Guided Biofilm Therapy (GBT) in non-surgical therapy of peri-implant diseases

A proven concept for the dental practice

A paper from Dr. Nadine Strafela-Bastendorf and Dr. Klaus-Dieter Bastendorf

Prevention and therapy of peri-implant infections only succeed with a systematic and structured protocol. Axelsson and Lindhe have already outlined a suitable concept for a systematic procedure in their "recall session" [12]. This concept is still largely valid today. Almost 50 years after publication of the Axelsson/Lindhe concept, adaptation to new scientific findings and technical progress is necessary. The authors present a systematic, preventive and universally applicable workflow protocol with Guided Biofilm Therapy (GBT). The protocol comprises eight steps from diagnosis to patient-specific recall intervals. The concept can also be used as post-operative prevention in the sense of supportive implant therapy (SIT).

Today, we know that oral diseases have a multifactorial etiology. As the main cause, the "Ecological plaque hypothesis according to Marsh" **[1]** is accepted worldwide as the etiology of the most important oral diseases. According to this hypothesis, vital supra- and subgingival dysbiotic biofilm is the main cause of oral diseases (caries, gingivitis, periodontitis, peri-implant mucositis, and peri-implantitis).

∧ 01a **Baseline examination immediately after insertion of the denture (X-ray and probing depth measurement)**

In summary, the biofilm or successful biofilm management is the biological challenge and the key to successful prevention and therapy of all oral diseases, including peri-implant diseases.
With an increasing number of implants to approx. 2 million a year **[2]**, the incidence of peri-implant diseases is also increasing **[3, 4, 5]**. There are a number of treatment approaches for the prevention and therapy of peri-implant mucositis and peri-implantitis. Although there are considerable physiological, anatomical, biological, and microbial differences between natural teeth and implants, the treatment strategies have been largely derived and modified from periodontal prevention and therapy.
In summary, this means: The best treatment of plaque-induced peri-implant inflammation is systematic prevention.

Regular domestic and professional biofilm management (cleaning) is essential. Regular examinations are also necessary to detect peri-implant diseases early on and treat them in good time. Peri-implant mucositis can be treated non-surgically. Successful non-surgical treatment of peri-implantitis is more difficult, especially due to the decontamination of the roughened threaded implant surfaces. Nevertheless – similar to periodontitis therapy – surgical peri-implantitis therapy should be preceded by minimally invasive non-surgical therapy.

When is peri-implant disease present?

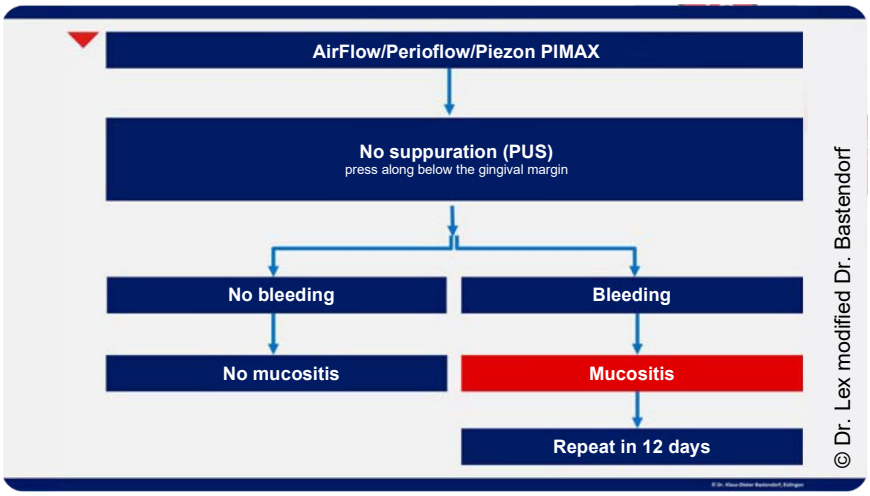
Peri-implant mucositis is a biofilm-induced disease. The host-microbe homeostasis at the implant-mucosa interface is disrupted, which can result in an inflammatory lesion. The goal of non-surgical treatment for peri-implant mucositis is similar to the treatment of gingivitis.

The clinical symptoms of the infection must be reduced. Like gingivitis, peri-implant mucositis is a reversible disease. In terms of secondary prevention, the disease can heal with optimal biofilm management. It is important to understand peri-implant mucositis, as it is considered to be the precursor of peri-implantitis **[6, 7, 8]**.

Peri-implantitis is a pathological condition occurring in the tissues around dental implants, characterized by inflammation in the peri-implant connective tissue and progressive loss of supporting bone. Sites of peri-implantitis show clinical signs of infection and increased probing depths. Similar to periodontitis, the goal of non-surgical treatment of peri-implantitis is to reduce the signs of infection using anti-infective therapies. Successful treatments should result in the reduction of pocket depth, resolution or reduction of bleeding on probing/suppuration, and stabilization of marginal bone levels **[7, 9]**. In terms of tertiary prevention (preventing progression or recurrence of the disease), the non-surgical treatment methods can lead to improvements in clinical parameters. However, the treated sites often show residual BOP values and deeper probing depths **[10]**.

Systematic, structured prevention with GBT

A result of the "11th European Workshop in Periodontology of the EFP" in 2015 called for increasing importance to be attached to the prevention of periodontitis and peri-implantitis **[11]**. The Swiss company EMS from Nyon, in collaboration with practitioners and university lecturers, has developed a modern prophylaxis protocol. GBT is a risk-oriented, evidence-based, systematic, structured, modular, individual, universally applicable prevention and treatment protocol (also for peri-implant mucositis) in eight steps **[13]**. GBT can also be used for peri-implant infections.



∧ 01b **Workflow protocol: Maintenance therapy and peri-implant mucositis**

Professional tooth cleaning (PTC) or better put, "Professional Mechanical Plaque Removal" (PMPR), is a central component of all systematic prevention.

In summary, this means: Both prevention and therapy of peri-implant infections can only be successful with a systematic, structured protocol. The requirements for systematic workflow protocols – also for peri-implant infections – are **[11, 12]**:

- diagnosis (continuous control of risk factors)
- homecare measures (information, instruction, motivation)
- professional mechanical plaque removal (PMPR/PTC)
- localized subgingival instrumentation for residual pockets
- and regular recall appointments.

GBT meets all these requirements.

The following addresses postoperative prevention of SIT (supportive implant therapy) using the GBT protocol. This supportive care for implants is not an isolated individual measure, but rather part of a systematic preventive protocol.

Step 1: Infection control/assessment (diagnosis)

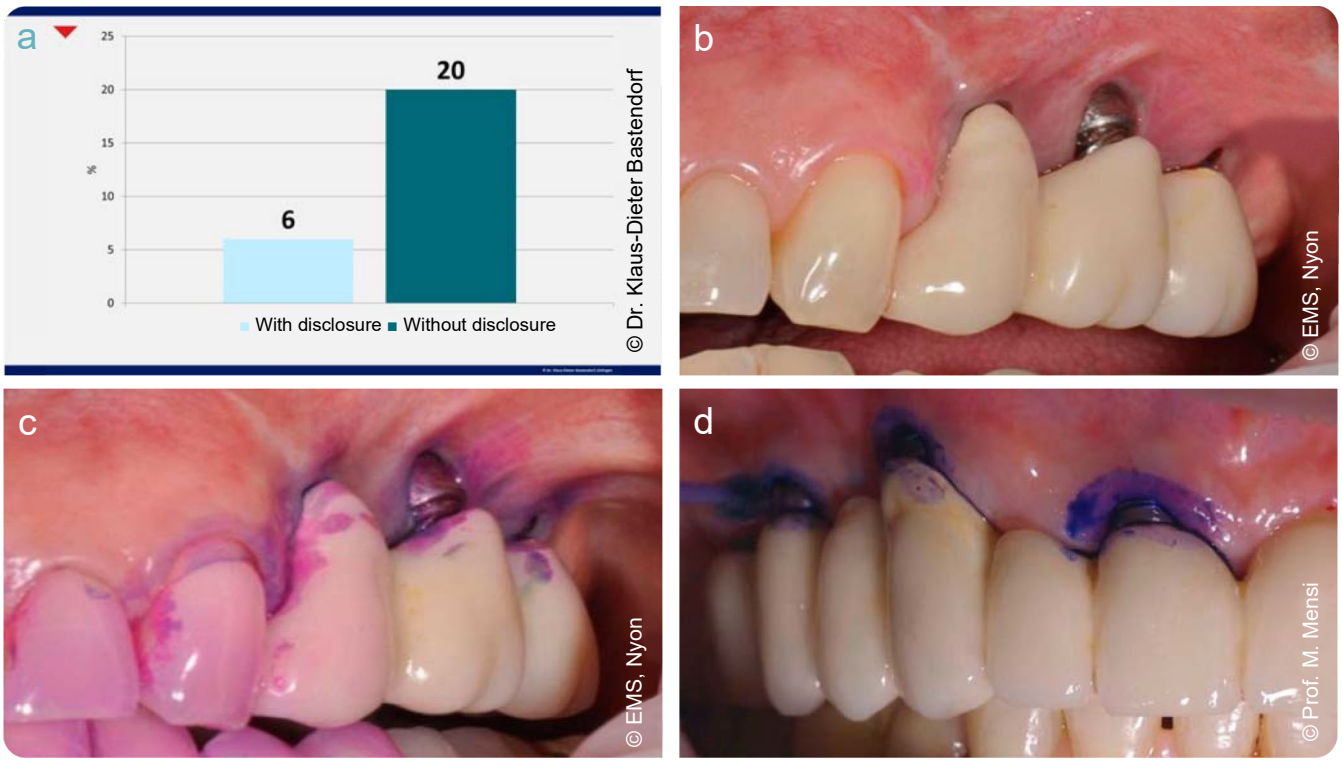
Prior to treatment, a mouth rinse with an anti-microbial agent reduces the number of microorganisms released by a patient in the form of aerosols/backspray mist. These can contaminate equipment, surgical surfaces and the dental staff.

Assessment of the findings, diagnosis and resulting disease risk are crucial for the successful prevention **[11]**. Modern digital aids are available for assessment of the findings and documentation of all oral diseases, including peri-implant infections. These aids not only allow identifying and documenting the current findings and risk factors, but also enable monitoring.

To obtain indications of peri-implant infections in good time, the initial situation must be established and documented after insertion of the superstructure. Only when compared with the initial values can visual inspection, palpation (secretion or pus discharge), probing depth measurement, BOP (particular prognostic significance for implants), mucosal recessions, and X-ray findings provide the necessary information for timely preventive intervention **(Fig. 1a and b).**

Step 2: Disclose

Current literature clearly shows that disclosing biofilm creates more precise plaque indices and achieves better results with homecare and professional biofilm removal **[15, 16, 17] (Fig. 2a to d)**.



∧ 02a-d **Visualization is "insight": Three times more biofilm is removed with disclosure than without disclosure (a). Biofilm not disclosed, not visible (b), biofilm rendered visible by disclosure (c, d)**

Step: 3: Motivate (homecare)

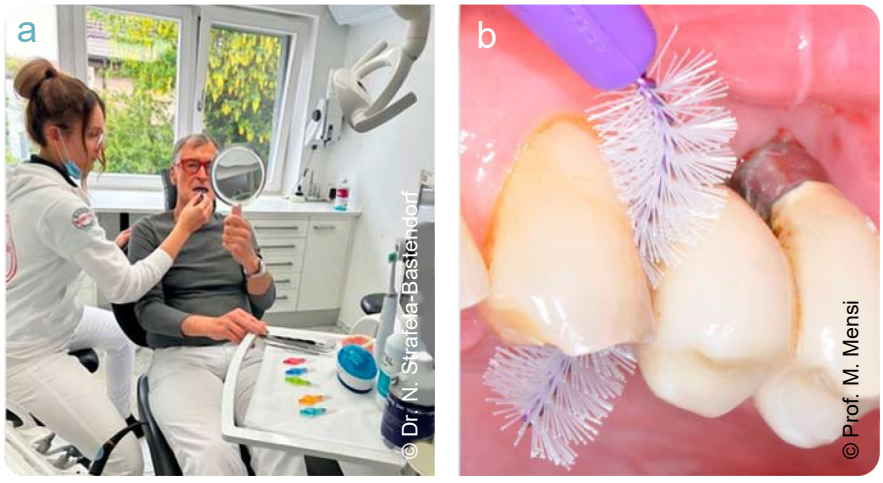
Successful prevention is always made up of the components of domestic and professional biofilm management, the so-called two pillar model as per Axelsson/Lindhe **[12]**.

An important component of supportive peri-implant therapy (SIT) is regular patient motivation and re-instruction by means of informing and instructing, which must be continuously updated and adapted **[18] (Fig. 3a and b)**.

The relationship between inadequate oral hygiene and peri-implant bone loss has been described in several studies.

The risk of suffering from peri-implantitis was considerably increased in patients with poor or very poor oral hygiene **[18, 19, 20, 21, 22]**.

In summary, this means: At-home plaque control around implants is indispensable, both for primary and secondary prevention as well as for tertiary prevention of peri-implant infections.



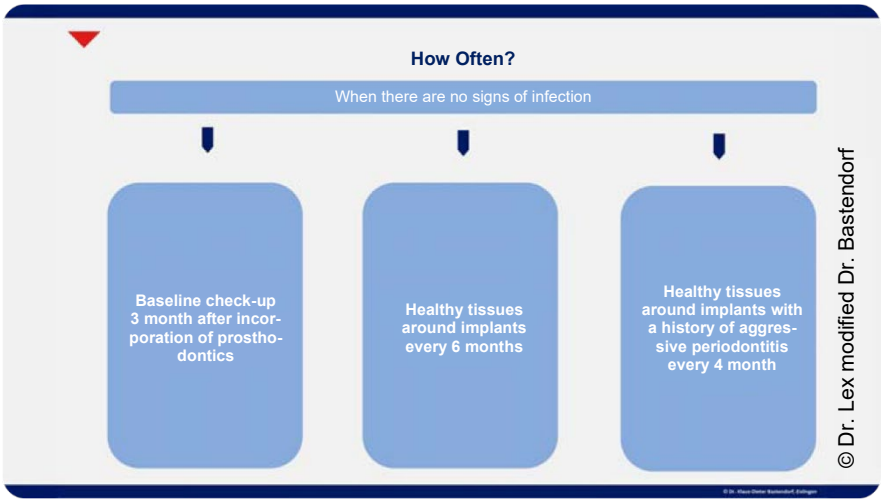
∧ 03a/b **Homecare, information, instruction, motivation and interproximal cleaning with interdental brushes are important.**

Steps 4, 5 and 6: Biofilm and calculus management

The removal of inflammatory bacteria (biofilm) is the undisputed goal of SIT. In addition to the mechanical removal of biofilm through homecare measures already mentioned earlier, professional mechanical biofilm management plays a crucial role. Various aids are available for this purpose:

- Special hand instruments
- Brushes and cups in rotary handpieces (Rubber Cup Polishing/RCP), chitosan brushes
- Sonic and ultrasonic instruments, and
- Powder-water-jet devices (Air-Polishing)

∧ 04a-c **Applied biofilm and calculus management: AirflowMAX handpiece (laminar flow) (a), Perioflow Nozzle handpiece (b) and Piezon No Pain PIMAX (carbon tip) (c)**



∧ 05 **Recall intervals for implants**

The goal of the professional procedure is to completely remove the biofilm while being gentle on the tooth substance **[26, 27, 28]** and maintaining a high level of comfort for patients and practitioners. The terms Air-Polishing and Air-Flowing are often used synonymously in this context, but they differ considerably and must be distinguished from each other: Both systems work according to the same principle of powder-water-jet technology. Air-Flowing is a technically, physically and chemically coordinated system consisting of:

- Airflow Prophylaxis Master device
- Airflow/Perioflow handpiece
- and minimally invasive, erythritol-based Airflow Plus powder.

The Airflow Prophylaxis Master is the only device that operates with a constant and regulated powder flow rate and laminar flow, unlike Air-Polishing, which has a turbulent and less regulated powder flow rate **(Fig. 4a to c)**.

Step 7: Check

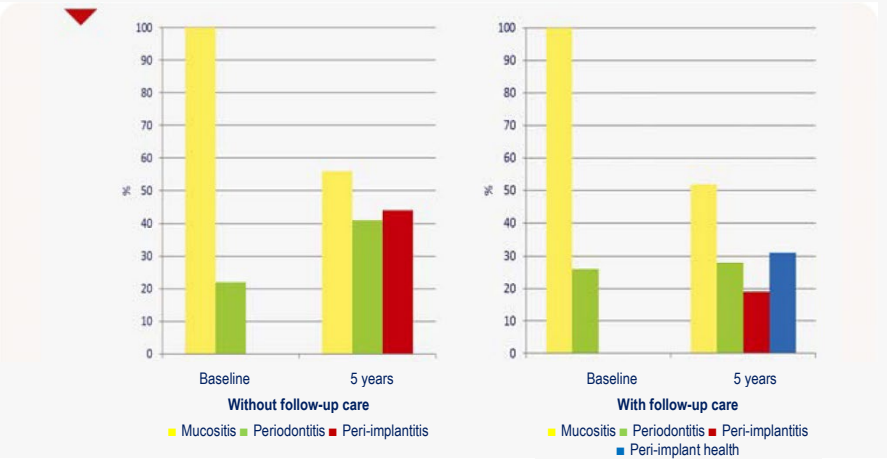
Through self-monitoring, the prophylaxis staff checks the degree of perfection of the treatment performed. The treatment carried out is then checked and documented in comparison with the dentist's initial findings to evaluate the individual risks of disease, make the final diagnosis, and plan any further necessary therapies.

Supervision of the dentist is also indispensable for proper delegation – also from the legislator – in Germany. At the end of the non-surgical treatment of peri-implant mucositis and/or peri-implantitis, local anti-microbial substances (chlorhexidine digluconate (CHX), mouth rinses or sodium hypochlorite) are often used in support.

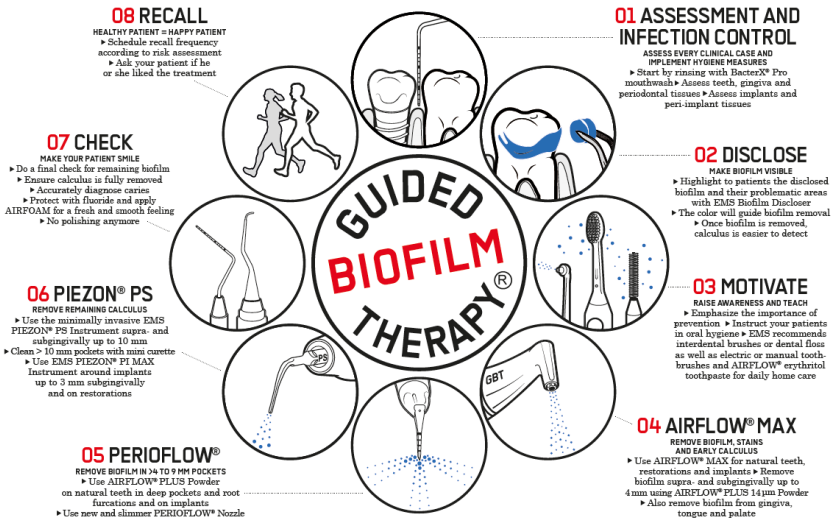
Step 8: Recall

The importance of maintenance therapy for oral health **[12]** and for the health of peri-implant tissue has long been recognized. Luengo F et al 2023 found that compliance with a strict SIT protocol keeps the peri-implant tissue healthy after one year, and even improves postoperative results **[35]**.

Stiesch M et al 2023 impressively pointed out the importance of SIT. The provision of SIT after peri-implantitis therapy can prevent recurrence or progression of the disease. However, there is still insufficient knowledge to determine a specific protocol for the supportive care for tertiary prevention of peri-implantitis, the effect of additional local antiseptic agents, and the impact of the frequency of supportive care measures. The protocols used should be a combination of preventive and therapeutic interventions at regular intervals. They should be matched to the patient's specific needs **[38]**.



∧ 06 **Risk of implant loss with and without follow-up care or maintenance therapy (© Costa et al.: Progression of periodontitis in a sample of regular and irregular compliers under maintenance therapy: a 3-year-follow-up-study J Periodontol 2011;282:1279-1287)**



∧ 07 **Systematic prevention with GBT**

GBT offers such a protocol, as all requirements of modern oral medicine are met: GBT is “predictive, preventive, personalized, participatory”, as well as minimally invasive with a maximum effect. **(Fig. 5)**

Summary, consensus and discrepancy

Derks et al 2015 showed in a systematic review that the prevalence of peri-implant mucositis is 43 per cent and of peri-implantitis 22 per cent **[39]**. After five years, clinically manifest peri-implant mucositis without therapy resulted in peri-implantitis in 43.9 per cent **[40]**. The paper by Costa et al 2012 was able to show the importance of regular preventive therapy.

In the control group (with regular preventive measures), the incidence of peri-implant mucositis dropped from 43.9 per cent to 18.0 per cent **[41]**. In summary, this means: The absence of preventive therapy (SIT) can result in peri-implant infections. Without SIT, peri-implant mucositis is associated with a high incidence of peri-implantitis. If left untreated, the progression of peri-implantitis leads to implant loss **[8] (Fig. 6)**.

In summary, this in turn means: In this article, there is a basic consensus with the current S3 guideline "The treatment of peri-implant infections on dental implants" **[41, 42]** in terms of systematic supportive treatment (SIT).

GBT is one such systematic treatment that can be used in supportive periodontal therapy **(Fig. 7)**.

A discrepancy with the S3 guidelines occurs when assessing which therapy aids (PTC/PMPR) result in an improvement in the clinical parameters for peri-implant mucositis. According to the S3 guideline, alternative methods (glycine powder air-polishing, chitosan brushes) for biofilm removal should not be used for peri-implant mucositis, as alternative methods for biofilm removal did not show any additional clinical effect compared to conventional debridement (ultrasonic, scaler with carbon fiber tips, Teflon/titanium curettes, RCP). This statement in the guidelines is in sharp contrast to the scientific papers listed in the section "Comparison of aids in literature". This discrepancy is also evident when comparing the literature on the treatment of gingivitis **[37]**.

It also has to be questioned why three times more biofilm can be removed for subgingival biofilm removal on natural teeth with Air-Polishing/Air-Flowing, whereas this is supposedly not the case for peri-implant mucositis **[43, 44, 45, 46]**. Being gentle on tooth substance and maintaining patient and practitioner comfort are not mentioned in the S3 guidelines.

Consensus with the S3 guidelines exists with the literature mentioned above for the non-surgical therapy of peri-implantitis. The S3 guidelines state in this case that alternative methods for biofilm removal (Air-Polishing/Air-Flowing) should be used.

Bibliography

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Comparison of aids in literature

As PTC/PMPR plays a particularly important role in systematic prevention, a current literature review is given here regarding the aids used for non-surgical peri-implant mucositis and peri-implantitis:

- **Figuero et al 2014:** Therapy of peri-implant mucositis and non-surgical therapy of peri-implantitis usually involve mechanical debridement of the implant surface using curettes, ultrasonic devices, air-abrasive devices or lasers, with or without the adjunctive use of local antibiotics or antiseptics. Controlled clinical studies show an improvement in clinical parameters, especially in bleeding on probing for mucositis. The results are limited for peri-implantitis, especially in terms of reducing probing depth **[18]**.
- **Nastri et al 2014:** The goal of the study was to compare the effectiveness of erythritol powder AirFlow (EPA) with piezo-ceramic scaling (Piezon/PI) and Teflon curettes in non-surgical peri-implantitis therapy for moderate peri-implantitis. After three months, there was a significant reduction in PPD, MR, and CAL in the EPA group compared to the control groups. The efficacy of EPA was superior to mechanical therapy (ultrasonic plus Teflon curettes). The average treatment time required with EPA was 3.25 minutes, while that of the control group was 13.50 minutes. Both patients and practitioners preferred the EPA method **[23]**.
- **Drago et al 2014:** The goal of this study was to investigate the antibacterial and anti-microbial in vitro effect of erythritol powder AirFlow (EPA) compared to glycine powder Airflow (GPA). For the bacterial strains and fungi investigated (Staphylococcus aureus, Bacteroides fragilis and Candida albicans), EPA showed a greater antibacterial and anti-microbial effect than GPA **[24]**.
- **Schwarz et al 2015:** Glycine powder air-polishing (GPA) is just as effective for mucositis as conventional mechanical debridement. GPA may improve the efficacy of non-surgical treatment of peri-implantitis over the control measures investigated. Complete healing of the disease was generally not achieved **[25]**.
- **Ronay et al 2017** investigated the cleaning potential of commonly used implant debridement methods that simulate non-surgical peri-implantitis therapy in vitro. Powder-water-jet devices (AP) showed significantly better results for all defect angulations. SEM evaluation displayed considerable surface alterations after instrumentation with Gracey curettes and ultrasonic devices, whereas glycine powder (GPA) did not result in any surface alterations **[26]**.
- **Tuchscheerer et al 2017** investigated in vitro surgical and non-surgical air-polishing (AP) efficacy for implant surface decontamination. The conclusion was that "Air-polishing is an efficient, surface protective method for surgical and non-surgical implant surface decontamination" **[27]**.
- **Mensi et al 2018** came to the following conclusions: Both sodium bicarbonate and erythritol powders are good tools for air-polishing at the implant surface. None of the powders determined a significant increase in titanium surface roughness, thus reducing the possibility to favor bacteria adhesion. Sodium bicarbonate and erythritol proved to be effective in plaque removal and adhesion prevention. Erythritol powder showed the best antibiofilm effect against the considered strains (Staphylococcus aureus and Aggregatibacter actinomycetemcomitans) **[28]**.
- **Latrou et al 2021:** Air-powder abrasion (AP) proved to be the most efficient non-surgical treatment method for each type of defect in this in vitro model with the least noticeable surface change. No decontamination method resulted in complete cleaning of the implant surface **[29]**.
- **Hatz et al 2022:** Regarding the active treatment of peri-implant mucositis and peri-implantitis, four systematic reviews could not show an improved clinical outcome when powder-water-jet devices (AP) were used as an adjunct to conventional treatment measures. In systematic reviews that also investigated patient perception, AP was perceived by patients as pain-free and significantly more pleasant. Treatment time with AP was considerably shorter **[30]**.
- **Ichioka et al 2023:** For surface decontamination, Air-Flowing showed outstanding biofilm removal and reduced the atomic percentage of carbon on implant surfaces when compared to methods restricted to wiping with gauze.

The use of an adjunct chemical agent to Air-Flowing showed no additional benefit **[31]**.

- **Francis et al 2023** showed in an in vitro study that biofilm can be reduced up to approx. 90% with six powders used today for Air-Polishing. No relevant changes in the microscopic ultrastructure of the surfaces were found, Air-Flowing with erythritol-based Plus powder showed the highest efficiency in biofilm removal **[32]**.
- **Fischer et al 2023** found that Air-Flowing was the most efficient cleaning method among the three modalities for treating implant surfaces (curettes, ultrasonic scaler and Air-Flowing with erythritol-based Plus powder). Furthermore, no titanium particles were released and no structural changes were detected with Air-Flowing in comparison to the other methods **[33]**.
- **Korello et al 2023** concluded that cleaning efficacy in the order Airflow, Airscaler, curettes decreases significantly in non-surgical and surgical implant surface decontamination. The SEM images showed severe surface damage after the application of curettes and Airscaler **[34]**.
- **Luengo F et al 2023** compared ultrasonic mechanical debridement (Piezon PI), Air-Flowing and RCP in a 12-month postoperative supportive peri-implant therapy (SIT). Air-Flowing showed a statistically significant reduction in probing depths (PD). In addition, the BoP (bleeding on probing) was also reduced in the test group with Air-Flowing.
- Brandenberger et al 2023 showed the influence of cleaning with Air-Flowing, Piezon/PS (PUS) in connection with the implant shoulder design. In the upper zones (upper marginal/zone A and X, lower marginal shoulder/zone B), Air-Flowing was almost 100% efficient with a new shoulder design, whereas ultrasound (Piezon/PS) was only 80–90% effective. In control implants (old shoulder design), results of Air-Flowing and Piezon/PS PUS were also almost 100 % in zone A, but only 55–75% in zone B. In both implants, Air-Flowing showed a significantly higher efficacy than PUS **[36]**.
- **Mensi M et al 2022:** The aim of the study was to evaluate the clinical efficacy of eliminating gingivitis using a GBT protocol. Air-Flowing/PUS versus Piezon/PS (PUS)/RCP was compared in PTC/PMPR. The results: The Air-Flowing/PUS protocol (GBT) is significantly better than Piezon/PS (PUS)/RCP for eliminating plaque-induced gingivitis in the short term. In addition, the Air-Flowing/Piezon/PS (PUS) treatment time was on average 9.2% shorter than Piezon/PS (PUS)/RCP and was preferred by a significantly higher number of patients **[37]**.

Summary: Based on the literature on the aids used for mechanical biofilm and calculus management, it is shown how PTC/PMPR can be performed effectively, while being gentle on the tooth substance and with a high level of comfort for patients and practitioners.

tw Bio

Dr. Klaus-Dieter Bastendorf has, in his role as a dentist and pioneer of prevention in dental practice, given over 750 lectures on this subject and written numerous articles on it. Since 1979 he has been in private practice in Eislingen and since 2014 has been working at Dr. Strafela-Bastendorf's practice.

tw Bio

Dr. Nadine Strafela-Bastendorf has had her own practice in Eislingen since December 2013. In her family practice, she provides the following services: Individual prophylaxis, Periodontology, Dentistry for children, Restorative Dentistry, Dental Prosthetics, and Bleaching.