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REVIEW

An update on early childhood caries: A review

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Early childhood caries (ECC) is one of the rapidly progressing dental carious lesions found to be affecting innumerable children worldwide in an endemic manner. Bacterial plaque retention, inadequate oral hygiene, and increased frequency of sugar consumption are considered the primary risk factors causing this lesion. Recent studies have shown that ECC has an undeniable influence on a child's growth and development, resulting in early loss of deciduous dentition, insufficient space for erupting succedaneous teeth, poorly developed speech, and mastication, which can finally affect the child's growth physically and psychologically. Hence, it is highly essential that these carious lesions have to be maintained and prevented in a therapeutically systematic manner, which can benefit the child. This study presents a review that enhances an update on ECC and details the various contributing factors and adds up the recent treatment and risk assessment strategies in ascertaining the carious lesions before its advancement.

Keywords: early childhood caries, oral hygiene, feeding habits

Introduction

Nursing caries is a recently introduced term that is used for detailing carious lesions in young children as a consequence of bottle feeding, especially during the night (1). One of the most challenging scenarios a pediatric dentist confronts in managing a child with ECC is the need for cooperation and rehabilitation of the affected carious lesions.

There are considerably numerous contributing factors and etiologies leading to the initiation of ECC. The undeniable contributors leading to ECC are fermentable carbohydrates (substrate), cariogenic microorganisms, frequent intake of sugar, and socioeconomic status (2). *Streptococcus mutans* and wiggsiae metabolize the residual carbohydrates, thereby producing destructive acids that cause a considerable decrease in the pH of the oral cavity. This subsequently leads to demineralization, finally progressing to dental caries (3). Unattended forms of ECC are now considered to be a part of generalized child neglect, thereby affecting a child's speech and overall growth and development (3).

Clinical features of early childhood caries

In the initial stage, the lesion appears as white opaque spots or as a white band in the cervical third of the maxillary incisors. The initial lesion can also appear around the gingival margin between the interproximal surfaces of teeth or on the palatal surfaces of teeth and, in extreme cases, at the incisal edge (4). As the condition progresses, the enamel surface breaks down and a cavity is created, which can turn yellow, brown, or black and gradually encircle the neck of the teeth with extensive loss of hard tissue. The thickness of enamel in primary incisors is less (<0.5 mm), and the immature enamel of primary teeth is porous and hence more easily dissolved by acids (5). These two factors contribute to the rapid progression of caries in primary teeth. In advanced cases, there may be a complete loss of crown structure of maxillary incisors, whereas the mandibular incisors remain caries free.

TABLE 1 | Classification of early childhood caries by Wyne.

Types	Location of lesion	Etiology
Type I—Mild to moderate	Caries on incisors and molars	Semisolid/solid diet rich in carbohydrates and sugary substrates and lacking poor oral hygiene
Type II—Moderate to severe	The lesions are present on the labial or lingual surface of maxillary central incisors. Molar caries may be present depending on the child's age and disease. The mandibular incisors remain unaffected	Prolonged utilization of feeding bottle and/or at-will breastfeeding with poor oral hygiene maintenance
Type III—Severe or extreme	Every tooth is affected.	Cariogenic food and lack of adequate oral hygiene

Classification

Early childhood caries has been classified earlier by several authors according to varying criteria and standards.

The first system of classification was given by Wyne (6) in 1999 (7). It was based on the severity and the associated etiology of ECC. According to this system, ECC was classified into three categories (**Table 1**).

Veerkamp and Weerheijm (8) in 1995 modified this classification based on the development of dentition and dental caries. According to this classification, dental caries occurs at successive ages beginning at 10 months and subsiding at 48 months of age. The extent of dental caries varies from demineralization to cavitated lesions (7).

Rate of ECC prevalence

The rate of ECC prevalence between 2- and 5-year-old children in the United States was found to be 27.9% between 1999 and 2004. In countries with developing financial strategies, the rate of ECC has increased by 85% among infants in an advertent manner. Recent studies show that Palestine has a prevalence rate of 76% and the United Arab Emirates depicts considerably a higher rate of 83%. India is reported to have a prevalence of 51.9%, Israel at about 64.7%, and Brazil at about 45.8%, respectively. According to recent studies conducted and evidence, children 3–4-year-old boys predominantly exhibit the highest prevalence rate of ECC (9).

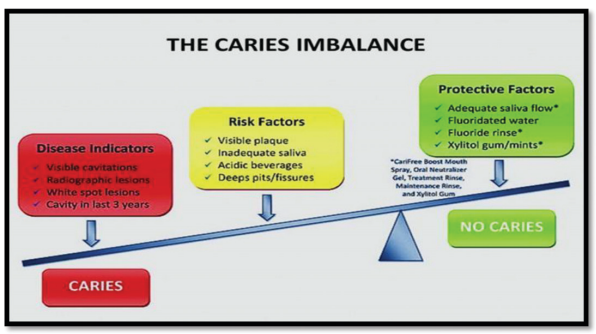

FIGURE 1 | Caries imbalance diagram (13).

Risk factors

Microbiologic risk factors

The prime microorganisms responsible for causing ECC are *Streptococcus mutans* (SM) and *Streptococcus sobrinus*. SM transmission occurs through two different modes of transmission, namely, vertical transmission and horizontal transmission. Vertical transmission occurs between a child and a caregiver. Poor maternal oral hygiene and frequent sugar intake increase the transmission rate to the child. Horizontal transmission occurs when neonates have an increased chance of acquiring these bacteria, especially in children born *via* cesarean section (10).

Dietary risk factors

Improper bottle feeding constitutes an important etiological factor of severe ECC. Several studies have shown a direct relationship between ECC and extended periods of bottle feeding. Children consuming frequent sugar-rich diets are also found to be highly susceptible to developing ECC. These sugars will be converted to demineralizing acids by cariogenic microorganisms, resulting in tooth surface demineralization. Recent studies have elaborated that cow's milk is considered to be the least cariogenic compared to other commercially available milk varieties (10).

Environmental risk factors

Dental plaque is one of the identified primary causative agents of caries. The effective removal of dental plaque is necessary for caries prevention. Therefore, children should receive oral hygiene instructions soon after the eruption of the first primary tooth. Salivary factors, including salivary flow rates, antimicrobial properties, and salivary buffering, play a major role in decreasing the prevalence of cavitated lesions in the oral cavity. The socioeconomic status of caregivers, fluoridation levels, ethnicity, educational status, and dental insurance inclusion are other subsidiary factors contributing to caries progression (10).

Factors	High Risk	Moderate Risk	Low Risk
Biological			
Patient is of low socioeconomic status	Yes		
Patient has >3 between meal sugar-containing snacks or beverages per day	Yes		
Patient has special health care needs		Yes	
Patient is a recent immigrant		Yes	
Protective			
Patient receives optimally-fluoridated drinking water			Yes
Patient brushes teeth daily with fluoridated toothpaste			Yes
Patient receives topical fluoride from health professional			Yes
Additional home measures (e.g., xylitol, MI paste, antimicrobial)			Yes
Patient has dental home/regular dental care			Yes
Clinical Findings			
Patient has ≥1 interproximal lesions	Yes		
Patient has active white spot lesions or enamel defects	Yes		
Patient has low salivary flow	Yes		
Patient has defective restorations		Yes	
Patient wearing an intraoral appliance		Yes	

Circling those conditions that apply to a specific patient helps the practitioner and patient/parent understand the factors that contribute to or protect from caries. Risk assessment categorization of low, moderate, or high is based on preponderance of factors for the individual. However, clinical judgment may justify the use of one factor (e.g., ≥1 interproximal lesions, low salivary flow) in determining overall risk.

Overall assessment of the dental caries risk: High ☐ Moderate ☐ Low ☐

FIGURE 2 | Caries risk assessment for 0–3 years (14).

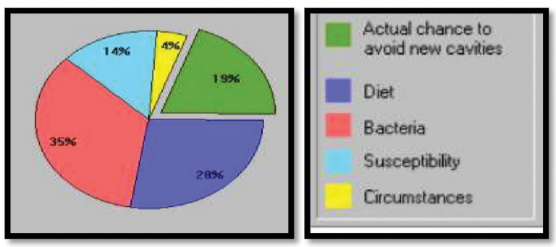

FIGURE 3 | Cariogram (15).

Prevention of ECC

Reducing the transmission of cariogenic bacteria from mother to child is the most ideal and initial preventive measure. The transmission of cariogenic bacteria from mother to child can be reduced by avoiding saliva-sharing activities such as sharing utensils, food, and drinks. The involvement of multidisciplinary professionals including pediatricians, physicians, and nurses can act as an adjunct in creating awareness among parents regarding early childhood caries.

Risk assessment

Apart from the traditional and conventional methods, which provide treatment only after the lesion has been established, the current risk assessment strategies prevent and manage before extensive destruction to the dental hard tissues (11).

Caries risk assessment tool (CAT)

The American Academy of Paediatric Dentistry (AAPD) (12) in 2006 introduced CAT depending on the child's age and incorporating biological factors, protective factors, and absolute clinical findings, which aids in identifying caries incidence in the child (13).

The biological factors include (a) the presence of caries in mothers, (b) patients from low financial backgrounds, (c) patients consuming frequent sugary snacks and beverages, (d) patients who require special healthcare needs and treatment, and (e) patients who are recent immigrants (13).

The protective factors of the patients include (a) having> 1 increased incidence of interproximal lesions, (b) presence of lesion activity, (c) having comparatively low salivary flow and rate, (d) possessing numerous defective restorations, and (e) continuously wearing any sort of intraoral appliance. (13) Subsequent progression or caries remineralization is identified by the altered balance existing between disease indicators along with risk factors on one side and the protective factors on the other side of the statistically balancing beam (**Figure 1**) (13).

Caries management by risk assessment (CAMBRA)

Western CAMBRA Coalition comprising multidisciplinary industrial analysts including government bodies and private practitioners of the United States introduced CAMBRA nearly a. (13). CAMBRA management is mainly dependent on the disease stage and its resultant severity on tooth surfaces (13). CAMBRA incorporates several therapeutic methods and strategies that prevent the progression of cariogenic microorganisms within the oral cavity and indicators that possess the remineralizing potential for the management of early carious lesions, thereby preventing demineralization (13). CAMBRA enhances the utilization of sufficient agents for remineralization of early white lesions along with minimally invasive restorative treatment modalities (**Figure 2**).

Cariogram

Cariogram is a recently developed strategical tool by Prof. D. Bratthall, which demonstrates the close relationship between caries and causative risk factors. This was instituted into a PC format by Dr. L. Allander and K.O. Lybegård. Peterson G. et al. in 2003 in their detailed experimental studies

Recommendations for Fluoride Supplementation

Age	Fluoride Ion Level Present in Drinking Water		
	<0.3 ppm*	0.3-0.6 ppm	>0.6 ppm
≤6 months	None	None	None
6 months–3 years	0.25 mg/day†	None	None
3-6 years	0.50 mg/day	0.25 mg/day	None
6-16 years	1 mg/day	0.50 mg/day	None

** 1 ppm = 1 mg/L*
† 2.2 mg sodium fluoride contains 1.0 mg fluoride ion.
ppm: part per million.
Source: Reference 13.

FIGURE 4 | Recommendations for fluoride supplementation (14).

FIGURE 5 | Preoperative.

determined the fact that the cariogram accurately determined the caries incremental rate and accurate rate of incidence (15). The previous history of dental caries, the probable increase in *S. mutans* count, the persistence of community fluoridation or other programs, and the influence of salivary buffer capacity are the factors incorporated in the cariogram model that showed considerable correlation with associated risk factors among the studied population. The cariogram is divided into five colored sectors in a pie circle diagram (15). These colors are as follows: the green sector (chances to avoid new cavities), the dark blue sector (diet), the red sector (bacteria), the light blue sector (susceptibility), and the yellow sector (circumstances). "0" is noted as the most acceptable best value, and "3" signifies that the individual has a high risk of caries. The program facilitates the entry of a maximum of ten values; however, seven scores would be sufficient enough for the cariogram to appear (**Figure 3**) (15).

Fluorides

Fluoride therapy forms an integral part of the caries preventive strategy. Fluoride is obtained from various sources such as fluoridated community water, food processed from fluoridated water, and fluoride supplements such as fluoridated milk and salt. It is also available in the form of toothpaste, mouth rinses, lozenges, chewable tablets, gels, foams, and varnishes. The most easily available and widely used form of fluoride is fluoridated toothpaste. There is strong scientific evidence that suggests that daily tooth brushing with fluoridated toothpaste is the most effective method of caries prevention.

The AAPD has described the following recommendations that should be strictly carried out while prescribing fluoride toothpaste or supplements to patients (**Figure 4**).

Management of ECC

Restorative treatment is based on the removal of caries, and the choice of restorative material depends on the site and extent of decay, the child's ability to cooperate, and the longevity of the restoration. The commonly used restorative materials are amalgam, composite, GIC, and resin-modified GIC. If extensive dental treatment is required for a non-cooperative child, then the procedure has to be carried out under GA. In teeth affected by severe ECC, pulpotomy followed by placement of preformed stainless-steel crowns in posterior teeth and strip crowns in anterior teeth is preferred. Atraumatic restorative treatment (ART) is a pain-free restorative procedure in which hand instruments are used for removing caries and glass ionomer cement is used as the restorative material. The major advantages of GIC are fluoride release, chemical adhesion to the tooth structure, and biocompatibility (16).

Case report

A 5-year-old girl reported decayed upper front teeth. It happened to be the child's first dental visit. Intraoral examination revealed severely decayed and carious 51, 52, 61, 62, 74, and 75 (**Figure 5**). Radiographs were advised for 51, 52, 61, 62, 74, and 75, which detailed that there was pulpal involvement in 51, 52, 61, 62, 74, and 75. Taking into consideration of the child's age, a treatment plan was formulated. After detailing the various available treatment options, a written consent explaining the selected treatment protocol was obtained from the parents. Pulpectomy with Metapex was carried out for 51, 52, 61, and 62 followed by strip crown placement with Filtek Z350 XT WD composite resin (3M ESPE) in color (A1). A probe was used to remove the excess material in the cervical region. Occlusal adjustment and polishing were then carried out. Pulpectomy was carried out on 74 and 75 followed by stainless steel crown placement. Fluoride application was done following the completion of the treatment, and the parents were advised to regular recall visits every 6 months (**Figure 6**).

Discussion

Ideal esthetic rehabilitation in children is always considered an uprising challenge among pediatric dentists as it should aid the child in reestablishing the child's esthetics and phonetics, thereby facilitating the achievement of normal developmental milestones of the child (16).

FIGURE 6 | Postoperative.

Loss of deciduous anterior teeth at an early age will lead to the development of detrimental oral habits and deleterious malocclusion. These associated problems will lead to severely reduced self-esteem in the child (17). In the present case report, the child presented with multiple carious lesions which were rehabilitated with a pulpectomy procedure followed by a strip crown and stainless steel crown, preserving the child's esthetic demands and functional ability up to a great extent.

Stainless steel crowns are the most preferred crowns in deciduous dentition following root canal therapies and are also indicated in cases of developmental anomalies of teeth (17). Harboring with the only disadvantage of its unesthetic appearance stainless steel crowns can be easily finished with an adequate fit due to its ease of manipulation in a single visit, thereby resulting in successful restorative treatments. The stainless steel crowns possess the ideal and acceptable features of extended durability, financial acceptability, and subsequent ease of chairside manipulation, offering an ideal full coverage restoration. In primary teeth, the stainless steel crowns are indicated following pulpotomy/pulpectomy and are also applicable for teeth with developmental defects, large carious lesions involving multiple surfaces where amalgam is likely to fail, and fracture teeth (17).

The increasing esthetic needs thereby ascertain strip crowns as the material of choice by the majority of pediatric dentists today. The main advantages of it being the material of choice include highly superior esthetics and ease of repair and use when compared to traditional crowns. However, early and prompt management along with adequate behavior modification is, therefore, a necessity in treating such carious lesions (18).

Conclusion

Early childhood caries is a rapidly progressing lesion of concern, which should be managed adequately before its advancement. In today's clinical scenario where esthetics is determined to be the prime concern, strip crowns prove to be the acceptable solution to esthetic restoration that provides adequate results for patient needs and demands. The advent of newer materials like zirconium is also gaining popularity considering its esthetically superior nature. The routine practice of compulsory and definitive oral hygiene strategies along with the advent of new restorative materials will aid in creating esthetically acceptable smiles and provide a new path in the process of rehabilitation in a cost-effective way.

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