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Review Article

Oral Histopathological Changes in Premature Infants

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Abstract

Preterm and low birth weight children comprise approximately 10% of all live birth. It is an enormous global problem that is exacting a huge toll emotionally, physically and financially on families along with medical systems. Prematurely born infants have short prenatal developmental period. Consequently, they become prone to many serious medical problems during the neonatal period which may affect the development of oral tissue. It was reported that premature born whom were intubated had developed erosions of the maxillary anterior alveolar ridge. The dragging motion of the orotracheal tube traumatized the mucosa with consequent ulceration and pressure necrosis of the alveolar ridge and underlying tooth buds. Hence, premature neonates require assisted ventilation using nasotracheal or orotracheal tubes. However, orotracheal intubation is not free of complications; these include, histopathological change to the airway, mucosa, damage to the larynx, subglottic and bronchial dentofacial deformities (primary tooth dilaceration cross bites), and poor speech intelligibility. As well as, enamel alteration, dental size and changes to the dental mineral content. At the same time, oral lesions represent a wide range of diseases often creating apprehension and anxiety among parents. Early examination and prompt diagnosis can aid in prudent management and serves as baseline in the future course of the disease. This present paper reviews the deleterious effect of preterm birth and oral tube on oral structures and their development with implications for long term care and follow up of dental concerns.

Keywords: *Histopathological Changes; Oral Complications; Premature Infants; Orotracheal Tubes*

Introduction

According to the World Health Organization, preterm delivery is when it occurs before the 37th week of pregnancy. Premature children with very low birth weight (VLBW ≤ 1500 gm) or extremely low birth weight (ELBW ≤ 1000 gm) are at greater risk for short and long term complications. The definition of premature infants has been changed during the years. Yippo., et al. (1919), defined prematurity by birth weight under 2500g [1]. Then Lubchenco., et al. (1963), reported that birth weight is determined by the fetal growth rate in addition to gestational age [2]. The mortality rate has fallen with time from 50% in the 1960's to 15% by the early 1990's [3]. Like other tissues of the body, the oral structures are also affected by premature birth, in which is exacting a huge toll emotionally, physically and financially on families along with medical systems. While the pathogenesis of the dental defects remains unclear, it is probable that both systemic disturbances and local factors contribute to the etiology. Derangement of calcium metabolism is considered as a possible systemic factor in the pathogenesis of dental defects. At the same time, local traumatic factor such as laryngoscopy and endotracheal intubation applied during the neonatal period may contribute to the etiology of these defects [4].

Growth and Development

Most of the anatomic structures are established 20 weeks of gestational age (GA). The last trimester is characterized by growth and neurological development and the accumulation of important minerals such as, phosphorus and calcium. A smaller head circumference has been noted in preterm children with impaired motor function and lower IQ. Neuro-psychiatric diagnosis among extremely preterm children are more common. Autism spectrum disorder as well as Attention Deficit Hyperactivity Disorder (ADHD) increase with lower GA [5].

Dental development

The development of teeth is an interaction between the cells driving from the ectoderm and mesoderm. The primary teeth are initiated between the sixth and eighth week of GA by an ingrowth of the ectoderm into the mesenchyme and completed by the first year. The enamel develops from the ectodermal dental lamina and differentiates through stages (bud, cap and bell) together with underlying dentin. Pulp and cementum will develop from the mesenchyme. The onset of the calcification process in primary teeth starts from the 14th week of GA and continues till the first year of life [6].

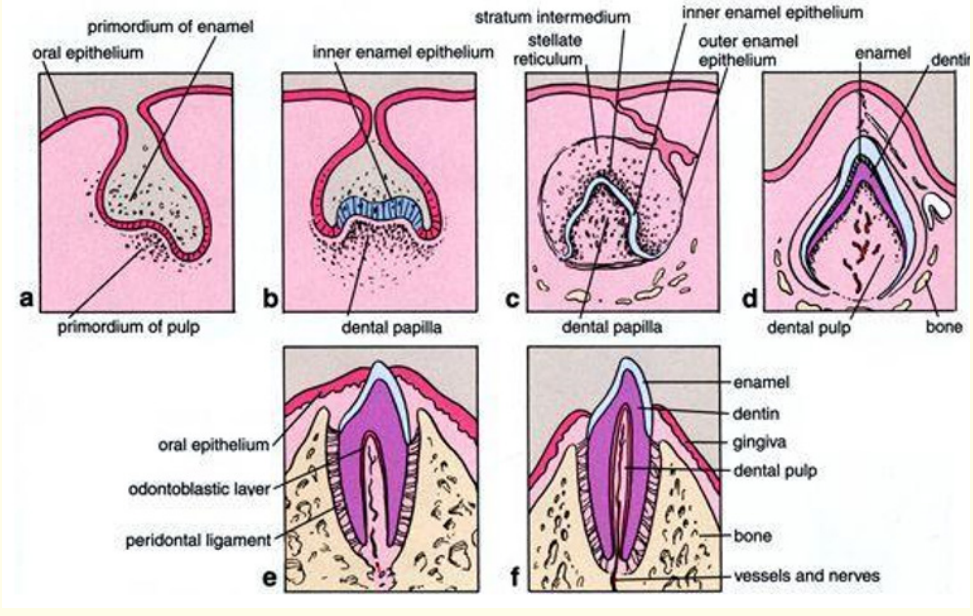

Figure 1: *Tooth formation.*

Enamel defect

Enamel is hard tissue that once formed, unlike bone, does not remodel. Insults during enamel development are permanent on the tooth surface. Dental enamel formation begin during the second trimester of pregnancy. Teeth are formed by mineralization of protein matrix about four months gestation and is not complete until late adolescence. It has been shown that the primary incisors and molars are mineralized incisally, cuspally at full term births (40 weeks of GA) [7]. The major portion of the newborns' stores of calcium and phosphorus are accumulated in the third trimester of pregnancy [4]. The essential nutrients required for dental development are calcium, phosphorus, fluoride and vitamins A, C, D and collagen [8]. Calcification of the first permanent molar crown occurs at about 28th to 30th week of gestation and is not complete until three to four years of age [9]. Therefore, an extremely low birth weight infant will not have accumulated these stores. Thus, enamel in children born preterm is poorly maturated at birth [10]. Enamel hypoplasia is defined as, deficient quality of enamel resulting from developmental aberrations. Enamel hypoplasia occurs in the form of pits, grooves or large areas of missing enamel. Medical complications of premature infants include, respiratory distress syndrome, asphyxia and hypoxia, hypocalcemia, renal immaturity, and infection or just some of the problems that may affect enamel formation [11]. Moreover, enamel hypoplasia is linked to plaque accumulation, dental caries, space loss and malocclusion [12].

Distribution of enamel defect

A controlled longitudinal study of VLBW children reported that approximately 40% of primary first molars, 50% of primary second molars and 30% of primary canines were affected by enamel defects. In those teeth, there was nearly an equal distribution in both the maxillary and mandibular arches, except in the case of incisor teeth where 80% of maxillary teeth were affected [13].

Figure 2: *Patient with enamel defect.*

Ultrastructural studies of enamel from preterm children

Reports, using polarized light and micro-radiography, suggests that the neonatal line was wider and located closer to the amelodentinal junction compared with those full term children [14]. A scanning electron microscopic study of enamel from VLBW children, showed two types of enamel hypoplasia. First, a honeycomb surface morphology which was characterized by pits. Second, a relatively smooth enamel hypoplasia with evidence of some poor quality enamel being formed later. Consequently, this may implicate higher susceptibility of enamel dental caries [15].

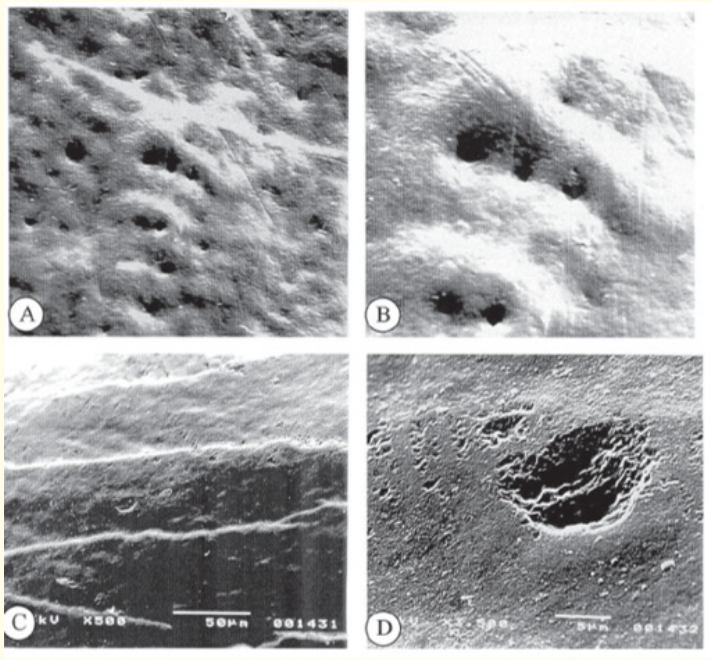

Figure 3: *Scanning electron microscopy of the normal enamel surface showing the presence of small circular pits corresponding to the Tomes' processes of ameloblast (A and B). Scanning electron microscopy of the enamel surface showing mild hypoplasia with a relatively homogenous surface and a few superficial depressions (C and D). Original Magnification: A- 2000X; B- 5000X; C- 500x; D- 3500X.*

Dilaceration of dental crown

The local traumatic forces from laryngoscopy and endotracheal intubation may cause dilaceration of the crown [16].

Alveolar grooving

Premature neonates frequently require assisted ventilation using nasotracheal or orotracheal tubes. Orotracheal tubes have been used to avoid the septal and respiratory impairments associated with nasotracheal tubes. However, orotracheal intubation is not free from complications. The movement of the tubes have been associated with histopathological changes to the airway mucosa and damage to the larynx, subglottic and bronchial mucosa. Boice., et al. (1976) were the first to report oral complications following orotracheal intubation in a neonate. They reported a noticeable concavity of the anterior alveolar ridge at the site of the orotracheal tube after three days. The enamel organ for the succedaneous teeth reportedly were normal in all sections examined [17]. Orally intubated neonate developed erosion of the maxillary anterior alveolar ridge. Resultant ulceration and pressure necrosis of the alveolar ridge and underlying tooth buds. In infants surviving several days, that orotracheal tubes secured with tape to the upper lip caused gingival excavation in the maxillary anterior region (Krous., et al. 1980).

Palatal grooving

Duke., et al. [19] reported that the cleft palate was associated with prolonged orotracheal intubation. A cleft of the hard palate extending from the incisive foramen to the soft palate was noted 40 - 50 days from intubation. Four month after extubations they reported a decrease in the size of the palatal deformity, in which it remodeled with time as a result of normal tongue function by age two.

Arch symmetry

Children who had been intubated had characteristics of: High palatal vault, posterior cross-bites, higher incidence of poor speech intelligibility [18].

Prevention of palatal grooves

Sullivan., et al. [20] described an appliance to support oral tubes in premature infants. The appliance described permitted oral tubes to be positioned securely, in which was constructed by taking an impression of the maxilla. The appliance consists of grooves extending antero-posteriorly to secure the tube. Rapid post-natal growth resulted in the loss of the peripheral seal and required that the appliance be relined frequently. He recommended that the appliance should be made for any infant requiring an oral tube for more than 24 hours.

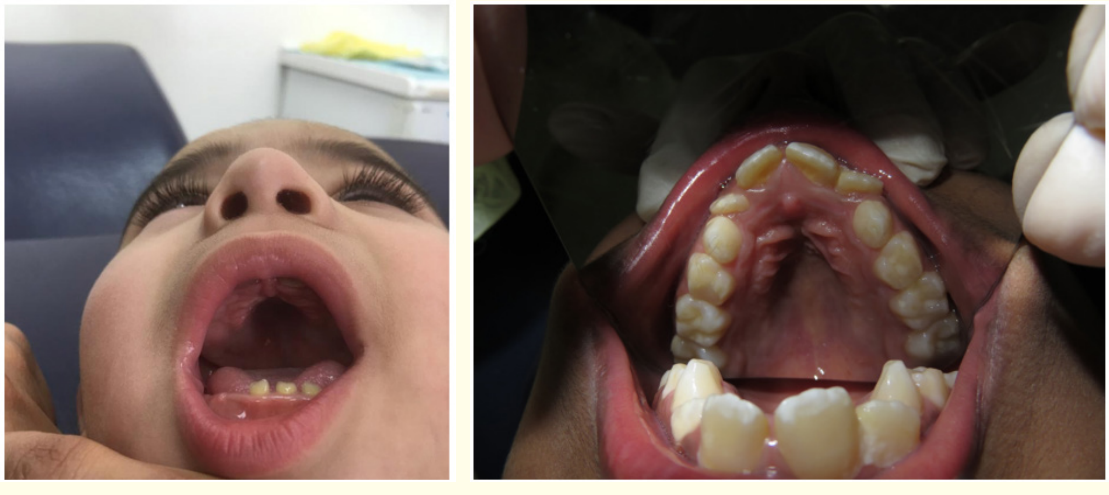

Figure 4: *Patient with high palatal vault.*

Delayed eruption and size of teeth

In most of the studies, the delay in tooth eruption was related to gestational age or low birth weight. An attempt to relate delayed tooth eruption to neonatal factors other than birth weight and gestational age was performed [13]. Thirty-five infants with birth less than 2,500 grams and gestational age less than or equal to thirty-six weeks. Results show 14 (40%) of this group had their first tooth erupt in the normal range of less than or equal to ten months chronological age, and 21 (60%) had the first tooth erupt over ten months of age. The late erupting group was comprised of those with birth weights < 1,000 grams and/or < 31 weeks' gestation. The nutritional factors that correlated significantly with tooth eruption were, age when full enteral feedings were achieved, age when oral vitamin supplements were started, and average weight gain per day. They concluded that prolonged intubation for illness and inadequate nutrition were important factors affecting the timing of tooth eruption. Senterre., et al. [4], studied the development of primary and permanent teeth in a group of preterm infants and also examined calcium, phosphorus and vitamin D supplementation. Preterm girls also had significantly later tooth eruption than preterm boys. Full term boys and girls showed no difference. Harila-Kaera., et al. [21], studied the effect of preterm birth on permanent tooth crown dimensions, 328 premature African and caucasian children and 1,804 controlled children were examined at six to twelve years of age. Difference between the gender, race, and growth patterns may influence the determination of permanent tooth crown dimensions. Preterm birth related to growth and skeletal development of the head. Craniofacial morphology in preterm children at eight to eleven years of age differs from children born at full term by a shorter anterior cranial base, less convex profile, and shorter maxillary length and more malocclusion.

Conclusion

Thereby, primary and permanent teeth of the preterm infant can be affected in a variety of ways. Education of both health care professionals and parents regarding overall dental health is important not only to minimize problems but also to promote good overall health. Health care providers need to include oral health and dental care as part of a routine examination and discussion with parents. Maternal dental care and good prenatal care must also be included in the education provided.

Parents should be given a demonstration of how to properly clean their child's teeth, starting with the eruption of the first tooth. Teeth should be cleaned routinely after feeding and especially at bedtime. Prolonged use of bottles, especially at night, should be discouraged to prevent caries. Fluoride supplementation should be prescribed as appropriate. Hence, parents need to be educated about the fluoride use and the dangers of excessive fluoride intake. American Academy of Pediatric Dentistry, American Dental Association and other dental organizations recommend that the first dental visit should be around one year of age. Indeed, it is important for preterm infants who are at higher risk for dental problems to be evaluated by this time. Therefore, promoting good oral health is an important aspect of promoting good overall health.

Conflict of Interest

Authors declare no conflict of interest.

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