

Newer Delivery Systems for Local Anesthesia in Dentistry

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Abstract

Effective local anesthesia is arguably the single most important pillar upon which modern dentistry stands. Paradoxically, the injection of local anesthetic is also perhaps the greatest source of patient fear, and inability to obtain adequate pain control with minimal discomfort remains a significant concern of dental practitioners. Although the traditional aspirating syringe is the most common method by which local anesthetics are administered, newer technologies have been developed that can assist the dentist in providing enhanced pain relief with reduced injection pain and fewer adverse effects. This article will discuss the clinical uses of various newer delivery systems for local anesthesia in dental field.

Key Words

CCLAD, intra-osseous anesthesia, Local anesthesia, STA, wand

INTRODUCTION

Local anesthesia forms the backbone of pain control techniques in dentistry and local anesthetics are the safest and most effective drugs in all of medicine for the prevention and management of pain. Nonetheless, the administration of these drugs is the most frightening and uncomfortable part of the dental appointment for most patients. The needle is the most fear inducing part of the armamentarium for the delivery of local anesthetics[1]. Over the years, many futile attempts have been made to provide clinically adequate pain control without the need for injection of drugs [2]. Although Cook invented the modern dental syringe more than one hundred years ago, [3] only recently many innovations have been added to the traditional methods of drug delivery systems. These include computer controlled local anesthetic delivery systems, jet injectors, intra-osseous systems, vibrotactile devices, safety dental syringes and denti-patch. This article discusses about these systems and their applications in dentistry.

1.COMPUTER-CONTROLLED LOCAL ANESTHETIC DELIVERY SYSTEMS [CCLAD]

It is essential to deliver local anesthetic solution at a constant rate and slower speed to avoid causing discomfort to the patient. Conventional syringes do not allow precise control of flow rate, and injections into dense tissues like palate needs adequate pressure which is difficult with conventional syringes. As a result of research in 1997, a new delivery system using computer technology to control the rate and flow of anesthetic solutions evolved, and are called as computer controlled local anesthetic delivery systems. The first of them is the Wand, followed by Wand Plus and CompuDent. **The Wand™** (Milestone Scientific, Inc., Livingston, N.J.), has 3 components: Base unit, Foot pedal and Disposable Hand piece assembly. Base unit consists of a microprocessor and connects to the foot pedal and Hand piece assembly that accepts the LA

solution from the cartridge passes through the microbore tubing in the Hand piece assembly and attached needle into the target tissue. The Light weight hand piece is held in a pen-like grasp that provides the user with greater tactile sensation and control compared to the traditional syringe. The available flow rates of LA delivery are controlled by a computer and thus remain consistent from one injection to the next and are delivered with a foot-activated control. The greater control over the syringe and the fixed flow rates of the LA drug are responsible for a significantly improved injection experience, as demonstrated in many clinical studies conducted with CCLAD devices in dentistry and medicine [4,5,6,7,8,9]. Dr. Mark Hochman and coworkers were the first to demonstrate a marked reduction in pain perception for injections using a CCLAD system [10]. Fifty blindfolded dentists participated in a controlled clinical study (they received the injection) comparing the standard manual syringe to a CCLAD system (the Wand) for palatal injections. Forty-eight (96%) preferred the CCLAD injections. Overall, pain perception was reduced two- to threefold when compared to the standard manual syringe. Nicholson et al. conducted a randomized clinical study in which two operators administered four different types of dental injections, comparing CCLAD to a standard syringe.[5]. Mean injection discomfort ratings were found to be consistently lower with CCLAD when compared to the manual syringe. Two-thirds of the patients wanted future dental injections to be performed with a CCLAD system. The investigators in the study increasingly preferred to perform all injections with the CCLAD technology. Fukayama et al. conducted a controlled clinical study evaluating pain perception of a CCLAD device. Seventeen of the 20 subjects reported a slight or no-pain rating on a visual analogue scale (VAS) for palatal injections administered with CCLAD. They concluded that “the new system provides comfortable anesthesia for

patients and can be a good alternative for conventional manual syringe injection.”[6]. There are three modes of flow rate available: slow, fast and turbo mode. In 2001, **the Comfort Control Syringe** (Dentsply International, N. York, USA) was marketed as an alternative to the Wand and has two components; base unit and syringe and there is no foot pedal. The most important functions of this unit is injection and aspiration can be controlled directly from the syringe. Five different basic injection rate settings for specific applications, block, infiltration, PDL, IO and Palatal regions. The unit uses two stage delivery rates for every injection. It initially expresses the LA solution at an extremely low rate and after 10 seconds the rate slowly increases to the pre-programmed value for the selected injection technique. Disadvantage is, the syringe is bulky and cumbersome to use when compared to the wand hand piece. Several CCLAD systems are available including the Wand/CompuDent™ system, QuickSleeper™, SleeperOne, Ora Star and Anaject™. Both the Comfort Control Syringe and the Anaject regulate the speed of injection, starting slowly and accelerating the speed of injection to minimize pain. The Comfort Control Syringe has five pre-programmed speeds for different injection techniques and can be used for all injection techniques. The Anaject has three pre-programmed speeds. CCLAD allows LAs to be administered comfortably to the patient in virtually all areas of the oral cavity. This is of greatest importance in the palate, where the level of patient discomfort can be quite significant. Computerized delivery of local anesthesia for palatal infiltrations has been found to result in low levels of stress and a low pain reaction, with the stress and pain reaction equivalent to that experienced following buccal infiltrations without computerized delivery. The nasopalatine nerve block may be administered atraumatically in most patients.[7,10].

Single-Tooth Anesthesia [STA]

In 2006, the manufacturers of the original CCLAD, the Wand, introduced a new device, Single Tooth Anesthesia (STA™) which incorporates dynamic pressure-sensing (DPS) technology that provides a constant monitoring of the exit pressure of the local anesthetic solution in real time during all phases of the drug’s administration.[11] STA with DPS technology can be used to give AMSA, P-ASA and PDL injections. It overcomes the problems associated with the traditional PDL injections. The system can be utilized for all traditional intraoral injection techniques. The DPS system provides confirmation (in audible tones, visual displays and spoken alerts) that the needle tip is in the desired location and has not moved outside this area during drug administration. DPS alerts the user if leakage of LA occurs (a common problem when traditional syringes are used for the PDL). Since the pressure of the LA is strictly regulated by the STA system, a greater volume of LA can be administered with increased comfort and less tissue damage than seen with traditional syringes or PDL pressure devices.[12] It has 3 modes for rate of injection: STA mode, normal mode and turbo mode.

New Injection Techniques

Two new injection techniques, [anterior middle superior alveolar nerve block] AMSA[13, 14] and P-ASA [posterior

approach to anterior superior alveolar nerve block] [15] have been described since the development of CCLAD. Though either may be administered with a traditional local anesthetic syringe, the level of patient discomfort minimizes their administration in this manner. CCLAD has made both techniques quite popular, as the level of patient discomfort is minimal. Periodontal ligament injection [PDL] or intraligamentary injection [ILI] is a very useful injection to achieve single tooth anesthesia. Using CCLAD to give this injection has proven to be very painless and comfortable for the patients, especially for the children.[16].

II. JET INJECTORS

Jet injection technology is based on the principle of using a mechanical energy source to create a pressure sufficient to push a liquid medication through a very small orifice, that it can penetrate into the subcutaneous tissues without a needle. Advantages are painless injection, less tissue damage, faster injection and faster rate of drug absorption into the tissues. Drawbacks are: it cannot be used for nerve blocks, only infiltration and surface anesthesia are possible. Dabarkis N.N et al [17] report, 17.6% [patients] experienced pain during injection of the anesthetic; and 32.3% reported feeling dread or fear from the explosion of the injector as it released the anesthetic. egs, are Injex, Syrijet, Mark II and MED-JET H III. In MED-JET H III the solution is injected through orifice which is 7 times smaller than the smallest available needle in the world.

III. INTRA-OSSEOUS ANESTHESIA SYSTEMS [IO] SYSTEMS

Aim of intra-osseous anesthesia is to inject local anesthesia solution into cancellous bone adjacent to the apex of the tooth by piercing buccal gingiva and bone in relation to the tooth to be anesthetized. It can be used as a supplemental technique with mandibular nerve blocks to enhance deep pulpal anesthesia or as a primary technique so that patients do not experience numb lips or tongues postoperatively. Systems include Stabident, X-Tip, IntraFlow. **Stabident**, an Intraosseous Injection delivery system has a disadvantage that it can be used only in visible and readily accessible area because while giving intraoral injection once the perforator is withdrawn, it can be extremely difficult to locate the perforation site with the anesthetic needle. To overcome this, **X-Tip** uses the pilot drill which is a hollow tube through which a 27-gauge needle can pass. The initial drill stays in place, allowing the anesthetic to be placed without hunting for the hole that was just created. The above two systems use a two-step method. **IntraFlow** anesthesia system further ease the IO injection by using a single-step method which allows entry into the penetration zone, injection, and withdrawal in one continuous step, without the need to relocate the perforation site. Reemers et al [18] reported that the IntraFlow system as a primary technique provide reliable anesthesia of posterior mandibular teeth in 13 of 15 subjects, compared to 9 of 15 with an inferior alveolar nerve block. Nusstein et al [19] found supplemental mandibular intraosseous injection using the Stabident system and 1.8 mL of 2% lidocaine

with 1:100,000 epinephrine was 88% successful in gaining total pulpal anesthesia for posterior teeth diagnosed with irreversible pulpitis.

IV. VIBROTACTILE DEVICES

These devices work on the principle of 'gate control' theory thereby reduces pain. It acts based on the fact that the vibration message is carried to brain through insulated nerves and pain message through smaller uninsulated nerves. The insulated nerves overrule the smaller uninsulated nerves. The devices are: VibraJect, Dental Vibe, Accupal.

VibraJect has a battery operated device which is attached to the standard anesthetic syringe, causing the syringe and needle apparatus to vibrate. Nanitsos et al [20] and Blair [21] have recommended the use of VibraJect for painless injection.

Dental Vibe is a cordless hand held device which gently stimulates the sensory receptors at the injection site causing the neural pain gate to close. Advantage is, the tissues are vibrated before the needle penetrates. Disadvantage is, it is not directly attached to the syringe and a separate unit is required, so both hands are engaged. Dentalvibe and syringe micro vibrator uses micro-vibration to the site where an injection is being administered

Accupal is a cordless device which applies both vibration and pressure at the injection site.

V. SAFETY DENTAL SYRINGES

Aim of these devices is to prevent from the risk of accidental needle stick injury occurring with a contaminated needle after local anesthesia administration. These syringes possess a sheath that locks over the needle when it is removed from the patient's tissues preventing accidental needle stick injury.[22]. Eg are 1. Ultra safe syringe, 2. Ultra safety plus XL syringe, 3. hyposafety syringe, 4. safety wand 5. Rev Vac safety syringe.

VI. DENTIPATCH [INTRAORAL LIGNOCAINE PATCH]

Dentipatch contains 10-20% lidocaine, which is placed on dried mucosa for 15 minutes. Hersh et al (1996) studied the efficacy of this patch and recommended it for use in achieving topical anesthesia for injections in both maxilla and mandible. It is not recommended in children. Disadvantages include central nervous system and cardiovascular system complications.

CONCLUSION

Research shows CCLAD systems to be very promising in achieving painless injections especially with the AMSA, P-ASA, PDL injections. Vibrotactile devices also are useful in achieving patient satisfaction during injection. Jet injectors are not very useful when compared to other devices. Intra-osseous systems are very useful tools to achieve profound anesthesia, as an alternative to conventional injections. Safety syringes prevent accidental needle stick injuries and its associated transmission of diseases, and it is advisable to use them in future. Thus, due to the advancement of technology, many newer delivery systems for local anesthesia have evolved and the dental

practitioners must be well aware of their usage and applications.[23] The required armamentarium may be chosen according to the patient's needs. Dentists must be well aware of these newer delivery systems, their usage and must have an up-to-date knowledge, so as to provide the benefits of latest technology to their patients. The ability to deliver painless injections and a desirable level and duration of anesthesia results in reduced patient fear, reduced patient stress and therefore reduced stress for the clinician and can aid patient compliance with dental treatment.

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