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Dental Injection Pain Reducer Instrument (DIPRI) with Micro Vibration to Reduce Pain and Stress of Injection

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Abstarct: Dental Injection Pain Reducer Instrument (DIPRI) is a new design being introduced for the first time in the terminology of the dentistry world. The theoretical advantage of DIPRI with vibrating needle is that it should reduce the injection pain and minimize discomfort. Based on the concept of the Gate-Control theory, it is designed for future use in clinical practice. This device is a promising breakthrough in pain management and may deliver solution for clinicians plagued with patient pain phobia. DIPRI is an off-set rotating micro vibration creator that can be easily placed on any standard dental syringe and some disposable syringes. It may also be adapted for conventional intra muscular injections. DIPRI with micro vibration would be effective in reducing the pain confronted with most types of injections as palatal, mandibular block, intraligamental, local infiltration, etc. DIPRI is not only a useful accessory device for conventional patients but also more useful for pediatric patients and those who had a past painful injection. The parts in contact with patient are autoclavable. DIPRI is a registered invention and has an Iranian Official Patent number of 63765.

Key words: Dental injection pain reducer instrument, painless injection, dental injection syringe, injection phobia, intra muscular injection, Iran

INTRODUCTION

The Gate-Control theory of Melzack and Wall (1965) state that stimulation of larger diameter fibers (e.g., using appropriate pressure or vibration) can close the neural gate so that the central perception of itch and pain is reduced. It is based on the fact that small diameter nerve fibers carry pain stimuli through a gate mechanism but larger diameter nerve fibers going through the same gate can inhibit the transmission of the smaller nerves carrying the pain signal. Chemicals released as a response to the pain stimuli also influence whether the gate is open or closed for the brain to receive the pain signal. This lead to the theory that the pain signals can be interfered with stimulating the periphery of the pain site, the appropriate signal-carrying nerves at the spinal cord or particular corresponding areas in the brain stem or cerebral cortex. It is generally recognized that the Pain gate can be shut by stimulating nerves responsible for carrying the touch signal (mechaoreceptors) which enables the relief of pain through massage techniques, rubbing, pressure, ice packs, acupuncture, electrical analgesia and also the application of vibration. Dental Injection Pain Reducer Instrument (DIPRI) bearing vibrating needle was designed to reduce the pain during the injection. It holds an off-set rotating micro vibration creator that can be easily placed on any standard dental syringe. Accordingly, Pain gate would be shut by stimulating nerves providing reduction in pain and discomfort associated with injections through micro vibration during injection period. Examples of less pain experiences based on Gate theory may include: incision in bare hands, while playing in snow feels less pain than normal, use of simultaneous cold and vibration in ladies epilating devices as accessory stimuli reduces transmission of main stimulus by local nerve endings in hair removal leading to reduced prick, some dentists have developed pain reducing techniques like shaking the syringe in their grasp while dispensing the anesthetic. DIPRI makes nerve endings sense micro vibrations at the very early stage, so will remarkably reduce the pain transmission.

MATERIALS AND METHODS

Structural components: Dental Injection Pain Reducer Instrument (DIPRI) was designed to provide feasibility and flexibility in clinical practice. DIPRI main parts consist of: four flexible attachment arms, stainless steel shell, eccentrically weighted plate of motor and attachment cap. Power to rotate the eccentrically weighted plate on motor

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are provided through either of four sources as batteries, air pressure provided by air compressor delivered to DIPRI attachment cap via a pair of in-out tiny flexible tubes, water pressure provided by water compressor delivered to DIPRI attachment cap via a pair of in-out tiny flexible tubes and winding spring. The spring is mounted on the central shaft winded anti clockwise through attachment cap using fingers. Upon release, the shaft rotates eccentrically weighted plate clockwise and Shielded rotary cable. Rotation of the cable is provided by an electromotor.

RESULTS AND DISCUSSION

Dental Injection Pain Reducer Instrument (DIPRI) was registered as an invention in the field of Dentistry and received Iran Patent number of 63765. Schematic attachment position of DIPRI is indicated in Fig. 1. It is well known that most patients feel physically and psychologically uncomfortable about penetration of injecting needle into their oral tissues. Some of them do not convey this feeling to the clinician, so the statistics of patients fearful of the dental pain experience and feeling discomfort is even beyond what is seen in clinic. DIPRI would have advantages of: lowering patient pain or injection phobia both physiological (based on gate control theory of pain) and psychologically (based on the instrument function as will be explained by dentist to the patient as a modern pain reducing technology), the eccentrically weighted plate of motor provides ultra high frequency and ultra low vibration altitude (which enhance patient pain reduction and ease of clinician maneuver and accuracy during injection, respectively) reduces two types of pain injections including both needle insertion pain and balloon effect due to forceful penetration of anesthetic into the surrounding tissue. The ultra vibration slowly reduces such balloon and enhances tissue infiltration of injected anesthesia, it is easy to use and does not provide any inconvenience for the clinician during injection operation due to low weight that does not affect the accuracy of clinician maneuver, small size that keeps well visibility, battery powered and lack of wire or hose attachment, the 1.5 Volt batteries are either replaceable or rechargeable, bearing four flexible attachment arms it provides: convey of efficient vibration to syringe barrel and consequently to needle, applicable to all standard conventional syringes which compensates minute variations of different barrel diameters, no screw or spare appliance needed for its attachment to or removal from the syringe barrel, so its application is fast and easy, DIPRI can be attached anywhere along the syringe barrel while it does not cover or mask the carpule, no need to replace the existing syringes or purchase further spare parts while using DIPRI, it has a detachable motor, a stainless steel shell and four positioning arms which are autoclavable and are the only parts who get in contact with patient during injection.

Fig. 1: Dental Injection Pain Reducer Instrument (DIPRI) scheme (left) and its schematic attachment position of on dental injection syringe (right)

The motor cartridge should not be heat sterilized but it can be sterilized by appropriate chemicals if needed, use of DIPRI would save time since it eliminates the period needed for topical anesthesia to cause numbness and it is clear that patients experiencing less pain injections will tell friends and family and that is practice building for the physician.

A similar device reported in the literature, VibraJect® has controversial performance. Blair (2002) recommended the use of VibraJect® for painless injection. In contrast, Yoshikawa *et al.* (2003) found no significant pain reduction when VibraJect® was applied with a conventional dental syringe. Saijo *et al.* (2005) evaluated the effectiveness of VibraJect® in combination with an electrical injection device. Injections were given into the alveolar mucosa adjacent to the root apex of the maxillary lateral incisor in 10 volunteers. VibraJect® was randomly applied to either the left or right side of the injection. They found no statistically supports use of VibraJect® and expresses that it offers a simple and easy-to-use solution that can anesthetize patients quickly in a more comfortable manner. They also points out that VibraJect® enables a less painful palatal injection because it delivers small amounts of anesthetic solution over a period of time. Another supporting result was statistically performed by DentistryIQ (2009) at Queens University with the result that the vibrating syringe attachment resulted in reduced pain levels on receiving intraoral injections. The study performed on 400 patients and showed that VibraJect® statistically reduced the amount of pain score from 4.6-1.7 which has never been statistically achieved before. From the stand point of technical and performance, a brief summary for specification differences between DIPRI and VibraJect® are shown in Table 1.

Table 1: Specification differences between Dental Injection Pain Reducer Instrument (DIPRI) and VibraJect®

Specifications	VibraJect®	DIPRI	Advantage of DIPRI
Mounting on syringe barrel	Clip	Four flexible grasping positioning arms	Firm grasping, efficient vibration conveyance
Attachment angle to syringe barrel	Angular	Parallel	Most efficient contact surface, least clinician vision masking, least patient discomfort
Vibration cause	Eccentrically weighted shaft	Eccentrically weighted plate	Yield of uniform micro vibration
Vibration power source	Batteries	Batteries, air pressure, water pressure, winding spring, shielded rotary cable	Versatility in power supply

CONCLUSION

In this study, DIPRI is not only a useful accessory device for ordinary patients but also more useful for pediatric patients and those who have a phobia of dental injections or pain and researchers believe it will bring more comfort for both patient and the physician during the process of injection.

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