Prevention and Early Intervention Strategies

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ABSTRACT

Many people in California face significant barriers to obtaining dental care. Creation of a community-based oral health delivery system that could deliver preventive and simple therapeutic oral health services in community settings where these populations live or receive social and/or general health services has been one of the proposed strategies for improving access to oral health care. Two of the newer techniques are caries management by risk assessment and interim therapeutic restoration.

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There is ample evidence that many people in California, and all across our nation, face significant barriers to obtaining dental care, and, as a result, these people have significantly worse oral health than other segments of the population. The barriers to dental care are greatest for children in general, minority children in particular, for children and adults with low incomes, and for children and adults with complex medical, physical, and social conditions. Many of these underserved individuals have difficulty getting to dental offices on a regular basis due to physical, medical, behavioral, cultural, or financial circumstances. For this reason, a number of organizations have expressed interest in addressing these health disparities by extending the reach of oral health professionals into community locations, creating a community-based oral health delivery system that could deliver preventive and simple therapeutic oral health services in community settings such as places where these populations live or receive social and/or general health services.

Preventive oral health services that can be readily delivered in a community-based setting include basic oral hygiene instruction (regular use of a soft-bristle toothbrush, proper brushing technique, flossing technique, use of fluoride-containing toothpastes and rinses), basic diet and nutrition counseling, smoking prevention and cessation counseling, risk assessment for periodontal, caries, and occlusion diseases, and oral cancer screening. The increased rate of caries disease is especially evident amongst populations with limited access to dental care, which emphasizes the tremendous need for caries prevention and therapeutic management services for these people. Community-based settings have been proposed as the first-line in caries prevention and treatment, and as a screening base for referral of patients to dental offices for definitive care. Two of the newer strategies for assessment and
management of caries disease are caries management by risk assessment (CAMBRA) and interim therapeutic restorations (ITR). This article will focus on the evidence for these new strategies and their potential application into community-based oral health care settings.

Caries Disease

As an infectious and transmissible disease, dental caries has had a tremendous negative impact on the oral and overall health of the population of the United States. According to the Surgeon General’s Report of 2000, dental decay in children is three times more common than hay fever and five times more common than asthma. The report goes on to state that at least 50 million school hours have been lost due to dental related illnesses within one year.1 While the traditional surgical approach to dentistry has excelled at being able to duplicate the form and function of diseased hard-tissue structures, it has done a poor job of making an impact in the continued downward spiral of oral health in many segments of our population. The successful management of dental caries goes beyond the form and function approach and must take into account a patient’s risk factors and disease indicators. This is where caries management by risk assessment can begin to make an impact on future caries experience.

Many segments of society encounter barriers when they attempt to attain oral health. Barriers to basic oral health care include financial, social, psychosocial, medical, developmental, and cultural. These barriers have created a stratification of disease where 80 percent of oral disease is concentrated in about 20 percent of the population. Our most vulnerable patients are children, the elderly, those with severe medical/developmental conditions, and under-represented minority populations. It has been found that dental disease is extremely prevalent in 25 percent of those with cerebral palsy and 30 percent of patients with head injuries. Additional studies have indicated that upward of 70 percent of America’s nursing home population have poor oral hygiene and severe dental disease.8

There have been some startling trends in the demographic profile of children in California over the last 30 years. Data from the National Center for Children in Poverty indicates that low-income families, there have been dramatic shifts in caries rates reflected in the pediatric population. According to the California Oral Health Needs Assessment of Children, greater than 50 percent of all California school-age children have untreated dental decay; more than twice the national average. Children of Asian, African-American, and Hispanic descent were found to have significantly higher rates of untreated dental decay than other populations.9

Our current method of surgically treating the destructive caries process has done little to address the extreme needs in these populations. Not only is the surgical approach to dentistry more costly, it fails to take into account the effect that oral bacteria have on newly placed restorations. Even in the presence of newly placed restorations using state-of-the-art techniques, if existing biofilm, oral flora, dietary and oral hygiene habits are not addressed, these restorations will eventually breakdown leading to further dental and oral health consequences.

Caries Management by Risk Assessment

In order to make an impact on oral health for underserved populations, studies have been undertaken to examine more cost-effective and efficient methods of managing dental caries. One promising approach is to manage caries via patient risk assessment, the so-called CAMBRA approach.

CAMBRA was intensely evaluated by a university-based, multiyear randomized blinded clinical trial funded by the National Institutes of Health.10 This assessment tool utilizes a medical-model approach to identifying and treating the underlying bacterial cause of dental caries. There are several assessment forms available for use and modification. The form most commonly used is based on the one

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accepted by the group that published the Consensus Statement for CAMBRA in April of 2003. The patient’s overall risk assessment is based on a combination of disease indicators, risk factors, and protective factors. Once the overall risk is determined, appropriate intervention can be recommended using one or a combination of several chemotherapeutic approaches and behavior modifications.  

Although currently published studies were not undertaken utilizing an allied dental workforce delivering CAMBRA interventions in community settings, it makes sense to assume that this workforce configuration does have the ability to reach populations that office-based dentists do not, and to apply effective CAMBRA interventions. A recent article in the Journal of Dental Education highlights the challenges that the growing group of vulnerable patients will have in maintaining good oral health as they age and while maintaining their natural dentition. It will be important that skilled allied dental health professionals be considered as part of a future workforce model for addressing the needs of vulnerable populations. This workforce has the potential to reach high-risk patients on a regular basis, which is likely to be an important and very effective method of reducing the high incidence of oral disease in this population — certainly more effective than anything that can be done in a dental office where these patients do not go on any regular basis.

CAMBRA measures the relative balance between three elements: disease indicators, disease risk factors, and protective factors. While there are several types of assessment forms currently in use, the elements in each assessment instrument have some general commonalities. Disease indicators include visible cavitations, dentinal lesions, smooth surface white spots, and whether restorations have been placed within the last three years due to caries lesions. Disease risk factors assess the presence of visible heavy plaque, frequency and type of snacking, presence of deep pits and fissures, salivary pH, bacterial load, and whether or not the patient presents with xerostomia. The elements measured for protective factors include whether or not the patient uses fluoride toothpaste daily, if a fluoride rinse is used daily, a history of antibacterial rinse use, and if the patient had an office fluoride treatment in the last six months. The protective factors are weighed against the disease indicators and the disease risk factors.

Within the risk assessment regimen there are two objective measurements that are of particular value. The first is a measurement of the patient’s salivary pH. Previous research has substantiated the value of pH in predicting future carious development. pH measurement is done by obtaining saliva from the sublingual or sublabial areas with a cotton swab and applying the sample to standard pH paper. pH is recorded as either acidic or alkaline on the CAMBRA assessment form.

Another parameter of interest is the measurement of bacterial load. One method of quantifying bacterial load is to measure ATP bioluminescence via the luciferin-luciferase assay method. This test specifically assays the activity of S. mutans and lactobacillus species. There are several products on the market for this assay that use a swabbed saliva sample and only take a few minutes to complete. Based on an assessment of the CAMBRA form, the patient can be put into risk categories that range from low risk to extreme risk. Using the risk assignment as a guide, the clinician can then recommend appropriate interventions that address the specific risk. For the low-risk patient, the clinician may only recommend continuing the current regimen such as a review of their daily oral hygiene activities and diet assessment. The extreme-risk patient would warrant more aggressive intervention to eliminate harmful biofilm. There are many approaches to modifying a patient’s biofilm, but they generally are aimed at two specific areas: lowering bacterial activity and remineralizing teeth.

Patients who have a higher risk of developing caries are out of balance in the risk factors, disease indicators, and protective factors equation. Patients who have a higher risk of developing caries are out of balance in the risk factors, disease indicators, and protective factors equation. In order to regain balance, attempts are made to first lower bacterial activity. This can be done in several ways and with a variety of products on the market. The use of 0.12 percent chlorhexidine has been shown to be very effective at lowering the levels of S. mutans in a patient’s biofilm. Various recommendations range from rinsing with chlorhexidine 1-2 times per day for several weeks on an ongoing basis to 1-2 times per day for one week per month. Other proprietary medications include formulations containing buffering agents, sodium hypochlorite, and iodine. Xylitol is a useful sugar substitute that can have dramatic effects on bacterial activity. It is equal to table sugar in terms of sweetness level and is formulated into gums, mints,
and other food products. Xylitol has the unique ability to inhibit the growth of \textit{S. mutans} by decreasing the bacteria’s ability to adhere to tooth surfaces. Research has shown that using maximal doses of xylitol products can dramatically reduce active caries activity in patients. The use of xylitol in the mothers of pediatric patients also demonstrates lowering of vertical transmission of \textit{S. mutans}.\textsuperscript{22,23}

In addition to modifying bacterial activity, and neutralizing acids, CAMBRA interventions also are aimed at remineralizing tooth structure. Teeth are in a continual balance between demineralization and remineralization. When this balance is interrupted, decalcification via acids leads to white spot lesions and the subsequent development of cavitated lesions. Successful attempts can be made even in early carious lesions to tip the balance back to remineralization and re-harden damaged enamel. Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) is the newest member of the family of remineralization agents and comes in a paste form. CPP-ACP releases calcium and phosphate ions when saliva is acid-challenged and when salivary flow is suboptimal. In this situation, CPP-ACP provides a reservoir of soluble calcium ions that diffuse into subsurface enamel with resultant remineralization.\textsuperscript{24}

This product is generally recommended for use at bedtime after regular brushing and flossing, and not rinsed away.

Addressing the patient’s salivary pH is important to guard against acidic demineralization of tooth structure. Use of sodium bicarbonate, (simple baking soda) after meals can also mitigate the effects of bacteria-generated acids.\textsuperscript{25}

Perhaps the longest studied remineralization aid is fluoride, which has both a remineralization effect and inhibitory effect against caries-forming bacteria. Fluoride works primarily by promoting the formation of fluorapatite in the presence of calcium and phosphate ions. The limiting factor of fluoride activity is the availability of calcium and phosphate. Although there are years of research that substantiate the safe and effective use of fluoride, many cities have not added fluoride to drinking water, leaving large patient populations without this important decay-fighting element. In these cases, fluoride should be added to the patient’s CAMBRA regimen. Fluoride is available in a variety of forms including high fluoride toothpastes (.05 percent sodium fluoride), tray foams (1.23 percent acidulated phosphate fluoride), rinses (.05 percent sodium fluoride), and varnishes (5 percent sodium fluoride). Varnish, which has the longest surface contact time of any of the preparations, is usually applied every three to six months in a clinical setting. They are typically useful in younger children where cooperation can be an issue.\textsuperscript{26,27}

Once a CAMBRA assessment has been done, the clinician can follow the patient through continued monitoring and assessment.

Interim Therapeutic Restorations

Interim therapeutic restorations (ITRs), sometimes also referred to as atraumatic or alternative restorative treatments (ARTs), are defined by the American Academy of Pediatric Dentistry for use “to restore and prevent further decalcification and caries in young patients, uncooperative patients, or patients with special health care needs or when traditional cavity preparation and/or placement of traditional dental restorations are not feasible and need to be postponed.”\textsuperscript{28} ITRs are a “holding-pattern” temporary, hence “interim,” minimally invasive treatment modality that, identical to ART, uses only hand instrumentation to remove markedly demineralized (softened), carious enamel and dentin, and then restores the cavitation with an adhesive restorative material.\textsuperscript{29}

This technique was originally developed for use in the less-industrialized parts of the world where access to traditional dental care is difficult, and IRT/ART has now become an accepted part of the minimum intervention philosophy in developed countries.
as well, and is increasingly becoming part of contemporary dental practice in the United States. ITRs have been shown to reduce the levels of cariogenic bacteria, such as mutans streptococci and lactobacilli, in the oral cavity, and are a recommended part of comprehensive care in the community-based dental home setting, as well as a beneficial technique in contemporary pediatric, special needs, and general restorative dentistry practices. There is substantial evidence that the removal of all carious infected dentin in deep lesions is not necessary for successful termination of the caries lesion destructive process, particularly if the removal of deep infected dentin would place the pulp at risk of exposure. Several studies have demonstrated that cariogenic bacteria, once isolated from their source of nutrition by a well-sealed restoration, either die or remain dormant and thus pose no risk to the health of the dentition. However, it is essential that restorations that leave infected dentin in the tooth must be well-sealed to isolate the lesion from the oral environment. The risk of leakage of ITR restorations can be minimized by thorough removal of all demineralized tooth structure from the periphery of the lesion, which maximizes the bond of adhesive restorative materials at the margins, and by the use of glass ionomer restorative materials.

High-viscosity glass ionomer cement (GIC) materials have been the preferred restorative material for ITR, especially when applied to single-surface or small surface restorations. The glass ionomer adheres to enamel and dentin primarily via calcium bonds to the mineral content of the tooth structure. This adherence provides an adaptive seal, and, as the material slowly leaches fluoride ions into the adjacent tooth structure, GICs are capable of halting or slowing the progression of carious lesions. More recently, newer resin-modified glass ionomer (RMGI) filling materials are showing considerable improvement of physical and adhesive properties, expanding the applications for ITRs and making it possible for them to be used in higher occlusal stress areas where failures previously occurred. The RMGI materials also permit broader application for more esthetic anterior temporary fillings and more wear-resistant posterior temporaries. It is significant that numerous studies show that ITR restorations with glass ionomer materials consistently demonstrate success rates equal to amalgam filling material, and, in some studies, their survival rate has exceeded that of amalgam fillings in single-surface and small surface restorations. This is an important factor when employing ITRs in community dental home settings where the timeframe from placement of the ITR temporary to definitive restoration in a dental clinic may be quite lengthy.

ITR restorations with glass ionomer-containing materials also demonstrate superior resistance to recurrent decay. In a meta-analysis of studies comparing the incidence of recurrent decay occurring at the margins of glass ionomer and amalgam restorations, significantly fewer carious lesions were found at the margins of single-surface GIC restorations in permanent teeth after six years as compared to restorations with amalgam (from six articles reporting on eight separate studies). Because stopping, or at the very least slowing, the progression of caries disease is one of the primary objectives of ITR in the community dental home application, the caries-preventing fluoride storage, release, and recharging characteristics of the GI materials in the ITR technique is highly advantageous.

One other concern that is sometimes expressed about the minimally invasive nature of ITR is that, because no local anesthetic injections are used, this technique may cause pain and discomfort to patients, resulting in fear and reticence for these patients to seek further dental care. This concern has been well-addressed in a number of quality studies reporting that ITR/ART causes less pain than traditional procedures and has been associated with less dental anxiety amongst patients, precisely because it does not involve drilling and injections. A meta-analysis of 17 articles evaluating patient responses to the ART technique stated, “All authors agreed that the ART promotes less discomfort for patients [versus conventional techniques], contributing to a reduction in anxiety and fear during ... dental treatment. Results also indicated that ART minimizes pain reported by patients.” In an effort to investigate potential discomfort caused by infiltrative local anesthesia injection versus the ITR/ART treatment approach, van Bochove and van Amerongen investigated discomfort in 6- to 7-year-olds with no prior dental treatment experience. The children were treated either by ART or by conventional technique, with both types of treatment rendered with or without local anesthesia injections. The study showed that during the first dental treatment
session, ART with no local anesthetic caused less discomfort than conventional treatment with no local anesthesia.

More interesting, though, was that during the second dental treatment session, ART without use of local anesthesia also caused less discomfort than the conventional treatment with local anesthesia injections. Thus, the authors concluded that the use of local anesthesia injections may in themselves contribute to the discomfort experienced by children during dental treatment. In comparison to the conventional treatment, the ITR/ART approach appears to cause a reduction in pain sensation, which may be related to the greater preservation of the dental tissues, and, consequently, the patient may become more receptive to the treatment. Ultimately, the ITR approach may be less traumatic to patients, and it may positively influence the patient’s behavior toward seeking future dental treatment. Simply stated, ITR/ART is a patient-friendly technique that has been shown to be readily acceptable in patients who have not received previous restorative dental care. "The application of RMGIC, in conjunction with the ART, presents a promising alternative for bringing dentistry to young patients, uncooperative patients, persons with special health needs, and in situations where traditional cavity preparation and placement of a traditional dental restoration is not possible.”

Conclusion

Community-based settings have been proposed as the first-line in caries prevention and treatment, and as a screening base for referral of patients to dental offices for definitive care, and CAMBRA and ITR are two strategies that fit this front-line approach to caries disease management very well. CAMBRA presents a disease prevention-based comprehensive assessment of the patient for the oral health team, and returns valuable oral health education, behavior modification counseling, and chemotherapeutic interventions to the patient. ITRs follow-up the preventive thrust of CAMBRA to stop, or at least to slow down, the progression of already cavitated caries disease lesions and to provide a temporary means of maintaining patient oral function and comfort. Due to the noninvasive techniques of CAMBRA and ITR, these disease prevention and management strategies also provide a very user-friendly introduction to oral health care to populations who have had very little to no prior contact with dental care. Combined with delivery in a familiar, community-based dental home setting, CAMBRA and ITR are likely to improve oral health for underserved populations, make them more receptive to dental treatment in general and more likely to seek more definitive dental care when they have the opportunity.

REFERENCES


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