

# Early Childhood Caries

## A Continuing Epidemic Oral Health Problem in the United Arab Emirates

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Early Childhood Caries (ECC) is a chronic, transmissible infectious disease affecting the primary (milk) teeth. The etiology of the condition is a combination of factors including frequent consumption of fermentable carbohydrates as liquids, especially when the baby is sleeping, with on-demand breast- or bottle-feeding. Other factors include oral colonization by cariogenic bacteria (especially mutans streptococci), poor oral hygiene and poor parent-

ing. It is the most common chronic disease among children. The prevalence of ECC in infants and preschool children has been reported to vary between 3% and 94% world-wide. In United Arab Emirates (UAE) the prevalence is one of the highest and reported to be over 90% in Abu Dhabi emirate. ECC can result in considerable suffering, pain, disfigurement and frequently compromises future (permanent) dentition. This ultimately leads to a reduction in the quality of life of affected children. This paper provides an updated

review of ECC covering its definition, aetiology, prevalence, clinical picture, complications and management and a solution to the continuing problem of ECC is suggested.

### Introduction

Caries or dental decay in children has been known to exist for many centuries [1]. Early Childhood Caries (ECC) is a chronic, transmissible infectious disease affecting the primary (milk) teeth. It is defined as the presence of one or more decayed, filled or missing tooth surfaces in any primary



Fig 1. The clinical picture of ECC in early (A) and advanced stage (B) in a preschool child.

tooth in a child 71 months of age or younger [2,3]. It can result in considerable suffering, pain, reduction of quality of life of affected children

and disfigurement and frequently can compromise their future dentition. The etiology of the condition is a combination of frequent consumption of fermentable carbohydrates as liquids, especially at night, with on-demand breast- or bottle-feeding, oral colonization by cariogenic bacteria (especially mutans streptococci) and poor oral hygiene [4].

In most cases, the aetiology will be a combination of several of these factors. The prevalence has been reported to vary worldwide. Higher prevalence has occurred in children from lower socio-economic status families, migrants and ethnic minority populations [5].

In the United Arab Emirates (UAE), ECC is the most common childhood disease. The prevalence of ECC in the UAE has been reported as 93.8% in 5-year-old children [6].

Prevention of ECC can be achieved by the education of prospective and new parents, as well as by the identification of 'high risk' children [7]. Strategies have focused on the individual mother and child by preventing transfer of cariogenic bacteria from mother to her infant, using preventive agents such as fluoride and teaching good oral hygiene practices [8]. Community-based approaches have been attempted. An example of a successful program was reported by Kowash et al [9] which investigated the effect of dental health education provided by trained, non professionals (not dentists) carrying out regular home visits in a low socioeconomic high-caries area in Leeds, UK. The study was able to demonstrate a significantly reduced occurrence of ECC after three years.

The treatment of ECC is very costly, time consuming and in most cases, requires full dental rehabilitation under general anaesthesia by a paediatric dentist. Unfortunately, in many countries, even in the developed world, these carious teeth end up being extracted.

This paper provides an updated evidence-based review of ECC. The literature in regards to ECC definition and terminology, aetiology, prevalence, clinical picture and management is discussed. A solution to the continuing problem of ECC is suggested.

### Definition and Terminology of ECC

ECC has been defined as "the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries) or filled tooth surfaces" in any primary tooth in a child 71 months of age or younger [2,3]. In children younger than 3 years of age, any sign of smooth-surface caries is indicative of severe early childhood caries (S-ECC). From ages three through five, one or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a de-

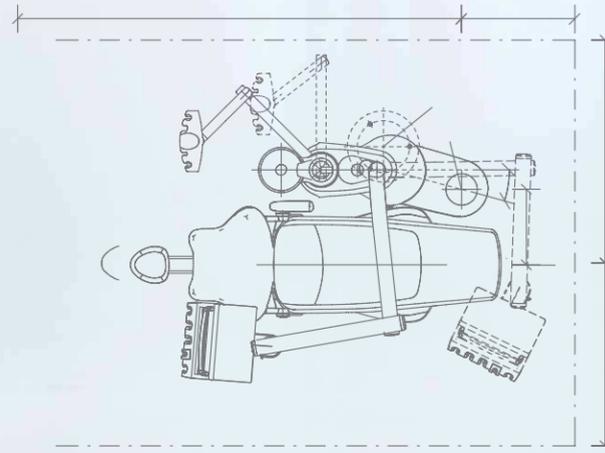
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cayed, missing, or filled score of fll4 (age three), fl15 (age four), or fl16 (age five) surfaces constitutes S-ECC [10]. Dental decay in infants and young children has several names including: "nursing caries", "nursing bottle caries", "nursing bottle syndrome", "baby bottle caries" and "baby bottle tooth decay" [4]. These terms are often used interchangeably in dental literature. They describe the condition and the possible etiological factors of the decay as understood by parents, public and professionals. However, none include the concept of a sweetened pacifier, which may be a significant cause in infants. Tinanoff and O'Sullivan used the term "Early Childhood Caries" which has been introduced in the USA to describe caries in infants and young children. This term has been widely accepted as the correct term by most dental clinicians and educators [11].

### Pattern and Clinical Appearance of ECC

ECC has a specific pattern and clinical picture. It is a specific form of rampant caries with the only feature differentiating it from generalized rampant caries being the usual absence of decay of the mandibular incisor teeth (Figure 1). The most commonly affected teeth are the maxillary incisors. Involvement of other teeth (the canines, first and second primary molars) depends on how long the carious process remains active but usually the severity of the lesions in these teeth is less than in the maxillary incisors. The mandibular incisors are usually not affected because the teat of the bottle is usually held above the tongue during sucking, so the lower incisors are protected by the tongue and also by the flow of saliva from the submandibular ducts [4]. The role of the innate infantile physiological tongue thrust pattern during deglutition is thought to be important in protecting the lower incisors [4].

In most cases of ECC, the first clinical sign is a band of dull white demineralization along the gingival line of the maxillary incisor teeth. As the lesion progresses, the white bands develop into cavities. This results in a brown or black collar around the necks of the incisors. In advanced cases, the lesions may become so severe that the crowns of the teeth are amputated leaving only decayed brownish-black root stumps (Figure 1). The commonly involved surfaces are the labial, palatal, mesial, distal of maxillary incisors and of the maxillary and mandibular canines. In the first and second primary molars, the occlusal surface is commonly affected [12]. According to Ripa [4], the reason for this unique distribution is related to three factors: 1) the chronology of tooth eruption; 2) the duration of the deleterious habit; and 3) the muscular pattern of infant sucking.

### Prevalence of ECC

The prevalence of ECC varies greatly in different studies. The prevalence worldwide has been reported to vary between 3% and 94%. This wide range may be due to several factors such as: 1) children studied; their age and the accessibility for examination; 2) socio-economic status; 3) ethnic and cultural factors and 4) criteria used for diagnosis.

The prevalence of ECC in one country usually cannot be compared with another [13]. Richardson et al reported that even results from one ethnic group cannot be extrapolated beyond that group, even within the same country [13]. In western societies, approximately 80% of caries is present in 20% of the population commonly in children from low socio-economic groups, certain immigrants, patients with learning

difficulties and those with physical and medical disabilities. The dental survey of children aged one and half to four years in Great Britain [14] showed that the proportion of children affected increased with age: 4% of one and half to two and half year olds, 14% of two and half to three and half year olds and 30% of those aged three and half to four and half years had some experience of dental caries. In contrast, in the city of Abu Dhabi in the UAE, ECC in 2, 4 and 5 year olds is 35.5%, 85.7% and 93.8% respectively [6]. Hashim et al. (2006) in Ajman, UAE studied caries prevalence and severity of ECC in 5-6-year-old children. They reported high caries prevalence (76.1 %) and an average decayed, missing and filled surfaces (dmfs) score of 10.2 and that the Emirati (local) children had higher caries severity than other children [15]. Al-Hosani and Rugg-Gunn (1998) examined 5-year-old children in Alain city and reported a mean decayed, missing and filled teeth (dmft) score of 8.6 [6]. Recently, Kowash (2015) in a cross sectional study in the same city reported a higher mean dmft of 10.9 [16]. The aforementioned ECC prevalence results are clearly a cause of concern for this continuing problem in the UAE especially when comparing it with the internationally accepted definition of severe ECC (S-ECC).

### Etiology of ECC

The exact etiology of dental caries is still obscure. However, there is good scientific evidence to show that, for dental caries to occur, four main factors and some other minor or predisposing factors have to be present. Thus dental caries has a multifactorial etiology [17]. The four main factors are a susceptible host (teeth and saliva), a substrate (fermentable carbohydrate), micro-organisms (mainly streptococci and lactobacilli) and time. Predisposing factors include: feeding habits, oral hygiene practices, general health and nutritional status. Socio-economic factors (parental education and occupation, family income, number of siblings, parental attitude and knowledge of dental health) and demographic factors such as race, age, gender, soil and mater aspects are also contributing factors. These factors are often used as indicators to identify caries risk in children. The aetiology of ECC is indistinguishable from other coronal carious lesions in older children and adults. However, the lesion progresses rapidly and the cariogenic challenge overwhelms the protective mechanisms [18]. The etiology of the condition is a combination of frequent consumption of fermentable carbohydrates as drinks, especially at night time, with on-demand breast- or bottle-feeding because during sleep, salivary flow is greatly reduced. Other contributing factors include oral colonization by cariogenic bacteria (especially mutans streptococci) and poor oral hygiene [4]. In most cases of ECC, the etiology will be a combination of several of these factors.

There is a considerable debate in the literature regarding the effect of milk on teeth. Several studies considered it to be cariogenic under certain conditions [19, 20, 21]. Others have shown it to be anti-cariogenic [22, 23, 24]. Storey [25] reported that the reasons for this controversy are due to: 1) the difficulty of studying the effect of one item of food on dental health in human, 2) the difficulties of designing definitive nutrition experiments even in animals, 3) the different effects of food processing procedures on milk and 4) basic differences in the composition of milk of different species. The lactose (a disaccharide composed of glucose and galactose) content of human and

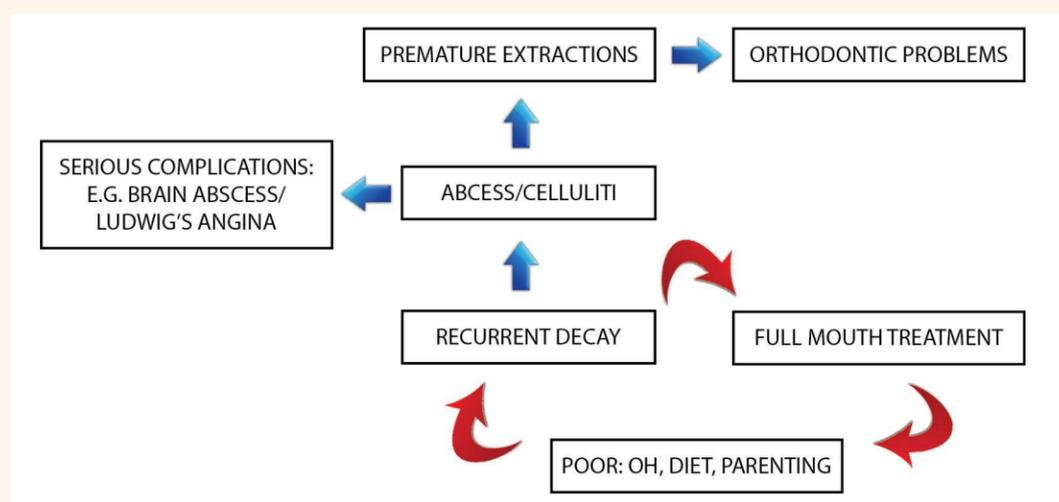


Figure 2. Vicious circle of treatment and re-treatment and its complications in the absence of an effective preventive strategy.

bovine milk aids the implantation of cariogenic bacteria and produces enamel demineralization and caries when fed to animals [19]. The effects of milk on teeth depend upon the type of milk feeding, feeding practice and time of weaning.

It is difficult to identify which type of microorganisms are responsible for causing dental caries due to the complexity of plaque micro-organisms. However, mutans streptococci (MS) and lactobacilli (LB) are considered to be the most important cariogenic bacteria [26]. MS and LB can grow at an intracellular pH value lower than 6 (high acidity) and unlike most other bacteria, they can also produce lactic acid when exposed to high concentrations of sugars [27]. MS is responsible for initiation of carious lesion, whilst LB is responsible for the progression of the lesion and is the predominant microorganism of the cavitated carious lesion. The major source from which infants acquire cariogenic bacteria, especially MS, is the mother's saliva (vertical transmission). MS can also be acquired from other family members including child minders and nannies (horizontal transmission) [5]. Teeth provide a non shedding surface for colonization of MS and its counts are related to the number of erupted primary teeth [28]. However, recent studies have also shown that MS can colonize the mouth of pre-dentate infant [29, 30].

### Consequences and complications of ECC

Depending on the severity and the extent of dental decay, ECC may lead to a significant impact on the child's oral and general health. Deep untreated carious lesions lead to pain and discomfort, inability to properly chew food and the child may avoid eating because of pain which may lead to weight loss and failure to thrive [31]. In severe cases, pulpal necrosis in primary teeth may lead to a dental abscess formation which can cause pain and damage the developing permanent tooth. If there is a necessity for premature extraction, primary tooth loss may result in various orthodontic complications (Figure 2). Premature extraction of primary maxillary incisors may also lead to problems in speech, normal development of language and aesthetic which may affect the personality and self-esteem of the child. Untreated ECC lesions may cause abscess, cellulitis and spread of infection, which may result in serious and fatal complications such as brain abscess and Ludwig's angina (Figure 2). Management of ECC complications requires increased emergency room visits and hospitalization. The socio-economic consequences of ECC manifest in increased treatment costs and missing school time as well as time off from employment for parents [32, 33].



Figure 3. General anaesthesia full dental rehabilitation of a child with severe ECC: pre-treatment (A) and post-treatment (B).

### Management of ECC

Prevention is the solution for the continuing problem of ECC. Despite following a high quality method for proper restoration of decayed teeth, recurrence of decay and its complications are very common in the absence of an adequate prevention program and follow up visits (Figure 2).

ECC is an infectious and transmissible disease but it is preventable. There are two main preventive programs: individual-based interventions and community-based interventions.

### Individual-based preventive programmes

This approach is used for high-risk populations because it is simple and does not require much effort from the parent or caregiver. The disadvantages of an individual-based approach are twofold. Firstly, it requires identification of at-risk children and secondly, it can be costly as it requires professional or auxiliary personnel. Studies have used this approach by treating the mother by counselling, toothbrushing and use of fluoride to reduce the number of maternal micro-organisms transmitted to her child. Restoration of the mother's open cavities and the use of anti-microbial agents can prevent or delay bacterial transmission to her infant [8].

The American Academy of Paediatric Dentistry (AAPD) [34] recommended dental health education program for parents with young children to improve their dental awareness and attitude toward dental health. The AAPD recommendations for the infant's oral health include.

**Establishment of a dental home:** a dental consultation visit no later than one year of age is recommended to educate parents and provide anticipatory guidance for prevention of dental diseases. The initial visit should include thorough medical (infant) and dental (parent and infant) histories, a thorough oral examination, performance of an age-appropriate tooth brushing demonstration and prophylaxis and fluoride varnish treatment if indicated.

**Oral hygiene:** oral hygiene measures should be implemented no later than the time of eruption of the first primary tooth. Twice-daily use of

fluoridated toothpaste using a soft toothbrush of age-appropriate size. Parents should assess and supervise their preschool-age child tooth brushing. Infant's newly erupted teeth may be cleaned using a cloth. Flossing of child's teeth is recommended when adjacent tooth surfaces cannot be cleaned with a toothbrush.

**Diet:** Human breast milk has not been epidemiologically associated with caries. Frequent night time bottle feeding with milk is associated with but not consistently implicated in ECC. Breastfeeding greater than seven times daily after 12 months of age is associated with increased risk for ECC. Night time bottle feeding with juice, repeated use of a no-spill cup and frequent in between meal consumption of sugar-containing snacks or drinks (e.g. juice, formula, soda) increase the risk of caries. [35, 36]. Therefore, it is recommended that infants should not be put to sleep with a bottle after the primary tooth begins to erupt. Parents should be encouraged to have infants drink from a cup after one year of age. Repetitive consumption of any liquid containing fermentable carbohydrates from a bottle should be avoided.

**Fluoride:** Optimal exposure to fluoride is important to all dentate infants and children [37]. Decisions concerning the administration of fluoride are based on the unique needs of each patient [38]. The use of fluoride for the prevention and control of caries is documented to be both safe and effective [39].

### Community-based preventive programmes

To solve the problem of ECC there should be collaborative efforts of caregivers, health professionals, and the community [40, 41]. Weinstraub [41] believed that public health or community approaches are more necessary and effective than individualistic or behavioural approaches. Oral health professionals like dentists and hygienists should be trained for skills, as necessary, for developing community-based initiatives and dental programs. These skills would include maintaining knowledge of social beliefs, culture and practices and establishing and implementing dental prevention programs [42]. A successful long-term dental health

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education program through regular home visits to mothers with infants, commencing at or soon after the time of the eruption of the first deciduous teeth, was shown to be effective in preventing the occurrence of caries, improving oral hygiene and dental attendance of young children. An added benefit was that the mothers of the children also significantly improved their oral hygiene in terms of debris, gingivitis and calculus scores [9]. Young children are dependent on their parents or caregivers for their daily dietary and oral hygiene practices. Therefore, it is important that the dental health messages should focus on educating and changing the behaviour of parents or caregivers. Moreover, the dental health messages should be practical by giving alternatives, for example substituting milk with water in baby bottles at night for those who find it difficult to stop nighttime bottle feeding. They should also consider the socioeconomic status of the parents and be cultur-

ally sensitive [9]. The benefit-cost (B/C) and cost-effectiveness (C/E) of a long-term dental health education program to mothers with young children through repeated home visits were evaluated [43]. Comparisons were made for B/C and C/E with results from a clinical trial of a slow releasing fluoride device, community water fluoridation and a school based fissure sealant program. The results showed that dental health education programs for mothers of young children starting at 8 months of age gave better B/C and C/E ratios than other preventive programs.

#### Restorative treatment of ECC

In recent years there has been a shift from the traditional (drill & fill) to a more conservative treatment modality (seal to heal) with better understanding of the caries process biology. Managing caries through minimally-invasive and low-cost treatment modality such as atraumatic restorative technique (ART) is

important especially in developing countries. It helps in slowing caries progression and hence minimizing the child's discomfort and preventing other decay complications. Studies have shown that, although caries causes demineralization of dental hard tissues and denaturation of collagen, the inner layer is minimally or even not infected by bacteria [44]. The inner part of decayed dentine contains a high concentration of minerals and can be remineralized [45]. Management of ECC should take into consideration the biology of dental tissues, remineralisation process and other protective mechanisms. The goal should be to minimize lifelong caries experience while performing the least possible intervention consistent with level of risk (Table 1).

The type of restoration chosen depends on: the tooth to be restored, present and past caries history, child cooperation and medical history. For example a decayed pri-

mary molar in a special need child is best restored with a durable restoration like stainless steel crowns (SSC). A multi-surface decayed primary molar also should preferably be restored with SSC [46]. Grossly decayed maxillary incisors are best restored with either composite strip or zirconia crowns with or without pulp therapy (Figure 3). Depending on patient cooperation, the severity and number of decayed teeth and medical history, dental treatment of paediatric patient can be performed under behaviour management and local analgesia, which is considered to be the best option in terms of cost, safety and acceptability to parents or caregivers. Other alternative options include oral or intravenous sedation and general anaesthesia (GA). Full dental rehabilitation under GA (Figure 2) is preferred by many clinicians in uncooperative preschool children requiring comprehensive dental care or those with special needs. All restorative techniques exhibit strengths and weaknesses for exam-

ple:

- Glass Ionomer Cement (GIC) is favourable for class I Cavities and in uncooperative children
- Compomers shows best long-term performance. The cooperation has to be sufficient, at least during bonding and layering.
- Resin composites after rubber dam application and correct technique – sensitive adhesion can reach the level of compomers.
- In severely decayed teeth and after pulp therapy, preformed SSC should be the restoration of choice.

#### Conclusion

Early Childhood Caries (ECC) is a chronic, transmissible infectious disease affecting the primary teeth. The etiology of the condition is a combination of frequent consumption of fermentable carbohydrates as drinks, especially when a baby is sleeping, with on-demand breast- or bottle-feeding, oral colonization by cariogenic bacteria (especially mutans streptococci), poor oral hygiene and poor parenting. It is the most common chronic disease among children and is still considered a continuing oral health problem in developing countries and also in most developed countries. It can result in considerable suffering, pain, disfigurement, reduction of quality of life of affected children and frequently compromises their future dentitions. The treatment of ECC is very costly, time consuming and in most cases, requires full dental rehabilitation under general anaesthesia by a paediatric dentist. ECC, however, is a preventable disease and the solution for this continuing problem can be achieved by educating parents of young children and pregnant mothers. It is important that the dental health messages should focus on educating and changing the behaviour of parents or caregivers. Moreover, the dental health messages should be practical, consider the socioeconomic status of the parents and be culturally sensitive. The management of ECC should take in to consideration the biology of the caries process and protective mechanisms and to be effective, the restoration of active lesions should be monitored through regular follow up and long-term preventive strategy.

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