Needle-less local anesthesia: Clinical evaluation of the effectiveness of the jet anesthesia Injex in local anesthesia in dentistry

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Objectives: To clinically evaluate the jet injection Injex (Rösch AG Medizintechnik) using 2 different anesthetic solutions, and to compare the jet injection and the standard needle injection techniques. **Method and Materials:** Of the 32 patients in the study, 10 received mepivacaine 3% anesthetic solution by means of the jet injection technique, while the remaining 22 patients received lidocaine 2% with epinephrine 1:80,000 by the same method. The 14 patients in whom pulp anesthesia was achieved were selected for an additional evaluation of the pulp reaction using standard needle injection anesthesia. The differences between the 2 compounds with Injex were statistically evaluated by means of independent-samples *t* test analysis. The differences between subgroups receiving both jet injection and needle injection anesthesia were evaluated by means of paired *t* test analysis. **Results:** The administration of mepivacaine 3% using Injex did not achieve pulp anesthesia in any of the 10 patients, although the soft tissue anesthesia was successful. The administration of lidocaine with epinephrine using Injex resulted in pulp anesthesia in only 14 patients; soft tissue anesthesia was observed in all patients of this group. There was no statistically significant difference between Injex and the needle injection technique in onset of anesthesia. However, the duration of anesthesia was significantly longer for the needle infiltration group than for the Injex injection group. **Conclusion:** The anesthetic solution should be combined with a vasoconstriction agent when the Injex technique is implemented. *(Quintessence Int 2007;38:881.e572–576)*

Key words: epinephrine, jet injection, lidocaine, local anesthesia, mepivacaine, needle-less anesthesia

One of the major problems in dental practice is the fear of the dental injection, which most patients exhibit during treatment. Patients are often more distressed by the sight of a needle during administration of local anesthetic than by the ensuing treatment. Despite improvements in both the effectiveness of anesthetic solutions and the quality of dental needles, the method of administration has largely remained unchanged. A needle connected to a syringe remains a necessity, and the realization that it will penetrate the oral mucosa is chilling for most patients.[1] To reduce and eliminate pain and thus alleviate the fear of the injection, clinicians have resorted to applying anesthetic topically beforehand to the mucosal area proximal to the site at which the syringe injection is to be administered.[2]

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Therefore, the challenge is to use a less invasive method of administration rather than to discontinue the use of local anesthesia. A step in that direction is the application of techniques whereby the anesthetic solution is introduced into the tissue without the use of a needle.[3] Needle-less local anesthesia with a jet injection device has been proposed[4] by which a high-velocity spray of anesthetic solution is forced under high pressure into the oral mucosa, leading to mechanical infiltration of the compound through the mucosa. The current opinion is that this technique can be used only for surface anesthesia and thus is supplementary to the standard infiltration techniques. It is intended to reduce the discomfort or pain of the ensuing syringe injection and ultimately to replace the standard syringe injection technique under specific conditions.

The purpose of the present study was to clinically evaluate the outcome of the jet injection Injex (Rösch AG Medizintechnik) using 2 different anesthetic solutions and to compare the jet injection and the standard needle injection techniques using the same anesthetic compound.

METHOD AND MATERIALS

Thirty-two patients admitted to our department for tooth extractions were included in the study. To obtain the most objective outcome, a double-blind registration method was used; neither the patient nor the operator were aware of the administered compound. Each patient signed a relevant consent, and a brief description of the therapeutic procedures, as well as a visual demonstration of the appropriate instruments, was given. In addition, it was confirmed that the patient could hear the characteristic "pop" sound when the release button of the Injex devise was pressed. All injections were made in accordance with the manufacturer's directions.

The technique is relatively simple but demands operator familiarity and provides the use of 1-use sterilized compartments. The manufacturer claims that the device was designed exclusively for submucosal injections. The Injex injector is the size of a ballpoint pen, lightweight (approximately 75 g), and reusable (Fig 1). A reusable transporter is a dosing tool designed for transferring liquid medication from cylinder cartridges to the Injex system ampoules (sterile- packed plastic ampoules) (Fig 2); the ampoule filled with the medication is screwed into the injector (Fig 3). The reset box is used for storing the injector. When the reset box is closed, a lever mechanism compresses the spring in the injector for recharging (Fig 4). The prepared injector is placed firmly on the firm attached gingiva at a 90-degree angle. The patient must be prepared for the release noise. With a short press on the trigger, the injection is completed in a fraction of a second. After the anesthetic has been applied, the injector must be left on the mucous membrane for 2 seconds.

In the present study, the injector was placed lightly over the buccal mucosa corresponding to the apex of a healthy tooth (Fig 5); the patient was instructed to stay still, and the release button was pressed, discharging 0.3 mL of anesthetic solution. Onset and duration of the anesthesia were recorded at each minute postinjection to determine *(1)* the pulp reaction of the test tooth and *(2)* the soft tissue pain reaction at the buccal apex of the tooth. The pulp reaction was measured with the aid of a digital pulp tester (Pulppen DP2000 Digital, Dental Elecronic); the soft tissue pain reaction was tested by means of a pinch with a forceps.

The patients were divided into 2 groups. Ten patients (group A) received mepivacaine 3% anesthetic solution (Mepivastesin, 3M Espe) using the jet injection technique. The remaining 22 patients (group B) received lidocaine 2% anesthetic solution with 1:80,000 epinephrine (Lignospan special, Septodont) using the same injection technique.

Fourteen patients of group B (subgroup B1) who responded positively to pulp anesthesia were selected for an additional evaluation of the pulp reaction 1 week postoperatively using the standard needle injection anesthesia. In each patient, the same amount of anesthetic solution (0.3 mL) was administered at the same area, and the

Fig 1 Injex injector.

Fig 2 Dosing tool used to transfer medication to the Injex ampoules.

Fig 3 Ampoule attached to the injector.

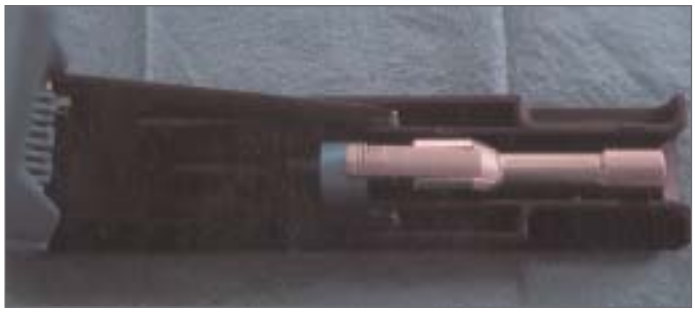

Fig 4 Placement of the injector into the reset box.

Fig 5 Placement of the injector vertically on the apex of the tooth.

measurement was made using the same technique as done previously. The recorded data formed subgroup B2.

The statistical significance of the differences between the 2 compounds (groups A and B) with Injex was evaluated by means of independent-samples *t* test analysis. The statistical significance of the differences between subgroups B1 and B2 was evaluated by means of paired *t* test analysis. The significance level for each test was $P < .05$.

RESULTS

The administration of mepivacaine 3% with Injex (group A) had no effect on pulp anesthesia in any of the 14 patients. However, soft tissue anesthesia was successful in this group, presenting a rapid onset (< 1 minute) and duration of 6.10 ± 4.04 minutes.

The administration of lidocaine with epinephrine with Injex (group B) resulted in pulp anesthesia in only 14 patients, while soft tissue anesthesia was obtained in all 22 patients of this group. Onset of pulp anesthesia took 2.59 ± 2.51 minutes, and it lasted 8.90 ± 10.02 minutes. Onset of soft tissue anesthesia was rapid (< 1 minute), and the duration was 39.77 ± 9.81 minutes.

Statistical analysis showed that the Injex technique with lidocaine and epinephrine achieved significantly longer duration of soft tissue anesthesia than that in the mepivacaine group (6.10 ± 4.04) ($P < .05$; independent-samples *t* test, $t = -0.379$, $df = 30$).

Pulp anesthesia with Injex and needle injection techniques (groups B1 and B2) was compared using only lidocaine and epinephrine solutions since mepivacaine had no positive effect on tooth pulp. Statistical analysis showed no statistically significant difference in the onset of anesthesia (4.07 ± 1.94 for group B1 versus 3.71 ± 1.20 for group B2; $P = .58 > .05$; paired *t* test, $t = 0.563$, $df = 13$). However, the duration of anesthesia was significantly longer for the needle infiltration group (B2) than for the Injex injection technique (21.71 ± 4.63 minutes versus 14.00 ± 9.24 minutes, respectively; $P = .001 < .05$; paired *t* test, $t = -4.170$, $df = 13$).

The experience of the patients who received anesthesia by means of the Injex technique was also recorded, using a pain-control method. Fifty percent of patients reported discomfort or pain before the spray of the anesthetic and from the contact of the tip of the device with the oral mucosa before injection; 17.6% 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. In 14.6% of the patients, there was limited bleeding at the injection site. Finally, 11.8% of patients experienced intense pain in the area of the injection after the anesthesia subsided.

After their experience with Injex, patients were asked about their future choice of local anesthesia technique: 17.6% expressed their preference for Injex, whereas 52.8% preferred the classic injection with needle-syringe; 29.6% expressed no preference.

DISCUSSION

John F. Roberts introduced the jet injection syringe in 1933, producing a prototype of the jet syringe. The medical profession has refined these syringes, and modified modes have found their way into dental application.[5] In 1958[4] the first publication on its use in dentistry stated that adequate anesthesia could be observed in gingiva, lips, and the inner part of the cheek by administration of small amounts of local anesthetic solutions.

The benefits of the jet injection technique are mainly based on the reduction of the patient's psychologic barriers and anxieties by eliminating the view of the needle. In addition, it is an easy-to-use and time-saving application that carries no risk of infection. However, some disadvantages, such as bleeding, trauma and pain to the injection site, and increased patient apprehension, have been reported.[2]

In the present study, mepivacaine with Injex did not achieve pulp anesthesia, but only soft tissue anesthesia. Mepivacaine's inadequacy to achieve pulp anesthesia can be explained by its rapid mechanical absorption that occurs after its fast application under pressure; since there is no vasoconstrictor action, it quickly enters general circulation. Pharmacokinetic studies have demonstrated that peak anesthetic blood levels of 3% mepivacaine exceeded that of an equal volume of 2% lidocaine with epinephrine by about threefold after maxillary infiltration injections.[6,7] In addition, studies on intraosseous and periodontal ligament injections have shown lower success rates when anesthetic solutions that do not contain vasoconstrictors or have reduced vasoconstrictor concentrations are used.[8–11]

Apart from pulp anesthesia, in this study, lidocaine with epinephrine was superior to mepivacaine in soft tissue anesthesia, as well. The duration of anesthesia achieved using the Injex technique with lidocaine with epinephrine anesthetic solution was significantly longer than that of mepivacaine, demonstrating agreement with previous studies[12,13] where mepivacaine's lower anesthetic success rate was mentioned. The presence of a vasoconstrictor in the anesthetic cartridge has a major influence on the duration of anesthesia.[14] The injection of epinephrine combined with a local anesthetic into the oral mucosa inhibits the compound's absorption by vasoconstricting action of the adjacent blood vessels.[15]

The results of this study showed that anesthetic solution used with the Injex technique should be combined with a vasoconstriction agent. However, even with the use of lidocaine with epinephrine as an anesthetic compound, the effectiveness of this technique is still limited; in this study, 8 of 22 cases did not achieved pulp anesthesia. Thus, the use of Injex should be confined somehow to only soft tissue anesthesia of the mucosa. The previous statement is enhanced by the fact that 52.8% of patients preferred classic injection with needle-syringe infiltration over Injex.

CONCLUSIONS

Apart from some mild complaints, the Injex technique exhibits all the advantages of jet anesthesia mentioned in this study. Although it is not a panacea, it is a useful adjunct to local anesthesia. The jet injection technique may be particularly beneficial in pediatric dentistry, where its use would reduce fear from needle view and contribute to limited dose administration, which is an important issue in the local anesthesia in young children.[16] The result of this study showed that the anesthetic solution used with the Injex technique should be combined with a vasoconstriction agent.

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