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REVIEW

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"Drill-less" Dentistry- The New Air Abrasion Technology

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ABSTRACT:

Air abrasion technology has re-emerged in dentistry. Air abrasion utilizes kinetic energy from alumina particles entrained in high velocity stream of air to remove tooth structure. The history, characteristics, its principle, abrasive particles, air abrasion variables, clinical application, limitations, advantages, disadvantages, contraindications and their safety issues are reviewed in this article. This technology may be especially suited for use in bonded restorations.

Key words: ***Air abrasion, kinetic cavity preparation, alumina particles, cracking and micro chipping.***

INTRODUCTION

Basic concepts of cavity preparation for amalgam restoration were introduced by Dr. G. V. Black[1], extension for prevention was incorporated to prevent marginal and recurrent caries. Extension and retentive undercuts often require the removal of healthy tooth structure. So, recent developments have started a trend towards the conservation of tooth structure and bonding technique provides an alternate to mechanical retention. Various systems are used to remove decayed tissue. They are rotary burs, sonic oscillation, chemo mechanical, laser, ozone, and air abrasion.

Air abrasion utilizes kinetic energy from alumina particles entered in high velocity stream of air to remove tooth structure. Air abrasive methods are suited for restorations with current bonded resin materials and well into a philosophy of tooth conservation and improve the longevity of restoration.

DEVELOPMENT OF AIR ABRASIVE TECHNOLOGY

- The father of concept of air-abrasive microdentistry is an American Dentist, Dr. J. Tim Rainey, from Refugio, Texas, USA[2]. He was a student and friend of late Dr. Robert Black, who actually invented and unsuccessfully introduced the first air abrasive machine in the 1950's. Dr. Rainey was able to improve and combine this technology with the use of modern adhesive restorative material.
- The instrument was first developed in the 1940's by Dr. Robert Black.
- In 1951- S.S. White technology introduced Air-Dent the first commercially available unit for preparing cavities in teeth with air abrasion.[3]
- New technology for the 1990's - Air abrasion resurfaced as an exciting "new technology" that acts in synergy with rapid evolution of adhesive

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dentistry, which has changed tooth preparation requirements and eliminated the need for mechanical retention.

AIR ABRASION SYSTEMS AND FEATURES

Air abrasion devices include cart, table top and handheld models. Hand held devices are generally not suitable for restoration preparation but used to prepare tooth, metal, composite or porcelain surfaces for bonding. Some models have built in features and accessories, such as additional compressor, evacuation system and high intensity curing light. Operator controls are either mechanical or digital. Some systems (eg. AIR-FLOW Prep K1) capture the aluminum oxide powder stream in water spray to reduce the pollution which increases comfort of operation.

Principle behind air abrasion is based on the formula for KINETIC ENERGY

$E = ½ mv^2$

M = mass

V = Velocity

Essentially this equation underscores the fact that the cutting capability of air abrasive is attributable to the energy of mass in motion unlike conventional mechanical methods that depend on friction.[4]

When that rapidly moving mass strikes its target, most of its energy is transferred to that material, if that material is hard the results is removal of small amount of material. If, on the other hand the material is soft, the energy is mostly absorbed by the material and then the mass rebounds[4]. When these highly energized abrasive particles are directed at healthy enamel, dentin the kinetic energy is absorbed by the substrate and cuts or abrades rapidly. That is why the modality is sometimes referred to as KINETIC CAVITY PREPARATION (KCP).

ABRASIVE PARTICLES

Abrasives normally employed for cutting tooth structure is Aluminum oxide, which is sharp, irregular particles, the hardness required and relatively low cost. Alumina particles- Alpha alumina, Pure, Bio-compatible long used in medicine and food. Infact it is prime ingredient in several popular tooth whitening pastes. Depending on the nature of abrasive used this technique has ability to effectively abrade both sound enamel and dentin, but to date, these applications using commercially available alumina abrasive do not include the efficient removal of softened carious dentin. Further investigation, into the use of alternative abrasive mixture has indicated that softer particles. (eg. Polycarbonate resin alumina-hydroxyapatite mixtures) might be more selective in removal of carious dentin, because they are only capable of removing tissue of equivalent hardness leaving healthier, sound tissue virtually unscathed.[5]

AIR ABRASION VARIABLES[6]

Air abrasive units allow the clinician to focus a stream of aluminum oxide particles on a specific area of the tooth. The restorative capabilities of these techniques are wide ranging and dependent on how the operator controls the following variables.

1. Pressure
2. Tip size
3. Tip angle
4. Tip distance
5. Dwell time
6. Particle size

Pressure: Most available units operate between 40-140 psi (pounds per square inch). The lowest effective pressure should be used to achieve the desired tooth preparation. For fissure cleaning prior to sealant application, a brief exposure of 40 psi is sufficient. While more extensive decay removal may require a nozzle pressure of 80 psi or more.

Tip Size: Tip aperture ranges from 0.015" to 0.027" in diameter, large tips allow more particles to pass through and are well suited for more substantial preparations, while smaller tips are used for discrete applications such as preventive resin restorations.

Tip Angle: Tip angle can range from 40° to 120° allowing access to both straight occlusal surfaces and the distolingual grooves of upper molars.

Tip Distance: By keeping the tip less than 2 mm from target surface, the clinician maximizes the focus of abrasive stream.[7]

Dwell Time: Longer the exposure, the further the preparation will advance.

Particle Size: 27 mm aluminum oxide powder is normal for intra oral procedure,[8] 50 mm powder for extraoral endeavors due to its excessive cutting and the difficulty in controlling over spray.

Scanning electron micrographic effects of KCP preparation on human enamel and dentine[9]

Cavity preparations of the high speed burs had sharply defined cavosurface margins. Higher magnification revealed that the cavosurface margins showed areas of cracking and micro chipping.

KCP preparations demonstrated.

1. Rounded cavosurface margins and internal line angles.
2. Microscopic roughness of treated enamel and dentin
3. A halo of abraded enamel surrounding the cavity's outline.
4. Apparent closure of dentinal tubules.

Applications and Limitations of Air abrasion

1. Cavity preparations - Class I, V, VI.
2. Internal cleaning of tunnel preparations.
3. Removal of temporary cement from inside a crown.
4. Microairabrasion of white spot enamel hypoplasia.
5. Stain removal.
6. Preparation of metal surfaces inside a crown for better bonding.
7. Aid in repair of acrylic, composite and porcelain. The narrow cutting path and lack of vibration and heat make air abrasion technology an alternate method for these repairs.

Situations in which Air abrasion is not an effective procedure include

1. Crown preparation.
2. Large carious defects - Air abrasion is not effective for removal of gross caries because it does not effectively cut substances that are soft or resilient.
3. Amalgam removal - Air abrasion is not an efficient means of removing amalgam restorations, as there is a release of mercury vapors when amalgam is abraded.
4. Class - II Cavity preparation - Soft materials such as carious dentin or moist and resilient decayed dentin cannot be abraded effectively with air abrasive unit. The particles tend to bounce and they do not cut effectively. Hand or rotary instruments should be use in these cases.[10]

Advantages of Air abrasion

1. Non - traumatic treatment.
2. Biocompatibility.
3. No chipping.
4. No microfracturing.
5. Decreased thermal build up.
6. Microsmooth margins.
7. Less invasive procedure that preserves more natural tooth structure than conventional instrumentation.[11]
8. Greater strength and longevity because of lesser preparation.
9. No anesthesia.
10. Less discomfort during preparation.

Disadvantages of Air abrasion

1. Ability to accomplish only some aspects of dentistry.
2. Lack of tactile sensation when using the air abrasion handpiece, because the nozzle of air abrasion instrument does not come in contact with the tooth[12].
3. Non contact based modality, leading to significant risk of cavity over preparation and inadequate carious dentin removal.
4. Mess and spread of aluminum oxide around the dental operatory.
5. Danger of air embolism and emphysema.

6. Impaired indirect view because abrasive particles collect on mirror rapidly blocking the viewing surfaces.[13]
7. Damage to dental mirrors, optical devices like magnifying loupes, intraoral camera lenses or photographic equipment.

Contraindications of Air abrasion

1. Asthma patients.
2. Severe dust allergy.
3. Chronic pulmonary disease.
4. Recent extraction.
5. Open wounds in oral cavity.
6. Subgingival caries removal.

Safety issues[14]

1. The particles inhaled are more than 10µm in size and cannot enter the alveoli, they are readily swept away by normal ciliary action.[15] To reduce respiratory exposure, the clinical staff should always use surgical face masks and use dry vacuum systems to reduce patient exposure.
2. Use rubber dam, protective eye glass and dead soft metal matrix to protect adjacent tooth structure.
3. Use disposable mouth mirrors.
4. Rinsing instead of rubbing the optical surfaces helps prevent scratches.
5. High speed suction and an external vacuum system are necessary to capture the powder that escapes into the air and to enhance practitioner vision and patient comfort.

Air abrasive Equipment available: Kavo Rondoflex (Kavo, India), KCP 100, Prepstart.

CONCLUSION

As an adjunct to traditional restorative techniques, air abrasion seems to be carving out a place of itself in dental armamentarium. Air abrasion tooth cutting has been accepted relatively well by a small segment of profession. It is growing, slowly and is expected to continue to grow in popularity. The ultimate goal is to extent life of restored tooth with as less intervention as possible. When operative care is indicated it should be aimed at **"PREVENTION OF EXTENSION"** rather than **"EXTENSION FOR PREVENTION"**.

References

1. Black G V. Lecturers on operative dentistry and bacteriology. Chicago: Blakelee publishing co; 1899.
2. Andrew Brostek: Air Abrasion Microdentistry- A new type of dentistry. Famdent 2002; Vol-**2**:19-23.
3. Pitel ML. The resurgence of air abrasion into restorative dentistry. Part 1. Dental Today 1998; **17**:62-69.
4. Myers TD. Advances in air abrasive technology. J. Calif Dent Assoc 1994; **22**:41-44.
5. Banerjee A Watson TF, Kidd Eam. Dentine Caries excavation: A Review of current clinical techniques. Br Dent J 2000; **188**:476-482.
6. Chris L. Byyant: The role of air abrasion in preventing and Treating Early Pit and Fissure Caries. J. Can. Dent. Assoc. 1999; **65**:566-569.
7. White JM, Eakle WS. Rationale and treatment approach in minimally invasive dentistry. J Am Dent Assoc 2000; **131**(suppl):13 s-19 s.
8. Kotlow LA. New technology in pediatric dentistry. N Y State Dent J 1996; **62**:26-30.
9. Kim A. Laurell, John A. Hess: Scanning electron micrographic effects of air abrasion cavity preparation on human enamel and dentine: Quintessence International 1995; **26(2):**139-144.
10. Goldstein RE, Parkins FM. Using Air abrasive technology to diagnose and restore pit and fissure caries. J Am Dent Assoc 1995; **126:**761-766.
11. Mayes J, Porth R. Air abrasion: The new "drill-less" dentistry. Dent Today 1997; 16:**58**, 60, 62-65.
12. Goldstein RE, Parkins FM. Air abrasive technology: Its new role in restorative dentistry. JADA 1994; Vol **125**:551-557
13. Christensen GJ. Air abrasion tooth cutting: state of the art 1998.J Am Dent Assoc 1998; **129**:484-485.
14. Paul Lamberchts, Daniela Mattar, Jan De Munck, Lars Bregmans, Marleen Peumans, Guido Vanhelle, Bratolomeus Van Meerbeek. Air abrasion enamel microsurgery to treat enamel white spot lesions of traumatic origin. Journal of Esthetic and Restorative dentistry 2002; **14(3):**167-187.
15. Wright GZ, Hatibovic-Kofman S, Millenaar DW, Braveman I. The safety and efficacy of treatment with air abrasion technology. Int J Pediatr Dent 1999; **9**:133-140.