Air polishing: a comprehensive review of the literature.

By: Gutmann, Marylou Everett Publication: Journal of Dental Hygiene **Date: Monday, June 22 1998**

“Oral health care professionals have a responsibility to patients to engage in life-long learning in order to provide the most contemporary clinical care. This review of air polishing should enable clinicians to make sound decisions regarding the most appropriate treatment for each patient. Air polishing has been studied extensively and, when used appropriately, provides a safe, efficient and contemporary approach to achieving a variety of treatment goals”.

Introduction

Air polishing was first introduced to the dental community in the late 1970s as a mechanism to quickly and easily remove extrinsic stain and soft deposits from tooth surfaces. Since that time, researchers have investigated various aspects of this polishing device. Areas of research have included efficiency and effectiveness, effects on hard and soft tissues and restorations, alternative uses, and safety of both the patient and the clinician.

Despite continuing research support for its use since being introduced, the air polisher has not been widely used. White and Hoffman surveyed 2,400 dental hygienists and only 22 percent reported using it routinely.[1] Use of air polishers decreased as the clinician's age and experience increased.[1] Curricula in many dental hygiene schools do not include clinical instruction in the use of this polishing device due to inadequate numbers of units and difficulty in moving units between clinic stations.[2] Inadequate or insufficient knowledge and experience, therefore, appears to be a major

factor in the underutilization of the air polisher. In an attempt to provide a suitable knowledge base for practicing dental hygienists, the primary purpose of this article is to provide a comprehensive summary and critique of the research on all aspects of air polishing. In addition, a suggested technique, common concerns, and possible solutions will be discussed.

Discussions are based on a review of the relevant literature on air polishing. Tables organize the data into categories to facilitate access of needed information. Because of the various research designs employed and the number of variables that must be controlled, comparative analyses of the studies are difficult. However, where possible, analyses of the validity and reliability of the studies are provided. It should be remembered that while laboratory (in vitro) investigations are useful, the most definitive conclusions must be obtained through clinical (in vivo) studies. Case reports or opinion articles have limited applications. Therefore, interpretation and application of research results must be done with caution.

Effectiveness and Efficiency

Air polishing has been compared to scaling and rubber-cup polishing for efficiency and effectiveness of stain and plaque removal. The literature overwhelmingly supports the use of the air polisher as an efficient and effective means of removing extrinsic stain and plaque from tooth surfaces (Table I).[3-8] Air polishing requires less time than traditional polishing methods and removes stain three times as fast as scaling with comers.[3,7] In addition, less fatigue to the operator has been mentioned as an important benefit of air polishing.[3]

Table I. Effectiveness/Efficacy Studies

Author(s), Type of

Year Study Findings

Christensen R[3], 1981 N/A Stain removal was more

thorough, less fatiguing to the operator, and required less chair time than traditional methods.

|  |  |  |  |
| --- | --- | --- | --- |
| deWet FA, Holtzhausen T, Nel JJ[4] 1984 | in | vivo | Very effective in removing extrinsic stains. |
| Boyde A[5], 1984 | in | vitro | Efficient stain removal from sound enamel surfaces. |
| Weaks LM, et al.[6], 1984 | in | vivo | Adequately removed stain and required less time than rubber-cup polishing. |
| Berkstein S, et al.[7], 1987 | in | vitro | Removed stain 3 times faster than curets. |
| DeSpain B, Noble R[8], 1988 | in | vivo | Stain and plaque scores post-treatment were |
|  |  |  | equivalent to rubber-cup  polishing. |

Effects on Enamel, Cementum, and Dentin

Most investigators agree that intact enamel surfaces are not damaged when stain removal is accomplished with an air polisher (Table II).[5,9-13] Even after exposure to enamel for the equivalent of a 15-year recall program, surfaces were not altered.[13]

Table II. Effects on Enamel, Cementum, and Dentin

Author(s), Type of

Year Study Findings

Willman D, Norling B, in vitro Effective stain Johnson W[9], 1980 removal. Air

polishing, rubber-cup polishing, and ultasonic scaling altered polished enamel surfaces to some degree.

Boyde A[5], 1984 in vitro Safe on intact enamel surfaces, but not

cementum or dentin. Not

for use on primary enamel except in preparing occlusal surfaces for sealants.

Galloway SE, Pashley DH[10], in vitro Less abrasive to enamel 1987 than rubber-cup

polishing with pumice; can cause loss of cementum and dentin.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | Not for prolonged use on any surface. |
| Berkstein S, et al.[7], 1987 | in | vitro | Removed less root structure than curet in simulated 3-month recalls for 3 years. |
| Kee A, Allen DS[11], 1988 | in | vitro | No significant loss of enamel. |
| Hosoya Y, Johnston JW[12], 1989 | in | vitro | No abrasion of primary enamel surfaces; deep |
|  |  |  | scratches using a rubber cup and pumice. |
| Gerbo LR, et al.[13], 1993 | in | vitro | Did not alter enamel surfaces, even after |
|  |  |  | exposure equivalent to a 15-year recall program. |
| Dentsply/Equipment Division | N/A |  | Not for prolonged use |
| Equipment Instruction Manual.[14], 1993 |  |  | on cementum or dentin. |
| Leknes KN, Lie T[20], 1991 rubber-cup polishing in | in | vitro | Equally effective as |
|  |  |  | decreasing root-surface roughness caused by  sonic scaling. |

Still, researchers and manufacturers caution against prolonged use of the air polisher on cementum and dentin.[5,10,14] When moderate to heavy stain is present on root surfaces, dental hygienists are often faced with the problem of removing it with the least alteration of cementum. One choice is to leave the stain and explain to the patient that stain is not associated with oral disease and will not harm the teeth or gingiva since it is only a cosmetic concern.[15,16] To many patients, this is not a viable choice since appearance is considered so important in today's society.

Other choices include removing the stain with a rubber cup polisher and prophylaxis paste; sonic, ultrasonic or piezo scalers; hand instruments; or the air polisher. Wilkins recommends removing as much stain as possible during root planing with curets.[16] However, in one in-vitro study, air polishing was shown to remove less root structure than a curet in simulated three-month recalls for three years.[7] Woodall agrees that the air polisher

may be preferable to curets in this situation.[15] Since less root structure is removed, decreased root-surface sensitivity also may be a benefit.

Because polishing with a rubber cup and prophylaxis paste has been shown to remove the fluoride rich layer of enamel and cause marked loss of cementum and dentin over time, this method of stain removal has been challenged.[16-19] Rubber cup polishing with prophylaxis pastes, therefore, may not be a suitable method for moderate-to-heavy stain removal on enamel, cementum, or dentin. One study, however, contradicted these findings and suggested that rubber cup polishing with chalk is equally effective in decreasing root-surface roughness caused by sonic scaling.[20] Chalk is not a common polishing agent and no comparison of the abrasiveness was made between it and the sodium bicarbonate used in air polishing powder. This study, therefore, may not simulate actual clinical situations.

Since results are inconsistent on this subject, dental hygienists should follow manufacturer recommendations. Presently, it appears that air polishing is the least damaging and most efficient means of removing stain on enamel.

However, an acceptable procedure for stain removal on root surfaces is being explored. It should be remembered that any method capable of removing moderate stain from root surfaces also may remove cementum.

Effects on Soft Tissues

Clinical studies to evaluate soft tissue usually provide generalizable conclusions (Table III). Gingival bleeding and abrasion are the most common effects of air polishing.[6,21,22] These effects are temporary; healing occurs quickly and effects are not clinically significant.[6,21,22] No complications were seen with healing at extraction sites following air polishing of teeth prior to extraction.[23] To avoid tissue trauma, the manufacturer recommends pointing the tip of the air polisher at the facial, lingual, or occlusal surfaces, thus avoiding the gingival margins.[14]

Table III. Effects on Soft Tissues

Author(s), Type of

Year Study Findings

Weaks L, et al.[6], 1984 in vivo Increased gingival

bleeding and abrasion, but no evident signs of trauma at 6 days

post-op.

Mishkin DJ, et al.[21], 1986 in vivo Caused gingival

irritation immediately post-treatment--not deemed clinically significant. No differences at 7 or

21 days.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Konturri-Nahri V, Markkanen S, Markkanen H.[22], 1989 | in | vivo |  | Localized gingival bleeding immediately detected, but no adverse reactions  2 days post-op. |
| Horning G, Cobb C, Killoy W.[23], 1987 | in in | vivo vitro | & | Most patients experienced a salty taste, but did not object. No problems |
|  |  |  |  | with healing at  extraction sites. |

Patients also have noticed a salty taste with air polishing, but this was not objectionable.[23] Covering the tongue with moist gauze may prevent irritation and excessive salty taste, as will rinsing with water, mouthwash, or a mint-flavored powder.[10,14,24]

Effects on Restorations

Numerous investigations have examined the effects of the air polisher on a variety of restorative materials. Some results have been positive, while others have recommended caution near restorations (Table IV). Although some studies are contradictory, most suggest caution or complete avoidance when air polishing on or near composite restorations.[3,25-29] On composites, surface roughness or pitting was the most common result seen. One study concluded that, although marginal microleakage was greater for composites than for amalgams, this loss was not statistically or clinically significant.[30] More research is recommended since previous studies do not

support this conclusion.[30] One study found that surface alterations depended on initial conditions, with smooth surfaces becoming rougher and extremely rough surfaces becoming smoother.[29] Since the majority of results support avoidance of composites with an air polisher, clinicians should follow these and manufacturer recommendations.

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Effects of air polishing on gold foil, gold castings, porcelain, amalgam, and glass ionomers have been studied.[3,26,28-36] Air polishing of amalgam alloys and other metal restorations has produced a variety of effects, including matte finishes, surface roughness, morphological changes, and structural alterations.[3,28,32,33] One study found no detrimental changes to the marginal integrity of amalgams.[30] Surface roughness, staining, pitting, and loss of marginal integrity were seen on porcelain surfaces.[26,28,35,36] One study reported only minimal changes in porcelain and gold alloys.[31] Hand instrumentation at the gingival margins and caution were recommended when working around these restorations.[35,36] The surface roughness of glass ionomers increased following either air polishing or rubber-cup polishing.[29,34] Until research findings on air polishing's effect on these restorative materials are unequivocal, clinicians should follow manufacturer recommendations to "avoid prolonged or excessive use on restorative dental materials."[14]

Safety

Three safety concerns regarding use of the air polisher appear in the dental literature (Table V),[14,16,37-46] including that of the patient, the operator, and others in the treatment room. Patient concerns include systemic problems from absorption of the sodium bicarbonate polishing powder, respiratory difficulties from inhaling aerosols that contain oral microorganisms, stinging of the lips from the concentrated spray, and eye problems from the spray entering the patient's eyes, especially if contact lenses are worn.[3,14,16,37,41,42] Some of these problems could be

addressed by coating a patient's lips with a protective lubricant, using the appropriate technique, removing contact lenses, wearing safety glasses, and placing a protective drape over the patient's nose and eyes.[14,16,24]

Due to the possible absorption of sodium bicarbonate powder through the oral mucosa, use of the air polisher generally has been contraindicated when the patient's medical history lists: a low sodium diet, hypertension, respiratory illness, infectious disease, renal insufficiency, Addison's disease, Cushing's disease, metabolic alkalosis, or certain medications, such as mineralocorticoid steroids, antidiuretics, or potassium supplements.[14,16,37,41] Despite these warnings, limited information has been published on the systemic effects of sodium bicarbonate absorption from air polishing powder. Air polishing for five minutes can cause a slight disruption of the acid/base balance, but serum ph does not remain at a dangerous level if the body's buffering system functions properly.[37] Only one subject's venous blood was evaluated in this uncontrolled pilot inquiry and hyperventilation was the cause of the alkalosis, not the air solemnities.[37,38] In addition, no statistical analysis was done to rule out changes occurring solely by chance. Conflicting findings were reported in a later study.[42] Following a five-minute exposure with an air polisher, no significant changes in the arterial blood supply of ten mongrel dogs was found for sodium, bicarbonate, pH, and other electrolytes.[42] Potassium levels showed a change that was not clinically significant.[42] In addition, arterial blood was thought to be more suitable for examining electrolyte changes than the venous blood used in the previous study.[37,42] More research regarding the air polisher's safety is recommended.

A very specific balance between acids and bases is important to maintain, usually by means of a complex system of controls within the body. Some individuals cannot readily adjust to disturbances to this balance. It is for this reason, due to the potential absorption of sodium bicarbonate by the oral mucosa, that air polisher manufacturers caution against their use with such

patients.[46] Clearly, more research with human subjects is needed to resolve this absorption issue.

Because of the marked rise in aerosols with air polishing, additional health hazards may potentially exist for patients, or health care professionals present in the treatment room during or after a procedure.[39] However, the extent of this possible hazard is difficult to assess; there is no evidence in the literature of anyone becoming ill from aerosol microorganisms produced by air polishers. Still, such exposure is undesirable.

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Patients also have noticed a salty taste with air polishing, but this was not objectionable.[23] Covering the tongue with moist gauze may prevent irritation and excessive salty taste, as will rinsing with water, mouthwash, or a mint-flavored powder.[10,14,24]

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Due to the possible absorption of sodium bicarbonate powder through the oral mucosa, use of the air polisher generally has been contraindicated when

the patient's medical history lists: a low sodium diet, hypertension, respiratory illness, infectious disease, renal insufficiency, Addison's disease, Cushing's disease, metabolic alkalosis, or certain medications, such as mineralocorticoid steroids, antidiuretics, or potassium supplements.[14,16,37,41] Despite these warnings, limited information has been published on the systemic effects of sodium bicarbonate absorption from air polishing powder. Air polishing for five minutes can cause a slight disruption of the acid/base balance, but serum ph does not remain at a dangerous level if the body's buffering system functions properly.[37] Only one subject's venous blood was evaluated in this uncontrolled pilot inquiry and hyperventilation was the cause of the alkalosis, not the air solemnities.[37,38] In addition, no statistical analysis was done to rule out changes occurring solely by chance. Conflicting findings were reported in a later study.[42] Following a five-minute exposure with an air polisher, no significant changes in the arterial blood supply of ten mongrel dogs was found for sodium, bicarbonate, pH, and other electrolytes.[42] Potassium levels showed a change that was not clinically significant.[42] In addition, arterial blood was thought to be more suitable for examining electrolyte changes than the venous blood used in the previous study.[37,42] More research regarding the air polisher's safety is recommended.

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Because of the marked rise in aerosols with air polishing, additional health hazards may potentially exist for patients, or health care professionals present in the treatment room during or after a procedure.[39] However, the extent of this possible hazard is difficult to assess; there is no evidence in the

literature of anyone becoming ill from aerosol microorganisms produced by air polishers. Still, such exposure is undesirable.

To decrease any potential risks, oral health care personnel can employ several measures, such as adhering to universal precautions in the operatory. This includes wearing a well-fitting mask with recommended Bacterial Filtration Efficiency (BFE) scores of 74 to 98 percent.[14,16,39,41- 44] Using high-volume evacuation will reduce aerosols better than a saliva ejector.[40,42,43] Rinsing with a preprocedural antimicrobial, such as chlorhexidine, for up to two minutes also reduces production of aerosols.[39,40] Only one report questions preprocedural antimicrobial rinsing as a method to reduce aerosols, possibly due to an inadequate rinse time of 30 seconds.[45] To help prevent cross contamination between patients, disinfection of contaminated surfaces as far as six feet from the immediate treatment area should be considered.[41]

An aerosol-reduction device (Safety Suction, Periogene, Ft. Collins, Colorado) has been shown to be effective in reducing aerosols produced by ultrasonic scalers.[47,48] Another device (Jet-Shield[TM], Dentsply Cavitron, Long Island City, New York) is now available for use with air-polishing systems (Figure 1), and in-vitro and in-vivo studies currently are investigating its ability to reduce aerosols.[49]

[Figure 1 ILLUSTRATION OMITTED]

Alternative Uses

Since the introduction of the air polisher for stain removal, many studies have been conducted to evaluate its usefulness in other dental procedures, including periodontal therapy, orthodontics, restorative dentistry, implants, and occlusal sealants (Table VI).

[TABULAR DATA VI NOT REPRODUCIBLE IN ASCII]

During periodontal surgery, air polishers can prepare root surfaces,[23,50- 52] detoxify them effectively and efficiently, and leave a uniformly smooth

root surface that is clean and free of diseased tissues.[50,51] Dentinal tubules are then occluded, which may result in decreased sensitivity.[50] Superior growth and vitality of human gingival fibroblasts was evident when ultrasonic scaling was followed by air polishing, compared to ultrasonic scaling alone.[51] Air polishing produced root surfaces that were comparable to manually rootplaned surfaces, and provided better access to furcations.[23] Tissue healing following air polishing was comparable to that achieved by hand instrumentation in root preparation during periodontal flap surgery.[52]

Research findings also support the use of air polishing with orthodontic patients. It is the most

Research findings also support the use of air polishing with orthodontic patients. It is the most efficient and effective method for plaque and stain removal around orthodontic brackets, bands, and arch wires.[53,54] It is not contraindicated on orthodontic bracket composite resin adhesive systems.[55]

In restorative dentistry, air polishers have provided stronger composite repairs than traditional etching gels.[56] They also are superior to rubber- cup polishing in preparing occlusal surfaces for etching prior to sealant placement because the rubber cup forces debris into the fissures.[57,58] Air polishing of occlusal surfaces also allows for deeper penetration of the sealant resin into the enamel surface than rubber cup and pumice cleaning of the fissures.[59] Air polishers also have enhanced sealant bond strength compared to traditional polishing with a low-speed handpiece, bristle brush, pumice, and water.[60]

Implants may be effectively polished with an air polisher.[61-63] Minimal alterations were found on implant specimens following air polishing, fibroblasts readily attached to the surfaces, and bacteria were completely removed.[64] Implant surfaces were generally smooth following air polishing and plaque formation was inhibited.[61-63,65]

Technique

Several recent articles on the clinical use of air polishers describe specific guidelines on patient selection, preparation, operation of the unit, clean-up, and maintenance protocols.[66-68] In addition, manufacturers provide comprehensive instruction manuals and videotapes on indications, precautions, installation, clinical use, and maintenance.[69]

Use of the air polisher for stain removal involves three steps: patient selection and preparation, clinician preparation, and the actual clinical technique. Air polishing should follow a careful review of the patient's medical and dental history, and a thorough examination of the oral hard and soft tissues. Indications and contraindications, effects on hard tissues, restorations, safety, and alternative uses should be reviewed prior to treatment planning the use of the air polisher (Tables II, IV-VI).

Preparation of the patient should include an explanation of the procedure, removal of contact lenses, an anti-microbial rinse, application of a lubricant to the lips, placement of safety glasses or a drape over the nose and eyes, and placement of a plastic or disposable drape over the patient's clothing.[14,16,24,39,40,43,66-69] Operators should use universal precautions, including protective apparel, a face shield or safety glasses with side shields, gloves, and a well-fitting mask with high-filtration capabilities. [14,16,41,43,66-69]

The actual air polishing technique includes proper patient and operator positioning for adequate access and direct vision, use of high-speed suction if an assistant is available, or use of the saliva ejector and aerosol-reduction device when working alone.[4,16,24,43,66-69] The suction orifice of the saliva ejector should be as close as possible to the tip.[43] It also may enhance patient comfort if a moistened 2x2 gauze square is placed over the tongue or lip in the area being polished.[24,68] Rapid, sweeping strokes are recommended, with the tip directed at a 60 [degrees] angle to the tooth for anterior teeth, 80 [degrees] for posterior teeth, and a 90 [degrees] for

occlusals.[14,68,69] Cupping the lip with the forefinger and thumb allows the water to pool in the vestibule for easier evacuation and minimal aerosol dispersion.[14] Polishing two to three teeth at a time by fully depressing the foot pedal, then rinsing the teeth and tongue by pressing the foot pedal half way increases efficiency and minimizes the saline taste.[14,66] A systematic approach to polishing all teeth will increase efficiency. Polishing for five seconds or less per tooth is usually adequate to remove most stains.

Research Direction

Future research should continue to explore ways to increase the safety of air polishing, reduce aerosol production, and increase its efficacy in periodontal therapy. Future research should include in vivo studies that directly compare the effects of hand instruments; air polishers; sonic, ultrasonic, and piezo scalers; and rubber cup polishers on all tooth surfaces. In addition, these studies should attempt to control the variables of quantity of stain, abrasiveness of polishing pastes, and amount of pressure applied to each surface.

Conclusion

Oral health care professionals have a responsibility to patients to engage in life-long learning in order to provide the most contemporary clinical care.

This review of air polishing should enable clinicians to make sound decisions regarding the most appropriate treatment for each patient. Air polishing has been studied extensively and, when used appropriately, provides a safe, efficient and contemporary approach to achieving a variety of treatment goals.

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