AIR-ABRASIVE TECHNOLOGY FOR PIT AND FISSURE CARIES

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ABSTRACT

Dental Research surveys indicate that the Incidence of pit and fissure caries constitutes a higher pro- portion of the total caries incidence among teens and children than in the past . Air abrasive technology may provide a more conservative alternative in the diagnosis and treatment of pit and fissure caries than traditional techniques using hand pieces. Using a pressurized stream of microscopic non-toxic abrasive powder, the technology provides a new means for rapidly removing enamel, dentin, decay and previous restorations. Although not appropriate for every clinical situation, the air-abrasive system offers several advantages over conventional hand pieces. The authors review pit and fissure lesions and discuss methods for diagnosing and treating these lesions using air-abrasive technology.

INTRODUCTION

Air abrasion was developed in the 1940 as an alternative to the slow-speed , belt-driven hand pieces used at that time. The S.S. White Company introduced the Air dent air-abrasive unit in 1951. The technology enjoyed a brief period of popularity due to its patient-friendly aspects: no heat, vibration or bone-conducted noise .The arrival of the Borden air rotor, the first air turbine hand piece, in tlate1950,however, quickly replaced alternatives such as the Air dent. Since its recent re-emergence, air-abrasive technology again offers an alternative to conventional hand pieces.

Using a pressurized stream of microscopic non-toxic abrasive powder, the technology provides a new means for rapidly removing enamel, dentin, decay and previous restorations. Although not appropriate for every clinical situation, the air-abrasive system offers several advantages over conventional hand pieces. For example, the air-abrasive system minimizes heat, vibration and bone-conducted noise associated with conventional means of caries removal since the cutting is accomplished by air pressure. Also, patients treated with the air-abrasion system rarely request anesthesia.

Dental Research surveys indicate that the Incidence of pit and fissure caries constitutes a higher pro- portion of the total caries incidence among teens and children than in the past. Air abrasive technology may provide a more conservative alternative in the diagnosis and treatment of pit and fissure caries than traditional techniques using hand pieces. The authors review characterizes pit and fissure lesions and discuss methods for diagnosing and treating these lesions using air-abrasive technology. The air-abrasive system uses a narrowly focused particle stream that abrades tooth structure in proportion to the particle size, air pressure and nozzle distance employed. Therefore, this newly revived technology may provide a more conservative means of diagnosing and treating pit and fissure caries than conventional methods . Exploring new avenues of addressing pit and fissures caries is particularly important now because recent surveys indicate that the incidence of pit and fissure caries has become a higher proportion of the total caries incidence among U .S. teens and children. This article reviews the characteristics of pit and fissure lesions and introduces methods to detect and treat pit and fissure caries with air-abrasive technology.

PIT AND FISSURE CARIES

Changing patterns of dental caries suggest the need for a new emphasis on diagnosing and treating pit and fissure caries. By 1985,Ripa noted that although occlusal surfaces constitute only 12 percent of the total permanent dentition surface area, they are the sites for the development of more than 50 percent of the caries reported among school- age children(figure I). This high rate may reflect the dramatic decline in the incidence of smooth-surface caries noted by Hicks in his discussion of sealants and caries-preventive resins. Pit and fissure caries, however, has not proportionally decreased in incidence and therefore has become a more significant problem. A national study of more than 30,000 school-age children dramatically documents this shift in caries incidence: the National Institute of Dental Research found that from 1980 to 1987, decay in pits and fissures was reduced by 31 percent, while caries in other surfaces dropped by 51 to 59 percent. In areas with non-fluoridated water, pit and fissure caries accounted for 80 percent of the total caries detected. This proportion jumped to 90 percent in areas with fluoridated water. Researchers in France reported similar findings.

Among other conclusions, the authors who reviewed the NIDR studies stated that the greatest caries sus-

ceptibility of both permanent and primary teeth is in the pit and fissure surfaces of the molars. In addition, researchers have begun to re-evaluate the methods used to detect pit and fissure lesions. Specifically, they question the traditional use of the explorer to probe for caries. Enamel undermined by carious dentin but strengthened by fluorides appears less likely to fracture and collapse than non-fluoridated enamel, making detection of underlying diseased dentin difficult . Additional reports scrutinize the effectiveness of radiographs and other diagnostic methods in diagnosing pit and fissure caries. Difficulty in distinguishing a stain on the surface from a darker-colored organic plug within the pit or fissure that can promote caries also contributes to the diagnostic dilemma.

AIR-ABRASIVE TECHNOLOGY

Air-abrasive technology offers new options in caries diagnosis and restoration. Scouring action of the air-abrasive method can clean out both stains and organic debris in preparation for sealant application and can open areas of early caries for replacement with resin restorative materials (figure II). This article will present methods of both diagnosis and treatment of pit and fissure caries employing air-abrasive technology . Air-abrasive technology provides a new approach to diagnosing pit and fissure caries. This method is of particular advantage in examining darkened areas in the bottom of pits and grooves. If a suspicious darkened area is detected on visual examination, the air-abrasive system can deliver one or more short bursts of alpha alumina powder into the pit or groove. If the darkened material is simply a stain or the organic plug, this abrasive action will quickly eliminate it while leaving all but a few microns of healthy tooth structure intact. Frequently, short bursts from the air-abrasive instrument reveal underlying

Fig 1: Pit and fissure caries w.r.t 75

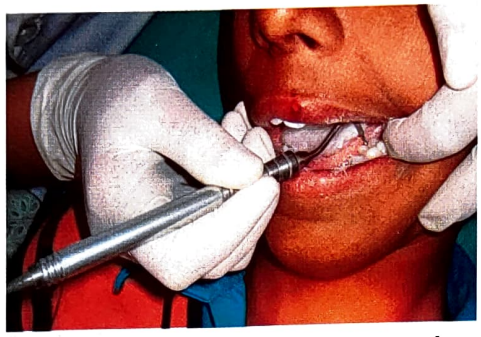

Fig 2: Using Air Abrasive system to diagnose pit and fissure caries

decay that had been masked by the stain. This previously undetected decay may even penetrate into the dentin. Further bursts of the abrasive powder stream may be used to completely eradicate these dark, carious veins until only lighter-colored healthy tooth structure remains. Because the dentist controls the duration and range of these bursts, he or she is able to remove tiny amounts of material at a time, preserving a maximum amount of healthy tooth structure.

The air-abrasive technique roughens the tooth surface, leaving it suitable for direct bonding techniques without acid etching. Carious dentin can be removed by additional bursts. An air-abrasive preparation can be restored immediately with either a filled or an unfilled composite resin. If the grooves are shallow and little or no tooth structure is eliminated, it may be appropriate. If the anatomy is irregular or decay had been present and tooth structure had to be removed, the lost material should be replaced with a bonded, filled resin and the restored tooth recontoured. Smaller secondary grooves may then be covered with sealant, creating a preventive resin restoration. If the caries extends beyond the enamel into the dentin, a glass ionomer liner should be placed before the composite and the sealant. Further, authors of one article recommended use of a laminate restoration consisting of a composite resin sandwiched between a glass ionomer liner as well as use of a covering sealant if the finished restoration will be subject to occlusal stress. These restorations can be completed quickly and conveniently using air abrasion because this technology does not require liquid cooling or acid rinses and, therefore, allows the dentist to work in an entirely dry field.

This device is not well-suited for removing all decay, however. Moist and resilient decayed dentin cannot be abraded effectively with the air-abrasion unit. The particles tend to bounce, and they do not cut efficiently. Hand or rotary instrumentation should be used in these cases. Air-abrasion devices also cut dentin more readily than enamel, which allows overhanging enamel to develop. To avoid overextension in dentin, clinicians may need to trim the enamel margins with a rotary instrument. Larger restorative preparations may require the use of a combination of techniques.

DISCUSSION

The air-abrasive technique provides an alternative to the traditional method of diagnosing and treating fissure caries that offers a number of advantages. For example , more accurate diagnosis with immediate cavity preparation is possible with the air-abrasion system. The process could start with the hygienist, who should carefully examine the teeth for darkened areas in the bottom of pits and grooves. If available , an air slurry pol-

isher can be used with a sodium-bicarbonate slurry to remove most stains if no decay is present . The dentist should do a follow-up examination of any darkened area that is not removed by the sodium-bicarbonate slurry.

The traditional means of diagnosing caries has included use of the explorer and radiography. However, researchers have questioned the validity of both these methods in recent years. A sticky fissure detected by the wedging of an explorer tip is no longer considered a reliable sign of caries. Probing of pits and fissures also has been de-emphasized because of its potential for damaging the same. Likewise, reports indicate that radiographs often fail to detect caries in the early stages. Instead, studies suggest that careful visual inspection of an air-dried tooth surface is most revealing. Intraoral video cameras can facilitate the viewing of caries in grooves that are too narrow for the penetration of an explorer tip. Any defects that are detected can be opened up and cleaned out using the air-abrasive system, revealing the true carious nature of the area beneath the organic plug. Studies also question the advisability of placing a sealant over decay, particularly when the decay extends into dentin. When sealants are properly applied over caries and carefully monitored, they are effective in arresting the disease. Unfortunately shrinkage and marginal wear commonly lead to leakage. In" Modern Concepts in the Diagnosis and Treatment of Fissure Caries," Paterson and others noted. If such leakage occurs over active dentinal caries, it may not be detected before pulpal involvement or extensive undermining of enamel and/or cuspal fracture occurs. This same risk of leakage and the reactivation of decay also is a concern when sealing over decayed enamel. By employing air abrasion to clean and reveal decay, this can be avoided.

From the patient's point of view, air abrasion offers several advantages. Patients readily appreciate the concept of conserving healthy tooth structure by attacking decay at the earliest possible moment. Psychologically, they also may feel better about maintaining teeth that have been restored to natural, healthy appearance, rather than restored teeth that retain unsightly stains around the restoration. Since the air abrasive system usually allows the procedure to be performed without anesthesia, vibration and annoying sounds, patients view the service as extremely valuable. Expense reductions can offset investment by reducing the use of prophy paste, disposable prophy angles or rubber cups and brushes. The tubular hand piece of the air-abrasive unit can be sterilized by bagging and autoclaving, and it does not require the labor-intensive lubrication and processing needed for high-torque/1ow-speed and air rotor hand pieces. Fewer burs, anesthetic cartridges and topical preparations also are used when the air-abrasive system is employed, further reducing expenses. Faster working times mean more accomplished at each sitting, increasing patient satisfaction. Faster working times also translate into more patient visits per day.

Researchers' interests have also been piqued by the re-entry of this technology into dentistry .Initial studies using the technology with bonded resin materials have been encouraging. Further studies of micro leakage and bond strength are needed . Studies evaluating dentin bonding after air-abrasive preparation vs. conventional acid etching have been favorable but also variable and require further research. Technique variations may reveal even more effective and efficient procedures with this new technology. Future air-abrasive equipment may incorporate improvements . Currently, the size of the available units is somewhat intrusive in smaller operatories. Also, the nozzle tip requires frequent monitoring for wear, but more resistant material could be found that would increase the nozzle tips' durability. Because the future of air abrasion seems secure, further improvements are inevitable.

CONCLUSION

Pit and fissure caries poses one of the most serious threats to the dental health of our next generation of patients. Air abrasive technology may provide a useful method to help meet that threat head on. In brief, the steps in the air abrasive approach to diagnosis and treatment of pit and fissure caries are visually detecting suspiciously stained pits or fissures;

- removing stain with an air abrasive stream;
- evaluating the pit or fissure for decay;
- if no decay is present, sealing the pit or fissure with resin materials;
- if caries is present, completely eradicating the decay using the air abrasive stream {hand or rotary instruments may be used if the area of decay is large); depending on the extent of decay, restoring with glass ionomer cement, an adhesive bonding agent, composite resin or sealant, or an additive combination of materials.

In many cases, the air-abrasive approach allows for the discovery and treatment of decay that was difficult to detect by other means. Patients appreciate the comfort of this approach to the early interception of decay. Air-abrasive technology provides a promising addition to available preventive and conservative methods for surface preparation and removal of stain or decay. Long-term clinical observations with these methods are needed.

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