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Alternative Caries Management Approaches in Children

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Abstract

Minimal intervention dentistry is a patient care concept based on etiological factors contributing to the onset of disease and its subsequent prevention. It assimilates concepts of preventing, controlling and treating oral disease hence is centered on biological solutions. Early carious lesions exhibit effects of a disease and require less invasive therapeutic strategies. This article provides an overview of the current non-surgical therapeutic interventions for incipient carious lesions like topical fluoride (toothpastes, gels and varnish), silver diamine fluoride, ITR, sealants and resin infiltration. Topical and therapeutic sealing along with restorative care effectively preserves sound dental tissue. This review article is an overview of the alternative caries management approaches in children. It aims to inform the dental practitioners about minimal intervention dentistry for facilitating the application of modern therapeutic concepts into everyday clinical practice tailored to the specific needs of a child.

Introduction

Dental caries is a severe and prevalent childhood disease. Clinical practitioners are progressively utilizing patient specific individually tailored strategies for arresting, preventing, or alleviating disease process in the infant and child population based on caries risk assessment [1].

Incipient caries are managed by a combination of early therapeutic interventions like topical fluoride and non-surgical restorative techniques such as sealants and resin infiltration. The antimicrobial and remineralizing properties of these methods arrest active carious lesions and obviate conventional acute disease treatment including cavity preparation and mechanical tooth restoration. The current policies, guidelines with recommendations illustrate the use of these early therapeutic interventions for caries control in clinical practice and inform about the success of their outcomes [2].

The systemic cariostatic effect of fluoride is enhanced and maintained by good oral hygiene measures [3,4]. Water fluoridation is defined as a controlled modification of natural fluoride concentration in drinking water endorsed for ideal dental health for reducing caries effectively [5]. This water concentration is a beneficial and inexpensive way for reducing caries occurrence [6]. Long-term fluoride use demonstrates oral health care cost reduction for children by almost 50% [7]. An optimum fluoride concentration of community water supplies is 0.7 ppm F [8].

Cariostatic benefits of fluoride can be achieved via over the counter preparations such as toothpastes, gels, and rinses [5]. Monitored use of topical fluoride products may prevent excessive fluoride ingestion [9]. Dental fluorosis is more likely if a fluoride supplement is introduced at an early age [10]. Caries prevention is offered by a fluoride toothpaste but fluoridated milk, salt, tablets and drops lack evidence for recommendations [11]. Level of drinking water fluoride ranges from 0.3-0.6 mg F/L additional fluoride is not needed for 2-3 year olds. In older age groups daily fluoride tablet dose should be 0.25 mg F/day. Fluoride drops and combination with vitamins exhibit caries preventive effect [12].

Topical fluorides are indicated in high caries risk and special needs children. Fluoride gels containing 5,000-12,500 ppm F should be used 2-4 times per year without exceeding the probable toxic dose [13]. A 1 minute oral swish of 10 ml at a concentration of 0.05% NaF containing 225 ppm F daily or 0.2% NaF containing 900 ppm F weekly may be used at home or in schools [14]. Fluoride varnishes at a concentration of 1,000-56,300 ppm F may be used 2-4 times per year [15]. Almost 80% daily fluoride intake in children is by fluoride toothpastes hence pea sized mount of 500 ppm F toothpaste suffices for up to seven years [16].

The teeth should be brushed with a manual or powered toothbrush with a soft small head. A thin smear or rice-sized tooth paste if less than three years of age and a pea-sized amount for children aged three to six years is recommended. Teeth should be brushed before bed and on one other occasion at least. The highest period of risk for dental fluorosis in permanent incisors and first molars is between 15 to 30 months when the teeth calcify and mature during this susceptibility period [17]. Fluoride content in ready-to-use infant formulas ranges from 0.1 to 0.3 mg/L [31]. The anti-caries effect of professional topical fluoride treatment encompassing 1.23% acidulated phosphate fluoride, 5% neutral sodium fluoride varnish, 0.09 % fluoride mouth rinse and 0.5% fluoride gel/paste is seen in numerous clinical trials [18].

Silver Diamine Fluoride

Topical products containing silver diamine fluoride (SDF) and silver nitrate arrest caries as well as reduce hypersensitivity in primary and permanent dentition [19]. 38% Silver diamine fluoride is equivalent to 5% fluoride in a colorless liquid at p^H 10. Since the mechanics of SDF are unclear it is hypothesized that the fluoride ions act on the tooth structure; silver ions are antimicrobial and react with hydroxyapatite to form calcium fluoride (CaF_2) and silver phosphate as end products in an alkaline environment. Calcium fluoride forms fluorapatite crystals which are less soluble in an acidic environment

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[20]. Discoloration of demineralized or cavitated tooth surface. SDF however arrests caries more effectively than fluoride varnish and retains 2-3 times more fluoride then stannous fluoride, acidulated phosphate fluoride or sodium fluoride. It poses slight toxicity or risk of fluorosis in children and adults [21].

Xylitol

Xylitol is a five-carbon alcohol derived from forest and agricultural materials [22]. It is used in infusion therapy for post-operative shock, burns, diabetics and as a product sweetener for oral health because it is a non-cariogenic sugar substitute which is not metabolized by oral bacteria [23]. It is available as mints, gums, lozenges, chewable tablets, toothpastes, cough mixtures, mouthwashes, nutraceutical products and oral wipes [24]. It shows varying results in incidence of caries reduction mutans streptococci in children and mutans streptococci transmission from a mother to a child [25-27]. Xylitol studies employ a very large dose at a high frequency (4-5 times a day) and an intake ranging from 4-15 g/day for 3-7 times which is unlikely in clinical practice [28,29]. Symptoms of xylitol ingestion include abdominal distress and osmotic diarrhea [30].

Interim Therapeautic Restoration

An interim therapeutic restoration is instituted for caries control prior to definitive restorations; when restoration needs to be postponed for arresting, restoring or preventing caries progression in young or special needs or uncooperative patients not amenable to conventional cavity preparation and/or placement of tooth restorations, when isolation for definitive restoration is suboptimal in the erupting molars, for step-wise excavation in multiple open carious lesions prior to definitive restorations, active caries lesion control prior to dental treatment under general anesthesia and for oral health care in the dental home [32,33]. Levels of oral cariogenic bacteria drop subsequent to ITR placement but may revert to pretreatment counts over a period of six months if it is not replaced by an alternative treatment [34-36].

Dental caries is removed from the peripheral lesion by a hand or rotary instrument without creating a pulp exposure and is followed by an adhesive restorative material like glass ionomer cement or a resin modified glass ionomer cement to prevent marginal leakage around a restoration [37]. Maximum success with ITR restorations is demonstrated with a single surface or two small surfaces whereas failure of an ITR restoration is due to inadequate cavity preparation leading to lack of retention and bulk deficiency [38,39]. Outcome of treatment improves in people with a high caries-risk, glass ionomer cement with a fluoride recharging/releasing property, follow-up care with oral hygiene instructions and topical fluorides [40].

Pits and Fissure Sealants

Pit-and-fissure sealant is a low-filled resin-based material for sealing the occlusal surfaces of primary and permanent molars. It isolates a lesion from dietary sugars in the biofilm to prevent caries formation [41].

Dental caries ensues following a loss of balance between enamel demineralization and remineralization. The temporal exposure to fermentable carbohydrates initiates a biological change in the organization of bacterial flora and their action in the biofilm. A non-cavitated caries lesion develops as an initial lesion as a change in surface gloss, color or structure via enamel demineralization before macroscopic breakdown and cavitation in the tooth surface [42]. Caries may be prevented by deterring the onset and managing with interventions which halt the progression from early stage demineralization to eventual cavitation [43].

The occlusal surface grooves or pits and fissures trap food debris to allow bacterial biofilm formation thereby increasing caries risk. Primary prevention involves occlusal surface sealing with a pit and fissure sealant for precluding initial caries [44]. Secondary prevention inhibits the progression of non cavitated carious lesions. It is therefore important for the clinician to determine an appropriate intervention for carious lesions in the initial stage [45].

Different sealant placement techniques are based on the type and brand of manufacturer. Resin-based sealants contain UDMA (urethane dimethacrylate) or bisGMA (bisphenol A-glycidyl methacrylate) monomers. They may be filled, opaque, tooth colored or white materials. Alternatively they may be unfilled, tinted or colorless transparent materials. Sealants polymerize via a light of specific wavelength and intensity or by a chemical activator and initiator. GI sealants are cements with an acid base reaction between fluoroaluminosilicate glass powder and a polyacrylic acid solution in conjunction with fluoride-releasing properties. Compomers or Polyacid-modified resin sealants are a combination of traditional resin-based material with the fluoride-releasing and adhesive GI sealant properties. Resin-modified GI sealants comprise of GI sealants with resin components having a longer working time, less sensitivity to water and fluoride release properties. BPA in some sealants may have estrogen like effects however there is scanty evidence to support this [46-48].

Conclusion

Child oral health is an indicator for ascertaining broader general health and social care. The current paradigm shift in dental caries management is from the traditional 'drill and fill' operative methods to less invasive reparative methods rendering it as a biofilm disease. The reparative options in conjunction with prevention and reorientation of lifestyle ensure optimum caries reduction.

Treatment plan for managing carious lesions include preventive plan secondary to identifying etiological disease factors (diet investigation, brushing habits, possible effects of other comorbidities such as reduced saliva flow, cognitive difficulties and so on). A program involves behavior change for improving oral hygiene (tooth brushing), reducing intake of dietary sugars, fluoride toothpaste and fluoride varnish application. Treatment of incipient caries usually involves non-surgical early therapeutic interventions such as fluoride in the form of topical fluoride, toothpastes, gels, varnish; silver diamine fluoride; ITR; sealants and resin infiltration. These therapeutic modalities encompass two approaches. The topical approach clears biofilm by tooth brushing or altering the biofilm ecology via medicaments as fluoride varnish and silver diamine fluoride or by reducing fermentable sugar intake. The sealing approach isolates biofilm from dietary foodstuffs via restorative materials.

Hence child-friendly dental techniques ensure optimum caries reduction in children and simultaneously instill a positive attitude towards their oral health and help modify their future approach as adults who manage their dental health without dental anxiety.

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