesser benefit after periodontal therapy than a patient with chronic periodontitis [38, 39]. However, some authors believe that the use of FMD has a benefit in non-surgical treatment, causing an improvement in pocket depth reduction and clinical attachment level. It should be mentioned that, in these patients, in addition to using the FMD technique, oral antibiotics are indicated.

Other authors compare the FMD technique with and without antibiotic therapy and agree that while there is improvement in attachment levels, pocket depth reduction, and bleeding on probing, there is no significant difference comparing both treatments [40-42].

Also, the variation of the technique using ultrasonic scalers is used to perform full-mouth scaling in a single session, without the use of antibiotics, in patients with aggressive periodontitis, smokers and non-smokers. Good clinical results are observed in both groups, finding a reduction in pocket depth and in bleeding. There is a slight improvement in the non-smoking group compared to smokers [43].

3.4.6 Microbiological results

The FMD treatment results in significant reductions of pathogenic species months after therapy, especially reductions of *Tannerella forsythia* [8, 24, 34]. Studies discuss the eradication of *P. gingivalis* and the reduction of spirochetes and motile organisms up to eight months post- FMD treatment [35] Together with Metronidazole, a significant effect was observed in patients with *P. gingivalis* and *T. forsythia*, finding a smaller number of these microorganisms at 3 to 12 months post-treatment [36].

The use of FMD can also be used to treat peri-implant mucositis, compared to traditional scaling of the implant's surface. In both treatments there is a significant reduction of the microbiome, but without a significant long-term change [37].

The key pathogens in aggressive periodontitis are *Aggregatibacter actinomycetemcomitans, Tannerella forsythia, Treponema dentícola, Prevotella intermedia and Porphyromonas gingivalis*, and these are found in all oral niches. After completing non-surgical periodontal therapy with FMD technique, a reduction in the prevalence of *A. actinomycetemcomitans, T. dentícola, T. forsythia, Parvimonas micra and T. socranskii*, pathogens found in the biofilm related to the disease was observed for the first three months after therapy. An increase of these microorganisms was observed twelve months post-treatment. "Non-periodontal" species, such as *S. gordonii* and *S. oralis*, also tended to increase in numbers, creating a microbiome compatible with periodontal health [5, 40-42, 44, 45].

In one study, A. *actinomycetemcomitans* was not detected in a culture biofilm at nine and twelve months after FMD treatment with the use of antibiotics. The plaque control and oral hygiene, in addition to the instrumentation of root surfaces in the supportive periodontal therapy could have had an effect in the reduction of certain pathogenic species. In this

study, no significant difference was observed between the group using and not using antibiotics [45].

4. Conclusions

In conclusion, FMD is an option to perform non-surgical periodontal treatment in a shorter operative time. It is a treatment without risks to the patient and may be more comfortable for them when they have no time disposal for four visits in a four to six weeks lapse of time. The results are like those of the traditional treatment, and there is no significant variation in clinical or microbiological changes. In case of aggressive periodontitis, good results are observed, and FMD can be a good option to treat these patients.

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