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REVIEW ARTICLE

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The use of dental sealants in adults: a long-neglected preventive measure

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Abstract: The consensus among the general public appears to be that dental sealants are intended to be used primarily with children whose teeth are in the early developmental stage, yet little attention is given to the preventive long-term aspects when applying them to adult permanent dentition. This article explores the rationale and substantiates the use of dental sealants among the adult population in reducing occlusal pit-and-fissure caries while accentuating a beneficial oral health lifestyle.

Key words: dental hygienist; dental sealants; pit-and-fissure sealants; preventive resin restorations; sealants

Introduction

The former United States Surgeon General C. Everett Koop once quoted, 'You're not healthy without good oral health' (1). Since the early introduction of sodium fluoride into US public water supplies in 1945 (2), along with the methods of incorporating fluoride into tablets, toothpastes, and mouth rinses, there has been a notable impact upon the treatment and preventive philosophy behind tooth decay. It is clearly evident that combining the effects of sealant placement and the application of fluorides onto the surfaces of teeth are both pinnacles behind a highly effective caries prevention programme. Dental sealants have been found to be the most cost-effective caries preventive measure for pits and fissures. On the contrary, topical fluoride must be applied four times a year, thereby making it more costly and only a short-term solution in resolving the problem of smooth surface caries. These topical fluoride applications still do not address the problem of pit-and-fissure caries (3). Curro and Levi have pointed out saying there is no evidence in the literature, based on scientific and clinical research, as to the reasons why sealant therapy should not be extended to the adult

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population (4). Studies have proven the occlusal surfaces of molars and premolars, lingual grooves and pits of maxillary molars and incisors, and the buccal pits of mandibular molars are especially susceptible to caries attack (5, 6). Since these surfaces are more susceptible to caries forming due to erosion and/or changes in the intrinsic factors found in a person's saliva, a large portion of the adult and geriatric population falls into this category. These individuals are often on life-long therapies capable of producing a number of systemic and oral complications, including xerostomia, which may increase caries susceptibility. The prevalence of dental sealants can inhibit the advancement of caries in these cases and is the ideal treatment of choice for borderline carious lesions (4).

Background

As early as 1955, Buonocore was the first researcher to describe the fundamental principles for placing sealants (7). Controlled clinical studies were conducted throughout the mid-1960s (8, 9) and eventually in 1976, the American Dental Association published a statement officially accepting sealants as a safe and clinically effective method of preventing dental caries (10). The concept of using a liquid resin flowing into deep crevices and fissures on the occlusal surfaces of teeth is a simple concept since these resins are capable of forming a physical barrier between the tooth and any bacterial invasion. Figure 1 illustrates a dental sealant occupying the deep pit and fissure of a tooth. In 1969, Keyes described three etiological factors which interact simultaneously for caries to occur and progress. These include a susceptible host, cariogenic microflora, and a suitable substrate (sugars) (11). If the source of nutrition for the cariogenic bacteria could be eliminated, the bacteria would die and the carious process arrested (12). Just as the use of fluoride has been effective in reducing carious lesions on the smooth surfaces of enamel, in contrast it has been *ineffective* in addressing caries found on the occlusal pits and fissures of teeth. It has been estimated that even though occlusal surfaces make up 12% of the total number of tooth surfaces in the mouth, the pits and fissures are approximately eight times more vulnerable than smooth surfaces (13). Studies have demonstrated the use of dental sealants in proving to be effective at preventing caries among children and adolescents (14). The disparaging fact is sealant usage is low in the United States. A review of data, released by the Third National Health and Nutrition Examination Survey (NHANES III), revealed less than 19% of children 5–17 years of age had at least one sealed permanent tooth (15). In another mail survey conducted in Minnesota, 95% of 375 dentists reported placing sealants, but the placement varied from 1 to 25 per week. The

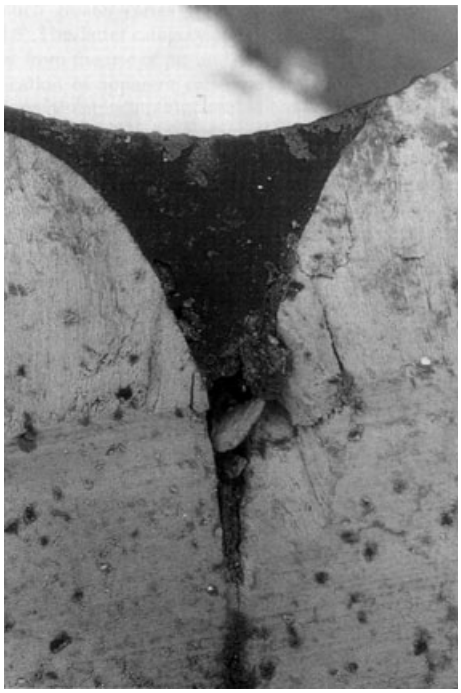

Fig. 1. SEM of a dental sealant inside the pit and fissure of a tooth (Courtesy of Roberson TM, *et al. Sturdevant's Art and Science of Operative Dentistry*, 5th edn, Copyright Mosby).

theory behind the disparity of these numbers was the fact that although a majority of the dentists placed sealants, the *frequency* of usage was low (16). The statistics for placing sealants in adults is even lower. In this age category, the NHANES III survey indicated that 5% of 18- to 24-year-old adults and 2% of 25- to 39-year-old adults had evidence of dental sealants (17). In some states, a positive trend was encouraging when sealant education programmes were instituted and the routine use of sealants increased significantly. For example, the Utah Department of Health implemented a sealant education programme in 1982 resulting in a phenomenal increase in sealants placed, ranging from 10% to 48% over a 5-year period (18). Equally impressive was a study conducted by Ripa where he reviewed 41 reports of 24 sealant effectiveness studies and discovered caries reduction in populations where sealants had been used. Reductions varied from 82% after 1 year of applying sealants to 34% after 7 years (19). A longevity study by Simonsen revealed a one-time application of sealants was responsible for reducing caries by 52% during a 15-year period (20).

Rationale for sealant use in adults

When a sealant sets up and becomes hard, it forms a physical barrier between the tooth and any invading bacterial species. *Streptococcus mutans*, the dominant member of the plaque flora

responsible for decay and caries, takes advantage of these pits and fissures as the ideal niche for multiplying and to produce large amounts of acids capable of destroying tooth structure (21). The idea of applying sealants is especially important during tooth eruption, even though the application of sealants in suspect fissures is advisable in older patients with a high caries risk (22). In a study by Stahl and Katz, the most susceptible teeth involving occlusal caries among college students were molars, especially second molars. In their study, assuming first molars erupted in the sixth year of life, they exhibited a 9.9% occlusal caries incidence rate in years 11–14 post-eruption. If the second molars erupted in the twelfth year of life, this same group exhibited an occlusal caries incidence rate of 14% during the years 5–8 post-tooth eruption (23). It has been suggested posterior teeth may remain susceptible to caries for many years, perhaps indefinitely, after eruption into the mouth (22–26) with caries progression continuing far into adulthood (27–30). Since secondary recurrent caries is the primary reason for the failure and replacement of restorations in the adult population, sealants can impact these statistics on the occlusal surfaces of teeth (31). Mertz-Fairhurst demonstrated in numerous trials that the sealing of amalgam restoration margins, immediately after placement, can improve the longevity of the final restoration (3).

Caries risk and caries reduction

The statistics regarding caries reduction are revealing. The 2000 NHANES III study reported 78% of the 17-year olds have tooth decay with an average of seven affected tooth surfaces. This number increases to 98% when we include the adult population of 40- to 44-year olds who had tooth decay with an average of 45 affected tooth surfaces (32). In a study by Beck, he discovered that among dentulous patients in Iowa over the age of 65, there were 90% having coronal decay and 39% had untreated carious root lesions, with a mean of 2.3 decayed and filled surfaces (33). The focus in reducing caries should be on prevention. Over 100 million Americans do not live in water fluoridated communities (34). Eighty per cent of the local health department in our cities and rural communities do not have any dental programmes (35) and nearly 93% of the US adult population, 40 years and older, have not had an oral cancer examination in the past year (36). Sadly, more Americans will die from oral and pharyngeal cancer than cervical cancer or melanoma each year (37). How many Americans do not have dental insurance? 125 million, and 81% of the nursing home adult residents have not had a dental visit within the last year (35). Finally, it is estimated 38% of rural counties have no dentist and 62% have no dental hygienist (38).

Combining the effects of fluoride on smooth surface caries with the routine, aggressive use of sealants against pit-and-fissure caries has a potential for eradicating caries in children, adolescents, and adults (3). In a study on military recruits, the use of dental sealants tripled over a 4-year period (1987–1991) resulting in a decrease in one-surface amalgam restorations which might have been placed without the use of sealants (26). In another military study, Simecek found 87.8% of the dental sealants placed were still retained after 35 months (15). Many dentists object to placing sealants feeling that the possibility may arise of inadvertently placing sealants over incipient carious lesions. The theory behind their reluctance centres on the fact that the caries would progress undetected and eventually advance to the pulp. This contentious issue was addressed and culminated in studies indicating caries actually does not progress as long as the pit and fissure remains sealed and intact (39–42). Separate studies also demonstrated that sealed, radiographically evident caries did not progress over a 10-year period (12, 43). Dental sealants have been reported to remain completely intact for as long as 7 years after one application compared with the life span of an amalgam restoration which ranges from 4–8 years (44). When the National Institutes of Health and the National Institutes of Dental Research held a conference on dental sealants, the final consensus revealed the 'expected' danger from sealing undetectable caries may actually be *beneficial* in arresting or stopping the caries process (45). In forming a physical barrier between bacteria and the nutrients normally found in the oral environment, the cariogenic bacteria including *S. mutans* cannot survive, and thus the sealed carious lesion becomes sterile in nature and will not progress and expand (41, 46–52).

Improving dental sealant retention in adults

The complete retention rates of dental sealants after 1 year are 85% or better, and after 5 years the number is at least 50% (45). What happens if a portion of the sealant is lost over time? It can simply be repaired. Romcke and others proved occlusal caries could be reduced by 95% over 10 years if 2–4% of the sealants were routinely repaired each year (53). When is the most opportune time to repair these sealants in the adult population and who should accept this responsibility? Foreman has stated, 'the purpose of an adult prophylaxis appointment should be expanded beyond the diagnosis and treatment of periodontal diseases. It should include the evaluation and repair of sealants that show partial loss' (26). There are

differences in opinion as to exactly how a repair should be implemented. Romke and others repaired their defective sealants in instances where a pit or fissure had been exposed. Using these criteria, there was virtually no difference between sealant placement and sealant repair. They estimated one-fourth of the sealants were repaired over a 10-year period (53). Foreman went on to conclude, in an adult patient with eight sealants, one sealant could be repaired every 5 years.

The role of the dental hygienist

The auxiliary (dental hygienist or dental assistant) is capable of performing the repair of a lost or missing dental sealant in approximately 2–5 min. The following Figs 2–5 illustrate the placement of a light-cured sealant on a molar tooth. Use of any dental auxiliary would be limited to those states where this procedure would be legally permitted (26). Presently, dental sealants can be applied by the dentist and hygienist in 30 states, or by expanded duty assistants in 10 states (4). The dentist is ultimately responsible for the screening process, however, if a dental practice is to become more productive, these auxiliaries could be trained and assigned to place sealants (54). Time management is maximized and staff personnel are used more efficiently. Using dental auxiliaries in this manner would be a significant factor when evaluating the cost-effectiveness of a sealant programme (55–57). An annual recall for adult patients could include a re-evaluation process of sealant retention, not restricted by their age, but as part of a long-term preventive patient maintenance programme ensuring optimum oral health.

Evidence-based research for sealant use in adults

Evidence-based dentistry (EBD) is becoming more relevant in treating our patients. The American Dental Association has defined EBD as an approach to oral health care requiring clinical decision-making based on the judicious integration of systematic assessments of clinically pertinent scientific evidence related to the patient's oral and medical condition and history, the dentist's clinical knowledge, and the patient's treatment needs and preferences (58). Observing dental caries as a 'medical model', where the etiologic disease-causing agents are balanced against other protective factors, including risk assessment, there can be a plausible solution involving patient-centred disease prevention and management before caries activity can damage the teeth. Concern for future caries in a fissure or groove on a tooth can easily be resolved by using a sealant, a technique which has been documented to

Fig. 2. Picture of a non-carious unsealed molar.

Fig. 3. Light-cured sealant placed before light-curing (3M ESPE Clinpro Sealant).

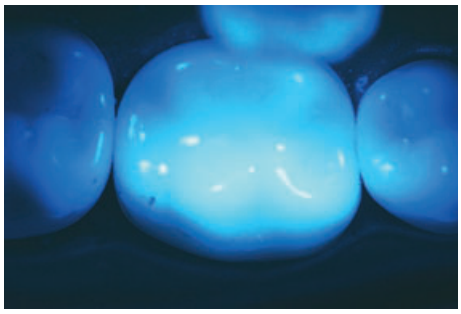

Fig. 4. Light-curing the sealant material.

Fig. 5. Molar with light-cured sealant in place.

prevent and arrest caries (59). Caries Management by Risk Assessment (CAMBRA) was developed as a solution to promote clinical management philosophy in which the caries disease process came under the guidelines of the medical model. It was CAMBRA which supported the use of chemical remineralization of early pre-cavitated lesions in adult teeth and the sealing of noncavitated carious lesions on the occlusal surfaces (60–62).

Future direction

The use of dental sealants in adult dentition has proven to be an effective oral health preventive measure. The patient benefits from improved oral health care, the dentist benefits from increased productivity in their practice, and the dental hygienist benefits from increasing their own knowledge and applying these skills while being an indispensable member of the dental practice team concept.

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