

Painless Anaesthesia in Pediatric Dentistry: An Updated Review

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Abstract: Pain management is a major concern for most practicing dentists and poses a problem for pediatric patients as well. There have been many recent developments in the field of local anesthesia for dentistry which can be utilized along with conventional techniques to minimize the pain associated with syringe and needles as well as alleviate the apprehension in patients. A pediatric dentist bears the responsibility of instilling a positive dental attitude among children and these newer techniques, when used exclusively or in conjunction with the traditional method of anesthesia, prove to be quite helpful in meeting the objective of pain control during dental procedures. This review aims to summarize the recent advances in painless local anesthesia techniques as well as provide information to practicing dentists regarding better pain control and patient management.

Key words: Dental anaesthesia, painless dentistry, pediatric dentistry, pedodontics

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I. Introduction

Anesthesia has been a boon to the branch of medicine as well as dentistry since it helps the surgeon to carry out surgical procedures painlessly¹. Local anesthesia was discovered in the year 1884 by Karl Koller¹. The skill of administering local anesthesia plays a very important role in dental practice as it helps in pain control and patient management¹. Effective local anesthesia delivery depends upon factors like knowledge of anatomical structures, neuroanatomy, devices and methods of delivering local anesthesia etc¹⁻³.

A dental practitioner has to carry out procedures like surgeries, root canal treatments, extractions etc. which are often painful. The main aim of the dentist is to ensure that these dental procedures cause minimal amount of pain to the patients⁴. And even though the pain subsides after the local anesthesia administration, delivery of the local anesthetic can be painful at times¹. The conventional way of delivering local anesthesia using syringe and needle appears to increase the patient's apprehension and anxiety even before the commencement of dental procedures¹. Hence, it is imperative to be informed about some newer techniques of local anesthesia delivery in order to overcome the previously stated hurdles^{4,5}. Convincing the pediatric patients for undergoing essential dental treatment and making them comfortable in the dental chair is in itself a great deal of work⁶. Pacifying them for accepting the local anesthesia using conventional system becomes extremely difficult for the dentist. It is also important for a pediatric dentist to instill a positive dental attitude in a child in order to reduce the apprehension for future dental treatments⁶.

Thus, it is important for the pediatric dentist to be informed about the latest upcoming methods of local anesthesia delivery systems that will definitely help them manage a painless dental practice and help inculcate a positive outlook for dental procedures amongst patients.

Local anesthesia delivering systems:

Although the commonly used method of local anesthesia delivery is still using the conventional needles and syringes, there are some newer advances seen in the field of local anesthesia. Some of them include the computer-controlled local anesthesia delivery, vibrotactile systems, intraosseous anesthesia, jet injectors etc (See table 1).

1.) **Computer controlled local anesthesia delivery (CCLAD) system**

Computer controlled local anesthesia delivery systems enable the regulation of the rate of flow of the local anesthetic using computers and therefore minimizes pain by delivering the anesthesia slowly and at a constant speed^{7, 8}. It is important for the operator to look at the design of the system which includes parameters like weight, infection management, speed and mode of drug injection, possibility of aspiration etc before choosing a suitable one. The first CCLAD used was the Wand system (introduced in 1997)⁹ and some subsequent versions include Wand Plus and CompuDent. Comfort Control Syringe (introduced in 2001) is another device that differs from the Wand system in a way that it does not possess a foot control.

a.) Wand system:

This system helps the operator to place the needle at the site to be anesthetized with finger-tip accuracy and better control as compared to traditional syringes¹⁰. The local anesthetic is administered at a constant rate with the use of foot activated control in this system¹⁰. The handpiece is lightweight and can be held with a pen-like grasp for better tactile sensations¹⁰.

The Wand system is the most popular and commonly used CCLAD owing to its operator friendliness and its circumference that is half the size of the conventionally used syringes^{10, 11}. This is, because the syringe is contained within the main system unlike the other devices (like Quicksleeper) that contain them in the hand pieces^{10, 11}. Moreover, the weight of the CCLAD plays an important role because the operator has to hold the device in the area to be anesthetized for a long period of time and thus, lighter devices are preferred over the heavy ones to avoid needle break injuries and muscle fatigue of the operator. The cartridges used in the Wand system are installed in the main unit and the assistant can change the cartridge during anesthesia but 0.3-0.4 ml of solution is lost in this method^{10, 12}. Aspiration time in the conventional Wand system was initially around 14 seconds which has now been reduced to 5 seconds in the advanced version of the system, WandPlus. Fedaa et al¹³ and Mittal et al¹⁴ reported that CCLAD proved to be of advantage while delivering the palatal anesthesia by reducing the pain as compared to buccal anesthesia.

b.) Computer comfort syringe (ccs) system:

CCS consists of a base unit, a syringe and no foot control, unlike the Wand system¹⁵. The injection and aspiration can be controlled with the help of the syringe itself and the solution is deposited into the desired tissues irrespective of the resistance offered¹⁶. This makes its use easier for practitioners, who are accustomed to using the traditional syringe and needle technique. The device has 5 programmed speeds and three buttons on it. The injection can be controlled using these buttons namely start or stop, aspirate and double button to start or stop the anesthetic delivery, aspirate or double the rate of delivery. The base unit has a digital feedback readouts which displays the time elapsed, rate and volume of anesthetic injected. When compared to the Wand system, CCS is not as preferred as the former because of the bulk of the device but however, CCS has a greater advantage over the conventional method of anesthesia delivery^{15, 17}.

2.) **Jet injectors:**

Jet injections work by mechanism of mechanical energy that is used for releasing the pressure, thereby allowing the liquid medication to be pushed through a small orifice¹⁸. This permits a thin column of fluid to be created that will allow the deposition of anesthetic into the subcutaneous tissue without the use of a needle¹⁹. Jet injections have an advantage of fast drug delivery and absorption, less tissue damage and lesser pain¹⁸. These injections are best used on patients with needle-phobia and apprehension. Commonly used brands of jet injections are SyrijetMarkII, MED H JETIII etc.

a.) MED JET H III:

This system was developed in the year 2011. In this system, the medication is directed through a small orifice that is 7 times smaller than the needle with the smallest diameter¹⁸. Its accuracy is unquestionable and it delivers the anesthetic at a low pressure and does not compromise on environment safety, patient comfort and user compliance.

b.) SYRIJET MARK II:

Syrijet has been in use since the last 40 years and has undergone some minor advancements as well²⁰. The unit uses 1.8cc syringes, which helps to deliver the local anesthetic solution from 0-0.2cc and is reusable since it can be autoclaved. It possesses a nozzle pressure of 2000 pounds psi and at this pressure the same effect is noted as that of the conventional needle being pierced at 1 cm deep into the tissue. According to William Greenfield and Joseph Karpinski et al^{21, 22}, minor surgical procedures like removal of deciduous anterior teeth and permanent central and lateral incisors, soft tissue procedures, removal of bone spicules, application and removal of arch bars and ligature wires could be carried out with the use of Syrijet alone.

Procedures that might require additional local blocks include extraction of permanent anterior and deciduous posterior teeth whereas extraction of permanent posterior teeth generally require the use of additional local blocks. Studies reported that the instrument was quite well perceived by the patients and could be used in areas that were sensitive to needle piercing like the incisive papilla.

However, the disadvantages of this system include bleeding from the punctured sites, especially if punctured twice or thrice as well as the unpleasant taste of the anesthetic which can be minimized by taking some extra precautions while injecting. Thus, it can be concluded that certain procedures can be carried out by the use of Syrijet alone while certain procedures would need an adjunctive anesthetic measures but pain perception was reduced to a large extent as compared to the conventional local anesthesia delivering system^{6, 21, 22}.

3.) Safety dental syringes:

The safety needles are reported to prevent the health care provider from needle stick injuries as these special needles have a sheath which covers the needle as soon as it is removed from the tissues. Some commonly used safety needles are Hyposafety syringe, Ultrasafety plus XL syringe, Ultrasafe syringe, SafetyWand syringe etc. However, these syringes are not thought to be better than the conventional syringes and are of inadequate help in preventing needle-stick injuries²³⁻²⁵.

4.) Topical anesthesia:

a.) Lidocaine patches:

Lidocaine patches have a muco-adhesive base and delivers the local anesthetic via the trans-oral delivery route. It is commonly used for superficial mucosal and gingival procedures and prior to needle pricking into the mucosa²⁶. It is absorbed into the mucous membrane and the effect is seen within 2 minutes and lasts up to 30 minutes after the removal of the patch⁶. The disadvantages of this system involve the high cost and poor adhesion to the oral mucosa.

c.) Emla cream:

EMLA stands for eutectic mixtures for local anesthesia and is generally used as topical anesthetics. These creams have lower melting points and are easily absorbed in the oral mucosa and are used for procedures causing minor pain^{27, 28}. It consists of a mixture of 2.5% prilocaine and 2.5% lidocaine in the ratio of 1:1. However, some dentists have reported no difference in the efficiency of 5% lidocaine and EMLA. And although it shows satisfactory results for pediatric use of the cream, additional research is yet to be conducted in order to determine the adverse effects and prevention of overdose of the anesthetic.

c) Intranasal sprays:

These are a mixture of 3% tetracaine hydrochloride and 0.05% oxymetazoline²⁹. A metered device is used for infiltrating an anesthetic solution through the nostrils to anesthetize the maxillary anterior teeth, canines and premolars²⁹. It reduces the bleeding by inducing vasoconstriction of the regional blood vessels thus making the operational field favorable to operation.

5.) Laser analgesia:

Laser analgesia does not produce a profound feeling of anesthesia³⁰. It causes temporary disruption of sodium-potassium pump and alter the behavior of neuronal cells. This stops the conduction of impulses to the brain temporarily and produces analgesia³⁰. An adjunctive anesthetic procedures should be used along with the laser analgesia as the anesthetic effect is

II. Conclusion

Providing painless dentistry has been a top concern for many practicing dentists. The biggest fear of a patient is the needle and the syringe and the pain associated with it. The above stated methods can prove to be useful in pain management in certain cases of apprehensive and anxious patients. These methods will serve their purpose by making the dental visits pleasant for pediatric patients and also help in instilling a positive dental attitude in them towards future treatments as well. Though some of these procedures are time consuming and/expensive, they are tested and proven methods and can be used as per one's requirement, feasibility and availability of equipments. Despite these advances, some dentists prefer employing the conventional techniques, however, the newer methods will help deliver efficient and effective dental health care with greater patient satisfaction and lesser discomfort.

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