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The Wand vs. traditional injection: A comparison of pain related behaviors

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Abstract

Purpose: The purpose of this study was to evaluate the efficacy of a computerized anesthesia delivery system (e.g., Wand) compared to a traditional anesthesia administration, with respect to reducing disruptive pain related behavior during injections.

Methods: Subjects consisted of 62 patients between the ages of 5 and 13 requiring local anesthesia for dental restorations in the maxilla. Patients were randomly assigned to either the Wand or the traditional anesthetic delivery system. A palatal approach to the anterior and middle superior alveolar nerves and the anterior superior alveolar nerve was used with the Wand injections. Buccal infiltration and palatal injections were used for the traditional method. Pain behavior was observed and coded. Pain ratings were obtained. Subjects also rated their satisfaction with treatment.

Results: Results of chi-square tests found that the Wand injections produced significantly fewer patients who exhibited disruptive behavior during the initial 15 seconds of an injection when compared with those who received a traditional palatal injection. Wand patients were significantly less likely to cry, to exhibit disruptive body movements, and to require physical restraint. In contrast, there were no significant differences in disruptive behavior when comparing the Wand with the traditional buccal injection. Pain ratings showed no statistical difference between the Wand and the traditional injections.

Conclusion: Wand injections can deliver proper anesthesia, utilizing one palatal injection site, while significantly reducing the likelihood of disruptive behaviors during the initial moments of an injection. (*Pediatr Dent* 22:458-462, 2000)

Dental anxiety and fear preoccupies the mind of many patients during dental procedures.^{1,2} There is a high correlation of adult dental fear and avoidance stemming from childhood experiences.^{3,4} For these patients, one of the disturbing aspects of dental treatment is the anxiety caused by the fear of the dental injection.⁵ When local anesthesia is administered properly, it affords advantages such as child/patient comfort, cooperation, and increased operator performance.⁶ In pediatric dentistry, delivering a relatively painless injection is the key to having a cooperative patient and is a skill every pediatric dentist should strive to master. Having a cooperative patient can alleviate stress and wasted time.

Despite the skill of the operator and the care with which the injection is administered, the pain of the injection and the anxiety that comes with it continue to plague the profession. Numerous studies have been conducted in an effort to alleviate the discomfort associated with the injection.⁷⁻⁹ Yet, the fact remains that 30-40 million people in the United States continue to be "phobic" and avoid dental treatment, while 90 percent of all dental patients report being anxious about going to the dentist and receiving an injection.¹⁰ Because of this fact, dentists continue to look for better and more comfortable ways to deliver local anesthetic. Topical anesthetic and increased injection time have been employed with limited results.¹¹ Even though these techniques have helped, they have not eliminated anxiety and fear in patients. Administering local anesthetic via a traditional injection continues to elicit a significant pain response in most dental patients, whether child or adult.

Recently, the "Wand," a computerized local anesthetic delivery system, has been developed as a potential means to reduce or virtually eliminate the pain associated with the dental injection. The Wand delivers anesthetic at a constant slow rate and controlled pressure, regardless of the resistance within tissue.¹² The manufacturer has proposed that the computerized system delivers anesthetic at a rate below the threshold of pain, allowing for a potentially pain free injection.¹² In conjunction with this new technology, two new palatal injections that can anesthetize multiple maxillary teeth have been defined.^{13,14} A palatal approach to the Anterior Superior Alveolar nerve (P-ASA)¹³ and a palatal approach to the Anterior and Middle Superior Alveolar nerves (AMSA)¹⁴ are recommended. In both, anesthetic perfuses the porous bone of the maxilla and produces anesthesia from the second premolar to the central incisor with the AMSA and from canine to canine with the P-ASA.¹⁰ With both of these injections, profound palatal and buccal anesthesia, as well as adequate buccal / facial anesthesia are thought to be achieved with one injection.

Preliminary studies performed with the Wand show promising data, but only one has been conducted with children. Asarch, Allen, Petersen, and Beiraghi performed a well controlled study using two groups of children with randomized assignment.¹⁵ One group received traditional anesthesia injections while the other received injections administered using the

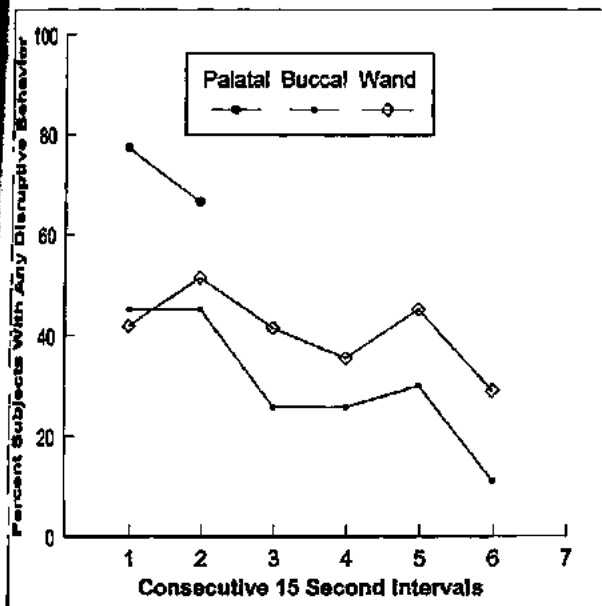


Fig 1. Percent of subjects displaying any disruptive behavior across consecutive 15 second intervals for the Wand and each of the Traditional injection conditions.

Wand. Asarch and his colleagues found no significant difference in pain ratings or disruptive behavior between injections given with the Wand and injections given with a traditional syringe. However, despite how well the study was executed, there were some problems with the study. First, Asarch et al.¹⁵ used the Wand to administer anesthesia at the exact same injection sites as a traditional injection. That is, the Wand was used to perform a buccal infiltration with palatal injection or a mandibular block with a long buccal injection, as would be done with a traditional syringe. Asarch et al.¹⁵ did not look, however, at the injection sites that are thought to be specific to the Wand (e.g., P-ASA, AMSA). Second, Asarch et al. averaged the disruptive behavior measures over the entire length of the injection duration. Because they did not control for inherent differences in the durations of the Wand and the traditional injections, it is difficult to interpret the results. Finally, Asarch et al. report delivering the anesthesia with the Wand at a fast rate, as soon as a positive aspiration was not detected. However, the Wand has two speeds to allow for slower infusion and, following the publication of the Asarch study, the manufacturer has emphasized use of the slower rate of injection throughout the palatal injection procedure. The purpose of this study was to continue to explore the efficacy of the Wand with children by extending and improving upon the limitations of the Asarch et al. study. The present investigation was designed to assess disruptive pain behavior and pain ratings by children, comparing Wand-specific injections with traditional buccal infiltration/palatal injections. Slower injection speeds were used with the Wand, as recommended by the manufacturer, and then differences in injection durations were controlled by conducting comparisons interval by interval across the different types of injection.

Method

Subjects

Sixty-two healthy pediatric patients ranging in age between 5-13 years were used in this study. There were no gender, race,

or ethnic restrictions used in the study. Patients were selected based on their need for operative dentistry in the maxilla requiring local anesthesia. All patients had had previous dental experience, including local anesthesia. No patients were included in the study that had easily discernable limitations of mental status. The procedures and possible discomforts or risks, as well as the possible benefits, were explained fully to the parent or guardian and the subject and their informed consent, as approved by the University's Institutional Review Board, was obtained prior to the investigation.

Equipment

The local anesthetic was delivered using either the Wand¹² or a traditional syringe. All injections consisted of 2% Xylocaine with 1:100,000 epinephrine, administered with a 30 gauge needle. The Wand can deliver anesthetic at two different rates controlled by a foot pedal. The Wand delivers a full standard cartridge (1.8cc / cartridge), however, .2cc are left in the cartridge and microtubing after it is spent and .2cc are spent purging the tubing of air prior to injection. Therefore, the maximum local anesthetic delivered by the Wand using one cartridge equals 1.4cc. The average amount of local anesthetic administered using the Wand was 1.0cc (range .7cc-1.3cc), delivered as an AMSA or a P-ASA injection. While administering a buccal infiltration, 1.8cc/carpule were delivered. The traditional palatal injection received 1/10 carpule or .18cc.

Dependent measures

Pain behavior was measured using an established pain behavior code.^{15,16} The four pain behavior categories used were: 1) body movements; 2) crying; 3) movements requiring restraint; and 4) movements requiring a temporary halt to treatment.¹⁵

Perception of pain was provided by each child using a 10 point visual analogue scale (VAS). An actual pain "meter" was used, about 6 inches long and an inch wide, with a red bar that could be slid freely from 0 (representing no pain) to 10 (representing the most pain). Children assisted in establishing the anchors for the scale.

After the restorations were complete, overall treatment satisfaction was evaluated with five questions.¹⁵ The patient used a 6 point VAS scale with one (1) representing strong disagreement from the patient and six (6) signifying strong agreement to the statement by the patient. Therefore, the maximum score for treatment satisfaction was 30, with an overall score of 20 or higher generally considered a positive dental experience.

Procedure

Subjects were selected from a continuous sample of patients of record and represented a cross section of children who presented at a university clinic at a large Midwestern urban setting. Prior to entering the dental operator, a researcher explained the VAS and each child then helped establish anchor points. The child was then randomly assigned to either the Wand or the traditional syringe technique for administration of the local anesthetic.

Topical anesthetic was placed in the area of the injection site for 60 seconds for each injection site. Nitrous oxide was not used during any of the injections. The injection was then administered. For the Wand, a cotton tip applicator was pressed firmly to the tissue at the proposed injection site. For the palatal approach to the P-ASA, the injection soft tissue site is just lateral to the incisive papilla. For the palatal approach

Table 1. Outcome Parameters for Wand vs. Traditional Method

Injection Type	Duration (sec)	% of patients with any disruptive behavior	% of patients who cried	% of patients with body movements	Number requiring restraint	Pain ratings
Wand	224	42	42	3	1	3.4
Traditional-palate	12.3*	77*	74*	39*	5	4.9
Traditional - buccal	115*	45	32	19	1	2.7

* Significantly different at the .01* and .05* levels

to the AMSA, an injection is administered half way between the mid-palatal raphae and the free gingival margin bisecting the first and second premolar. The needle tip bevel was placed flat against the tissue. Administration of anesthetic at the slow rate began and, after 5 seconds, slight tissue penetration was established. The slow rate of delivery was continued once the needle penetrated the soft tissue. This allows an anesthetic pathway to develop prior to further tissue penetration. Once the needle tip reached the level of the bony palate, the slow rate of administration was continued until slight blanching of surrounding tissue was visualized. This technique is to the specifications of the Wand manufacturer. Buccal infiltration and palatal injection were administered for the traditional technique. A distraction technique in the form of a cheek wiggle was employed for the buccal infiltration upon insertion of the syringe. For the traditional palatal injection, pressure was applied using a cotton tip applicator, similar to that used with the Wand injection, before insertion of the syringe. Once anesthesia was achieved, dental treatment was delivered. The Tell-Show-Do technique was utilized for all patients; however, the subjects were visually shielded from knowing which local anesthesia technique he/she received. No subject was used twice for this study and the same operator delivered treatment throughout the study.

A research assistant observed all treatment sessions and coded occurrence of these behaviors on a 15-second interval recording system. Pain ratings were solicited after each injection for both groups. The research assistant timed the duration of each injection while concurrently coding behavior. Coding of the "injection" procedure began at the point of tissue penetration. The research assistant administered the treatment satisfaction rating scale at the conclusion of treatment.

Data Analysis

Statistical analyses generally used χ^2 tests for dichotomous variables and *t*-tests for continuous variables. If an expected cell frequency was less than 5, Fisher's exact test was used instead of a χ^2 test. Some analyses emphasized the first injection interval (first 15 seconds). The first interval was emphasized because it represents the initial penetration of the needle and it also represents the patients' initial reaction to pain/discomfort. For clarity, the "Wand" refers to the AMSA and P-ASA injections, which were administered on the palate. The two traditional syringe techniques were designated as "buccal" and "palatal". Some analyses compared the Wand injection with either the buccal or the palatal injection. Other analyses compared the Wand group with the Traditional group.

Results

Descriptive statistics showed that the age and gender distribution of the two groups were comparable. The mean age for both the Wand and the Traditional groups was 8.6 and 8.0 years, respectively, while both groups also had identical numbers of females ($N=15$) and males ($N=16$). Both groups required similar restorative procedures and only one subject in each group required additional local anesthesia after the initial injection. Comparisons of the injection durations showed that, as expected, the Wand required significantly more time than the Traditional injections. On average, the Wand injections required 3.73 minutes, while the traditional injections required, on average, 2.1 minutes ($t(60) = -7.92, P < .001$).

Because the injection times varied significantly, statistical analyses were performed only at intervals in which at least 85% of each sample were included. Thus, statistical comparisons were only performed on the first six intervals that were observed. Figure 1 shows the percentage of patients with any disruptive behaviors during each of the first six successive 15 second interval of the injections. During the first 15 second interval, a significantly lower percentage of patients exhibited disruptive behaviors with the Wand injection as compared to the Traditional palatal injection ($\chi^2 = 8.11, P < 0.01$). There were no significant differences between the Wand and the Traditional buccal injection on percent with disruptive behavior in any of the first six intervals.

These differences in overall disruptive behaviors were generally reflected in the specific types of disruptive behaviors that were observed (see Table 1). Significantly fewer patients cried or exhibited body movements during the first interval of the Wand injection than patients given the Traditional palatal injection ($\chi^2 = 6.62, 11.78$, respectively, $P < 0.05$). In addition, while 5 children receiving traditional palatal injections required physical restraint to complete the procedure, only 1 child receiving a Wand injection required restraint to complete the procedure. There were no significant differences between the Wand and the Traditional buccal injection in crying, body movements, or restraint throughout the first six intervals.

Child pain ratings were compared across the Wand and Traditional injections. There were no differences in pain ratings for the Wand compared to either the traditional palatal or the traditional buccal injection, although the traditional palatal injection did produce high ratings (more discomfort) than either the Wand or the traditional buccal injection (see Table 1). Because most pain ratings were either at the maximum or minimum levels, the data were transformed to permit a comparison between the percentage of patients with pain ratings of 9 or 10 on the 10-point scale. Only 4 of the patients re-

ported such very high pain ratings for the Wand injection, compared to 10 for the palatal injection ($X^2=3.32$, $P<0.10$). Note that this shows only a trend toward significance, even after dividing the pain distribution at the most advantageous point on a post hoc basis.

There were no significant differences on the patients' overall satisfaction rating for the Wand (mean rating = 4.1) vs. traditional (mean rating = 4.3) groups. No significant differences were found between the Wand (mean = 24.5, median = 26) and the Traditional injection (mean = 25.6, median = 28) method. It should be noted that the satisfaction scores were skewed and tended to cluster at the high end (25-30).

Discussion

Overall, this investigation found that the Wand resulted in significantly fewer disruptive behaviors during the initial moments of the injection when compared with a traditional palatal injection. Indeed, nearly twice as many children exposed to the traditional palatal injection were disruptive compared to those exposed to the Wand injection. These disruptive behaviors included significantly more intervals of crying and disruptive body movements. In addition, 5 times more patients receiving a traditional palatal injection required restraint than did patients anesthetized with the Wand. Finally, patients receiving the traditional palatal injection rated the experience as more painful and more of them rated the experience as extremely painful than did those who experienced the Wand. In sum, the Wand appears to offer a valuable means of reducing the disruptive behavior of children during the initial moments of a palatal injection.

Any benefit derived from the Wand seems most likely attributable to the slow rate of delivery of anesthetic solution. On average, the Wand injections were nearly 110 seconds longer than a traditional buccal/palatal injection. Indeed, the manufacturer claims that it is precisely this slow rate that allows the Wand to deliver anesthesia with less pain.¹² Further, the markedly longer injection times did not have a negative impact on the subjects' cooperation with treatment.

The Wand was not found to produce any significant benefit over a traditional buccal injection. There were no differences in disruptive behaviors, pain ratings, or the amount of restraint required. Thus, a palatal injection given with the Wand was comparable to a traditional buccal injection. In addition, all of the children reported being satisfied with treatment. Therefore, the Wand may be a realistic alternative to a traditional buccal injection.

In contrast to the recent Asarch investigation of the Wand¹⁵, the current investigation found that the Wand can administer local anesthetics in a manner that produces significantly fewer disruptive behaviors and less discomfort compared to a traditional injection. Thus, the manner in which the Wand is used may be critical. In the Asarch investigation, the Wand was used as an identical alternative to traditional injections and it did not appear to offer any benefit. In this investigation, however, where the Wand was used to deliver anesthetic, using a unique palatal approach to P-ASA and AMSA, it did appear to offer significant pain reduction benefit.

Although the impact of the Wand on disruptive behavior is an important consideration in deciding whether to use the Wand, there are other considerations. First, the physical equipment is approximately \$1,000 and there is a per use cost of

\$1.25 for the tubing and the luer lock needle tip. In addition, the Wand requires significantly more time to administer anesthesia. However, there are several benefits. In addition to the fact that the Wand produced less disruptive behavior, we also found that the palatal approach to the P-ASA and AMSA produced profound pulpal/palatal anesthesia with adequate buccal anesthesia with no collateral numbness to the lip and face. Equally important, however, was that this level of anaesthesia was achieved at the same comfort level as a traditional buccal injection. Finally and anecdotally, the Wand offers an additional benefit: Only 1.4cc or 78% of a "Wand cartridge" is actually delivered to achieve proper anesthesia. Therefore, by using palatal AMSA injections, one can anesthetize second premolar to the central incisor using 1.0cc or 18mg of 2% Xylocaine with 1:100 epinephrin. This holds true for the P-ASA, which will anesthetize canine to canine with the same dosage. This would appear to increase the number of teeth that can be restored at one visit without placing the patient in a position of possible local anesthetic toxicity. This is an area for further research.

There are a few limitations to this study that may require the results to be interpreted with caution. First, this study, as well as the Asarch et. al. study, investigated children between the ages of 5-13 years old. It will be important to explore the benefits of the Wand with children 2-5 years of age to evaluate the benefits on a younger age group. Second, the results could be biased since the operator was not blind to the type of injection that was being delivered. However, an attempt to control for this was made by using an independent observer who coded behavior and collected ratings. Finally, the results could be influenced by operator experience. Since there was only one operator, the results may be specific for this one individual. It would be beneficial, in the future, to compare the Wand across multiple operators.

Conclusion

The cost/benefits must be weighed by each practitioner, but it appears that the Wand, when used with the palatal approach to P-ASA and AMSA, offers less pain and behavior disruption and possibly increased safety, making it a potential asset to any practitioners' armamentarium.

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ABSTRACT OF THE SCIENTIFIC LITERATURE

TREATMENT OF CHEMOTHERAPY INDUCED ORAL MUCOSITIS

This study evaluated the effectiveness of 3 mouthwashes commonly used to treat chemotherapy induced mucositis in an adult population. A randomized double blind clinical trial evaluated three agents, Chlorhexidine, salt and soda (1 teaspoon each of salt and sodium bicarbonate per pint of water), and "magic mouthwash" (lidocaine, Benadryl and Maalox). The patients followed a prescribed oral hygiene protocol and were randomly assigned a mouthwash. 142 of 200 patients reported a cessation of symptoms during the 12 day study period. No significant differences in time for the cessation of signs and symptoms were observed among the three groups. The authors conclude that give the comparable effectiveness of the three agents, the least costly agent, salt and, can be recommended.

Comments: This is a follow up to a previous study by this group that assessed these three agents and their ability to prevent oral mucositis during chemotherapy. In both studies, each agent was found to have similar effectiveness as part of either therapeutic or preventive regimens. Curiously, the group treated with "magic mouthwash", designed for its local anesthetic effects, reported similar pain ratings to the other groups. CH

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Randomized clinical trial of the effectiveness of 3 commonly used mouthwashes to treat chemotherapy induced mucositis. Dod, MJ, Dibble SL, Miaskowski C, MacPhail L, Greenspan D, Paul SM, Shiba G and Larson P. *Oral Surg Oral Med Oral Path Oral Radiol Endod.* 2000. 90:39-47.

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