Biofilm Removal With Air Polishing & Subgingival Air Polishing
A Peer-Reviewed Publication
Written by Karen Davis, RDH, BSDH

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Abstract
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At the end of this course participants will be able to:
1. Distinguish between air polishing with sodium bicarbonate and subgingival air polishing with glycine powder.
2. Describe the benefits and contraindications of air polishing.

Author Profile
Karen Davis, RDH, BSDH is an international speaker and practices dental hygiene in Dallas, Texas. She has served on numerous advisory boards for corporations and is recognized by Dentistry Today as a “Top Clinician in Continuing Education”. She is an accomplished author related to her passion of practicing on the cutting edge of the profession. Karen is a member of the American Academy of Oral & Systemic Health and the American Dental Hygienists’ Association. She can be reached at karen@karendavis.net.

Author Disclosure
Karen Davis, RDH, BSDH discloses that she is the owner of Cutting Edge Concepts™, a dental presentation company. She further discloses that she is a field evaluator for Electro Medical Systems (EMS) the commercial supporter of this educational activity.

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Supragingival air polishing is not new in the armamentarium of technology designed to remove soft deposits, stain and polish enamel; however, subgingival air polishing to remove biofilm in periodontal pockets is an emerging technology with clinical data proving its safety and efficacy to support use in treatment of periodontal diseases and peri-implant diseases. Unique nozzle designs and powders support the use of polishing under a variety of clinical conditions.

Thorough removal of subgingival plaque biofilm is a crucial component of successful periodontal therapy yet mechanical debridement remains challenging due to limitations of accessibility in many diseased pockets. For the purposes of debridement, hand, sonic or ultrasonic scalers may be used for removal of hard and soft deposits. Air polishing technology uses an abrasive powder and a stream of compressed air to clean or polish a surface by removing soft deposits attached to it. Many dental professionals are familiar with air polishing technology for supragingival biofilm and stain removal but recently technologies have been introduced in the United States that utilize a specially-designed nozzle to deliver a very low-abrasive glycine powder into the subgingival environment for biofilm removal. This air polishing technology differs from traditional air abrasive technology commonly used by dental professionals based upon the type of powder utilized and the design of the tip for subgingival placement in pockets measuring 4mm or greater. Subgingival air polishing technology using a low abrasive powder has been proven clinically effective and efficient for biofilm removal without damage to soft tissues, enamel, dentin or cementum. Utilization of air polishing and subgingival air polishing will be reviewed, featuring clinical integration of these technologies.

**Air Polishing Technology and Benefits for Clinical Usage**
Air polishing removes stain and plaque biofilm from tooth surfaces using pressurized air, water and particles of various abrasiveness. The most common abrasive agent used with air polishing technology is a sodium bicarbonate powder specifically designed for air polishing. Water flow acts as a carrier for the types of powder used in air polishing devices and the particle size and hardness or density of the powder will influence the substance removal. In vitro studies have shown that increasing the water flow leads to an increase in instrument efficacy yet patient comfort and water evacuation are also considerations when selecting the amount of water to be used during air polishing.

Air polishing devices were first introduced to dentistry in 1945 and initially were used for cavity preparation but have undergone many technological changes since that time. These devices are produced as stand-alone units, or combined with power scaling technology, or as handheld devices connected to the dental unit. While all three types of devices are designed to remove stain and biofilm; to date, no published data is available comparing the effectiveness of the various types of devices. Operator preferences and/or costs generally determine the type of air polishing technology clinicians invest in.

Advantages of air polishing compared to prophy cup polishing with pastes include no direct tooth contact or pressure against the tooth, therefore no discomfort from potential heat generated with prophy cups. Other advantages include more efficient stain and plaque biofilm removal, greater access into pits and fissures, less abrasive than pumice or prophy pastes, and the ability to safely use on implants.

**Precautions for Air Polishing**
In spite of many advantages of air polishing with sodium bicarbonate powders, clinicians must take into considerations potential contraindications, which include; patients on sodium-restricted diets, respiratory diseases, infectious diseases, patients that are immunosuppressed and those with renal diseases or hypertension among others. Air polishing with a low-abrasive glycine powder is not contraindicated for patients on sodium-restricted diets, or those conditions where sodium is a concern, although it would be contraindicated for those with respiratory diseases. Review of the patient’s medical history is imperative prior to use of this technology, and consultation with the patient’s physician may be indicated.

From a safety perspective, patients should always be instructed to pre-rinse with an antimicrobial agent prior to treatment to reduce the bacterial load in aerosols that are generated during use. Protective eye-wear is mandatory. Lip balm should cover the patient’s lips for protection from the spray. Clinicians should wear eye protection and a well-fitting mask with high-filtration capability. High speed evacuation is instrumental in helping to contain aerosol spray during use. The tip of the nozzle delivering the powder spray should be positioned minimally 3 – 4 mm from the tooth, and kept moving in circular or sweeping motion while the spray is being dispersed. Even though different manufacturers may offer specific guidelines for angulation of the nozzles, according to Mosby’s Dental Hygiene Con-
cepts, Cases, and Competencies,\textsuperscript{3} angulation of the nozzle should be approximately 60 degrees for anterior teeth, 80 degrees for posterior teeth, and 90 degrees for occlusal surfaces. Exposure time should be approximately 5 seconds or less on each tooth, and care should be taken to avoid demineralized tooth structures, composite restorative materials, and luting agents when air polishing with sodium bicarbonate.\textsuperscript{3} Use of glycine powder for air polishing has been shown to have the lowest surface damage on nanocomposites in comparison to other methods of deplaqueing.\textsuperscript{4}

Even though some clinicians avoid using air polishing due to the risk of the patient developing air emphysema, exhibited by a sudden swelling in the dento-facial area, the potential risk of such a condition appears to be very low in the literature.\textsuperscript{5} Until 2009 only a total of 8 cases have been reported in five publications. Cases that have been reported generally resolve in 1 to 3 days without complications. Air emphysema is actually reported more frequently in the literature with the use of high-speed handpieces than during air polishing. Air polishing can be considered a safe technology, yet clinicians should follow the manufacturer’s guidelines for clinical use and be prepared to recognize air emphysema and discontinue use in the unlikely event it should occur.

Subgingival Air Polishing with Glycine Powder

Glycine powder is an amino acid that has a significantly smaller particle size (25 microns) compared to sodium bicarbonate powders (~65 microns). It is safe for all of the same supragingival applications as sodium bicarbonate powders. It can also be used to treat periodontal infections, treat peri-implantitis, with patients on a sodium-restricted diet and around nanocomposite restorations. Significant research has been published to date on the utilization of a customized nozzle for placement into the subgingival pocket in conjunction with a low-abrasive glycine powder for biofilm removal in pockets measuring 4mm or greater.\textsuperscript{6–8} The patented PERIO-FLOW® nozzle by Electro Medical Systems (EMS) was launched in 2007. It has three horizontal outlets for air and powder and one vertical outlet for water to optimize the mixture in the pocket and prevent soft tissue emphysema. This uniquely designed tip is flexible and attaches to the Air-Flow® Perio handpiece to slide into periodontal pockets for biofilm removal. During subgingival debridement, the tip is directed at a 90-degree angle to the long axis of the root and a 5-second activation of the tip disperses air, water and glycine powder in order to accomplish biofilm removal. This technology can be seen in Figure 1 as it would appear placed into a periodontal pocket. For clinicians interested in combining supragingival air polishing technology with piezo technology and subgingival glycine air polishing technology, EMS has created a unique unit that combines all three technologies into one unit called the Air-Flow Master Piezon\textsuperscript{8}.

For those preferring to use subgingival air polishing that is portable and attaches to the dental unit, EMS and Acteon both make portable technologies that can be attached to the dental unit. EMS makes the Air-Flow® Handy Perio which comes with the PERIO-FLOW® nozzle and disposable tips which are flexible and have a chamber designed for glycine powder. EMS also makes a portable supragingival air polishing unit that is portable called the Air-Flow® Handy 2+ that uses sodium bicarbonate powder. Acteon makes the Air-N-Go® air polisher that has both a supragingival and subgingival air polisher with interchangeable nozzles and powder chambers. The Air-N-Go® SUPRA nozzle is ideal for sodium bicarbonate powder and the subgingival PERIO nozzle on the Air-N-Go® has a metal tip slightly larger than a periodontal probe and is designed for use with glycine powder.

For dentists and dental hygienists trying to navigate deeper pocket spaces in order to accomplish complete periodontal debridement, subgingival air polishing should be considered a significant clinical breakthrough. Adverse events such as pain, gingival recession or tooth sensitivity have not been reported with subgingival glycine powder air polishing and at least one publication has reported that patients perceive this method of biofilm debridement as being more comfortable than hand instrumentation when used as a part of periodontal maintenance.\textsuperscript{1}

Safety of Glycine Powder

It has been demonstrated that use of glycine powder instead of conventional sodium bicarbonate powder reduced the abrasiveness seen on root surfaces by approximately 80%.\textsuperscript{1} In 2008 the Journal of Clinical Periodontology published an in vivo study evaluating the safety of glycine powder in comparison with sodium bicarbonate powder and hand instrumentation on gingival epithelium using histological analysis.\textsuperscript{9} Immediately following debridement using one of the following: a) glycine powder air polishing, b) sodium...
bicarbonate air polishing, or c) hand-instrumentation biopsies were obtained from the pocket epithelium. Damaged gingival epithelium was assessed by light microscopy and quantified by a histological score of 1 being the least erosion and 4 being the most erosion. Glycine powder air polishing biopsies displayed an intact epithelial layer and resulted in the least amount of gingival erosion compared to the other methods of debridement, Figure 2. Consistent with other published data, histological evaluation of the gingival epithelium following hand instrumentation revealed significant epithelial destruction. Nevertheless, a follow-up biopsy of these same sites revealed that the epithelium in all groups healed uneventfully after about 1 week; therefore, no long term tissue damage occurred in any of the scenarios tested.

Figure 2. Light micrographs of biopsied oral epithelium. (A) Gingival epithelium with no mechanical debridement. (B) Gingival epithelium immediately following glycine air polishing. (C) Gingival epithelium immediately following sodium bicarbonate air polishing. (D) Gingival epithelium immediately following hand instrumentation.

A more recent study evaluated the efficacy and safety of glycine powder in deep periodontal pockets with probing depths of 4 to 9 mm via subgingival air polishing, followed by deposit removal with curettes compared to scaling and root planing, followed by coronal polishing. Results indicated that not only was the subgingival glycine powder safe, it was more efficacious in removing biofilm in moderate to deep periodontal pockets than SRP followed by coronal polishing. Microbiological analysis showed that full mouth glycine powder air polishing in supra and subgingival pockets may result in a beneficial shift of the oral microbiota. Additional studies are needed to confirm this.

Subgingival Air Polishing During Periodontal Maintenance

An interesting investigation was published in the Journal of Clinical Periodontology designed to determine the clinical and microbiological effects, as well as perceived treatment discomfort of root debridement by subgingival air polishing compared with ultrasonic instrumentation during supportive periodontal therapy. While both treatment procedures resulted in significant reductions in bacterial pathogens immediately, 2 days post-treatment, bleeding upon probing and pocket depth in addition to improvements in clinical attachment levels at 2 months post-treatment. Perceived treatment discomfort was lower for air polishing than ultrasonic debridement. The study revealed no significant differences in clinical or microbiological outcomes between the two treatment groups. As newer technologies are developed that accomplish the same goals clinically but more efficiently or more comfortably for patients, clinicians should be open-minded about incorporating such technologies.

Effects of Air Polishing With Glycine Powder on Implants

Most inflammatory peri-implant conditions are caused by plaque biofilm colonizing around implant surfaces. Peri-implant mucositis is an inflammatory condition that resides in the mucosa and bleeds upon gentle probing. Peri-implantitis affects the mucosa and the supporting bone and is characterized by crestal bone level changes in conjunction with bleeding upon probing and pus formation. Peri-implantitis may or may not exhibit deepening of the peri-implant pockets. A randomized, controlled clinical study evaluated clinical parameters of patients that presented with peri-implantitis that were treated with use of an air polishing device with glycine powder, or mechanical debridement using carbon curettes and chlorhexidine therapy. At the end of 6 months, both treatment procedures resulted in comparable clinical attachment level gains, but the air abrasive and glycine powder group showed significantly higher reduction in bleeding than the mechanical & antiseptic group. Treatment of severe peri-implantitis using an Er:YAG laser versus an air polishing device using glycine powder revealed similar clinical results after 6 months of therapy. One must keep in mind that treatment of severe implantitis irrespective of the mode of treatment has been shown to be effective only to a certain point. Given the difficult nature in maintaining good long term clinical outcomes with peri-implantitis, this approach of subgingival air polishing with glycine powder into the peri-implant pocket should be a promising option, as no
adverse effects have been reported using this technology with implants and biofilm removal is clinically effective.

Titanium abutment surfaces can act as a reservoir for plaque biofilm. An in-vitro study evaluated morphological changes induced by glycine powder air polishing on titanium abutment surfaces and its effect on bacterial recolonization compared to sodium bicarbonate air polishing. Results revealed that there was less surface roughness created on the titanium surface with use of glycine powder compared to sodium bicarbonate powder, and the glycine powder appeared to have an active role in inhibiting bacterial recolonization at least within the test period of 24 hours. Interestingly, treatment with glycine powder inhibited biofilm formation on surfaces previously treated with sodium bicarbonate. The cultivable bacteria were less than 30% of that observed at baseline and with the use of sodium bicarbonate powder air polishing treated surfaces. In view of this data, air polishing with glycine powder might be considered both preventive and therapeutic treatment for peri-implantitis.

**Paradigm Shift for Air Polishing**

Traditionally, polishing is performed near the end of a dental hygiene appointment, following instrumentation. Clinicians should consider using supragingival air polishing technology prior to instrumentation for efficient removal of plaque biofilm and stains from tooth surfaces as opposed to use of hand or power instruments to remove soft deposits. Depending upon technology and nozzle choice, air polishing can be used prior to therapeutic debridement to reduce overall bacterial load. However, one air polishing technology has clinical protocol recommendations that advise subgingival air polishing only after initial debridement.

Since supragingival air polishing is safe to use around most orthodontic brackets and bands air polishing prior to instrumentation can reduce time required for thorough de-plaquing. In-vitro studies have shown that essentially 100% of endotoxins and bacteria can be removed with air polishing supragingivally and to some degree even subgingival plaque removal occurs with angulations of the nozzle at 90 degrees to the interproximal spaces so that a vacuum effect takes place to extract fluids, including subgingival bacteria.

Supra and subgingival air polishing earlier as opposed to later in the appointment may be a paradigm shift for clinicians, but patients adapt their expectations easily when it is explained that air polishing efficiently removes soft plaque and stains prior to deposit removal.

**Clinical Integration of Air Polishing Technology**

Clinicians often seek evidenced-based technologies that can either yield a better clinical outcome, or produce outcomes more safely or comfortably for patients. Integration of air polishing technology can be instrumental in accomplishing those goals, but clear guidelines as to when to use sodium bicarbonate and/or subgingival glycine powder technology does not appear to exist in the literature. Figure 3 provides a sample method of integration for both preventive and therapeutic treatment protocols incorporating use of a subgingival air polishing nozzle.

**Figure 3. Sample flow chart for clinical integration of supragingival air polishing, subgingival air polishing and Piezo ultrasonic technology.**

<table>
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<tr>
<th>UPDATE MEDICAL HISTORY</th>
<th>AIR POLISHER REMOVAL OF STAIN &amp; SUPRAGINGIVAL &amp; INTERPROXIMAL BIOFILM</th>
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<td>BIOFILM REMOVAL OF 4MM+ POCKETS WITH SUBGINGIVAL AIR POLISHING TIP</td>
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<td>PIEZOD POWER SCALING FOR SUPRAGINGIVAL &amp; SUBGINGIVAL DEPOSIT REMOVAL</td>
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</table>

Updating the patient’s medical history gives the clinician an opportunity to discover any contraindications for air polishing technology followed by intra/extraoral examinations, caries and periodontal risk assessments, and exposure of necessary radiographs. Determination of the need for preventive or therapeutic treatment is based upon the patient’s current diagnosis. When preventive treatment
is indicated, stain, supragingival and interproximal biofilm removal with sodium bicarbonate air polishing can reduce the biofilm burden initially, followed by power scaling and hand instrumentation, as indicated. Necessary preventive and remineralization products would be applied as a final step in clinical services.

When therapeutic treatment is indicated, immediately following stain, supragingival and interproximal biofilm removal, subgingival glycine air polishing would be used in pockets measuring 4mm or deeper with a 5 second application of the tip per pocket to remove subgingival biofilm. Power scaling and hand instrumentation would follow, as indicated, as well as necessary application of therapeutic and/or remineralization products. This subgingival protocol for treatment of periodontal pockets anecdotally appears to be more clinically effective in treatment of biofilm infections than instrumentation alone, according to the author. The sample protocol of using piezo power scaling, sodium bicarbonate air polishing supragingivally, and glycine power air polishing subgingivally can be accomplished via the use of Air-Flow Master Piezon® by EMS or air polishing could be accomplished via the use of their portable technologies.

Acteon recommends clinicians follow a somewhat different protocol for subgingival biofilm removal. Their portable dual system includes interchangeable SUPRA and PERIO air polishing powder chambers and nozzles. According to the manufacturer, initial therapy to remove deposits supra and subgingivally should be performed prior to subgingival air polishing. Re-assessment should be performed 7–10 days following therapy. Once bleeding has subsided the Air-N-Go® PERIO subgingival air polishing technology can be utilized to remove biofilm in pockets 4mm and greater with 20 second exposures per tooth, or 5 second per pocket. For situations with high demands on biofilm management, a full mouth debridement with glycine powder is recommended for both supra and subgingival debridement on all teeth and associated mucosal tissues to suppress periodontal pathogens. For subgingival debridement using Acteon technology, the PERIO nozzle and powder chamber is recommended while supragingival and tissue debridement is treated using the SUPRA nozzle. Glycine powder rather than sodium bicarbonate powder is recommended for full mouth debridement. The Air-N-Go® PERIO nozzle is angled at 20 degrees for adaptation around the tooth and has openings in the nozzle for powder and water as well as a separate water opening at the end of the tip to flush the pocket with water.

**Different Powders for Different Clinical Scenarios**

Manufacturers of the technologies discussed here for subgingival air polishing have several types of air polishing powders available and are compatible with other types of air polishing technologies dependent upon each manufacturer’s recommendations. Having options to use different types of powders depending upon the type and amount of soft deposit and/or stain present and whether supra and/or subgingival air polishing is desired broadens the opportunities for air polishing in a variety of clinical situations.

Key factors in powder selection for the patient include the level of stain and biofilm removal required, the nutritional or health concerns of the patient; such as a low sodium diet and the level of gum sensitivity in the individual. Available powders range from 25 microns to 75 microns and include glycine, sodium bicarbonate, and calcium carbonate options. Flavoring agents are also available for patients who prefer a masking flavor.

**Emerging Technologies**

Continual improvement and innovation is expected in the development of air polishing equipment and powder options. A number of companies are in the process of launching combination units which utilize technology such as Piezo ultrasound technology with a multitude of various tips for numerous clinical indications. New powders include an erythritol based powder that measures a remarkably low 14 microns, yet is safe and effective in both supragingival stain removal and subgingival biofilm removal. Other technology innovations include powders that can be used for both supra and subgingival air polishing without having to change the powder chambers. Emerging varieties of powders and technologies to enhance air polishing results and ease of use will continue to evolve.

**Summary**

Even though there are some contraindications for use of sodium bicarbonate and glycine powder air polishing, there are numerous potential benefits when included into clinical protocols, as indicated. Sodium bicarbonate air polishing can effectively eliminate plaque biofilm and reduce the biofilm burden on supragingival surfaces more efficiently than other methods of deplaquing.

Low abrasive glycine powder has been shown to be clinically safe and effective for biofilm removal in subgingival sites and is beneficial for treating, and possibly preventing peri-implantitis. Subgingival air polishing with glycine powder has been shown to be equally as effective as use of an Er:YAG laser in the treatment of peri-implantitis and equally effective as ultrasonic instrumentation in biofilm removal for periodontal maintenance patients. Air polishing with glycine powder can also be used instead of sodium bicarbonate when a low abrasive agent is desired or when a patient has a sodium-restricted diet. As dentists and dental hygienists are in a position to make decisions regarding the types of technologies that can render optimal clinical outcomes, air polishing technology should be considered as a safe and clinically effective method for supra and subgingival biofilm removal.
References:

Author Profile
Karen Davis, RDH, BSDH is an international speaker and practices dental hygiene in Dallas, Texas. She has served on numerous advisory boards for corporations and is recognized by Dentistry Today as a “Top Clinician in Continuing Education”. She is an accomplished author related to her passion of practicing on the cutting edge of the profession. Karen is a member of the American Academy of Oral & Systemic Health and the American Dental Hygienists’ Association. She can be reached at karen@karendavis.net.

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Questions

1. Air polishing technology has been show to remove:
   a. Biofilm
   b. Stains
   c. Calculus
   d. A, and B

2. Removal of substances by air polishers is influenced by:
   a. Water flow
   b. Particle size
   c. Particle hardness
   d. All of the above

3. Clinical studies have shown superior performance for:
   a. Stand-alone air polishing units
   b. Hand-held air polishing units
   c. Air polishing units combined with power-scaling technology
   d. None of the above

4. Advantages of air polishing compared to prophylaxis cup polishing includes:
   a. No heat on the tooth, greater efficiency, less cost, less abrasiveness
   b. Less abrasiveness, greater efficiency, minimal heat, less cost
   c. No heat on the tooth, less abrasiveness, greater efficiency, safe for implants
   d. Safe use with implants, less abrasiveness, no heat on the tooth, less cost

5. Contraindications of air polishing with sodium bicarbonate powder include patients with:
   a. Sodium-restricted diets, respiratory diseases, renal diseases, hypertension
   b. Sodium-restricted diets, cardiovascular disease, respiratory diseases, renal diseases
   c. Sodium-restricted diets, respiratory diseases, immunosuppression, diabetes
   d. Sodium-restricted diets, immunosuppression, cardiovascular disease, respiratory diseases

6. Safety precautions for patients undergoing air-polishing include the following:
   a. Protective glasses
   b. Pre-Rinse with antimicrobial rinse
   c. Lip balm
   d. All of the above

7. According to the article, angulation of 90-degrees of the air polishing tip to the tooth is recommended for:
   a. Anterior teeth
   b. Occlusal surfaces
   c. Posterio teeth
   d. Root surfaces

8. Based upon reports in the literature, the risk of air emphysema with use of air polishing is:
   a. Very high
   b. Moderate
   c. Very low
   d. Non-existent

9. According to the course, benefits of air polishing prior to instrumentation include:
   a. Reduction of bacterial load
   b. Less time required for deplaquing
   c. Removal of subgingival plaque in interproximal sites
   d. All of the above

10. Glycine powder for air polishing:
    a. Is less abrasive than sodium bicarbonate powder
    b. Costs less than sodium bicarbonate powder
    c. Removes more stain than sodium bicarbonate powder
    d. A and C

11. Based upon a study referenced in this course, which revealed the least amount of trauma or damage to the gingival epithelium?
    a. Air polishing with glycine powder
    b. Air polishing with sodium bicarbonate powder
    c. Hand instrumentation with curettes
    d. None of the above

12. Use of the subgingival air polishing technologies discussed in the course can be used for:
    a. Biofilm removal in shallow pockets
    b. Biofilm removal in pockets 4mm and deeper
    c. Biofilm removal for peri-implantitis
    d. B and C

13. Based upon studies reported in the course air polishing with glycine powder:
    a. Is equal in effectiveness as ultrasonic biofilm removal
    b. Is equal in effectiveness as Er:YAG laser for peri-implantitis
    c. A and B
    d. None of the above

14. A study reference in the course reported the following advantages of air polishing during periodontal maintenance:
    a. Less severity of periodontal disease over a 6-month period, and less discomfort
    b. Less discomfort, and equal clinical results compared to ultrasonic instrumentation
    c. Less discomfort and less bone loss over a 6-month period
    d. Less discomfort and equal clinical results as chlorhexidine therapy used daily

15. The difference between peri-implant mucositis and peri-implantitis is:
    a. Pus formation with peri-implant mucositis
    b. Loss of supporting bone with peri-implantitis
    c. Severe deepening of the peri-implant pocket
    d. All of the above

16. According to the results of a clinical study reported, which group had the greater reduction in bleeding for treatment of peri-implantitis following 6 months of therapy?
    a. Mechanical debridement plus chlorhexidine therapy
    b. Air polishing plus minocycline microspheres
    c. Air polishing with glycine powder
    d. Air polishing plus Er:YAG laser

17. Which of the following have been reported to possess possible anti-bacterial properties on titanium abutment surfaces?
    a. Glycine powder
    b. Sodium bicarbonate powder
    c. Propylaxis paste
    d. All of the above

18. The difference in particle size between sodium bicarbonate powder and subgingival glycine powder is:
    a. Glycine powder is 65 microns and sodium bicarbonate is 25 microns
    b. Glycine powder is 25 microns and sodium bicarbonate is 65 microns
    c. Glycine powder 25 microns and sodium bicarbonate is 14 microns
    d. None of the above

19. Which of the following statements are true based upon the evidence in the course?
    a. Sodium bicarbonate air polishing is more efficient in biofilm removal than prophylaxis cup and paste polishing
    b. Glycine powder is safe and effective for subgingival biofilm removal in pockets with a 5-second application
    c. Glycine powder may possess bactericidal properties with titanium implants
    d. All of the above

20. Glycine powder for air polishing:
    a. Is low-abrasive
    b. Is less costly than other powders for air polishing
    c. Is more effective in stain removal than sodium bicarbonate powder
    d. Is less abrasive than water

21. Which of the air polishing powders have been shown to have the lowest surface damage on nanocomposite restorations?
    a. Sodium bicarbonate
    b. Calcium bicarbonate
    c. Sodium-calcium bicarbonate
    d. Glycine

22. In the unlikely event of air-emphysema, the clinician should immediately:
    a. Discontinue use
    b. Take an intra oral picture to document
    c. Place a warm compress on the area
    d. Call 911
Questions (Continued)

23. Which nozzle has been used in the bulk of clinical studies testing the safety and efficacy of subgingival air polishing?
   a. Mectron’s combi nozzle
   b. EMS Perio-Flow® nozzle
   c. Acteon Air-N-Go® nozzle
   d. EMS Handy2+ nozzle

24. According to the article, which of the adverse events have been reported in the literature with the use of subgingival air polishing with glycine powder?
   a. Tooth sensitivity
   b. Pain
   c. Gingival recession
   d. None of the above

25. Gingival epithelium micrographs as depicted in the article revealed the greatest amount of histological tissue damage following which technique:
   a. Air polishing with sodium bicarbonate powder
   b. Air polishing with erythritol powder
   c. Air polishing with Glycine powder
   d. Hand instrumentation with curettes

26. Clinical testing on titanium abutment surfaces reveals they can become a reservoir for plaque biofilm. Use of glycine powder with air polishing shows:
   a. 100% less cultivatable bacteria compared to sodium bicarbonate
   b. Equal cultivatable bacteria compared to sodium bicarbonate
   c. 30% less cultivatable bacteria compared to sodium bicarbonate
   d. More cultivatable bacteria compared to calcium bicarbonate

27. Which subgingival air polishing technology is recommended to follow initial debridement therapy by 7 – 10 days?
   a. Acteon Air-N-Go® PERIO
   b. Acteon Air-N-Go® SUPRA
   c. EMS Handy 3.0 Perio
   d. Mectron Combi

28. Different air polishing powders can accomplish different outcomes. Which air polishing powders can be used with patients that are on sodium-restricted diets?
   a. Powders with an erythritol, glycine or calcium bicarbonate base
   b. Powders with a sodium bicarbonate base
   c. Powders with an erythritol, sodium bicarbonate and Novamin base
   d. No air polishing should be used on those with a sodium-restricted diet

29. Use of high-speed evacuation with air polishing is:
   a. Instrumental in reducing aerosols
   b. Is equally effective as use of saliva ejectors
   c. Is mandatory
   d. Is contraindicated

30. Air polishing by clinicians should be considered:
   a. An emerging technology that requires additional safety studies prior to implementation
   b. A safe and efficient method of biofilm removal for supra and subgingival plaque
   c. A safe and efficient method of biofilm removal for coronal surfaces only
   d. An emerging technology that is appropriate for implant and abutment surfaces only

Notes
Biofilm Removal With Air Polishing and Subgingival Air Polishing

Name: ___________________________ Title: ___________________________ Specialty: ___________________________

Address: ___________________________ E-mail: ___________________________ 

City: ___________________________ State: ___________________________ ZIP: ___________________________ Country: ___________________________

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Educational Objectives
1. Distinguish between air polishing with sodium bicarbonate and subgingival air polishing with glycine powder.
2. Describe the benefits and contraindications of air polishing.

Course Evaluation

1. Were the individual course objectives met? 
   Objective #1: Yes No Objective #2: Yes No Objective #3: Yes No

   Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

2. To what extent were the course objectives accomplished overall? 5 4 3 2 1 0
3. Please rate your personal mastery of the course objectives. 5 4 3 2 1 0
4. How would you rate the objectives and educational methods? 5 4 3 2 1 0
5. How do you rate the author’s grasp of the topic? 5 4 3 2 1 0
6. Please rate the instructor’s effectiveness. 5 4 3 2 1 0
7. Was the overall administration of the course effective? 5 4 3 2 1 0
8. Please rate the usefulness and clinical applicability of this course. 5 4 3 2 1 0
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