Scientific

# Teething, teething pain and teething remedies

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## Abstract

Teething has long been regarded as an unpleasant experience for infants and their parents. Many parents, child carers and health professionals still believe that teething signs and symptoms and in particular, teething pain, should be managed. There is limited evidence to support current pharmacological and non-pharmacological therapies for teething, and the risks associated with some current agents may outweigh their supposed benefits. This paper discusses the current understanding of teething, teething pain and the management of teething in infants.

**Keywords:** *Teething, primary tooth eruption, infant, pain, teething symptoms, teething remedies.*

## Introduction

Even though teething is a normal part of infant development, surprisingly little is known about the causes and management of teething signs and symptoms. It is widely believed that pain and other discomfort associate with tooth eruption in infants should and can be managed by pharmacological and non-pharmacological means, but this has yet to be proven. This paper presents the current understanding of teething, teething pain and the management of teething pain, based on current literature.

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## Teething

The eruption of primary teeth usually begins around 4-8 months of age with the eruption of the lower incisors, and is complete at around 30-36 months of age when second primary molars erupt. The timing of tooth eruption varies by as much as six months.[1,2] The physiological process of tooth eruption is regulated by an array of genes, hormones and factors (Table 1).[1,3-8]

Tooth eruption requires bone resorption and formation on opposite sides of the dental follicle to create an eruption pathway.[1,3,5,6,11] The tooth germ forms within a dental follicle covered by the reduced enamel epithelium,which fuse to the oral epithelium over the cusp of the developing tooth. [1, 9,10] Prior to the tooth crown emerging through the gingiva, the overlying epithelium degenerates.[1,3,4,9,11] The periodontal ligament and the ongoing development of the pulp and roots tooth provide the motive forces for eruption.[6,10,11]

## Teething Disturbances

Neaderland[12] described three common perceptions of teething: i) teething is pathological and has cause-effect

**Table 1**
Examples of regulatory factors involved in the teething process [1.3-8]

| | |
|---|---|
| **Genes** | c-fos |
| **Hormones** | Pituitary growth hormone, thyroid hormones, parathyroid hormones |
| **Growth Factors** | Epidermal growth factor (EGF), colony-stimulating-factor-1 (CSF-1), transforming-growth-factors-β1 (TGF- β1) |
| **Cytokines** | Interleukin-1α (IL-1α), interleukin-1β (IL-1β), interleukin-10 (IL-10), tumour necrotising factor-α (TNFα) |
| **Others** | Parathyroid hormone-related peptide (PTHrP), monocyte chemotactic protein 1 (MCP-1),immunoglobulin-A (IgA) |

relationships with symptoms, ii) teething is physiological, symptoms are merely co-incidental; and iii) teething is predominantly physiological, and discomfort is a normal consequence. For many people, teething is perceived to cause significant discomfort to infants and substantial distress to the parents (Table 2).[1,2,10,13-30] Disturbances are transient but may recur repeatedly during 4 to 36 months of age. Evidence regarding teething signs and symptoms is mostly subjective comments from parents, child care workers and/or health professionals.[2, 10,14-17,21, 26-32] Moreover, studies of teething have in general been small, retrospective, descriptive and cross-sectional in design.

Studies of larger cohorts[13] show no causal association between teething and infection, fever, or diarrhoea. In some children, teething may be associated with increased drooling, sucking of digits and rubbing of gingivae. Nevertheless, more recent prospective studies reveal that most systemic teething signs and symptoms (fever, vomiting, facial rashes, sleep disturbances, stool looseness, decreased appetite for liquids, and cough) are due to other causes.[1,16-19,22,24,32] Examples of these alternate causes are well documented in the literature,[27,33-38] and include meningitis, bacterial infections, and herpes simplex virus infections. The latter are painful in their own right.[34-37] Teething disturbances may also be due in part to development changes, including the decline of maternal antibodies,[10,24, 39,40] while wakefulness and night crying may be due to separation anxiety or attention seeking.

**Table 2**
Teething Signs and symptoms

| **Signs and symptoms commonly attributed to teething[1,2,10,13-30]** | |
|---|---|
| agitation | malodorous urine |
| bowel upset including diarrhoea, | otitis media |
| constipation, loose stool | painful gingiva / mouth |
| colic | perioral rash |
| convulsion | primary herpetic gingivostomatitis |
| cough | respiratory problems including runny nose, |
| croup | congestion, throat infection |
| ear rubbing / pulling | restlessness |
| excessive saliva and drooling | severe crying |
| facial flushing | skin rash |
| fever | sleep disturbance |
| inflamed / irritated gingiva | vomiting |
| loss of appetite | wakefulness |
| malaise | weight loss |

**Table 3**
Common non-pharmacological strategies against teething pain [10,24,31,51,52]

| Method | Examples |
|---|---|
| Cooling | Chewing of chilled teething rings, cold wet towels, chilled fruits and vegetables e.g. cucumber, carrot, apple<br>Cooling of the gingival with cold compress, frozen peas, ice<br>Wiping gingiva with alcohol |
| Rubbing | Gingival massage using firm finger pressure<br>Chewing of teething rusks, dry toasts, pacifiers |

## Teething Pain

Teething pain, sometimes referred to as "dentitio difficilis", is the commonest symptom associated with the eruption of the primary dentition.[4,10,23-25] Despite a reported prevalence of around 85%, evidence for this condition is weak.[4,10,23-25, 41] Adults assume an infant is experiencing pain because they appear distressed, or because they believe the incisal edges of teeth "cut through" the alveolar bone and gingiva during eruption.[24,40,41] Pain may result from elevation of inflammatory mediators in the crevicular fluid and in tissues surrounding the erupting tooth, which stimulate nociceptive receptors.[3-6,8,10,24,43-45] Local pain may be further exacerbated by rubbing or scratching the gingival tissues, by biting into hard objects, or by the presence of pathology such as eruption cysts.[10,45,46]

## Management of Teething Pain

There is no basis for the aggressive management of teething symptoms.[4,10,24,47] Historical practices with no sound basis are many, and include lancing the overlying gingival tissues, applying leeches,[24] applying necklaces,[10,48] rubbing the gingiva with various animal extracts, and administering or applying heavy metal salts or opiates.[10,18,24]

The management of teething pain is still the most frequently sought teething advice today.[4,11,31] Despite a lack of evidence supporting the efficacy of teething remedies, parents and health professionals have continued to actively manage teething.[10,41,49, 50] Many teething remedies are implemented without the advice of a dental professional, bur rather based on input from community nurses, friends, other mothers, self-help books, doctors and pharmacists. Pharmacological and non-pharmacological strategies are usually used in combination.

### *Non-pharmacological strategies*

These approaches aim either at cooling the teething site and/or rubbing the site (Table 3).[10,24,31,51] Cooling may reduce inflammation by causing constriction of dilated blood vessels and by temporarily numbing the gingivae.[52] In contrast, pressure from chewing and gingival massage may reduce pain by overwhelming the sensory receptors.[31,51]

### *Pharmacological strategies*

Pharmacological strategies for teething generally aim to achieve analgesia, anaesthesia, sedation or a combination of these (Table 4).[10,24,31,51,52,55-71] While a range of preparations are available over the counter, evidence for efficacy against teething pain has yet to be demonstrated.[53]

#### *Paracetamol*

Paracetamol (Table 4), also known as acetaminophen, is used commonly in managing teething pain and other symptoms. It reduces synthesis of prostaglandins by inhibiting cycloxygenase-3 in the central nervous system.[54,56,72,73] Analgesia results from the peripheral blockage of nociceptive impulses and their generation. Antipyresis results from the central inhibition of the hypothalamic heat-regulatory centre. In addition, paracetamol reduces hyperalgesia by reducing production of Substance P and nitric oxide.[73]

Overdosing with paracetamol results in hepatocellular necrosis, renal tubular necrosis and death.[24] For infants, paracetamol is commonly used at a dose of 10-15mg/kg/dose every 6-8 hours. At the lower end of this recommended dosage, paracetamol lowers fever but has little effect on pain.[74,75] Analgesic effects require a dose of at least 15mg/kg.[76]

Paracetamol may be formulated alone or in combination with other agents (Table 4). A particular concern is drug interactions when additional agents are used, such as herbal remedies, or preparations which contain high concentrations of ethanol.[78,79]

### *Ibuprofen*

Ibuprofen is a commonly used non-steroidal anti-inflammatory drug (NSAID) in children. It exerts analgesic, antipyretic and anti-inflammatory effects,[75,76,80,81] through peripheral inhibition of cycloxygenases and prostaglandin synthetase. Compared to paracetamol, ibuprofen may be more efficacious for management of pain and fever though it causes more frequent adverse reactions in children.[80,81]

### *Choline Salicylates*

Salicylates are synthetic NSAIDs with analgesic, antipyretic and anti-inflammatory actions. Choline salicylate is a "counter-irritant",[23,55-57] which when applied topically irritates sensory nerve endings and causes vasodilatation, which alters pain in the underlying tissues served by the same nerves.[55-57]

Used sparingly, choline salicylate does not cause mucosal irritation, however excessive application can cause a chemical burn.[24,57] Being related to aspirin, choline salicylate may cause Reyes syndrome in susceptible children, especially those with or recovering from viral infections, or when used in combination with other NSAIDs.[31,40, 58]

### *Lignocaine and Benzocaine*

These local anaesthetics agents are found commonly in teething preparations (Table 4).[58] Both act by decreasing the permeability of sodium ion channels in neuronal membranes leading to inhibition of depolarization and inhibition of nerve impulse propagation and conduction.[59] There are no studies on the efficacy of these topical anaesthetic agents for teething, however supportive literature exists for temporarily relief of toothache[60,61] and for relief of pain associated with needle penetration into mucosal tissues.[62-65]

As an amino-acyl amide, Lignocaine (or Lidocaine) penetrates oral mucosa readily.[59,63] Temporary pain relief is possible using 5% lignocaine gel.[63] The mucosal onset of anaesthesia occurs within 2-5 minutes, with a duration of 10-20 minutes.[58,63] Blood levels after topical application of lignocaine is similar to that of intravenous administration.[65] Side effects from this agent are rare when used in accordance with recommendations.[59]

In contrast, benzocaine is an ester anaesthetic agent.[59] It also penetrates the oral mucosa well,[60,64,65] with an onset and duration of action similar to lignocaine.[59,63] Benzocaine at a concentration of 20% gives temporary relief of pain on mucosal tissues.[59,60,63-65] However, as an ester, it poses a higher risks of hypersensitivity reactions and severe adverse effects such as methaemaglobinaemia.[58,66-70]

## *Complementary and Alternative Medicines*

A range of complementary and alternative medicines (CAM) have been suggested for managing teething pain, including tea tree oil-based ointments, clove oil-based ointment, acupressure, herbal formulations, aromatherapy and homeopathic remedies.[24,82] None of these methods has proven effectiveness for managing teething pain.[24,82] Problems may arise when CAM are used in conjunction with conventional analgesics, for example, garlic interferes with the pharmacokinetics of paracetamol.[79,83]

## Discussion

Eruption of primary teeth is a significant developmental milestone for infants. As highlighted in the foregoing discussion, there is only weak evidence for pain and no evidence to support the wide array of systemic signs and symptoms often attributed to teething by parents, child carers and health care professionals. Bennett and Brudno[50] in the Pediatric Infectious Disease journal presented a deliberately flawed study on teething. Their paper "The teething virus"[50] highlighted the lack of evidence-based practice in the management of teething symptoms. Teeth, whether primary or permanent, do not "cut" through bone, connective tissue and oral epithelium during eruption as an eruption pathway is formed by via bone remodelling. The lack of any significant "teething pain" associated with eruption of permanent teeth is remarkable. Although it can be argued that in older children there is greater pain tolerance and lower pain sensitivity compared to infants.[84,87]

If some pain is experienced during teething, this will be impossible to assess reliably because infants cannot communicate their pain specifically or describe their pain experience explicitly. Instead, adults interpret various cues (vocalization, facial expression, body movements and changes in breathing rates) and attribute these to pain in the infant.[84,85] Such cues are not specific and are caused by other forms of stress or distress. Moreover due to cortical immaturity of infants, biologic responses to stimuli are not consistent.[85]

**Table 4**

Common pharmacological strategies against teething pain [10,24,31,51,52,58]

| Strategy | Brand / Active Constituents | Dosage / Instruction for Use | Notes / Cautions |
|---|---|---|---|
| Analgesia | Panadol<br>Paracetamol<br><br>(Panado, Adcock Ingram) | Oral dose 15mg/kg every 4-6hrly, up to 4 times a day. | "Indicated for temporary relief of fever and pain associated with teething"<br>"Administration to infants under 1 month is not recommended" |
| | Dymadon<br>(J&J Pacific)<br>Paracetamol | Oral dose 15mg/kg every 3-4hrly, up to 4 times a day | "Indicated for relief of pain and fever associated with teething" |
| | Nurofen<br>(Reckitt Benckiser)<br>Ibuprofen | Oral dose 5-10mg/kg every 3-4 times daily, maximum 1200 mg per 24hrs | "Indicated for temporary relief of pain associated with teething"<br>"For children aged 3mths to 12yrs" |
| | Painstop For Children Day-Time Pain Reliever Syrup (Care Pharmaceuticals) 120mg paracetamol & 5mg codeine phosphate per 5mL<br>"Contains no alcohol or sugar" | Oral dose 0.5mL/kg 6hrly, "for children 1-2yrs old (10-12kg) 5-6mL; 2-3yrs old (12-14kg) 6-7mL; 3-4yrs old (14-16kg) 7-9mL; 4-5yrs old (16-18kg) 9-10mL." | "Indicated for relief of moderate to strong pain when analgesia greater than that provided by paracetamol alone is required including dental pain"<br>"Not recommended for children less than 12mths old" |
| | Bonjela Teething Gel<br>(Reckitt Benckiser)<br>87mg/g choline salicylate<br>Also contains: ethanol, saccharin, cetalkonium chloride | Topical use – "Massage approximately 0.5cm of gel" every 3hrly and not more than 6 applications in any 24hrs period | "Indicated for relief of pain and discomfort in abrasions, ulcers, irritations of the gums, palate, cheek, tongue and lips; infant teething disorders"<br>"Not recommended for infants under 4 months of age"<br>"Preparations containing aspirin should not be given to children under 12 years of age during treatment" |
| | Curash Family Oral Pain Relieving Gel<br>(Church & Dwight)<br>90mg/g choline salicyclate, 350mg/g ethanol<br>Also contains: 0.38mg/g cetylpyridinium chloride, 0.25mg/g cetalkonium chloride | Topical use – "Apply to saliva free area and gently rub in every 3hrs" | "Indicated for pain relief for teething and relief of sore gums"<br>"Do not use on infants under 4 months of age"<br>"While using gel, young children should not be given aspirin or other salicyclates" |

**Table 4**
continued

| Strategy | Brand / Active Constituents | Dosage / Instruction for Use | Notes / Cautions |
|---|---|---|---|
| Analgesia | Herron Bay Teething Gel (Herron)<br>8.7% w/w choline salicylate<br>Also contains: 0.01%w/w cetylpyridinium chloride, 0.01% w/w ethanol, 38% w/w clove oil, menthol, aniseed oil as preservatives | Topical use – "Wipe surface free of saliva before application; use enough gel to cover the tip of the index finger or cotton swab) every 3 hrly | "Temporary relief of teething pain and sore gums"<br>"Not recommended for babies under 4 months of age"<br>"Preparations containing aspirin should not be given to children during treatment" |
| | Oral-Sed Jel (Hamilton)<br>9% choline salicylate, 0.01% benzalkonium chloride, 31.7% ethanol<br><br>(Teejel, Adcock Ingram) | Topical use – "Apply every 3 hrs and massage into gums before meals and at bedtime"<br><br>"Do not apply more frequently than every 3hrs" | "Indicated for relief of pain and discomfort of infant teething and sore gums"<br><br>"Do not use in children where viral infection is suspected"<br><br>"Avoid prolonged treatment in infants"<br>"Do not treat children under 12yrs of age with aspirin during use" |
| | Seda-Gel (Key)<br>8.7% w/w choline salicylate, 0.01% w/w cetalkonium chloride, 39% w/w ethanol, 0.057% w/w mentol, 0.15% w/w hydroxybenzoates | "Apply an adequate amount of gel to the tender areas, massage in well, repeat application every 3hrs"<br><br>"Should not be applied more often than every 3hrs" | "Indicated for relief of discomfort of infant teething troubles"<br><br>"Not suitable for babies under 4mths of age"<br><br>"Babies being treated with gel should not be given products containing aspirin" |
| Anaesthesia | Applicaine Drops (Church & Dwight) 50mg/mL benzocaine, 587mg/mL ethanol.<br>Also contains 0.75mg/mL cetylpyridinium chloride, 0.5mg/mL cetalkonium chloride<br><br>(Prodol Drops, Technikon Laboratories) | Topical use – "apply 1-2 drops" every 2-3 hrly | "Indicated for relief of discomfort of the gums caused by infant teething" |
| | Medijel (Key)<br>0.66% lignocaine hydrochloride, 0.05% aminacrine hydrochloride | Topical use – "Apply directly to affected area with finger or cotton wool pad; repeat after 20mins if necessary" | Not specified for teething<br><br>"Indicated for relief of pain caused by sore gums" |
| | Seda Lotion (Key)<br>2.5% w/v lignocaine | Topical use – "Apply to the affected area every 2hrs" | Not specified for teething<br>"Indicated for pain associated with sore gums" |

**Table 4**
continued

| Strategy | Brand / Active Constituents | Dosage / Instruction for Use | Notes / Cautions |
|---|---|---|---|
| **Anaesthesia** | EMLA cream<br>(AstraZeneca)<br>25mg/g lignocaine, 25mg/g prilocaine | No dosage recommended for teething.<br>Anecdotally, used by some as per other teething gel.<br>"Use up to 10g for children 1-6 years old" | Not specified for teething<br>"Should not be used in infants between 0-12mths of age receiving treatment with methaemoglobin inducing agents"<br>"Prolonged exposure significantly increases the risk of methaemoglobinaemia" |
| **Analgesia and Anaesthesia** | SM-33 Gel<br>(Bayer Consumer)<br>2% salicylic acid, 0.5% lignocaine, 0.5% tannic acid, 0.05% menthol, 0.05% thymol, 40% ethanol | Topical use – "Apply to area every 3 hours" | "Indicated for infant teething; abrasions and inflammation of gums, palate, tongue"<br>"Not recommended for infants less than 6mths of age"<br>"Concomitant use of aspirin contraindicated in children" |
| **Analgesia and Sedation** | Painstop Night-Time Pain Reliever Syrup<br>(Care Pharmaceuticals)<br>120mg paracetamol, 5mg codeine phosphate & 6.5mg promethazine hydrochloride per 5mL<br>Also contains:<br>10% v/v ethanol, sucrose<br><br>(Stopayne Syrup, Adcock Ingram) | Oral dose "4-5mL for 2yrs old; 6-7mL for 3-4yrs old; 7-8mL for 5-6 yrs old, 6-8 hrly" | "Relief of moderate to strong pain, when analgesia stronger than paracetamol alone is required and also when sedation may be beneficial, including dental pain"<br>"Not recommended for children under 2years old"<br>"As with all sugar containing medicines, it is advised that the mouth be rinsed after dosing as this minimises the incidence of tooth decay" |
| **Sedation** | Phenergan Elixir<br>(Sanofi-Aventis)<br>5mg/mL promethazine hydrochloride | No dosage recommended for teething<br><br>Oral dose for sedation "for children 2-5yrs old: 5-15mL as a single dose at night or 5mL 2-3 times daily" | Not specified for teething<br><br>"Not recommended for children under 2 years old"<br><br>"Children may experience paradoxical excitation with promethazine" |
| | Vallergan Syrup<br>(Sanofi-Aventis)<br>7.5mg/5mL Trimeprazine tartrate | No dosage recommended for teething<br><br>Oral dose for sedation "for children 3-6yrs old: up to 30mg twice per day" | Not specified for teething<br><br>"Indicated for oral treatment of pruritus irrespective of the cause"<br><br>"Not recommended for children under 2 years old" |

Despite uncertainty surrounding teething pain per se, most prefer to manage teething actively using a combination of non-pharmacological and pharmacological means. Given that evidence supporting the presence of teething pain is inconclusive and the efficacy of most current therapies against teething pain is yet to be determined, the risks vs. benefits of using various therapies must be considered with great care. The placebo effect must not be overlooked. For example, applying a gel of 20% benzocaine in polyethelene glycol may give only a modest benefit over applying the placebo, which gives an efficacy of 60% compared with 90% for the active preparation.[60] Moreover, the efficacy of such topical applications is limited by dilution of the active components into saliva. The limited benefit of using topical gels for the duration of teething (24-36 months approximately) is further argument against such practices.

Overall, the risks and adverse effects from inappropriate or prolonged use of pharmacological agents outweigh their potential benefits.[53,54,70] The psychological trauma involved in administering medications or applying topical preparations to infants must be considered. Attributing symptoms and signs to teething, without first excluding other causes, may result in misdiagnosis and delayed management of more serious systemic conditions which cause fever and other systemic signs. Cognitive management of teething should be considered. Behavioural therapies such as sleep management can be used to combat sleep disturbances, wakefulness and irritation.[41]

This paper highlights the importance of separating time-honoured myths and traditions from evidence-based practices. Parents, carers and health professionals need to be well informed and given rational rather than conflicting advice. To that end, further research into teething and its management should be supported and encouraged. Likewise, the inclusion of teething and its management as a topic in antenatal classes, in professional health programs and in continuing professional education for health professionals and childcare workers should be considered.

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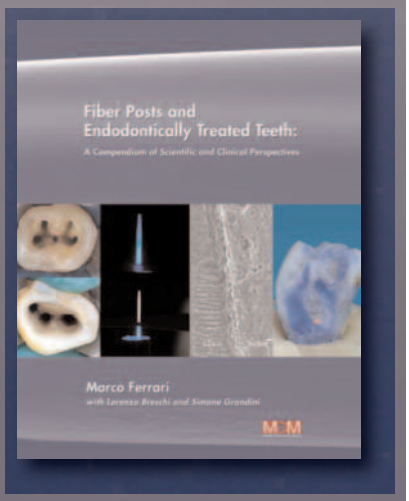


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