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Review Article

Efficacy of Fluoride in Inhibition of Caries among Various Age Groups – An Overview

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Abstract

Dental decay is one of the most prevalent diseases of mankind. In many countries, its severity increased in correlation with importation of sugar, reaching its zenith in about 1950s and 1960s. Dental caries, unlike periodontal disease, is now recognized as an infectious, transmissible, multifactorial disease of bacterial origin. The philosophy of caries management by risk assessment, or CAMBRA®, represents a paradigm shift. Current evidence-based emphasis is on the need to recognize a carious lesion in its earliest stage before demineralization has produced a cavitated lesion that requires restoration by a dentist. Prevention strategy is to determine the dental caries risk factors for patients of all ages and to introduce remineralization strategies into the patient's dental care plan. Therapy should focus on patient-specific approaches that include disease monitoring and preventive therapies supplemented when necessary by restorative care. Changes in the management of dental caries will require health organizations and dental schools to educate students, practitioners, and patients in evidence and risk-based care. This paper discusses current understanding of the caries balance, the process of demineralization and remineralization of tooth structure, caries risk assessment, the different levels of caries risk and a brief review of strategies to control dental caries. Adequate treatment protocols specifically related to the remineralization of non-cavitated lesions using dentifrices and related studies are discussed.

Keywords: Dental Caries/etiology, Dental Caries/ prevention & control, Dental Caries Susceptibility, Fluorides/therapeutic use, Fluorides, Topical/therapeutic use, Fluoride dentifrices.

INTRODUCTION

Dental decay is one of the most prevalent diseases [1]. In many countries, its severity increased in parallel with importation of sugar, reaching its zenith in about 1950s and 1960s.[1] In the past, the dental profession has adhered to a rigid tenet: remove decay from a tooth and then restore it, a mindset that has been proverbially dubbed as "drill and fill." But today, dental caries is recognized as an infectious disease that affects children and adults throughout life [2]. Because of this understanding of caries; caries prevention has been sought since long time in the published literature [3-9]. Few earlier studies also conducted research on the preventive aspects way back to 1950-1980's[4,10–14].

The philosophy of caries management by risk assessment, or CAMBRA®, represents a paradigm shift. The CAMBRA concept provides the dentist with, evidence-based solutions with which to approach the treatment of dental caries [2]. Current evidence-based emphasis is on the need to recognize a carious lesion in its earliest stage before demineralization has produced a cavitated lesion that requires restoration by a dentist. As a result of current understanding of caries control, the dentist's role in prevention is to determine the dental caries risk factors for patients of all ages and to introduce remineralization strategies into the patient's dental hygiene care plan [15]. Conservative strategies of a concentrated program include initial infection control with a chlorhexidine rinse; extra daily fluoride exposures; placement of pit and fissure sealants where indicated; control of sucrose exposures; use of sugar substitutes, particularly xylitol-containing sugar-free chewing gum; and an emphasis on a daily bacterial plaque removal routine [15].

Fluoride and caries

Since researchers first became aware of the anticaries action of fluoride, they have been investigating the effect of this preventive agent in inhibiting or arresting caries development[16]. Many forms of systemic or topical fluoride have been studied and tested for clinical application. Water, salt, milk

fluoridation and the use of fluoride supplements were introduced for systemic fluoridation mainly using sodium fluoride. Solutions, gels, toothpastes and rinses of sodium fluoride, stannous fluoride, amine fluorides, acidulated phosphate fluoride and monofluorophosphate were used for topical fluoridation[17]. More recently nonaqueous fluoride varnishes in an alcoholic solution of natural resins and difluorosilane agents in a polyurethane matrix were introduced[16]. Although all of these fluoridation methods have a caries-preventive action, these benefits and the ease of application is variable[18]. As fluoride is a key component of oral health promotion a coordinated approach on a community and individual basis seems to be needed to maximize the cost-benefit ratio of prevention.

The first investigations into incorporating fluoride into toothpastes and mouthrinses were reported in the mid 1940's. Unlike water fluoridation (which is 'automatic fluoridation'), fluoride-containing toothpastes and fluoride containing mouthrinses are, primarily, for home use and need to be purchased by the individual[19-22]. By the 1960s, research indicated that fluoride could be successfully incorporated into toothpastes and clinical trials demonstrated their effectiveness[1,23]. By the end of the 1970s, several toothpastes contained fluoride. The widespread use of fluoride-containing toothpastes is thought to be the main reason for much improved oral health in many countries. Of the many fluoride compounds investigated, sodium fluoride, with a compatible abrasive, is the most popular, although amine fluorides are used widely in Europe [23]. The situation is similar for mouthrinses. Concentrations of fluoride (F), commonly found, are 1500 ppm (1500 µg F/g) for toothpastes and 225 ppm (225 µg F/ml) for mouthrinse[23]. Several systematic reviews have concluded that fluoride-containing toothpastes and mouthrinses are effective, and that there is added benefit from their use with other fluoride delivery methods such as water fluoridation.

The relative caries-preventive effects of fluoride toothpastes of different concentrations increase with higher fluoride concentration. There is strong evidence that daily use of fluoride toothpaste has a significant caries-preventive effect in children compared with placebo (prevented fraction 24%). The effect was boosted by supervised tooth brushing, increased brushing frequency to twice daily, and use of a toothpaste concentration of 1,500 ppm fluoride [24]. However, there is weak, unreliable evidence that starting the use of fluoride toothpaste in children under 12 months of age may be associated with an increased risk of fluorosis[18,25]. The decision of what fluoride levels to use for children under 6 years should be balanced between the risk of developing dental caries and that of mild fluorosis[25]. The use of topical fluorides in young children is usually associated with the inadvertent ingestion and systemic absorption of fluoride. The use of "adult" toothpaste in very young children seemed to increase the risk for mild dental fluorosis in low-caries communities but not in socially deprived high-caries populations [24]. Although the mild forms of dental fluorosis do not pose a public health problem, more severe forms will be of aesthetic concern, especially when the upper anterior teeth are involved. It is therefore very important to achieve an appropriate balance between the beneficial and harmful effects of topical fluoride therapies [26]. Supported by more than half a century of research, the benefits of fluoride toothpastes are firmly established for prevention or remineralisation of early caries[27].

Research on prevention of caries

The quality of evidence related to self-applied and professionally applied fluorides, antimicrobial agents, fissure sealants, temporary restorations, and restorative care for the prevention and management of early childhood caries (ECC) study showed moderate and limited quality of evidence in support of fluoride toothpaste and fluoride varnish for ECC prevention, while the evidence for fluoride tablets/drops was insufficient[28]. The support for the use of silver diamine fluoride, xylitol, chlorhexidine varnish/gel, povidone iodine, probiotic bacteria, and remineralizing agents (casein phosphopeptide-amorphous calcium phosphate) was insufficient[28]. There was also insufficient quality of evidence for the use of sealants, temporary restorations, and traditional restorative care to reduce incidence of ECC[28].

Dental caries prevention programmes among schoolchildren in Chile used three community-based programmes like water-fluoridation, salt-fluoridation and dental sealants; and four school-based programmes like milk-fluoridation; fluoridated mouthrinses (FMR); APF-Gel, and supervised toothbrushing with fluoride toothpaste. Based on cost required to prevent one carious tooth among schoolchildren, salt fluoridation was the most cost-effective, with APF-Gel ranking as least cost-effective. Findings confirm that most community/school-based dental caries interventions are cost-effective uses of society's financial resources. The models used are conservative and likely to underestimate the real benefits of each intervention[29].

Clinical decision making for caries management in children is to integrate current knowledge in the field of cariology into clinically usable concepts and procedures. Current evidence regarding the carious process and caries risk assessment allows the practitioner to go beyond traditional management of dental caries[30]. Therapy should focus on patient-specific approaches that include disease monitoring and preventive therapies supplemented when necessary by restorative care[31]. The type and intensity of these therapies should be determined utilizing clinical data as well as knowledge of the caries process for that child. Changes in the management of

dental caries will require health organizations and dental schools to educate students, practitioners, and patients in evidence- and risk-based care[30].

Many reviews were conducted to understand the present evidence for the effectiveness of floured in the prevention of caries[17–22, 25, 28, 32–44]. Preventive treatment options can be divided into primary, secondary and tertiary prevention techniques, which can involve patient- or professionally applied methods. These include: oral hygiene (instruction), pit and fissure sealants ('temporary' or 'permanent'), fluoride applications (patient- or professionally applied), dietary assessment and advice (modification), other measures to help remineralize demineralized tissue and measures to help modify the biofilm to reduce the cariogenic challenge[45,46].

There is a considerably strong evidence supporting the use of specific techniques for primary prevention of caries in children, e.g. pit and fissure sealants and topically applied fluorides (including patient-applied fluoride toothpastes and professionally applied fluoride varnishes), but limited strong evidence for these techniques for secondary prevention-i.e. where early to established lesions with ICDAS codes 1-4 (and also the severer lesions coded 5 or 6) are involved--and in relation to adults[45,46]. This lack of evidence reflects a shortage of high-quality trials in the area, as opposed to a series of good studies showing no effect. Since there is also limited longitudinal evidence supporting conventional operative care, and since controlling the caries process prior to first restoration is the key to breaking the repair cycle and improving care for patients, future research should address the shortcomings in the current level of supporting evidence for the various traditional preventive treatment options. Treating the disease, not the symptoms, is the change in managing dental caries[47,48]. As researchers supply the tools, dentists can apply more efficient and realistic methods for better patient care[47,49].

CONCLUSION

Evidence supports the management and monitoring of dental caries. Caries risk level must be reevaluated at each maintenance appointment. Appropriate in-office strategies to preserve tooth structure should be carried out and followed by applicable home regimens that are based on need, not age. While the incidence of caries has decreased during the past 50 years because of the introduction of water fluoridation and fluoride toothpastes, it is still widespread. Improved therapies, using topical treatments to replace lost calcium and phosphate minerals from early carious lesions, will reduce the need for “drill and fill” intervention in the future. Early caries detection techniques currently being developed will allow dentists to maximize the usefulness of these treatments. Fluoride toothpastes and mouthrinses have been developed and extensive testing has demonstrated that they are effective and their use should be encouraged.

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