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Polishing

by Trisha E. O’Hehir, RDH, MS
Hygienetown Editorial Director

The subgingival root surfaces feel smooth to the explorer and the patient appears to be doing well with oral hygiene, yet there is bleeding upon probing. Why? There’s buzz about the immune response explaining this bleeding. The immune response explains the second stage of this disease. The first is infection triggered by toxic waste products from subgingival bacterial biofilm. Endotoxins and antigens pass through an altered junctional epithelium, triggering the body’s immune system. It is this bacterial infection that triggers the second step – the immune response. For the immune system, the first line of defense is white blood cells. The body sends polymorphonuclear neutrophils (PMNs) to the area to phagocytize the intruding bacteria. Mast cells around the blood vessels in the connective tissue release histamines causing vasodilation and slowing of the blood flow so that PMNs can exit the blood vessels by squeezing between the endothelial cells. The PMNs are on a mission to attack the bacteria in the sulcus and to reach the sulcus they must travel through healthy connective tissue and epithelium. The PMNs release cytokines that act as chemical machetes to chop through and destroy healthy cells. At last the PMNs reach the sulcus, which takes them outside the body where they no longer function. Their traverse and destruction of healthy tissue didn’t eliminate bacteria in the sulcus. With a constant influx of endotoxins and antigens, the body’s immune system continues sending PMNs to the area causing significant connective tissue, bone and epithelial damage.

The key is removal of subgingival bacterial biofilm. Hand instruments, power scaler and rubber cup polishing are used but these approaches need to touch each area of bacterial biofilm to remove it. Glycine, a new air polishing powder that is safe for subgingival use just might turn dental hygiene treatment upside down, resulting in faster and better removal of subgingival bacterial biofilm.

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New Tip for Air Polishing Reaches Subgingivally

Following periodontal therapy, subgingival microflora returns within days, necessitating periodontal supportive therapy (PST) visits every few months to maintain periodontal tissue health. Mechanical disruption of the subgingival microflora has long been accomplished with hand instruments. Scraping of the root surfaces removes cementum, creating irreversible hard tissue damage and in some cases, recession.

Air polishing traditionally uses a sodium bicarbonate powder that effectively removes plaque and stains from tooth surfaces, but damages gingival tissues when directed subgingivally. To solve this problem, a glycine powder was recently introduced that does not cause tissue trauma when directed subgingivally. To enhance subgingival cleaning, EMS designed a tip to direct the glycine powder subgingivally with lower jet spray flow and lower pressure than is used supragingivally.

Researchers at the University of Geneva in Switzerland compared air polishing with glycine powder using the new subgingival tip to hand instrumentation in 50 periodontal maintenance patients. These subjects all had at least two residual pockets measuring 5mm or more in two separate quadrants. Sites for each patient were randomly assigned to test and control treatments. This seven-day study measured subgingival microflora and bleeding upon probing.

Air polishing time averaged 30 seconds per site compared to curette use averaging 1.4 minutes per site. Bleeding upon probing was reduced for both groups, with greater reduction in the control group. No differences were observed for subgingival microflora between test and control groups. No tissue trauma was noted with air polishing.

Patients preferred air polishing over curettes.

Clinical Implications: The new subgingival air polishing tip provides an alternative to hand instruments for SPT.


Air Polishing to Replace Subgingival Instrumentation

Air polishing in the past used a bicarbonate of soda powder that was effective for plaque and stain removal, but damaging for the tissues. Today, glycine powder is available for air polishing that can be used with a new tip to polish subgingivally, reaching into both shallow and deep pockets.

Researchers at the University of Washington in Seattle, Washington, compared full-mouth Glycine Powder Air Polishing (GPAP) to traditional scaling and root planing with curettes and rubber cup polishing. All patients had undergone initial periodontal therapy prior to this study.

Subjects were all found positive for intra-oral levels of P. gingivalis and T. forsythia. Probing depths ranged from 4mm to 9mm. Patients were instructed to rinse twice daily with 0.12 chlorhexidine mouthrinse for two weeks following treatment. Microbial and clinical indices were repeated at day 10 and day 90.

At each time point, the patients receiving the subgingival GPAP had lower total viable bacterial counts in the moderate to deep pockets compared to those receiving instrumentation with curettes and rubber cup polishing. Patients found both treatment approaches comfortable. Air polishing with glycine powder in subgingival pockets is more effective than using curettes to shift the oral flora from one conducive to infection to one more conducive to periodontal health.

Clinical Implications: Despite our tradition of instrumenting all subgingival areas during a perio maintenance visit, these findings suggest that air polishing with glycine power in the subgingival areas just might be able to replace subgingival instrumentation with curettes.

Air Polishing Treats Peri-implantitis

Peri-implant mucositis is inflammation limited to the mucosa, while peri-implantitis is characterized by changes in bone levels plus bleeding. The three primary risk factors for peri-implantitis are poor oral hygiene, smoking and a history of periodontal disease.

Non-surgical treatment of peri-implant mucositis, including mechanical instrumentation, ultrasonics, and delivery of chemicals, is usually successful in reversing the infection. Not so in cases of peri-implantitis which has unpredictable outcomes limited to six-12 months.

The use of air polishing has not been an option with the traditional sodium bicarbonate powder because it damages implant surfaces. With the introduction of amino acid glycine powder, air polishing can now be used on implants.

Researchers at Heinrich Heine University in Düsseldorf, Germany, compared air polishing using glycine powder and the new subgingival Perio-Flow tip from EMS to the use of carbon curettes and subgingival delivery of chlorhexidine.

One month prior to baseline, the 30 patients with early to moderate peri-implantitis received a prophylaxis and oral hygiene instructions. This protocol was repeated at baseline and every two weeks for three months and then monthly for the next three months. Both treatments resulted in reduced probing depths of half a millimeter. Bleeding was reduced more in the air polishing group, from 95 percent to 50 percent compared a reduction from 95 percent to 84 percent in the curette and chlorhexidine group.

Clinical Implications: Air polishing with glycine powder using the new subgingival tip provides another option for treating peri-implantitis.
Air Polishing and Laser Both Effective for Treating Peri-implantitis

Peri-implantitis is difficult to treat. Fortunately, the success rate of implant placement is around 95 percent. As more and more implants are placed, the incidence of peri-implantitis might increase, posing major treatment challenges. Implant surfaces and threads pose significant challenges to mechanical disruption to bacterial biofilm. In a recent consensus report, it was concluded that traditional non-surgical therapy for peri-implantitis was not effective. Slightly better results are possible with the Er:YAG laser.

Researchers at Kristianstad University in Kristianstad, Sweden, compared the new EMS glycine air polishing powder with the EMS new disposable subgingival tip to the KaVo Laser 3 Perio laser for treating peri-implantitis with 21 subjects in each group over six months.

All test subjects received a Philips Sonicare FlexCare power toothbrush, detailed oral hygiene instructions and new brush heads every three months.

Both groups showed significant healing with 25 percent of subjects in the laser group with average probing depth reductions of 1mm and 38 percent of those in the air polishing group showing a 1mm average probing depth reduction. Laser treatment resulted in improved health at 44 percent of implant sites and air polishing at 47 percent of sites.

Although both the laser and the air polishing did help some sites with severe peri-implantitis, neither therapy provided predictable treatment for severe peri-implantitis.

Clinical Implications: For severe peri-implantitis both air polishing with glycine power using the disposable subgingival plastic tip and laser treatment using an Er:YAG might improve some lesions, but not with any degree of predictability.

Subgingival Debridement Effective with Air Polisher

Periodontal therapy patients are seen frequently for supportive periodontal maintenance visits to control subgingival microflora. This is usually done with curettes or power scalers. A new subgingival approach uses glycine powder in an air polisher.

Researchers at the University of Gothenburg, Sweden, compared subgingival air polishing with glycine powder to ultrasonic scaling. Perio maintenance patients with two probing sites measuring 5-8mm in different quadrants were included in this two-month study. The control group was treated subgingivally with the EMS Piezon Master piezoelectric scaler set at 75 percent power with water coolant. The test group was treated with a new subgingival tip on the EMS Air-Flow air polisher with glycine powder.

Subgingival bacterial samples were collected before treatment, right after treatment, two days later and at 14 days.

Clinical indices were taken before treatment, 14 days and at 60 days. A total of 20 patients were treated with air polishing at a test site in one quadrant and ultrasonic scaling at a second site in another quadrant.

Both treatments resulted in significant reductions in subgingival bacteria immediately after treatment and two days later. By day 14, both groups returned to baseline levels of subgingival bacteria.

Clinical reductions in probing depths and bleeding scores were significant for both the treatment and control sites. Patients were also asked to rate comfort with each procedure. Air polishing was found more comfortable than ultrasonic scaling.

Clinical Implications: Subgingival air polishing with this new tip and glycine power could replace ultrasonic instrumentation during periodontal maintenance visits.
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Air polishing was first introduced to the North American dental profession in the 1970s as an effective means of quickly and easily removing extrinsic stains and soft debris from tooth surfaces. Despite scientific evidence showing it to be an effective and efficient means of plaque and stain removal, being at least three times faster than rubber cup polishing, it hasn’t been widely accepted. This is likely due to the fact that dental hygiene programs don’t routinely incorporate air polishing into the curriculum, preferring instead to focus on rubber cup polishing. Opposition often points to the mess of aerosolized sodium bicarbonate coating everything in the operatory, people included.

Air polishing research has taken an interesting turn, focusing more recently on subgingival biofilm removal to control disease, rather than stain removal for aesthetic reasons. To do this, a new powder was needed that was significantly less abrasive than sodium bicarbonate yet effective for biofilm removal. Glycine powder is 80 percent less abrasive, safe on oral tissues and root surfaces, effective for biofilm removal, and comfortable for the patient. One of the leaders in this research endeavor is Dr. Thomas Flemmig, currently a professor at the University of Washington in Seattle. His work focuses on the subgingival effects of glycine air polishing as well as the economic and clinical practice implications. I recently had the pleasure of speaking with Dr. Flemmig on this subject.

What peaked your interest in air polishing?

Flemmig: Several years ago I read a research abstract about how air polishing with sodium bicarbonate reduced subgingival biofilms in periodontal pockets. At the time, conventional wisdom suggested that sodium bicarbonate was so abrasive that it caused root surface abrasion and traumatized gingival tissues. What we needed was a powder that was less abrasive than sodium bicarbonate and less harmful to the tissue yet still removed biofilm. With that as our goal, we looked into other powders, testing many types and finding glycine powder to be 80 percent less abrasive than sodium bicarbonate and safe for the gingival tissues. We tested the glycine powder in an air polishing unit with a standard, supragingival nozzle and found it effectively removed both supragingival and subgingival biofilm and was safe on root surfaces. With a standard air polishing nozzle the powder opened the sulcus to allow the glycine powder to access the subgingival area to remove subgingival biofilm (Fig. 1).

How did you test the glycine powder clinically?

Flemmig: In a series of clinical trials, we compared hand instrumentation for subgingival biofilm removal and air polishing with glycine powder. In the first two clinical trials we found a significantly greater reduction in viable counts of subgingival bacteria following glycine air polishing with a standard nozzle...
compared to hand instrumentation. No adverse effects were experienced by the patients; in fact, the patients preferred the air polishing to hand instrumentation. They found it to be more gentle and comfortable.

How much time was spent air polishing each tooth?

**Flemmig:** Without any previous studies to guide the time factor, we limited the time to five seconds per surface, which equates to approximately nine minutes for a full dentition. Recent data in our laboratory using a biofilm model indicated that the time may be cut in half, but that still needs to be confirmed in a clinical trial.

Many hygienists today use an ultrasonic power scaler to deplaque subgingival areas. How does this compare to air polishing?

**Flemmig:** Air polishing is more effective as the spray reaches much further than the localized effect of an ultrasonic scaler. To effectively remove subgingival biofilm, the ultrasonic tip must be moved in an overlapping fashion to touch the entire surface while the air polisher spray easily reaches a broader area.

What about reaching into a deep periodontal pocket rather than a healthy sulcus?

**Flemmig:** With a standard nozzle, air polishing with glycine powder has been shown to be significantly more efficacious in removing subgingival biofilm. EMS developed a subgingival nozzle to reach deeper sites. The subgingival nozzle will reach pocket depths up to 9 mm (Fig. 2). In studies comparing the subgingival nozzle to hand instruments, air polishing is consistently more effective for biofilm removal.

How do you see air polishing with glycine powder being used clinically today?

**Flemmig:** In a healthy mouth or one with mild gingivitis with probing depths of 4 mm, the standard nozzle with glycine powder will be effective. In sites with deeper probing depths of 5 mm or more, the subgingival nozzle with glycine powder will be the instrument of choice. Air polishing is done first to remove biofilm, the primary cause of both caries and periodontal disease. When this is complete, calculus is easier to see and can be removed with a power scaler or hand instruments.

Clinicians feel strongly that air polishing is too abrasive and harmful to gingival tissues. Is the glycine powder both effective and safe?

**Flemmig:** Yes, the glycine powder is effective for biofilm removal and safe for gingival tissues and mucous membranes. The low abrasive nature of glycine makes it safe for root surfaces and oral mucous membranes. Rather than the stinging feeling of air polishing with sodium bicarbonate, air polishing with glycine powder feels as gentle as the water syringe spray on the tissues. In fact, in a recently published clinical trial we have directed the air polishing toward all the mucous membrane tissues in the mouth with no damage or discomfort for patients.

Since much of the initial air polishing research took place in Europe and glycine powder is easily available there, has this approach been widely accepted?

**Flemmig:** Yes, reports suggest that supra- and subgingival air polishing with glycine powder is widely accepted in Europe.

Do you anticipate North American hygienists will embrace this approach to treatment as glycine powder becomes more widely available here?

**Flemmig:** We are creatures of habit and the longer we are in practice, the harder it is to change. The idea of replacing hand instrumentation and prophy cup polishing with a few minutes of air polishing with glycine powder feels to clinicians as though their patient care is put into question. Change comes slowly when it turns a long-held approach upside down. Traditionally the approach to deplaque subgingival areas has been to insert instruments to the base of the pocket and move the biofilm in an apical to coronal direction. With subgingival air polishing with glycine powder, the approach is coronal to apical.

Were you immediately convinced that air polishing effectively removed subgingival biofilm?

**Flemmig:** I was skeptical at first, as I expect most clinicians would be. After subgingival air polishing with glycine powder I went back and checked with the probe and curettes to see if in fact it was effective. My colleagues did the same. We weren’t ready to trust that this easier, faster approach was as good as our old ways. When we were convinced it was effective and had sound evidence from randomized controlled clinical trials, we embraced the change in patient care as it led to better treatment in less time with more comfortable patients. It takes time to overcome skepticism of this new approach.

There is some worry that this technology will cause emphysema by forcing air and powder into the tissues. What are the statistics on this?

**Flemmig:** Based on the published cases with air emphysema following glycine powder air polishing, the estimated incidence of air emphysema is 1 in 666,666. That means that a hygienist...
would have to perform glycine powder air polishing on all of her patients for 350 years to experience one emphysema case. Furthermore, all of the three reported emphysema cases following glycine powder air polishing resolved without treatment. It has not been a serious issue.

Is there still a use for sodium bicarbonate air polishing powder?

**Flemmig:** Yes, for supragingival areas with heavy stain, sodium bicarbonate powder, which is much more abrasive than glycine powder, is the powder of choice. For deplaqueing, glycine is the powder of choice because it is effective, safe and comfortable for the patient.

I realize your research has been with glycine powder for subgingival air polishing. Are there other powders on the market for subgingival deplaquing?

**Flemmig:** There are several other powders on the market for supragingival air polishing: sodium bicarbonate, calcium carbonate, aluminum trihydroxide and calcium sodium phosphosilicate. When selecting an air polishing powder for subgingival deplaquing, it must be safe on root surfaces and gingivae. Many of these other powders are safe on enamel, but too abrasive for root surfaces and gingivae. Check abrasiveness before using powders other than glycine subgingivally. There are more than 30 publications demonstrating that glycine powder is safe on a variety of restorative materials, orthodontic brackets and root surfaces, and is approximately five times less abrasive than sodium bicarbonate.

Besides being safe on root surfaces, you showed that glycine powder is safe on all the oral tissues. What prompted you to go beyond tooth surfaces for biofilm removal?

**Flemmig:** The concept of full-mouth disinfection led us to consider using the air polisher for all oral tissues: tongue, buccal mucosae and palate. Bacteria are not limited to supra- and subgingival tooth surfaces. The oral cavity is a reservoir for recolonization. These tissues harbor microflora contributing to new biofilm formation on the teeth so it makes sense to include them in the deplaqueing approach and not limiting the air polishing to just the teeth. Air polishing with glycine powder is faster and much easier than profuse irrigation of the entire mouth and oral tissues with chlorhexidine. Our goal with these studies was a Proof of Principle that a low abrasive air polishing approach to full-mouth disinfection was a safe and effective option (Fig. 3). We were able to show in a clinical trial that in patients with periodontitis, full-mouth glycine air polishing significantly reduced the oral load of *Porphyromonas gingivalis* compared to conventional treatment using hand instruments. Our future research will be conducted including this approach.

How do you see subgingival air polishing with glycine powder impacting dental hygiene care in the future?

**Flemmig:** This new technology will make work easier and faster for the RDH. It will reduce the amount of time and effort needed to effectively deplaque the mouth. Prophylaxes accounts for approximately one quarter of the national expenditures for dental services. Here is an example of how adding this new technology that takes less time will impact the business of dental hygiene and the practice. For this I will use nationwide surveys by the ADA to compare an average restorative dental practice with three operatories and no hygienist to the same practice plus an additional operatory for a dental hygienist seeing eight patients a day or 1,900 prophylaxis or periodontal maintenance visits per year. The take-home income of the dentist employing an RDH is 40 percent higher than the dentist working alone. If the RDH now incorporates subgingival air polishing with glycine powder and saves 12 minutes per appointment, allowing him/her to see 10 patients per day, the costs don’t go up but the profit doubles, providing a financial benefit to both the hygienist and the dentist. On the business side, this new approach to patient care provides a benefit for the patient of greater health and comfort, an easier appointment for the hygienist and increased income for both the dentist and the hygienist. Embracing new technology provides benefits for all involved: the patient, the RDH and the dentist.

Thank you Dr. Flemmig for your focus on the future, your exciting research findings and your dedication to improving patient oral health.
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