

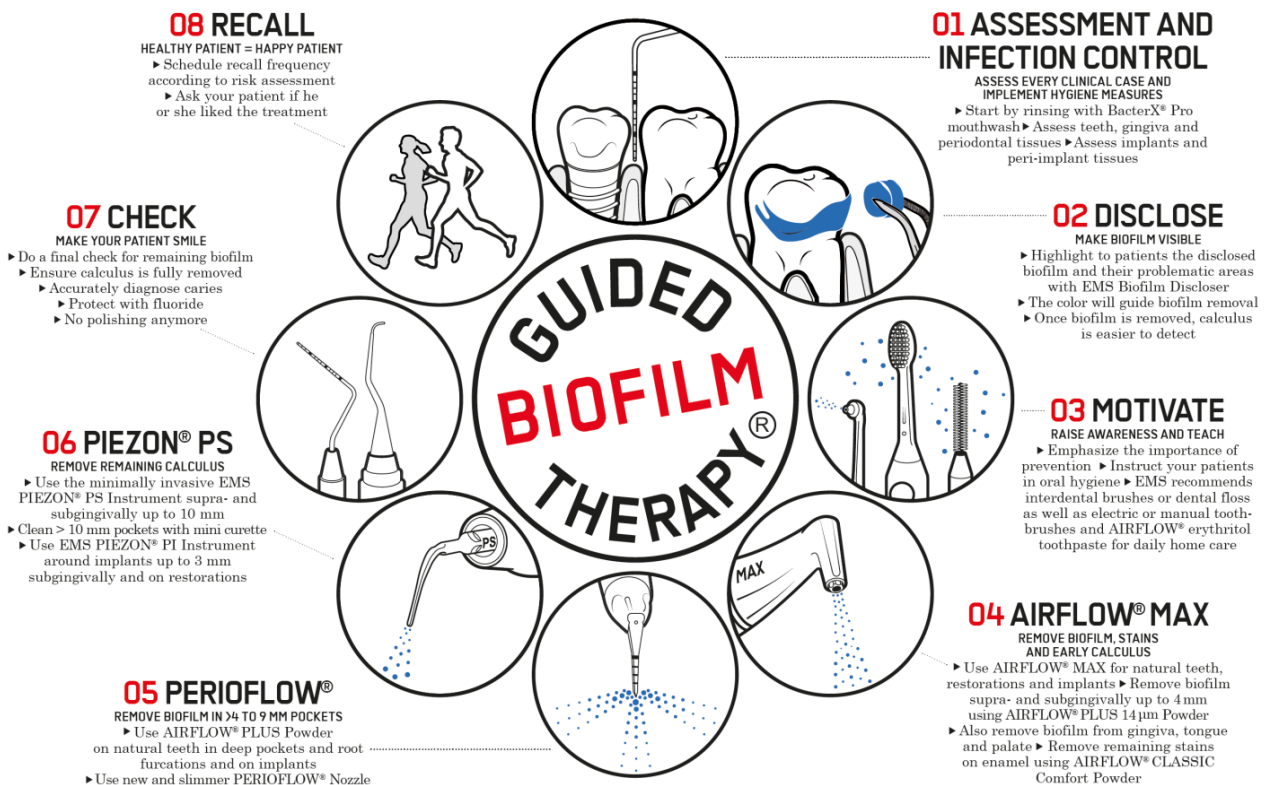
REVIEW ARTICLE // A biofilm is a microbially formed sessile community characterized by cells that are irreversibly attached to a surface, an interface, and to each other. Biofilms are embedded in a matrix of extracellular polymeric substances that they have generated themselves. They exhibit an altered appearance (phenotype) in terms of growth rate and gene expression compared to suspended living cells.

STATE-OF-THE-ART BIOFILM MANAGEMENT – A PARADIGM SHIFT

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Dental plaque is also a biofilm.^{1, 2} Vital diseases (caries, gingivitis, periodontitis). diversity of germs takes place in the sub- and supragingival dysbiotic biofilm is An ecological shift (dysbiosis) in favor of biofilm (disruption of the cause of the most important oral "specialists" and a decrease in the homeostasis/dysbiosis).³

Fig. 1: The sequence of Guided Biofilm Therapy. The supragingival and subgingival biofilm is removed after disclosure.



The oral biofilm inhabits the surfaces of the oral cavity.⁴ These surfaces can be hard or soft tissues of the oral cavity, inanimate surfaces such as orthodontic bands, aligners, crowns, bridges, dentures and implants, etc.⁵ Proximity to the gingival epithelium can worsen periodontal and peri-implant health.⁶

Oral biofilms also form in some inaccessible areas of the oral cavity from which they are difficult to remove, thus compromising homecare management. For a very long time, scaling and root planing (SRP), mainly with hand instruments, and classic rubber cup polishing (RCP) were considered to be the gold standard for professional mechanical biofilm and calculus management.⁷ New scientific findings and technical progress make a reorientation of biofilm and calculus management necessary. In general today neither the effectiveness, surface protection or clinician and patient comfort are proven in case of SRP.⁸⁻¹⁰

To meet state-of-the-art requirements, an alternative new approach to biofilm removal is practiced. Supragingival biofilm

Treatment	Application Force (p)	Mean loss of substance (µm) after 12 strokes	Loss of substance (µm) par working stroke
Ultrasonic scaler	100	11.6 (8.0– 15.1)	1.0
Air scaler	100	93.5 (84.2–102.7)	7.8
Fine curette	500	108.9 (101.8–116.0)	8.1
Diamond bur	100	118.7 (114.1–123.4)	9.9

Fig. 2: Loss of substance for dentin. Reference: Ritz L, Hefti AF, Rateitschak KH: An in vitro investigation on the loss of root substance in scaling with various instruments. J Clin Periodontol 1991; 18: 643-7

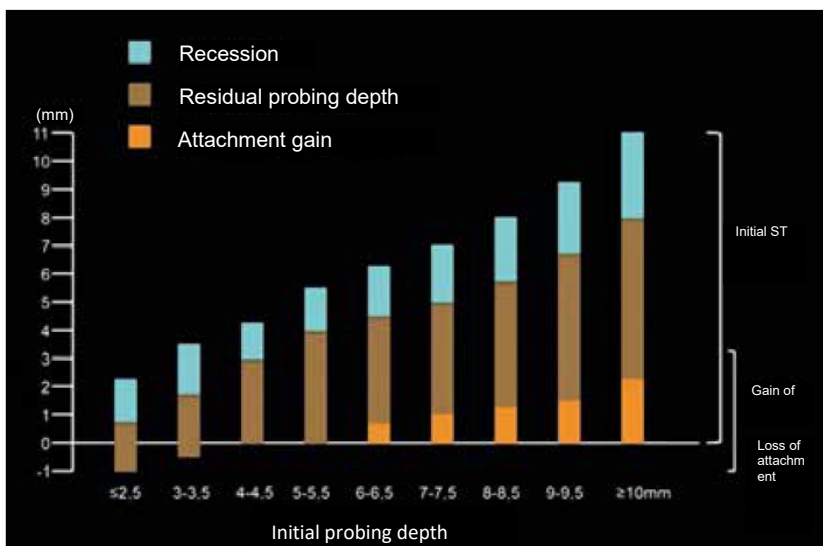
piezoceramic ultrasound (Piezon No Pain/PS). This treatment concept was introduced in 2015 as "Guided Biofilm Therapy" (GBT). (Fig. 1)^{10, 11}

Comparison of instruments for biofilm management

The most important tools available today include:

therapy, the focus is not merely on cleaning performance (effectiveness) but also on substance protection, patient satisfaction and practitioner comfort. In 1997, Flemmig already postulated that a loss of more than 0.5 mm cementum/dentin over the short period of 10 years is already unacceptable in maintenance therapy. This means that a maximum of 0.05 mm (50 µm) per year could be removed during the maintenance phase.¹²

Fig. 3: Attachment loss when using hand instruments in pockets up to 4 mm. Reference: Badersten. A, Nilveus, R, Egelberg J: Effect of nonsurgical periodontal therapy. II. Severely advanced periodontitis. J Clin Periodontol 1984; 11: 63–76.



is made visible by disclosure. The biofilm is then removed using AIRFLOW technology (AMPF, AIRFLOW Propylaxis Master) with a low-abrasive erythritol-based powder (PLUS powder). This is followed by targeted supra- and subgingival calculus management with

- hand instruments
- sonic and ultrasonic instruments
- classic polishing (RCP)
- AIRFLOW systems

When comparing the instruments in use today for initial and maintenance

Hand instruments (scalars and curettes)

Calculus is the mineralized form of biofilm. Calculus is not a primary cause of the most important oral diseases. Calculus has a secondary influence on the pathogenesis of oral diseases. Calculus facilitates the retention of bacteria and complicates oral homecare.



Fig. 4: The new AIRFLOW® MAX handpiece with the patented Laminar AIRFLOW® Technology (laminar flow) for more comfort and significant reduction of powder consumption and aerosols.

Scalers and cures have proven effective in removing hard deposits. Their application is technically demanding, requires good tactile sensitivity, is difficult to learn and involves a long learning phase. Application is time-consuming, numerous instruments are required, which must be sharpened regularly. The comfort level for patients and practitioners is low. The disadvantages, particularly when applied regularly, lie in inadequate protection of the substance. (Fig. 2)^{13, 14} The consequences are loss of tissue with scarring, loss of attachment in shallow pockets (Fig. 3), exposed tooth necks (hypersensitivities), and esthetic problems.

Classic polishing versus AIRFLOW

Classic polishing with rotary instruments, rubber cups, brushes and polishing paste

(RCP) has considerable disadvantages when compared to the AIRFLOW application:

- Time-consuming
- Incomplete biofilm removal in fissures, pits, in the case of implants, in the interdental space, in case of crowding, in the sulcus, during fixed orthodontic treatment (Fig. 4)
- Subgingival biofilm removal is not possible
- Polishing pastes are transported into pockets and remain there
- Too abrasive for exposed tooth necks
- Heat generation when applied incorrectly
- Many different tools, high material consumption, difficult reprocessing

The significantly better cleaning effect (effectiveness) in supragingival biofilm removal of AIRFLOW compared to RCP was demonstrated in a paper from the

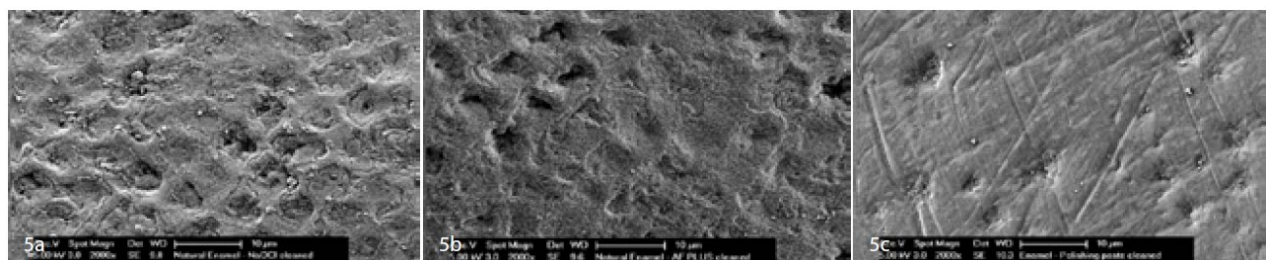
University of Krems in 2021: Erythritol powder Airflow (EPAF) achieved significantly better results for supragingival biofilm removal on anterior and posterior teeth. After 24 hours, new formation of biofilm was lower after EPAF than with RCP.¹⁵

AIRFLOW technology also scores the best results in terms of values for substance loss and roughness. This was demonstrated in a comparative study conducted by the University of Graz in 2018.¹⁶ The study investigated the effects (roughness, substance loss) of instrumentation (hand instruments, piezoceramic ultrasonic systems, AIRFLOW with erythritol powder, classic polishing and its combinations) during sub- and supragingival tooth cleaning. The results obtained confirm the findings of a paper from 2016.¹⁷ Best deep cleaning with the least loss of enamel, dentin and cementum is achieved with AIRFLOW and erythritol powder. Further polishing only appears to give better results, as the depths of the profile are filled with paste (Fig. 5).

Sonic and ultrasonic instruments

The main advantages of piezoceramic ultrasonic technology in particular (Fig. 6) over hand instrumentation are well documented scientifically:

Fig. 5: Enamel surface after cleaning with RCP and AIRFLOW **5a:** Natural enamel **5b:** AF PLUS cleaning **5c:** RCP cleaning Reference: Dr. Donnet 2016



- 1.No loss of attachment for pockets up to 4.5 mm.¹⁴
- 2.10 times less loss of cementum and dentin, smoother surfaces. (Fig. 2)¹⁸
- 3.Better access in pockets over 6 mm and furcations, constantly irrigated working field.
- 4.Less invasive procedure, anesthesia is frequently not required.¹⁹
- 5.Can be used universally (supra- and subgingivally) to remove mineralized deposits and bacterial biofilm. Due to their higher efficiency compared to hand instruments, ultrasonic systems enable shorter treatment sessions (20-60%). Compared to curettes, they cause patients less pain sensation and therefore find higher acceptance among patients.¹⁹



Fig. 6: The PIEZON NO PAIN® PS instrument is very gentle, almost silent and painless when applied correctly; piezoceramic discs provide perfect linear movement.

AIRFLOW technology

The literature on AIRFLOW technology (Fig. 4) with low-abrasive powders in subgingival biofilm management compared to hand and ultrasonic instruments impressively illustrates the advantages of this new technology:

- 1.The advantages of supragingival biofilm removal have already been discussed in the section Classic polish versus AIRFLOW.
- 2.In shallow pockets (up to 4 mm probing depth), AIRFLOW removes subgingival biofilm more effectively with low-abrasive powders.²⁰
- 3.In medium/deep pockets (≥5 mm probing depth), AIRFLOW removes subgingival biofilm more effectively with low-abrasive powders.²¹
- 4.The application of AIRFLOW with low-abrasive powders resulted in a significantly greater reduction in the amount of subgingival bacteria, recolonization occurs considerably slower.²²
- 5.Application of the AF technique with erythritol powder to the gingiva does not cause any irritation of the gingiva.²³
- 6.When AIRFLOW is applied with low-abrasive powders, better removal of subgingival and supragingival biofilm can be achieved in considerably less time.²⁴

- 7.Biofilm management with AIRFLOW (AIRFLOW®/PERIOFLOW®PLUS Powder) and low-abrasive powders exhibits only minimal loss of substance on enamel, dentin and composite while maintaining the lowest surface roughness at the same time.²⁵
- 8.Subgingival AIRFLOW with low-abrasive powder is gentle and safe on cementum.²⁶
- 9.AIRFLOW with low-abrasive powders is far more comfortable for patients and associated with less pain.^{24, 2, 28}
10. A high level of patient acceptance has been documented for state-of-the-art methods (Guided Biofilm Therapy).³¹

This is followed by equally targeted, gentle removal of the hard deposits using piezoceramic ultrasonic technology (Piezon No Pain®/PS Instrument).

In summary it can be concluded that the AIRFLOW technique with low-abrasive powders nowadays represents the gold standard for biofilm management. The advantages of this technology are that it is better, faster and safer, does not damage the tooth structure, soft tissue and restorations, and saves both patients as well as clinicians from discomfort.

Summary

When should new approaches (paradigm shifts) be taken in the field of medicine as a matter of principle and also in biofilm management (paradigm shift)? If the new therapy is superior to the old one in clinical, microbiological results and substance preservation. Or if the new therapy offers additional relevant aspects, such as patient comfort, practitioner comfort, time savings, and/or cost-effectiveness.

In this context, the scientific knowledge and technical progress of the last decades must lead to a modification of the workflow protocol according to Axelsson and Lindhe^{28,29}. Biofilm must be made visible by disclosure and then removed in a targeted, effective, fast, painless and substance-preserving manner

Literature can be requested from the editorial office at dz-redaktion@oemus-media.de.

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