Full-mouth Disinfection:

an overview of research and clinical application

This approach to periodontal therapy shows promise for restoring patients to optimal oral health while bringing practical benefits to clinicians.

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The American Dental Hygienists' Association defines optimal oral health as a standard of health of the oral and related tissues that enable an individual to eat, speak or socialize without active disease, discomfort or embarrassment, and one that contributes to general well-being and overall health.[1] In light of recent research establishing the oral infection/systemic health connection,[2] progressive clinicians and patients alike have become increasingly interested in methods to enhance the effectiveness of periodontal therapy and achieve optimal oral health. As a result, there has been a renewed interest in the concept of full-mouth disinfection (FMD).[3,4]

Overview of FMD

FMD protocol requires that full-mouth instrumentation and oral disinfection procedures be completed in two appointments within 24 hours of each other. This approach provides an interesting treatment option and proves more effective than traditional quadrant scaling and root planing, or partial-mouth disinfection. What follows is an overview of the research, clinical application, and necessary armamentarium.

Quirynen, et.al., first reported the concept of FMD in the *Journal of Dental Research* in 1995.[5] Since then, FMD has been a successful treatment modality in both chronic, advanced and early-onset periodontitis populations. The purpose of Quirynen's studies was to investigate FMD as a means of reducing the re-infection that theoretically can occur with traditional quadrant scaling and root planning.[5-10]

The research compared FMD to partial-mouth disinfection, which is defined

Adjunctive antimicrobial delivery options

Product	Company	Active ingredient	Indications	Delivery	Clinical outcome	Additional information
PerioChip®	Dexcel Pharma Inc. 866-PERIOCHIP (866-737-4624)	2.5 mg chlorhexidine gluconate	PerioChip is indicated as an adjunct to scaling and root planing procedures for reduction of pocket depth in patients with adult periodontitis. PerioChip may be used as part of a periodontal maintenance program, which includes good oral hygiene and scaling and root planing.	Subgingivally placed 4 mm x 5 mm x 0.35 mm bioabsorbable sustained release chip. Easily inserts within one minute. Dissolves in 7-10 days. Restrict interdental care in treated area.	Results showed improvement in secondary outcome variables over SRP alone.	Results were based upon baseline SRP and placement of the chip, followed by placement of additional chips and three and six months with supragingival instrumentation at sites that were 5 mm or greater.
Atridox™	Block Drug Corp. 800-OK-BLOCK (800-652-5625)	10% doxycycline hyclate	Atridox is indicated for for use in the treatment of chronic adult periodontitis for a gain in clinical attachment, reduction in probing depth, and reduction in bleeding on probing.	Controlled/sustained release gel for subgingival application. Hardens to a wax-like consistency upon subgingival application; 14-day release. Restrict interdental care in treated area.	Results were equal to SRP with secondary AND primary outcome variables achieved.	Mono-therapy based research against SRP. The only ADA sealed product for use in the arrest of periodontitis.
Arestin™	OraPharma Inc. 866-ARESTIN	1 mg resorbable minocycline microspheres	Adjunctive treatment for adult periodontal disease used in conjunction with scaling and root planing.	Powder substance placed subgingivally; 14-day release	Clinical data online at arestin.com	Available April 2, 2001. Received FDA approval in February, 2001.
Periostat™	CollaGenex Pharmaceuticals 888-339-5678	20 mg doxycycline hyclate	Periostat is indicated for use as an adjunct to scaling and root planing to promote attachment level gains and to reduce pocket depth in patients with adult periodontitis.	Oral capsule, 20 mg twice a day (BID). No restriction on oral hygiene care.	Results showed improvement over SRP group, including secondary *and* primary outcome variables achieved.	Oral enzyme suppresser. Research based upon baseline SRP and Periostat taken twice a day with clinical perimeters measured at three, six, and nine months. No additional instrumentation was performed at those intervals.

Source: Manufacturers' packaging inserts; also, see references 23-25, 27.

as "quadrant or sextant scaling and root planing that is completed, quadrant by quadrant, at two-week intervals, or six weeks from instrumentation of the first quadrant to completion of the fourth quadrant." Control populations received the standard instrumentation protocol, or partial-mouth disinfection, while the other group underwent FMD.

FMD consists of two appointments within 24 hours, each approximately one hour in length, at which full-mouth scaling and root planing are performed and immediately followed by oral disinfection procedures. The disinfection procedures included application of chlorhexidine to supra- and subgingival environments along with tongue brushing and mouth rinsing with chlorhexidine. Prior to instrumentation, pockets were irrigated with a 1% chlorhexidine gel. After instrumentation, the following additional disinfection procedures were performed:

1. Brushing the tongue was for 60 seconds with a 1% chlorhexidine gel
2. Rinsing twice with a 0.2% chlorhexidine solution for one minute
3. Spraying the pharynx with 0.2% chlorhexidine
4. Subgingival irrigation of all pockets three times within 10 minutes with a 1% chlorhexidine gel

Subgingival application of 1% chlorhexidine gel was repeated at day eight. In addition to daily interdental plaque control, toothbrushing, and brushing of the dorsum of the tongue by both groups, the test populations also rinsed with and sprayed tonsils twice a day with 0.2% chlorhexidine for two months.

Research results

The patients who underwent FMD in a number of studies exhibited both primary and secondary gain in clinical attachment outcomes.[5-9,12] Primary clinical outcome variables included an increase in clinical attachment of alveolar bone, while secondary clinical outcome variables included reduction in probing depths, bleeding on probing, and inflammation as well as a decrease in microbial counts.[11] The FMD population showed a significant reduction in probing depths and gain in clinical attachment over those receiving standard therapy. The pooled results of the FMD data demonstrated significant reduction in probing depths for test groups over the control groups.

With respect to primary clinical outcomes, the test groups experienced a more significant gain in clinical attachment than the control population in all studies. These results were maintained for eight months, and in the test population the reduction of probing depths, bleeding on probing, and gain in the clinical attachment continued to improve from the baseline data. In addition, the FMD populations experienced a greater reduction in spirochetes and motile bacteria, eradication of *p. gingivalis*, and decrease of oral malodor.[19,20]

The initial pilot study and studies that followed suggest that the clinical outcomes are directly related to the accelerated instrumentation and disinfection process. The re-infection potential significantly decreases as a result of this process and the authors also suggest that the results are comparable to those seen with local delivery, controlled-release antimicrobial agents. Although this research was conducted with small populations and represents only a few completed studies, the results warrant consideration for clinical application in initiating periodontal therapy for both aggressive and chronic periodontitis populations.[19,20]

It is important to note in reviewing the methodology of these studies that the concentrations of chlorhexidine utilized are not currently available in the United States. Regardless, this limitation may actually represent an opportunity to explore and utilize currently available agents and procedures that may, in fact, enhance the outcome of FMD. With regard to chlorhexidine application subgingivally and to intraoral surfaces, a recently published study compared the FMD protocol with and without chlorhexidine.[12] The results indicated no difference between the two populations and concluded the mechanical instrumentation within 24 hours was the reason for improved results over traditional scaling and root planing. With this in mind, the unavailability of the concentrated chlorhexidine used in this research becomes less critical when one considers whether to implement this procedure. Clinicians should consider additional options that *could* enhance FMD results.

Implementation of FMD into periodontal therapy

Certainly, completing full-mouth instrumentation within 24 hours is a patient-centered approach. However, actually incorporating the basic premise of FMD into a practice's current periodontal therapy services requires clinicians to consider innovative methods and agents commercially available in the United States to realize and potentially improve upon the FMD results seen in the literature.

Even more motivation to modify the disinfection protocol is provided by the latest follow-up study, which illustrates that the disinfection procedures with low-concentration chlorhexidine did not result in any improved outcomes.[12] Theories behind these results include the fact that the chlorhexidine was not of sufficient concentration and did not reach the site of the disease, combined with the fact that the chlorhexidine was not retained in the disease sites for any significant period of time.

Modified FMD protocol

Given this information, what follows is a proposed modification to the FMD protocol that utilizes currently available local delivery agents and includes realistic, easily implemented processes.

Pre-procedural rinsing

To begin the disinfection process and reduce aerosolized bacteria during the procedure, the FMD appointment should be initiated with antimicrobial pre-procedural rinsing with chlorhexidine or essential oils.

Scaling and root planing

Initially, the use of powered instrumentation will provide an effective method for debriding and irrigating subgingival environments. Powered instruments that incorporate self-contained water/medicament reservoirs will be advantageous for use with antimicrobial agents, such as 0.12% chlorhexidine. Combined with hand instrumentation, powered instruments may offer additional benefits of tissue detoxification, quick, effective removal of subgingival deposits, and reduction in operator fatigue.

While irrigation with chlorhexidine is limited in long-term antimicrobial benefits, this agent neutralizes volatile sulfur compounds (VSCs),[10] which are the odor-associated by-products produced by gram-negative, anaerobic bacteria. VSCs have been associated with increasing permeability of mucosa, which results in increased bacteria invasion; and, most importantly, VSCs have been shown to interfere with collagen and protein synthesis.[13,14,15,16] For this reason, use of an antimicrobial agent is warranted to eliminate VSCs and improve oral malodor.[17] Additional VSC-neutralizing agents include triclosan, essential oils, chlorine dioxide, and zinc. Numerous commercially available daily-use products that contain these active ingredients can be used long-term to reduce VSCs and bad breath.[31]

Oral disinfection procedures

At the completion of mouth instrumentation/irrigation, tongue and buccal mucosa disinfection procedures should be performed. In the FMD studies, the tongue was brushed with a 1% chlorhexidine gel for 60 seconds. Most of the bacteria accumulation is on the posterior one-third of the tongue, and brushing may not reach this area or be comfortable for the patient. Procedurally, this presents a problem since 1% chlorhexidine gel is not available in the U.S., combined with the fact that most bacteria accumulation is on the posterior third of the tongue, and brushing may not reach this area or be comfortable for the patient.

While brushing the tongue with an antimicrobial will eliminate some of the bacteria, deplaquing with a tongue scraper will be safer and more effective.[18,19,20] Additionally, the patient will find the deplaquing procedure with a scraper more comfortable. Recommended protocol would include having the patient extend the tongue, applying an antimicrobial

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Proposed alternative FMD clinical protocol

Two appointments of appropriate length scheduled within 24 hours

- Pre-procedural antimicrobial rinse for 30 seconds with antimicrobial agent
- Anesthesia administration
- Scaling and root planing:
  - Powered instrumentation with self-contained water/medicament reservoir and antimicrobial irrigant
  - Hand instrumentation
- Tongue deplaquing/scraping with antimicrobial agent
- Post-procedural rinse for 30 seconds with antimicrobial agent

2-month evaluation

- Placement of local delivery/ controlled release agent or prescription for subclinical dosage doxycycline:
  - 2.5 mg. chlorhexidine chip
  - 10% doxycycline gel
  - 1 mg. minocycline microsphere power
  - 20 mg. systemic/ subclinical dosage doxycycline bid
- Schedule appropriate recare.

Re-evaluation at appropriate time, with referral for non responsive cases.

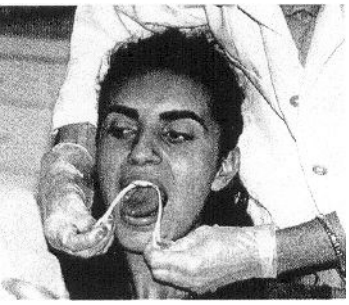
Note: Daily oral hygiene should include toothbrushing, interdental cleansing, and tongue deplaquing along with appropriate adjunctive chemotherapy.

Benefits of FMD

- Reduction in probing depths over traditional quadrant scaling and root planing
- Gain in clinical attachment
- Reduction in oral malodor
- Greater reduction in spirochetes and motile organisms in subgingival flora
- Eradication of *p. gingivalis*

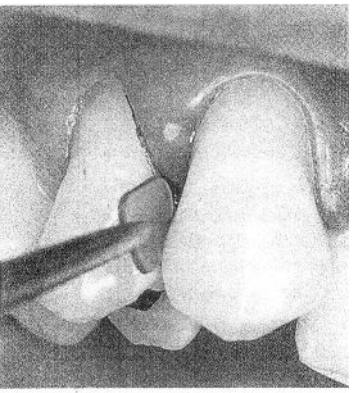
Utilized in both chronic and early-onset populations

Tongue disinfection



Deplaquing with a tongue scraper is safer and more effective than brushing the tongue with an antimicrobial alone.

Local delivery



The PerioChip is one of three bioabsorbable delivery vehicle options available for use in the FMD protocol.

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agent to the tongue surface, and ending with the scraping/deplaquing procedure. This is an important step in the FMD protocol and for daily application by the patient as the tongue's coating on the posterior one-third has been implicated as a major contributor to oral malodor and VSC content of the oral cavity. Additionally, scraping has been shown to reduce VSCs by up to 75% compared to tongue brushing, which resulted in a 25% reduction of VSCs.[32,33] The final phase of the disinfection procedure will include rinsing with an antimicrobial mouthwash, instructing the patient to gently gargle prior to expectorating to disinfect the tonsilar region.

Oral hygiene considerations

The FMD studies included daily oral hygiene protocol for both test and control populations that featured brushing, interdental and tongue. The test population also used 0.2% chlorhexidine to disinfect oral niches. With this in mind, it is essential to consider daily oral hygiene practices as an integral part of any successful periodontal therapy and to implement the FMD protocol. In addition to daily plaque control by traditional means—the modified Bass technique and flossing—clinicians should consider automated technology.

Patients spend an average of 24 to 60 seconds on oral hygiene routines and only 2% to 10% of the population flosses regularly and effectively.[21] Given these dismal compliance realities, the availability and use of automated technology is warranted. Automatic toothbrushes have proven safe and effective and can minimize undesirable side effects, such as chlorhexidine staining; they also can provide patients with tangible visual and tactile cues of successful plaque control. The FMD protocol includes twice-a-day use of chlorhexidine rinse for two months. This agent is approved as an anti-gingivitis/plaque agent and also has been shown to reduce oral malodor and VSCs. For clinicians choosing to use this agent, patients should be instructed to lightly gargle to disinfect the tonsilar region as well. The FMD protocol does not appear to rely upon the use of low-concentration chlorhexidine and should be used on a case-by-case basis.

A fairly new option to the automated market has been interdental aids. Two examples—the Oral-B InterClean and the Water Pik Flosser powered flossing aids—both are supported by published research that indicate they are equally as effective as manual flossing.

In addition to interdental care, patients should perform daily tongue deplaquing. The most effective method for tongue deplaquing is with a tongue scraper. Tongue scrapers produce a cleaner tongue, provide a safe means for tongue coating removal and remove more bacteria than traditional toothbrushes.[18-20,22]

Evaluation of FMD

Once patients have completed the FMD process, they should be scheduled for a two-month evaluation appointment. At the two-month appointment, oral disinfection procedures with chlorhexidine were provided as in the initial FMD appointments. In these studies it was determined that the FMD protocol had little effect on *A. actinomycetemcomitans*, a tissue-invasive bacteria. As a result, additional clinical interventions might include use of local delivered/controlled-release, antimicrobial agents or systemic sub-antimicrobial doxycycline. These medicaments have been used successfully as adjuncts to traditional scaling and root planing and may provide additional benefits outside of those demonstrated in the FMD studies.

Adjunctive, non-surgical innovations

Evaluation of the accelerated instrumentation process should include assessment of periodontal tissues, including probing depths, clinical attachment, and presence/absence of inflammation and bleeding. Those sites that have not responded and exhibit evidence of continuing periodontal infection represent ideal candidates for adjunctive local therapy. Locally delivered controlled-release agents are considered effective in reducing periopathogens if they provide minimum inhibitory concentrations for more than one day. In addition, these agents are placed at the site of infection and deliver a lower total dosage of the drug in a more controlled concentration. With a lower systemic dosage and improved patient compliance, these agents are a welcome addition and option in periodontal therapy. In light of the recent study[12] that showed no difference in those receiving disinfection with chlorhexidine from those who did not, local delivery/controlled-release agents may provide the additional benefit for full-mouth disinfection and improved periodontal health.

Three bioabsorbable delivery vehicle options are currently available (see chart on page 10): 2.5-mg chlorhexidine chip (PerioChip® by Dexcel); 10% doxycycline (Atridox™ by Block Drug) and 1-mg minocycline (Arestin™ by OraPharma). All of these products have been shown to reduce pocket probing depths, inflammation, and bleeding (and in the case of Atridox, a gain in clinical attachment) when compared to scaling and root planing alone.

At this time, there are no published head-to-head comparisons of these options. Clinicians should carefully review the literature to determine which medicament will best suit the patient's therapeutic needs. Basic parameters for use include pocketing of 5 mm or greater. In addition, research on all three agents allowed for additional placement at certain intervals of time.[23,24,25]

It is also important to check with state

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boards regarding the use of these agents by registered dental hygienists. Placement by the registered dental hygienist is restricted in California, pending in New York, and only the PerioChip can be placed by the registered dental hygienist in Florida. As of press time, all other states permit placement, with 33 states having specific language regarding usage of the agents within the dental hygiene practice act.

An additional treatment strategy is the use of a systemic subclinical dosage of doxycycline for generalized pocketing. For the most part, the local delivered/controlled-release agents are considered appropriate for localized pocketing. Localized pocketing is defined as ≤30% of sites are involved, while generalized refers to ≥ 30% of the sites are involved.[26] In these cases, use of systemic sub-antimicrobial doxycycline (PerioStat™ by CollaGenex) may be warranted. Use of this product twice a day, one hour prior to meals, interferes with the production of tissue-destroying enzymes, such as collagenase. The dosage of doxycycline is not concentrated enough to eradicate periopathogens; however, research demonstrates the interference with tissue-destructive enzymes will reduce probing depths and result in a gain in clinical attachment levels when accompanied by scaling and root planing.[27]

The need for these agents at the two-month point is determined by initial healing response from the FMD procedure. Given the concern regarding use of topical or systemic antibiotics, this approach not only will minimize indiscriminate use of these agents but also will provide a more economical option for patients.[28] This evidence-based strategy will provide maximum benefit and potential for both the FMD protocol and the conservative use of newly available therapeutic agents.

Although the research on FMD utilized small patient populations, the results warrant consideration for application in periodontal therapy. This patient-centered approach allows the maximum host immune response and minimum re-infection potential, compared to partial-mouth disinfection or traditional quadrant scaling and root planing.

Practice concerns, benefits

Scheduling two appointments within 24 hours for complete scaling and root planing and disinfection procedures may present a challenge for practices in which periodontal/preventive appointments are booked in advance. In these cases, delaying treatment until the needed appointment time becomes available would in all likelihood be no different than traditional scaling and root planing, which can take anywhere from six to 12 weeks or more to complete. Additionally, the FMD approach will afford clinicians the opportunity to accelerate therapy, which could lead to quicker referrals for surgical intervention for those cases that do not respond.

For clinicians who have the goal to help patients achieve optimal oral health, FMD represents an additional method and approach to periodontal therapy. This method also provides key patient benefits, such as reduction in oral malodor.[29] Bad breath is a key reason individuals seek dental care, and it should be addressed because patients expect assessment and treatment of the condition by the dental professional.

Clinicians reap benefits as well, by expediting therapy and having a new means to improve periodontal health. To quote internationally renowned dental hygienist, Trisha O'Hehir, RDH, BS, "These new findings have the potential to not only change the way we provide conservative periodontal therapy, but also the results we can expect." Continued research on this premise would be advantageous and perhaps change the traditional periodontal therapy. After all, it is a matter of total health.