



# Behavior management and pain control in treatment of children with molar incisor hypomineralization

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## Abstract

Molar incisor hypomineralization (MIH) describes the clinical picture of more or less strongly hypomineralized first permanent molars with or without the involvement of permanent anterior teeth. In the meantime, however, MIH-typical substance defects were found on every possible tooth. Affected teeth can be hypersensitive. This hypersensitivity can only be treated when complete pain control is ensured. With the awareness of possible causes of hypersensitivity and the help of a correct behavior management and anesthesia technique as well as sometimes with the help of sufficient premedication and compassion for our patients, it should be possible to treat most of these hypersensitive teeth affected by MIH. With the therapy-appropriate formulations of the adequate anodyne, it is also possible to control the symptoms of chronically inflammatory MIH molars (pain protocol; pain algorithms). Sedation with nitrous oxide/oxygen allows a more intensive use of behavior management techniques. As a last treatment option, the patient could be brought to rehabilitation under general anesthesia.

**Keywords** Molar incisor · Hypomineralisation · MIH · Pain control · Behaviour management · Hypoplasia

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## Quick reference/description

With the increase in prevalence of molar incisor hypomineralization (MIH), pediatric dentists are challenged with MIH teeth that require restorative treatment. Early restorations in MIH molars are usually complicated by existing hypersensitivity that can also lead to fear, anxiety and uncooperative dental behavior. Hence, MIH patients should receive competent and pain-free treatment that is oriented towards proper pain management and behavior control.

## Description of MIH-typical treatment procedures

Dentists should be aware about the fact that children with MIH teeth experience more hypersensitivity, secondary caries and dental anxiety. A significant difference exists between younger and older children during treatment of MIH-affected patients. Treatment of younger patients with a history of chronic pain and associated caries in MIH molars is considered as the most difficult scenario for pediatric dentists. Hence, devising a MIH-specific pain control method in association with a unique treatment protocol is vital. While managing pain and behavior, certain principles should be strictly observed. The principles are:

- Avoidance of pain at each phase of treatment
- Use of best possible pain control
- Paying meticulous attention to the behavior feedback from MIH patients

For management of MIH patients, it is essential to develop a concept for optimal pain and behavior control. This concept should have the ability to be adapted to the level of discomfort of MIH patients. The MIH-treatment need index (MIH-TNI) provides clinicians with a similar treatment protocol that also considers the sensitivity of MIH teeth to pain.

MIH TNI, the indices

MIH-TNI 0 = no signs of MIH

MIH-TNI 1 = diagnosed MIH without substance defects and without hypersensitivity

MIH-TNI 2 = diagnosed MIH with substance defects and without hypersensitivity

MIH-TNI 3 = diagnosed MIH without substance defects and with hypersensitivity

MIH-TNI 4 = diagnosed MIH with substance defects and with hypersensitivity

## Pain and fear in children

Pain is a subjective feeling of discomfort that is induced by a stimulus. Its intensity is influenced by age, gender, stimulus strength and prior pain experience. Religion,

social origin and philosophical attitudes can influence pain perception. Acute pain is mostly self-limiting, and chronic pain can persist for months to years.

Fear is a strong, vague feeling of concern, discomfort or threat. In children, the manifestation and projection of anxiety depends on the developmental age, social environment and prior distressing experiences. Fears triggered by pain can become chronic in the absence of direct help or coping strategies.

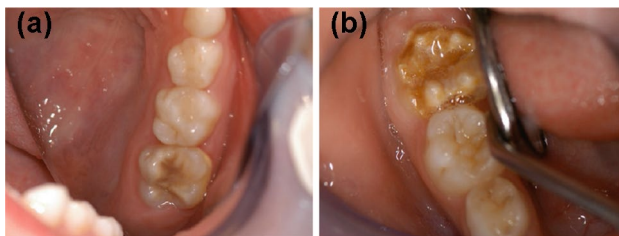
### Features of pain perception in children

Children of all ages experience pain. Pain in children is associated with unique issues (child-like pain) based on the child's age. Common problems with pain perception in children are aggravated by a restricted communication ability, cognitive problems with pain allocation, a lack of experience and an incomprehensible social environment.

### Pain associated with MIH teeth

The pain of hypersensitive MIH teeth manifests as soon as the MIH-affected tooth erupts into the oral cavity. It mostly occurs at the age of 5–6 years and influences a child's understanding. The child's experience of inexplicable pain in the mouth is difficult for him/her to explain without help and understanding of the social environment. From tooth eruption onwards, there is constant moderate to severe chronic pain in most portions of the severely hypoplastic first molars. Severe hypersensitivity of MIH molars is a key symptom of MIH. It occurs due to spontaneous enamel breakdown and rapidly progressing caries. Hence, one of the two major factors of the MIH-TNI is hypersensitivity. The consequences of chronic hypersensitivity are (Fig. 1):

- Limitations in maintaining oral hygiene
- Issues with intake of warm and cold food
- Chronic pain
- Sudden anxiety episodes during the day
- Limited ability to cooperate during dental treatment



**Fig. 1** **a** A 7-year and 6-month-old caries-free child with MIH-TNI 3 without enamel disintegration on tooth 26. Only limited brushing is possible on this MIH tooth. **b** A 7-year and 2-month-old child with severe MIH, enamel disintegration and associated caries on tooth 46. Oral hygiene is almost impossible on this hypersensitive MIH tooth, and any intake of cold or warm food is painful

**Fig. 2** A 7-year and 1-month-old child with severe MIH. Despite several treatment attempts, tooth 26 is insufficiently treated, and adequate oral hygiene is impossible due to hypersensitivity leaving even an experienced dentist helpless



Achieving painless dental treatment is difficult or almost impossible with hypersensitive MIH molars. Treatment sessions involving MIH-affected teeth are often disrupted in routine clinical practice because of inadequate pain control in spite of repetitive administration of high-dose local anesthesia. It has been shown that the worst restored MIH molars demonstrate the most severe hypersensitivity among treated MIH teeth (Fig. 2).

Chronic pulpal inflammation seems to be the main cause of hypersensitivity in MIH teeth. The porous hypomineralized enamel and dentin layers do not adequately protect the pulp tissue of hypoplastic teeth against the persistent chemical, physical and thermal stimuli occurring in the mouth. Hypersensitivity of MIH teeth occurs almost exclusively in the first permanent molars, rarely in primary molars and almost never in the incisors.

### **Behavior management and pain control treatment protocols for children with MIH**

In pediatric dentistry, the prerequisites for successful treatment are management protocols specially adapted for children along with behavior management techniques (Fig. 3). The efficacy of behavior management approaches largely depends on the social environment, particularly the parents and teachers. The techniques that impact the mind of pediatric patients are:

- Classic tell-show-do technique
- Classical conditioning
- Positive reinforcement
- Distraction and attention control
- Systematic desensitization
- Cognitive modeling

**Fig. 3** Behavior management: joint training of patient and dentist of the stop signal



It is crucial to follow certain recommendations for a comprehensive and almost painless dental clinical examination followed by traumatic treatment for a child with chronic hypersensitive MIH teeth. The recommendations are:

- Painless examinations and confidence-building measures
- Local anesthesia
- Premedication
- Postoperative pain control
- Additional sedation
- General anesthesia

### Painless examination

In children with MIH, affected teeth should be carefully handled starting from the initial examination. Only cotton rolls should be used to dry the MIH teeth (Fig. 4). The use of thermal stimuli like air syringe, warming surgical lamps or cold instruments should be carefully considered. If necessary, the use of such stimuli should be avoided at all costs. In children with previous episodes of painful experiences during dental check-ups, special measures for confidence-building measures are crucial at the initial examination. Greatest possible pain control during all dental procedures forms a good basis for the management of traumatized patients with MIH.

### Local anesthesia

A major clinical issue in treatment of chronically inflamed MIH molars is difficulty in effective application of anesthesia. There appears to be a direct association between the prevalence of anesthesia failures and the strength of hypersensitivity of MIH teeth.

The hypersensitivity of MIH teeth should be managed by local anesthesia for any restorative procedure. Local anesthetics block the sodium channels resulting in reversible pharmacological elimination of pain receptors and pain conduction, which is impaired in MIH teeth. In such cases, selection of local anesthetics for intraoperative pain control should depend on:

- General medical condition
- Desired duration of action
- Desired depth of anesthesia

**Fig. 4** Auxiliaries for drying hypersensitive MIH teeth, during examinations without air blower insert



The most commonly used anesthetic is articaine (4%) with a small amount of adrenaline (epinephrine). Three formulations of articaine are available depending on the addition of adrenaline (Ultracain<sup>®</sup> with adrenaline addition of 1:100,000, 1:200,000 or 1:400,000). All formulations can be administered to children to manage hypersensitivity in MIH teeth. The proportion of adrenaline influences the duration of the anesthesia. Hence, local anesthetics with adrenaline addition of 1:400,000 can be used for a lower systemic load because of epinephrine. However, the dose of articaine required may be higher than in 'normal' teeth.

Maintaining the individual daily maximum dose is crucial in children. It primarily depends on the age and body weight of the child to be treated. The recommended daily dose of articaine in children is 5 mg/kg.

**Optimized clinical anesthesia technique** Painless local anesthesia requires atraumatic needles with a counter-section and a deliberate slow injection technique. All types of routine local anesthesia can be administered in MIH-affected teeth (Table 1). In children, the anesthetic effect is faster because of the more permeable compact bone. Hence, infiltration anesthesia is usually adequate in the maxilla and mandible. A depot of anesthetic is initially administered for anesthesia of the puncture site followed by gradual infiltration of the required amount of anesthetic. Special anesthesia techniques can be used in children owing to the enhanced permeability of the jaw structures (Table 2).

**Optimized technical equipment** Use of the crestal intraosseous technique for anesthetizing MIH molars can be beneficial. It is atraumatic and effective particularly when performed in association with a computer-controlled injection system. The STA Wand<sup>®</sup> Plus is a pen-like electronic anesthesia system, which provides computer-controlled local anesthetic infiltration. It has an extra thin needle making the anesthesia less painful. The device has a different appearance than a conventional syringe.

The STA Wand<sup>®</sup> Plus anesthesia delivery system administers the anesthetic drop by drop either by the slow-flow method, which deposits a drop of local anesthetic every 2 s or by the fast-flow method, which administers the anesthetic at double speed. The slow-flow method is useful for single-tooth anesthesia. A foot pedal can control the speed of infiltration and the automatic aspiration of the injection system.

The infiltration and conventional nerve block techniques are both usually suitable for anesthesia. However, infiltration anesthesia with the CIA technique can be beneficial for children as it minimally affects the soft tissues (Fig. 5). The STA Wand<sup>®</sup> system uses the porosity of bone for effective anesthesia. Therefore, it can anesthetize individual teeth more precisely.

The QuickSleeper<sup>®</sup> device (Dental Hi Tec. Cholet, France) utilizes a well-cutting needle and a special application handpiece for initial cutting followed by rotation for intraosseous anesthesia (Fig. 6). It facilitates controlled injection of the local anesthetic through the cortical bone into the cancellous bone of the

**Table 1** Conventional techniques for pain elimination in hypersensitive MIH teeth

Conventional anesthesia techniques	Description	Usefulness for MIH
Terminal anesthesia	Injection of local anesthetic into submucous tissue as close as possible to the bone and the tooth to be anesthetized	Yes, with partially insufficient effect on hypersensitive MIH teeth
Anesthesia with nerve block	Injection of local anesthetic near a peripheral nerve trunk	Yes, with partially insufficient effect on hypersensitive MIH teeth
Intraligamentary anesthesia	Injection of local anesthetic into periodontal ligament	Yes, with partially insufficient effect on hypersensitive MIH teeth
Intraosseous anesthesia	Rotating needle systems or special drills used to provide access through compact bone for infiltration anesthesia	Yes, with mostly adequate anesthesia

alveolar process. The Quicksleeper system is superior than the STA Wand<sup>®</sup> as it utilizes normal dental injection needles or special DHT needles (Dental Hi Tec). However, it has a somewhat bulkier handpiece. The DHT needles allow more gentle cutting of the mucosa rather than sharply perforating it.

Application of local anesthetic to the alveolar process adjacent to a hypersensitive tooth facilitates achievement of deeper and more reliable anesthesia, while reducing the amount of anesthetic required and also the associated toxic load. Currently, the QuickSleeper is the only computer-controlled device available that enables a precise perforation through the cortical bone using a rotating needle. This allows favorable repetitive treatment of even MIH molars.

## Premedication

Prescribing analgesic premedication to children with hypersensitivity of MIH teeth before any procedure seems to be a prudent treatment modality for pain control. Occasionally, it is important to consider premedication with selected analgesics for an actual painless MIH-treatment protocol when local anesthesia alone appears to be inadequate. Premedication facilitates a decrease in the chronic inflammatory condition below an acute threshold. The basis of the MIH premedication protocol is as follows:

- Use of the most effective analgesic for premedication
- Very high and short-term dosing of analgesic (1–2 days)
- Targeted effect of the pre-staggered analgesic to repress chronic pain (48–24 h before treatment)
- Prolonged (maximum: 2–3 days) and repetitive (not more than 3–4) analgesic treatment cycles should be avoided

**Table 2** Special intraosseous anesthesia techniques in treatment of hypersensitive MIH teeth

Special intraosseous anesthesia techniques	Application	Advantages for hypersensitive MIH teeth
Crestal intraosseous approach (CIA)	45° angle from buccal under interdental papilla (into cancellous bone) or root furcation	Less pain, high reliability, less soft tissue anesthesia
Palatal anterior superior alveolar (PASA) nerve block	45° angle from palatal into the palatal mucosa at the level of the incisors	Less pain, high reliability, less soft tissue anesthesia
Anterior middle superior alveolar (AMSA) nerve block	45° angle from palatal into mucosa at the level of the first premolars	Less pain, high reliability, less soft tissue anesthesia

In case of doubts about the dosage and type of premedication, consultation with a pediatrician is recommended. Commonly, same drugs are used for premedication as well as postoperative pain management. Premedication used in MIH should have an analgesic and an anti-inflammatory effect. A variety of approved analgesic medications are available for use as premedication for management of MIH. The current state of pharmacology should always govern the decision of selecting the analgesic premedication in children with MIH.

### Medication after treatment

For routine treatment procedures, a special postoperative pain control measure is usually not required. In patients undergoing painful interventions such as extraction of permanent molars, the analgesic used as premedication can be prescribed for a longer period after the procedure.

### Sedation

The consciousness and pain threshold in children can be influenced by sedation. The type of sedation used in children varies with age. Drug sedation is useful in very young patients, while inhalation sedation with nitrous oxide and oxygen is preferred in 5- to 7-year-old children. Nitrous oxide-oxygen (N<sub>2</sub>O) sedation is greatly effective in MIH patients with several previous experiences of treatment failure. Inhalation sedation with 30–50% N<sub>2</sub>O content (moderate dosage) has a greater sedative effect and a lower analgesic effect (Fig. 7). Appropriate application of N<sub>2</sub>O sedation can aid in improving anxiety, avoiding anxiety-induced gag reflexes and developing optimum treatment protocols.

### General anesthesia

In few cases that require extreme pain control measures and anxiety management, the approach seems inappropriate for the patient's age. Therefore, treating





**Fig. 5** a STA Wand<sup>®</sup> system, **b–d** CIA injection method using computer-controlled injection device STA Wand<sup>®</sup>

**Fig. 6** Quicksleeper intraosseous injection system when the cortical bone is perforated at region 16



the patient under general anesthesia seems to be a prudent alternative when more intense and painful procedures like multiple teeth extractions are to be performed.

## Overview of possible treatment techniques

Pain control techniques	Indications	Rationale
Drying of teeth with cotton wool rolls and controlled use of thermal stimuli	Painless clinical examination For confidence-building	Effective pain control and building of patient's confidence in all dental procedures form a good basis for successful treatment of MIH patients
Local anesthesia	Effective intraoperative pain control	Effective local anesthesia is required to control the hypersensitivity of MIH teeth Painless administration of local anesthesia needs optimization of technique and equipment
Premedication	When local anesthesia alone is inadequate for pain control	Premedication with selected analgesics is crucial for a real painless treatment protocol for MIH
Medication after treatment	Postoperative pain control especially after painful procedures like permanent molar extractions	Selected analgesics can be prescribed after painful procedures for postoperative pain management
Sedation (drug-induced or inhalational)	Additional measure of pain control in children with acquired deep unconscious fear Prevention of anxiety-induced gag reflexes	Sedation is particularly helpful in MIH patients, who have experienced prior treatment failures
General anesthesia	If the clinical effort required for pain control and anxiety management is so extreme that the treatment seems inappropriate for the patient's age	Pain management of MIH patients with several previous experiences of treatment failures

**Fig. 7** N<sub>2</sub>O sedation and simultaneous injection in the left mandible for treatment of MIH tooth 36



## Pitfalls and complications

- Conventional behavioral management techniques are sensitive to other disturbing factors.
- Invasive behavior management approaches like hand over mouth, active restraint and corporal punishment (also by parents) can adversely affect the psyche of children and are not recommended in pediatric dentistry.
- Adverse drug reactions in children are rare and are often caused due to negligence of local anesthesia dosage guidelines.

## Conclusion

Children who have MIH hypersensitive teeth require a special, problem-oriented treatment technique. Traditional pain control techniques, such as local anesthesia, may be ineffective in hypersensitive MIH teeth. Children with chronic complaints due to hypersensitive MIH teeth have an increased perception of pain. With a problem-oriented treatment technique, even children with hypersensitive MIH teeth can be treated in most cases. However, these techniques differ considerably from those used for children without chronic pain.

## Further reading

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