IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 13, Issue 3 Ver. I. (Mar. 2014), PP 62-66
www.iosrjournals.org

New Gadgets in Local Anesthesia: A review

Varun Salgotra[1], Raghav Agrawal[1], Soumen Mandal[1] , Sonam Kohli[2]
[1]*Dept.of Oral and Maxillofacial Surgery, D.J. College of Dental Sciences and Research, India*
[2]*Dept.of Oral Medicine and Radiology, D.J. College of Dental Sciences and Research, India*

Abstract: *Local pain management is the most critical aspect of patient care in dentistry. When efforts to achieve local anesthesia are unsuccessful, the resulting stress for both the patient and practitioner can be significant. It is imperative on our part to update our knowledge and skills in using newer alternatives in pain control and management and ways of administering them to increase the comfort level of our patients and resolve the clichéd paradigm of "Pain and Dentistry are inseparable". The improvements in techniques for local anesthesia are probably the most significant advances that have occurred in dental science. This paper provides an update on comparatively newer gadgets that are less commonly used to deliver local anesthetics.*
Keywords: *Computer controlled local anesthesia delivery system (CCLAD), Intraosseous Injection delivery system, Local anesthesia delivery device, Needle-less injector, Vibrating tactile devices.*

I. Introduction

Pain has long been associated with dentistry and has a peculiar relation. Pain is the main reason that brings the patient to the dental clinic and also it's the fear of pain that drives him away especially from receiving non-emergency dental care. So the aim of dental practitioners has always been to successfully render the painless dental care and local anesthesia has been used to achieve this objective. Henceforth, the painless and effective local anesthetic administration has been paramount for any dental surgeon. To accomplish this, every dental surgeon should be critically updated about the newer local anesthetic delivery equipment's that have been introduced into the market.

I. Computer-Controlled Local Anesthetic Delivery Systems (CCLAD system)

Fig. 1 - Comfort Control Syringe

The pain experienced by the patient is experienced at three junctures i.e. during skin puncture with needle, during local anesthetic deposition and with the acidic pH of the local anesthetic solution which causes local irritation.[1] Numerous attempts have been made to diminish this anesthesia-associated pain, such as by using anesthetic solution patch, chemically modifying anesthetic agents, adding buffering agents, or changing the anesthetic temperature during administration.[1] However, very little attention has been given to the current syringe design and the administration methods, and effectively, syringe systems have changed a little since their introduction. Conventional syringes do not allow precise control of the flow rate, and while slow injections are possible, the mechanics are challenging.[2] Injections into dense tissues such as the palate may require pressures up to 660 psi, possibly making control of a syringe even more difficult, erratic, and uncomfortable.[3] CCLAD System, a pen-like plastic handle, works on eliminates the variability of a thumb-operated plunger, allowing for

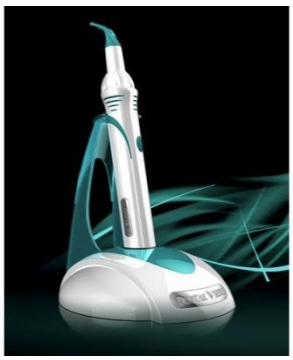
maintenance of an ideal flow rate of anesthetic[3]. The infusion rate is precisely regulated by a computer processor which immediately compensates for varying tissue resistance encountered in a single injection. The first of these CCLAD devices, the Wand, was introduced in 1997. Several other CCLAD systems are available, including Comfort Control Syringe, QuickSleeper and Anaeject[4,5,6]. Both the Comfort Control Syringe and the Anaeject 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[4]. The Anaeject has three pre-programmed speeds.

Some studies have shown to reduce anxiety as well as pain and pain perception in pediatricand general population with CCLAD system[3,7,8,9,10,11,12,13]. However D. Ram et el[14], Versloot J et el[15] and Asarch T[16]et el found no statistical significant difference between conventional injection and a computerized device.

II. Vibrotactile Devices

Fig. 2(a) - VibraJect

Accupal



DentalVibe

Fig. 2(b) – Accupal and DentalVibe

Vibrotactile devices use vibration to reduce the sensation of pain during injections. It takes advantage of the gate control theory of pain management[17,18]. It has been suggested that when vibration is applied as a counter stimulation to an anesthetic injection, it will reach the brain before the pain sensation does. The brain can perceive only one sensation at a time; therefore, the sensation that arrives at the brain first is the one that will be felt[17,18,19,20].

These devices have shown controversial performance. While Nanitsos et al[20] and Blair[21] have recommended the use of VibraJect for painless injection, M Saijo et el[22], Roeber B et el[23] and Yoshikawa F et el[24] have found no significant pain reduction when VibraJect. Other devices availabe working on the same principle are Dentalvibe, Syringe Micro Vibrator (smv) and Accupal. Dentalvibe and syringe micro vibrator uses micro-vibration to the site where an injection is being administered while Accupal uses both vibration and pressure[25,26,27]. However, there are no good quality studies that have compared these devices with conventional syringes. So their effectiveness is yet to be confirmed by independent sources.

III. Needless Injector

Fig. 3 - Injex

Needless injector is based on Jet-injection technology which works by creating a high pressure jet of anesthetic solution.[1] This jet of anesthetic solution painlessly or by causing only slight pain can penetrate the mucosal tissue[29] also it is seen to have a lateral spread in the tissue.[30] The degree of penetration in the tissue is a function of volume of anesthetic being used and the nozzle pressure.[31] Researchers also suggest that a layered deposition of anesthetic solution was seen with needle-less injector.[31,32] The depth of penetration for the volume (0.3ml) used by us is1cm,[31] which would be sufficient enough for giving infiltrations. Directing the jet within the tissues, so that it reaches the foramens is not feasible, thus ruling out the possibility of its use in giving blocks.[31] Difficulty in positioning the device[33]& the need for close tissue contact during deposition of solution using needle-less injector precludes its use posterior region. Only limited volume (0-0.3 ml) of local anesthetic solution can be administered with a single injection[5,34,]. The needle-less injector have shown to provide painless injection when compared to conventional syringes[29,32,35,36,37,38,39]. However, Dabarkis N.N et al[40] report that '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.' The successful anesthesia with needle less injector is reported between 50% to 90%[32,33,35,37,38,40,41]as compared to over 90% success with conventional supraperiostealinjection. The experience with needle-less injector by various controlled and uncontrolled studies [29, 33,35,37,38,39] are quite promising. The needle less jet injector that are available in the market are Injex, Syrijet Mark II and MED-JET H III. The Syrijet Mark II, can accept 1.8ml cartridges of LA solution but permits only 0 to 0.2 mL administrations in single shot[5]. The MED-JET has claimed to have the medication injected with it, penetrates through a small orifice 7 times smaller than the smallest needle on the market.[42]

IV. Intraosseous Injection Delivery System

Fig 4. Intraflow Anesthesia Delivery System

Intraosseous anesthesia involves the placement of local anesthetic directly into the cancellous bone spaces adjacent to the tooth or teeth that require anesthesia. 'Intraosseous injection (IOI) can be used as a supplemental or primary technique to bring about local anesthesia in routine dental procedures. It can be used as a supplemental technique with mandibular nerve blocks to enhance deep pulpal anesthesia. It can be used as a primary technique so that patients do not experience numb lips or tongues postoperatively.'[43] Devices have been developed to help administer these injections with ease and to overcome the shortcomings of their predecessor.

Stabident, an Intraosseous Injection delivery system has a disadvantage that it can be used 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[5]. 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.[4] 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[4].

Reemers et el[44] 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. Nussteinet el[45] 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. Parenteet el[46] used the Stabident intraosseous injection in patients with irreversible pulpitis when conventional local anesthetic techniques failed. They found an initial supplemental intraosseous injection was successful in 91% of posterior mandibular teeth. Nussteinet al[47] used an X-tip supplemental intraosseous injection in patients with irreversible pulpitis when a conventional inferior alveolar nerve block failed. They concluded that when the inferior alveolar nerve block fails to provide profound pulpal anesthesia, the X-tip system, when used in an apical location and when there was no backflow of the anesthetic solution into the oral cavity, is successful in achieving pulpal anesthesia in mandibular posterior teeth of patients presenting with irreversible pulpitis. Gallatin[48] et el reported that the primary injection with Stabident intraosseous injection system and a primary X-tip intraosseous injection system were similar regarding the anesthetic success, onset and duration in mandibular posterior teeth but found higher incidence of postoperative swelling.

V. Conclusion

With less number of contradicting studies needle-less injector and CCLAD system appear to be painless in comparison to conventional injection. Effectiveness of vibrotactile devices is controversial on the basis of present data and data available is itself insufficient. Intraosseous devices have shown significantly promising results in achieving supplemental anesthesia. High cost of devices is a setback. More number of randomized controlled trials and cost cutting would guide their future.

References

[1] André S. Nimigan and Bing Siang Gan. Pain and Efficacy Rating of a Microprocessor-Controlled Metered Injection System for Local Anaesthesia in Minor Hand Surgery. Pain Research and Treatment. 2011;Article ID 362396, 6 pages

[2] Krochak M and Friedman N. Using a precision-metered injection system to minimize dental injection anxiety. CompendContinEduc Dent. 1998 Feb; 19(2):137-40.

[3] J. W. Nicholson, T. G. Berry, J. B. Summitt, C. H. Yuan, and T. M. Witten, "Pain perception and utility: a comparison of the syringe and computerized local injection techniques." General Dentistry. 2001;49(2):167–173

[4] P Saxena, S K. Gupta, V Newaskar and Anil Chandra. Advances in dental local anesthesia techniques and devices: An update. Natl J Maxillofac Surg. 2013 Jan-Jun; 4(1): 19–24.

[5] Clark TM, Yagiela JA. Advanced techniques and armamentarium for dental local anesthesia. Dent Clin North Am. 2010;54:757–68.

[6] S F Malamed. Handbook of Local anesthesia. 6th edition

[7] Gibson RS, Allen K, Hutfless S, Beiraghi S. The Wand vs. traditional injection: a comparison of pain related behaviors. Pediatr Dent. 2000;22:458-62.

[8] Fukayama H, Yoshikawa F, Kohase H, Umino M, Suzuki N. Efficacy of anterior and middle superior alveolar (AMSA) anesthesia using a new injection system: the Wand. Quintess Int. 2003;34(7):537-41.

[9] Perry DA, Loomer PM. Maximizing Pain Control. The AMSA Injection can provide anesthesia with few injections and less pain. Dimensions of Dental Hygiene. 2003;1:28-33.

[10] Singh S, Garg A. Comparison of the pain levels of computer controlled and conventional anesthesia techniques in supraperiosteal injections: a randomized controlled clinical trial. ActaOdontol Scand. 2013;71(3-4):740-3.

[11] Yenisey M. Comparison of the pain levels of computer-controlled and conventional anesthesia techniques in prosthodontic treatment.J Appl Oral Sci. 2009;17(5):414-20.

[12] Al Amoudi N, Feda M, Sharaf A, Hanno A, Farsi N. Assessment of the anesthetic effectiveness of anterior and middle superior alveolar injection using a computerized device versus traditional technique in children.J ClinPediatr Dent. 2008 Winter;33(2):97-102.

[13] Palm AM, Kirkegaard U, Poulsen S. The wand versus traditional injection for mandibular nerve block in children and adolescents: perceived pain and time of onset. Pediatr Dent. 2004;26(6):481-4.

[14] D. Ram, B. Peretz. The assessment of pain sensation during local anesthesia using a computerized local anesthesia (Wand) and a conventional syringe.Journal of Dentistry for Children. 2003;70(2):130–133.

[15] Veerslot J, Veerkamp JS, Hoogstraten J. Pain behaviour and distress in children during two sequential dental visits: comparing a computerisedanaesthesia delivery system and a traditional syringe. Br Dent J. 2008 Jul 12;205(1):E2; discussion 30-1.

[16] Asarch T, Allen K, PetersonB, Beiraghi S. Efficacy of a computerized local anesthesia device in pediatric dentistry. Pediatr Dent. 1999;21(7):421-4.

[17] Melzack R, Wall P: Pain mechanisms: a new theory. Science 1965, 150:971-979.

[18] Sufka KJ, Price DD: Gate Control Theory reconsidered. Brain Mind 2002, 2:277-90

[19] Lundeberg T, Nordemar R, Ottoson D: Pain alleviation by vibration stimulation. Pain 1984, (20):25-44.

[20] Nanitsos E, Vartuli R, Forte A, Dennison PJ, Peck CC: The effect of vibration on pain during local anaesthesia injections. Aust Dent J 2010, 54:94-100.
[21] Blair J. Vibraject from ITL dental. Dent Econ. 2002;92:90.
[22] Saijo M, Ito E, Ichinohe T, Kaneko Y. Lack of pain reduction by a vibrating local anesthetic attachment: A pilot study. AnesthProg. 2005;52:62–4
[23] Roeber B, Wallace DP, Rothe V, Salama F, Allen KD. Evaluation of the effects of the VibraJect attachment on pain in children receiving local anesthesia. Pediatr Dent. 2011;33(1):46-50.
[24] Yoshikawa F, Ushito D, Ohe D, Shirasishi Y, Fukayama H, Umino M, et al. Vibrating dental local anesthesia attachment to reduce injection pain. J Japanese Dent Soc Anesthesiology. 2003;31:194–5.
[25] http://www.Dentalvibe.com
[26] http://www.accupal.com
[27] A H S Bonjar. Syringe micro vibrator (SMV) a new device being introduced in dentistry to alleviate pain and anxiety of intraoral injections, and a comparative study with a similar device. Annals of Surgical Innovation and Research 2011, 5:1.
[28] M. Hochman, D. Chiarrello, C.B. Hochman, R. Lopatkin and S. Pergola. Computerized local anaesthetic delivery v/s traditional syringe technique. NYSDJ.1997;Aug-Sept:24-29.
[29] RA Hingson& JG Hughes. Clinical studies with jet injections. A new method of drug administration. Anesthesia and Analgesia. 1947; Nov-Dec: 221-230
[30] Whitehead FIH and Young I. An Intra-oral Jet Injection Instrument: An Histological, Bacteriological and Clinical Assessment. Br. Dent. J.1968;125: 437
[31] Bennett CR, Mundell RD and Monheim LM. Studies on tissue penetration characteristics produced by jet injection JADA Sept. 1971, 83(3) 625-9
[32] Margetis P, Quarantillo E and Lindberg R. Jet injection of local anaesthesia in dentistry. U S Armed Forces Med J 1958;9 625-634
[33] T Lambrianidis, JP Rood and JH Sowray. Dental analgesia by jet injection. British Journal of Oral Surgery.1979-80;17: 227-231
[34] http://www.injexuk.com/files/instruction_manual_UK.pdf
[35] Bennett CR and Monheim LM. Production of local anesthesia by jet injection. Oral Surg.1971; 32(4): 526-530
[36] Epstein S. The clinical effectiveness of jet injection of local anaesthetics. Journal of Oral Therapeutics and Pharmacology. (1965)2, 37.
[37] Saravia ME and Bush JP. The needleless syringe: efficacy of anesthesia and patient preference in child dental patients. J ClinPediatr Dent. 1991;15(2):109-12.
[38] Munshi AK, Hegde A, and Bashir N. Clinical evaluation of the efficacy of anesthesia and patient preference using the needle-less jet syringe in pediatric dental practice. J ClinPediatr Dent. 2001;25(2):131-6
[39] Geenen L, Marks LA, and Martens LC. Clinical evaluation of the INJEX system, a local anesthesia system without needles: a comfort evaluation study. Rev Belge Med Dent (1984). 2004;59(3):149-55
[40] Dabarakis NN, Alexander V, Tsirlis AT, Parissis NA, and Nikolaos M. Needle-less local anesthesia: clinical evaluation of the effectiveness of the jet anesthesia Injex in local anesthesia in dentistry. Quintessence Int. 2007 Nov-Dec;38(10):E572-6.
[41] W Greenfield and JF Karpinsld. Needleless Jet Injection in Comprehensive Pain Control and Applications to Oral Surgery Anaesthesia Progress. 1973;July – August: 94-97
[42] http://www.mitcanada.ca/fr/products/med.html
[43] Kleber CH. Intraosseous anesthesia: implications, instrumentation and techniques. J Am Dent Assoc. 2003;134(4):487-91.
[44] Remmers T, Glickman G, Spears R, He J. The efficacy of IntraFlow intraosseous injection as a primary anesthesia technique. J Endod. 2008;34(3):280-3.
[45] Nusstein J, Reader A, Nist R, Beck M, Meyers WJ. Anesthetic efficacy of the supplemental intraosseous injection of 2% lidocaine with 1:100,000 epinephrine in irreversible pulpitis. J Endod. 1998;24:487–91.
[46] Parente SA, Anderson RW, Herman WW, Kimbrough WF, Weller RN. Anesthetic efficacy of the supplemental intraosseous injection for teeth with irreversible pulpitis. J Endod. 1998 Dec;24(12):826-8.
[47] Nusstein J, Kennedy S, Reader A, Beck M, Weaver J. Anesthetic efficacy of the supplemental X-tip intraosseous injection in patients with irreversible pulpitis. J Endod. 2003 Nov;29(11):724-8.
[48] Gallatin J, Reader A, Nusstein J, Beck M, Weaver J. A comparison of two intraosseous anesthetic techniques in mandibular posterior teeth. J Am Dent Assoc. 2003 Nov;134(11):1476-84.