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Teething: Facts and Fiction

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Objectives After completing this article, readers should be able to:

1. Understand normal tooth anatomy and the physiology of tooth eruption as well as causes of delayed eruption.
2. Be aware of the historic beliefs about the effects of teething and therapies that have been used in the past.
3. Recognize the manifestations ascribed to teething today by parents and health professionals.
4. Describe the effects of teething.
5. Discuss the acceptable therapies for relief of the symptoms of teething.

Introduction

Teething is a process that all children experience. Most children get their first tooth around 6 months of age and have a complete set of 20 deciduous teeth by 30 months of age. Parental perceptions and beliefs about teething often influence the symptomatology a child experiences with tooth eruption. From medical professionals to grandmothers, everyone seems to have a list of symptoms they believe are linked to teething. “Teething, like colic, is an ill-defined nonevidence-based entity for which parents receive much advice.” (1) It is important to remember that during this same time period of an infant’s life, passive immunity due to maternal antibodies wanes and exposure to a wide variety of childhood illnesses occurs. Due to this temporal relationship, teething often is blamed for symptoms such as changes in sleep and eating patterns, rhinorrhea, drooling, rash, fussiness, and diarrhea. Medical professionals need to be educated about teething to provide reasonable explanations to concerned caregivers.

Teeth have two distinct parts, the crown and the root, and are composed of four different tissues (Fig. 1). The crown, which is made of enamel, lies above the gum line and covers the sensitive root, which lies below the gum line. The root makes up two thirds of the tooth’s total length, goes through the periodontal ligament, and attaches into a socket in the alveolar bone of the jaw.

The four tissues that make up a tooth are:

- Enamel: durable white covering of a tooth
- Dentin: soft bonelike material that supports the enamel and carries some nerve fibers
- Pulp: center of the tooth that contains blood, lymph vessels, and nerves
- Cementum: covers the root of the tooth; the periodontal ligament sits between the cementum and the jaw bone and helps connect the two

Teeth form embryologically from neuroectoderm, which is the portion of embryonic ectoderm that develops into the central and peripheral nervous systems. Tooth development begins in the fetus around 28 days, but mineralization does not occur until 14 weeks in utero. Tooth eruption occurs when the formation and mineralization of the crown are almost complete, but before the roots are fully formed.

Tooth Eruption

Tooth eruption or teething is the process by which a tooth moves from the pre-eruptive position in the alveolar bone through the mucosa into the oral cavity. It is believed that the dental follicle (sac containing the developing tooth and its odontogenic organ) rather than the tooth itself plays the essential role in this process. The dental follicle is a source of

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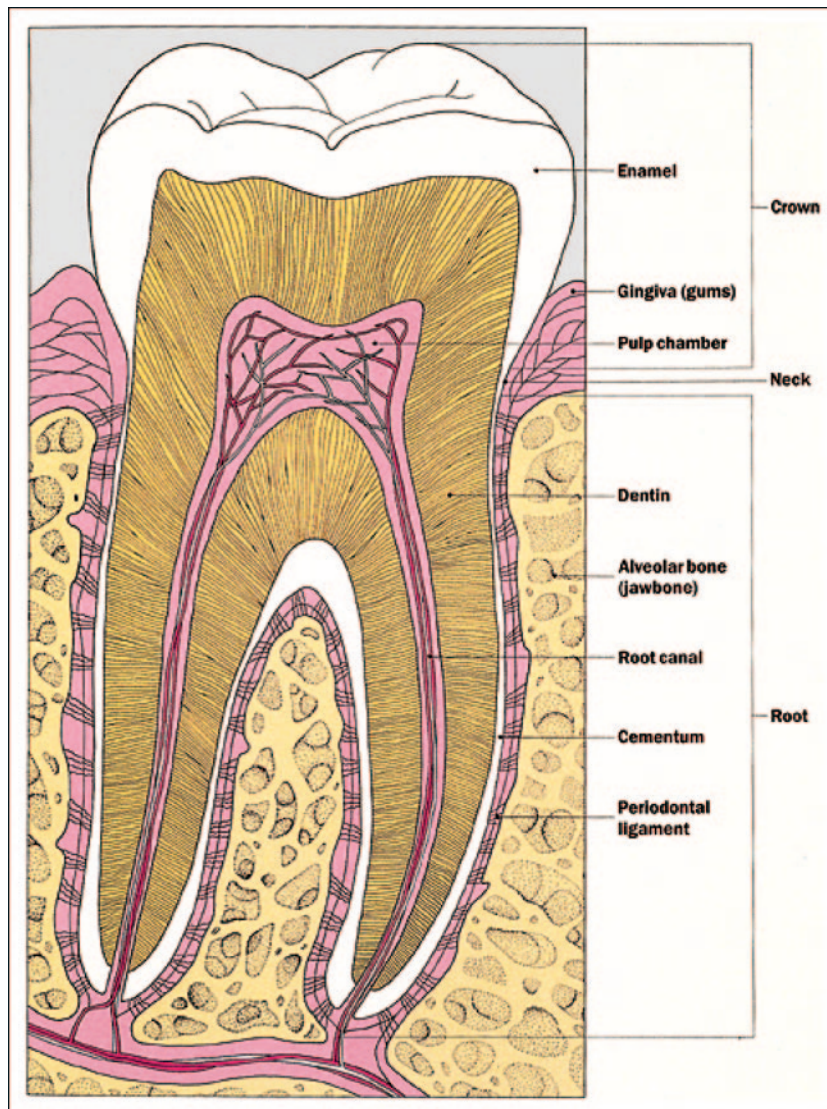


Figure 1. Tooth anatomy. © American Dental Association. Used with permission.

eicosanoids, cytokines, and growth factors and, thus, may contribute to some of the localized symptoms seen with teething.

Prior to erupting, the crown of the tooth is covered by reduced enamel epithelium. As the tooth moves upward in the jaw, the enamel epithelium and oral epithelium of the gingiva fuse over the advancing tooth; this area of fused epithelium subsequently breaks down, and the tooth erupts into the mouth. Prior to tooth eruption, the gingiva may appear bluish and swollen as a result of a transient hematoma. In rare cases, an eruption cyst develops (Fig. 2).

Primary teeth, also known as deciduous teeth or milk teeth, comprise 8 incisors, 4 canines, and 8 molars for a

total of 20 teeth (Fig. 3). Beneath the primary teeth, 20 permanent (succedaneous) teeth are developing. The timing of tooth eruption varies widely, although most children get their first deciduous tooth around 6 months of age and their last between 24 and 30 months of age. The lower central incisors usually erupt first and the molars last. Teeth tend to emerge in pairs, with the lower teeth erupting prior to the upper teeth, and girls often get their teeth earlier than do boys. The average child acquires one tooth per month between 6 and 30 months of age. The average number of teeth a child should have is roughly his or her age in months minus 6 until 24 months of age. Of note, preterm infants acquire their teeth at a later chronological age but the same postconceptional age as term infants.

A number of pathologic conditions are associated with a delay in tooth eruption (Table 1).

History of Teething Lore

Hippocrates claimed that children experiencing teething suffered from itching gums, fever, convulsions, and diarrhea, especially when cutting their eye teeth (canines). These beliefs were shared by many other philosophers of his time, and the belief that teething was a deadly disease was widely accepted until the late 19th century. Teething was known as “*dentition difficilis*,” Latin for pathologic dentition or difficult dentition.



Figure 2. Eruption cyst. Permission to use from Homer Sedighi, DMD.

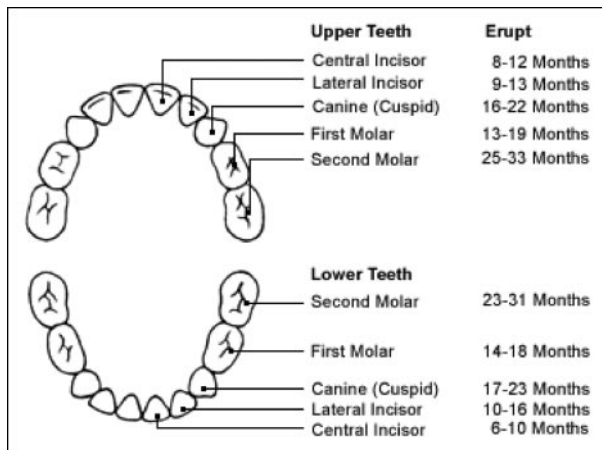


Figure 3. Primary teeth eruption chart. © American Dental Association. Used with permission.

The belief that teething caused disease was not based on scientific fact, but rather on the theory that the nervous system acted as a link between the noxious stimulus of tooth eruption and systemic disease. An infant's nervous system was believed to be very sensitive, and teething was believed to alter this fine balance, resulting in illness and death.

Historically, it was presumed that children who survived a difficult teething period would be less likely to succumb to other illnesses. Infant mortality was extremely high in previous centuries, typically peaking at 6 months to 4 years of age, a time period temporally corresponding to tooth eruption. Thus, it is not surprising that teething was believed to be the cause of death. Symptoms attributed to teething included fever, convulsions, diarrhea, vomiting, paralysis, cholera, tetanus, meningitis, insanity, and penile discharge. In 1839, 5,016 childhood deaths in England were attributed to teething, and teething was the cause of death of record for 12% of all deaths of children younger than 4 years of age. From the 16th to the 19th century in France, 50% of all infant deaths were attributed to teething. In 1894, Dr Thrasher, a well-known dentist, wrote in *Dental Cosmos*, "so deadly has teething become that one third of the human family die before 20 deciduous teeth have fully appeared." (2)

Compounding this widespread association of infant mortality with teething was that many common treatments and medications prescribed for teething were poisonous and contributed directly to the high morbidity and mortality of teething infants and children. In the 6th century, treatments for teething included eating or placing hare brains on the gums, drinking dog's milk, and employing charms and amulets. In the 18th and 19th centuries, pur-

gatives and emetics were common treatments, even if the child presented with vomiting and diarrhea. Other common remedies included opiates, lead, mercury salts, bromide, honey, and salt (Table 2). Such remedies no longer are used or recommended because of their well-known toxicities.

Autopsies of young children often revealed their deciduous teeth under their gums, further boosting a practitioner's supposition that teething was the cause of death. It soon became universal practice to assist children in the teething process to save their lives. Lancing of the gums became widely accepted and was considered a lifesaving procedure. As medical professionals became more advanced in their understanding of normal growth and development as well as in the pathophysiology of disease, this practice fell out of favor and was discontinued in most, but not all places.

Table 1. Causes of Delays in Tooth Eruption

Impacted Teeth

Impedance of tooth eruption by adjacent or overlying tooth or bone.

Down Syndrome

The first tooth usually erupts at 12 to 24 months of age, but may be delayed up to 24 months. It is common for children who have Down syndrome to be 4 to 5 years of age before they have a complete set of deciduous teeth.

Cleidocranial Dysplasia

An autosomal dominant disorder affecting the clavicle (cleido) and causing cranial and facial abnormalities, including delayed eruption of deciduous teeth.

Congenital Hypothyroidism

Failure of the thyroid gland to develop properly, resulting in a low concentration of thyroxine, leading to abnormal growth and development.

Gaucher Disease

Lysosomal storage disease (missing glucocerebrosidase).

Osteopetrosis

Syndrome caused by the failure of the osteoclasts to resorb bone; a defect in bone resorption can lead to delayed tooth eruption.

Rickets

Nutritional deficiency of vitamin D that leads to failure of the proper mineralization of bone and affects tooth eruption.

Table 2. Historical Teething Remedies

Teething Treatment	Adverse Effects
Emetics, purgatives, and salts	Dehydration
Honey	Tetanus
Opiates	Somnolence, respiratory depression
Lead	Paralysis, encephalopathy, seizures
Mercury	Vomiting, diarrhea, renal failure
Bromide	Seizures, hallucinations

Many of the historical misconceptions about teething and the related dangerous remedies persist. Because diarrhea with dehydration continues to be the leading cause of childhood mortality in developing countries, the belief that teething causes diarrhea remains commonplace. In some rural areas of Eastern Africa, the gum swelling that precedes tooth eruption is believed to be the cause of diarrhea, vomiting, and fever. Treatment of these symptoms often involves removal of teeth (ebinyo), hot nails pressed into the gums, and lancing of the gum tissue. These remedies are believed to relieve the pathologic tension on the gums, thereby alleviating diarrhea and vomiting.

The complications of these types of procedures can be disfiguring and deadly. Traditional healers or village elders often use unsterilized equipment, leading to localized and systemic infections. Lancing or tooth removal can cause enamel defects, malformed teeth, and altered mandible size. Clinicians who care for children who have emigrated from these areas and are found to have missing or malformed canines and lateral incisors should ask about these practices. Affected children should be referred to a dentist and consideration given to testing such children for human immunodeficiency virus and hepatitis B and C because of the common practice of using unsterilized equipment. Continued worldwide education about teething and diarrhea is needed to ensure that infants and children are treated appropriately and safely.

Teething Today

In 1975, RS Illingsworth wrote, “Teething produces nothing but teeth.” (3) This simple statement is a straightforward summation of the actual process of teething, but it still is not universally accepted.

Parents and caregivers today attribute a wide variety of signs and symptoms in young children to teething. Often, the diagnosis of teething seems to help alleviate parental anxiety. Parental surveys have found that caregivers attribute symptoms and behaviors such

as fever, pain, irritability, sleep problems, mouthing/biting, drooling, red cheeks, decreased oral intake, gum inflammation, runny nose, and diarrhea to teething. Such parental beliefs are consistent worldwide, across all education levels, and for both first-time and experienced parents.

Among medical professionals, pediatricians ascribe the fewest symptoms to teething and nurses attribute the most. Dentists also are more likely to attribute a greater variety of symptoms, including diarrhea, to teething. This practice likely is due to a lack of exposure to young children and that the differential diagnosis of diarrhea is not part of dental training. Dentists, however, are likely seeing more young children because the American Dental Association and the American Academy of Pediatric Dentistry now recommend that all children establish a dental home by 1 year of age. The purpose of this early intervention is to help establish good dental hygiene and decrease the risk of dental caries; however, parents are bound to discuss teething with the dentist when their children are evaluated.

Results of studies undertaken to determine which symptoms are caused by teething are varied. Most have relied on caregiver questionnaires, which have the potential for reporter bias. The teething period has been described as an 8-day window, including the 4 days before tooth eruption and the 3 days following. The two most recent prospective cohort studies found only a weak, if any, association between teething and many previously reported symptoms. The symptoms seen most consistently were biting/mouthing, drooling, gum rubbing, and irritability. Decreased appetite for solid foods and mild temperature elevation ($<38.9^{\circ}\text{C}$) also have been reported in many studies. No group of symptoms, however, can predict the emergence of a tooth. (4)(5)

There is agreement on the signs and symptoms that should not be attributed to teething. Teething does not cause systemic manifestations such as decreased appetite for liquids, congestion, sleep disturbances, diarrhea/loose stools, vomiting, cough, body rash, or fever greater than 38.9°C . The belief that teething causes systemic symptoms is unfounded, but localized symptoms and low-grade fever may be seen.

Treatment

With the understanding that teething causes localized symptoms, the best treatments are those that relieve these complaints. The expression “born with a silver spoon in his mouth” has its origin as a teething remedy. This expression referred to wealthy 19th century parents who would give their teething children a silver spoon to bite on to relieve discomfort. Unlike many historical teething remedies, the

“silver spoon” treatment was effective and still is used. Most silver spoons, however, have been replaced by more affordable textured or cold teething rings. The cold temperature of the object causes localized vasoconstriction, which decreases the inflammation, and biting on the object gives further relief by applying pressure to the gums.

Liquid-filled teething rings should be chilled in the refrigerator, not in the freezer, and should not be sterilized in boiling water or in the dishwasher (unless specified by the manufacturer). The extremes of temperature can disrupt the plastic material and lead to leakage of the fluid. Recent reports have cited fluid-filled teethingers being contaminated with bacteria such as *Pseudomonas*.

The use of diisononyl phthalate in plastic teethingers, which is a chemical used as a softening agent during the manufacturing process, also has been of recent concern. Animal studies have shown a variety of toxicities, including fetal demise, reproductive problems, and carcinogenesis. No human studies are available. The Consumer Product Safety Commission has advised parents to dispose of phthalate-containing plastic products that children place in their mouths. In response to this potential risk, many manufacturers have stopped using phthalates in their products. It is important to check product information on items that are not manufactured in the United States to avoid inadvertent exposure.

Other treatments, such as teething biscuits, teething bagels, or frozen or cold food such as waffles or vegetables, work by creating pressure on the gums. Such remedies should not be used in children who are not yet taking solid foods, and foods that have a high sucrose content are not recommended. Supervision is needed to ensure that small pieces of food do not break off and pose a choking hazard.

Homeopathic Remedies

Although homeopathic and natural remedies are widely used and reported to aid in relieving teething discomfort, sufficient evidence does not exist to recommend their use. It is important, however, for clinicians who care for children to be aware of the types of products that are available and used by parents.

Amber is a traditional European remedy for teething and is worn by the child as a necklace, bracelet, or anklet. Amber is believed to be a natural analgesic, and when worn, small amounts of oil are released onto the skin, which is believed to relieve the discomfort of teething. Amber is not an oral remedy, and the beads are not to be sucked or chewed. Other natural or homeopathic remedies include application of oils and herbs to the gums, including diluted clove oil, natural licorice sticks (not candy), fennel, green onion, olive

oil, ginger root, and vanilla. Many over-the-counter homeopathic remedies contain chamomile. Chamomile is purported to be especially helpful if the child is suffering from diarrhea, irritability, or red cheeks.

Medications

The conservative use of acetaminophen and ibuprofen can aid in the discomfort caused by teething. It is important that parents know the correct dosage for their children and maintain awareness of the differences between the infant drops and the regular suspension.

Benzocaine is the active ingredient in some of the most popular over-the-counter teething remedies. Benzocaine should be used with caution and generally is not recommended because of the risk of methemoglobinemia.

Methemoglobinemia

It is well established that benzocaine, a known oxidizing agent, can lead to methemoglobinemia. Young children are particularly susceptible to this complication because cellular mechanisms that protect against oxidative stress have not yet matured.

Methemoglobinemia has been seen, even when therapeutic and subtherapeutic doses of benzocaine are used. Anxious parents can become overzealous and apply more medication or a stronger preparation, increasing the likelihood of potential adverse effects. Benzocaine works well as a topical anesthetic because of its low water solubility and low absorption. Absorption is increased, however, when benzocaine is ingested or when there is inflammation, increasing the risk of methemoglobinemia.

Acquired methemoglobinemia occurs when the hemoglobin iron molecule is oxidized from its resting ferrous form (Fe^{++}) to the ferric form (Fe^{+++}). In the ferric form, hemoglobin is incapable of oxygen transport. Methemoglobinemia occurs when the oxidation of hemoglobin exceeds the enzymatic rate of hemoglobin reduction. The ferric heme groups also affect nearby ferrous heme groups by impairing their release of oxygen. The oxygen/hemoglobin curve shifts to the left because methemoglobin cannot transport oxygen or carbon dioxide.

The symptoms of methemoglobinemia include sudden cyanosis and ultimately hypoxia. Whereas normal blood turns bright red when exposed to oxygen, blood containing methemoglobin appears chocolate brown. Such blood discoloration can give the patient's mucous membranes a brownish hue, and the patient may appear cyanotic prior to becoming hypoxic. Treatment includes providing supportive care, discontinuing the inciting agent, and administering methylene blue and ascorbic acid.

Summary

- Historically, many of the treatments and remedies for teething have been dangerous and have contributed to the high morbidity and mortality attributed to teething.
- Today, teething treatments range from teething rings and cold washcloths to homeopathic oils and topical benzocaine. Although many of these treatments are benign, others have the potential to lead to serious disease or pose a choking risk. Vigilance and caution should be used when physicians prescribe treatment and when parents choose to use nontraditional remedies.
- Young children are exposed to a wide variety of situations, environments, and illnesses and virtually are guaranteed to have multiple episodes of fever, congestion, and diarrhea. Physicians and caregivers need to be aware of the temporal relationship between teething, exposure to infection, and normal childhood illnesses. This perspective will help ensure that teething is not used as a blanket diagnosis to explain both potentially serious illness and normal childhood behavior.
- Parents need to be educated that local symptoms may occur, but systemic symptoms are not caused by teething.

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