

## **PAINLESS ANESTHESIA IN PEDIATRIC DENTISTRY**

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**ABSTRACT:** Pain management remains a key priority for dentists, extending to the treatment of pediatric patients as well. In the field of local anesthesia in dentistry, there are a number of recent developments that can be used in conjunction with conventional techniques to eliminate pain. Pediatric dentists play a crucial role in nurturing a positive view of dentistry in children. The application of these advanced techniques, whether on their own or in combination with traditional anesthesia, has shown significant efficacy in successfully managing pain during dental procedures. This review aims to summarize recent advances in painless local anesthetic techniques as well as enlightening practicing dentists about pain control and better patient management.

### **Introduction**

The International Association for the Study of Pain characterizes pain as an "unpleasant sensory and emotional experience associated with actual or potential tissue damage, or that can be expressed in terms of such damage." Pain is a multifaceted

phenomenon impacted by psychological and physiological factors.<sup>1</sup> Properly managing a child's discomfort during a dental visit can have a significant impact on their behavior throughout the appointment and in future dental appointments. The provision of dental care, particularly emergency services, is a major impetus for pediatric patients to seek treatment. An important aspect of managing pain in pediatric dental care is the anxiety that often accompanies it, as this leads to increased perception of pain and exacerbates the experience for those suffering from it. Thus, these individuals experience heightened levels of anxiety.<sup>2</sup> In appropriate pain control in children not only elicits negative reactions and fear but also presents a challenge for dentists in fostering a positive mindset among young patients. Hence, treating pediatric patients with minimal distress and pain has become a predominant objective for every pediatric dentist.

Injecting a local anesthetic is one of the most common ways to avoid pain during dental treatment. Karl Koller discovered local anesthesia in the year 1884. Since then, local anesthesia has been a boon in the medical and dental fields as it allows various surgical procedures to be performed

painlessly. Pain management can be greatly improved using local anesthesia.<sup>3</sup>

Recent advances in the field of anesthesia have made it possible to achieve enormous therapeutic advances that would not have been possible otherwise. The implementation of local anesthesia should have knowledge of anatomical structure, equipment and methods used, neuroanatomy, etc. Dentists perform various minor and major oral surgical procedures. Regardless of the type of surgery, the patient always has to work through some level of pain. To avoid this, local anesthesia is administered using conventional techniques using a syringe and needle.<sup>2</sup> While this conventional method aids in alleviating the pain linked to the treatment, the child's worry and fear of pain can still be a problem. According to Majstorovic and Veerkamp, 19% of 4–6-year-old children and 11% of 10–11-year-old children are diagnosed with needle phobia. According to Vika et al. , as many as 6% of kids will bypass dental counseling when the injection involves a needle. Age-appropriate nonthreatening terminology, distraction, topical anesthetics, appropriate injection technique, and pharmacologic management can help make

the patient's experience with local anesthetics more positive.<sup>4</sup>

Diverse technologies involving local anesthetic delivery with reduced injection tenderness have been introduced by scientists. This growth in the field of pain management in dentistry has led to the introduction of newer and greater delivery systems that will ensure painless counseling to the patient. Their final focus is on authorizing clinicians to have the optimum counseling approach, connected with negligible injection pain, crucial for administering anguish in pediatric patients.<sup>3,4</sup> This review means to modify and educate pediatric dental surgeons on current advances and numerous approaches to the potent administration of local anesthesia and pain management.

**History:**

Earlier coolants, ice were used for surgical procedures. Later clamps were used, compression of tissues and nerves helped in carrying out pressure anaesthesia.

Ether spray – by Ward – used for tooth extraction

1884	First clinical operation-cocaine-Koller
1891	pure cocaine

1904	Procaine by Einhorn
1905	Clinical use of procaine by Braun
1920	Cook Labs- anaesthetic syringe and cabridge
1943	Lignocaine by Lofgren
1947	Dental aspiration syringe by Novocol
1959	Sterile disposable needles
1995	Vibrotactile devices
1997	CCLA- computer controlled local anaesthetic delivery system
1999	Lidocaine patches- Lidoderm
2001	Computer comfort syringe system
2006	WAND- single tooth anaesthesia system
2016	Intranasal sprays
2018	Eutectic mixture of local anaesthetic agent

Various advanced methods are available for the delivery of local anesthesia have been enumerated in this article to ensure painless dentistry.

- Topical anaesthesia:

1. **Topical spray:** Sprays have the ability to effectively block a wide surface. It is known that spray anaesthetics are good for use before oral radiographs and before taking imprints for prostheses in patients with excessive. Types of topical anesthetics include:<sup>5</sup>

- Non-aqueous Ethyl aminobenzoate (benzocaine)
- Lidocaine base
- Aqueous Benzyl alcohol
- Tetracaine hydrochloride
- Lidocaine hydrochloride

The only drawback is prolonged exposure increases the risk of absorption into the circulatory system. Depicted in Fig 1



Fig:1- Topical Spray

<https://www.researchgate.net/publication/332098359/figure/fig1/AS:742164090875905@1553957116230/Lignocaine-spray-15>.

2. **Intranasal sprays:**

Anesthetic solution is infiltrated through a metered device into the nostrils to anesthetize the maxillary anterior teeth, canines and premolars. This mixture of 3% tetracaine hydrochloride and 0.05% oxymetazoline constricts the vessels, reducing bleeding and making the operating field favorable for the same. Though it has limited area of action, it is still one of the most promising techniques for delivering painless anesthesia.<sup>5</sup>

Depicted in Fig 2



Fig 2- Intranasal sprays

[https://img.dentistryiq.com/files/base/ebm/diq/image/2019/03/content\\_dam\\_diq\\_en\\_articles\\_apex360\\_2016\\_07\\_kovanaze\\_a\\_clinical\\_overview\\_for\\_dentists\\_leftcolumn\\_article\\_thumbnailimage\\_file.png?auto=format,compress&fit=fill&fill=blur&w=1200&h=630](https://img.dentistryiq.com/files/base/ebm/diq/image/2019/03/content_dam_diq_en_articles_apex360_2016_07_kovanaze_a_clinical_overview_for_dentists_leftcolumn_article_thumbnailimage_file.png?auto=format,compress&fit=fill&fill=blur&w=1200&h=630)

3. **Lidocaine Patches:**

This patch is designed to deliver local anesthetics through the transoral route. It has

a mucoadhesive base that helps it to stick well to mucous membranes, and it is often used before needles are pricked into the skin and for superficial procedures such as gingivitis and ulcers. Effects are seen within 2 minutes after application, and the patch will last for 30 minutes after removal which has a success rate of 87%. However, there can be some variability in adhesion to mucosa, so it is important to test the patch prior to use.<sup>5</sup>

Depicted in Fig 3



Fig 3 – Lidocaine patches

<https://www.researchgate.net/profile/Dilip-Kumar-70/publication/337187823/figure/fig6/AS:824407392022531@1573565447250/Lidoder-m-patch-Fig-9-Dentipatch-Combinations-of-lidocaine-hydrochloride-Eutectic.jpg>

#### 4. EMLA:

EMLA stands for the emulsion of local anesthetics. It consists of 2.5%

prilocaine and 2.5% lidocaine in a 1:1 ratio and is supplied in various forms like tubes of 5 to 30g, patches or discs. These are easily absorbed into the oral mucosa and can be used only for minor procedures like teeth whitening or filling. EMLA is contra indicated in patients with meth memoglobinemia or those having allergy towards amide-type local anesthesia as can cause allergic dermatitis from oral mucosa.<sup>6</sup>

- Distraction Anaesthesia: (Virtual Anesthesia)

The most commonly used behavioral techniques for reducing dental anxiety are distractions, with virtual reality (VR) being a more engaging form of distraction. Clinical trials have found that VR can be an effective tool in reducing pain and anxiety during dental procedures in children. This is currently termed "virtual anesthesia." Atzori et al. and Nunna et al. suggested that VR is a useful technique that helps children cope with dental fillings and extractions in a non stressful manner with higher fun levels than its counterpart. Pain perception theory suggests that by using virtual reality

glasses, the patient can be made to feel less pain during dental treatment. In order to achieve this, it is important for the dentist to keep all syringes and needles out of sight, as well as proceed without warning and engage the patient in conversations. Though some patients are more cooperative than others, it is still not effective in all cases.<sup>7</sup>

- **Vibrotactile Devices :**

Vibratory stimulation is a prospective technique that is used to reduce pain. The "Gatecontrol theory" declares that the neural gate could be shut by using force and vibration, which would then reduce itch and sting. It is denoted as a form of distraction and tenderness reduction in children by vibrating massages, and in cases where topical anesthesia is undesirable or inadequate for relieving sting. It should not be used in epileptic patients, in neurological disorder patients, or in areas of interest that require deep anesthesia. It can be used together with an anesthetic procedure if desired.<sup>7</sup>

- 1.) **Vibra Jet:**

The VibraJect power source was introduced by Miltex Inc. in 2002. It is a contrivance that is able to seamlessly fit the classic dental syringe and creates higher-frequency vibration to the needle and for the patient to sense when the knob is turned clockwise. Chaudhry et al. and Nanitsos et al. concluded that kids perceived less pain with VibraJect than administering local anesthetic injections, which needs local anesthesia established procedures, in both maxillary and mandibular teeth<sup>7</sup> depicted in fig:4



Fig: 4- Vibrajct

<https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcSWD0yufr2M-R6qXh-p5caAJrsP7aShmd5rmB1lj7YWles3cl38KqXTKQaHvmVBQrJeIbM&usqp=CAU>

- 2.) **Dental Vibe:**

This device is a rechargeable, cordless handheld vibrotactile intention that was created by Dr. Steven Goldberg in 2008. It delivers injections with soothing percussive microoscillations at the station of administration. It contains a U-shaped vibrating tip associated to a microprocessor-controlled Vibra pulse motor that quietly stimulates the injection site's sensory receptors, thereby shutting the gate and blocking the painful sensation of injection slash. Tung et al. in 2018 and Sermet Elbay et al. in 2016 concluded that the dental vibe reduces pain in pediatric patients receiving dental injections.<sup>8</sup>

Depicted in Fig 5



Fig 5- Dental Vibe

[https://www.dentistrytoday.com/wp-content/uploads/2010/09/0910\\_DentalVibe.j](https://www.dentistrytoday.com/wp-content/uploads/2010/09/0910_DentalVibe.jpg)

pg

### 3. Accupal :

The device is designed to condition the oral mucosa by vibration and force. Michael Zweifler invented this



device, which uses pressure and vibration to close the “pain gate”. Afterwards, the device applies temperate force to position the needle at the injection site.<sup>8</sup> Depicted in Fig 6

Fig 6- Accupal

[https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTVT61IgjFEIjneIovuJ6KOqEgzpjLTn9IximVG1JBW62\\_gBR3uBGdqGGaA9i9BHwDkofQ&usqp=CAU](https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTVT61IgjFEIjneIovuJ6KOqEgzpjLTn9IximVG1JBW62_gBR3uBGdqGGaA9i9BHwDkofQ&usqp=CAU)

### 4. Transcodent Needle Tips:

Compared to the common needle tips, contemporary forms and constructs of

the bevel, three-edge lancet grinding write in Transcendent systems with greater outcomes. In this design, due to the sharpness of the needle tip and stiffness of the cannula silicone, the needle tip softly inserts in dental tissues resulting in patients' consolation and reduction of tenderness. The needle is ultrasharp and siliconized, so it favours composed penetration into tissues, inducing less hurt<sup>7</sup>depicted in Fig:7



Fig 7- Transcendent needle tips

<https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQijPttx6MmzOEC3I1HvXs2LmK7oYWEFCelBavkzNePoPhdwpIfditRoF4jTJmNR0IOPDU&usqp=CAU>

## 5. Buzzy Device

The bee-shaped device is comprised of two components: the buzzy body and detachable ice wings. It operates on the gate control theory principle and the descending inhibitory controls, which work together to

reduce pain. The buzzy body produces vibration that blocks pain-receptive fibers (A-delta and C fibers), while the detachable ice wings cause persistent cold (30–60 seconds) stimulation, which blocks A-delta signals.<sup>9</sup> Studies have shown that using the BuzzyR device to apply cold and vibration close to the area where local anesthesia is being administered can reduce pain and anxiety in children during local anesthesia delivery for dental procedures.

- CCLAD(Computer controlled local anesthesia delivery systems):

Anesthesia delivery systems which are controlled by computers allow for the slow and consistent release of local anesthetics, minimizing pain. It is important to consider the design features of the system, such as weight, infection management, speed, and mode of drug injection when choosing one.system in a way that it does not possess a foot control.<sup>9</sup>

### 1. WAND:

This system enables the operator to precisely position the needle at the targeted anesthesia site, offering enhanced tactile control compared to conventional syringes. The administration of the local anesthetic is maintained at a consistent rate through the utilization of foot-activated control. The



handpiece, designed for a pen-like grip, is lightweight and offers a more comfortable tactile experience. The Wand system stands out as the most widely used CCLE device due to its user-friendly nature and a size that is half the circumference of traditional syringes. Unlike alternative devices such as Quicksleeper, which house syringes in handpieces, the Wand system incorporates the syringe within the main unit. Moreover, the weight of the CCLE is a crucial factor, considering that operators must endure prolonged holding times during the anesthesia process. Hence, lighter devices are preferred to mitigate the risk of needle break injuries and operator muscle fatigue. In the initial conventional Wand system, the aspiration time was approximately 14 seconds, but the advanced version, WandPlus, has successfully reduced it to just 5 seconds. LA flow rate is controlled by computer which is maintained consistently thus making it one of the benefits of this system<sup>10</sup> Depicted in Fig 8.



Fig:8 WAND

<https://victoriadentists.co.nz/wp-content/uploads/2020/02/pic-sta-wand-system.jpg>

## 2. Comfort control syringe

There are five different speeds available with this device, which is great because there is no need for a foot pedal. However, due to the bulky and cumbersome design of the syringe, this device may not be ideal for everyone. Additionally, administration of this type of pump can be difficult in comparison to conventional pumps.<sup>11</sup>

- Jet Injectors:

Jet injections operate by utilizing mechanical energy to release pressure, propelling the liquid medication through a small opening. This creates a thin column of fluid

that can deposit anesthetic into the subcutaneous tissue without the need for a needle. Jet injections are faster than traditional injections, cause less tissue damage, and are less painful. They're best used on patients with needle-phobia and apprehension. Some common brands of jet injections include SyrijetMark II and MED H JET III.<sup>12</sup>

#### 1.) Syrijet Mark II:

Since the introduction of Syrijet, a local anesthetic solution delivery system, 40 years ago, it has undergone minor advancements. The system utilizes 1.8cc syringes, enabling the delivery of the solution in the range of 0-0.2cc. The syringes are reusable as they can undergo autoclaving. Additionally, the unit features a nozzle pressure of 2000 pounds per square inch (psi), which produces the same effect as when a conventional needle is pierced at 1 cm deep into the tissue. Syrijet alone suffices for minor surgical procedures like the extraction of deciduous anterior teeth, as well as permanent central and lateral incisors. For procedures involving the extraction of permanent anterior and deciduous posterior teeth, additional local blocks may be necessary. Moreover, the extraction of permanent posterior teeth

typically requires the use of extra local blocks. Research indicates that patients positively respond to the instrument, and it is deemed suitable for use in sensitive areas, such as the incisive papilla. The main advantage is that it has autoclavable cartridges and also accepts standard cartridges. One downside is that patients may experience bleeding from punctured sites, as well as an unpleasant taste from the anesthetic. By taking some extra precautions, this can be minimized.<sup>11</sup>

Depicted in pic 9



Fig 9-Syrijet

[https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRsDyVELN7gu0DhnKVhxJ3\\_sCeI2F9vnRmpbwo2QASVRDv7IHEAbm1tVOBBMEAWRlOQegs&usqp=CAU](https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRsDyVELN7gu0DhnKVhxJ3_sCeI2F9vnRmpbwo2QASVRDv7IHEAbm1tVOBBMEAWRlOQegs&usqp=CAU)

#### 2. Medjet H III:

This system was developed in 2011 and it uses a small orifice that is 7 times smaller than the needle with the smallest diameter. It is accurate and does not compromise on environment safety, patient comfort. Its advantages include being accurate, convenient, and easy to use. However, its drawbacks include the high cost and slow delivery of substance.

#### Laser Analgesia:

This anesthetic interrupts the sodium-potassium pump, causing a change in neuronal cell behavior. This leads to profound analgesia, but it should be used in combination with other anaesthetics to have the most effective results.<sup>13</sup>

#### CONCLUSION:

Dentistry is a field that is constantly evolving and adapting to the needs of its patients. One of the biggest concerns for many patients is the pain that may be associated with a dental visit. Although there are various methods that dentists can use to manage pain, some of them can be

particularly effective with anxious and apprehensive patients. These methods include using numbing agents and needles, which can make the experience more comfortable for pediatric patients and instill a positive attitude towards dental care in them for future treatments. Though some procedures may take longer than others, they are all proven methods and can be used as needed, depending on the patient's preferences, equipment availability and other factors. Recent techniques for effective and pain-free local anesthetic administration result in a more pleasant experience for the dentist and children, resulting in more positive outcomes in maintaining a proper child-dentist relationship.

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