Using a Precision-Metered Injection System to Minimize Dental Injection Anxiety

CE 2

Abstract: *In this study, 90% of dental patients reported being at least mildly anxious about receiving dental injections. A new precision-metered injection system has been developed that can greatly increase the probability of painless injections of local anesthetic. Surveys were administered to patients to quantify their fears of dental injections and to measure the desensitization effect of using the new injection system. According to survey results, fear levels decreased significantly when the new technology was used.*

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Learning Objectives:

After reading this article, the reader should be able to:

- recognize the prevalence of dental anxiety.
- explain the design limitations of hypodermic syringes.
- describe the benefits of a new precision-metered injection system.

It is estimated that nearly 50% of the population in the United States experience some anxiety when visiting the dentist. Of these, 30 million to 40 million are termed phobic, persons with such severe anxiety that they avoid dental care.[1-3] One of the most common fears patients report regarding dental treatment is fear of the dental injection.[4-6]

Anxiety about dental injections is a common obstacle to dental treatment in that it causes many patients to delay or avoid treatment. Although many dentists are often able to give virtually painless injections, it is almost impossible to predictably achieve this in every circumstance. Certain injections are more traumatic than others because, for instance, various anatomical locations have different tissue resistance. In addition, clinical parameters such as inflammation or anatomical differences between patients may exist.

Highly anxious patients who have had traumatic or painful dental experiences in the past often have multiple fears beyond the fear of the injection itself. Some patients have experienced trauma in a medical setting and distrust all health care professionals. Often a feeling of helplessness and lack of control are strong components of their anxiety. Much has been written about behavioral techniques for treating these highly anxious patients, such as iatrosedation, relaxation training, systematic desensitization, perceived control, and modeling.[2,5-15]

As soon as local anesthesia is achieved, patients with a specific fear of dental injections usually exhibit confidence that they will not experience pain during the remaining dental treatment. Nevertheless, many of these patients have additional fears, of the drill or other dental instruments,[1-6,10] so it is paramount that the dentist use methods to ensure profound anesthesia so patient comfort is maintained for the duration of the appointment. These methods include sufficient dosages, supplemental injection sites, periodontal ligament (PDL) injections, or intrapulpal techniques.

A New Injection System

Since the mid-1800s, dentists have used a hypodermic syringe to administer local anesthetic solutions. The design of the syringe requires a thumb-palm grasp that is awkward and unique to this instrument. The dentist must place the needle with precision while holding the syringe with the thumb-point as far as nine inches from the insertion point of the injection. As the injection proceeds, the dentist's arm must function as a pump using forearm muscles that are a substantial distance from the needle. This physical requirement means that a

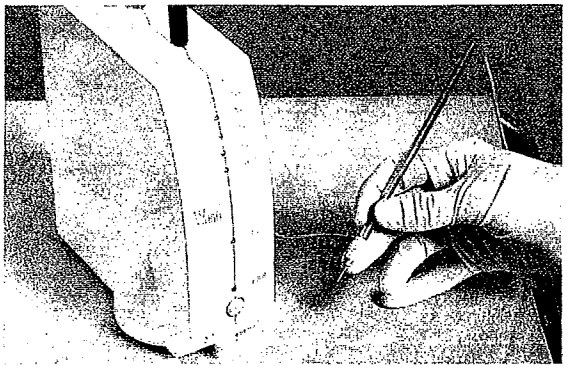


Figure 1—The Wand precision-metered injection system, consisting of a computerized drive unit with plunger, air-activated foot pedal, and disposable handpiece that houses the anesthetic cartridge and needle.

certain amount of antagonistic muscular movement is unavoidable. In addition, although dentists are trained to inject slowly, the conventional syringe does not allow precise control of the anesthetic flow rate.

Historically, many dentists have dedicated themselves to developing a "light hand" at dental injections. An atraumatic injection has a communicative as well as a manual component. Supportive and preparatory communica-

Figure 2A—Preoperative survey developed to quantify and measure patient anxiety levels regarding dental injections with conventional syringe.

DENTAL INJECTION SENSITIVITY SURVEY
Conventional Syringe (Preoperative)

Please respond to the following situations related to a dental injection by applying the number of the statement which best represents your feelings about each situation described below.

STATEMENT OPTIONS: (use any one to respond to the situations below)

0. Not anxious (nervous), completely calm.
1. Mildly anxious (nervous), hardly bothered.
2. Somewhat anxious (nervous), in control.
3. Very anxious (nervous), continuous negative thoughts.
4. Extremely anxious (nervous), near panic.

SITUATIONS: (place a number beside each statement which reflects how you feel)

Making a dental appointment and believe I may need an injection.____
Arriving at the office and receptionist confirms I need an injection.____
Sitting in the dental chair and I see the injection syringe.____
Dentist is preparing to administer the local anesthetic injection.____
Dentist carefully administers the local anesthetic injection.____
Numbness is inadequate and the dentist prepares another injection.____

Figure 2B—Nearly identical survey used after patient exposure to the Wand. This survey was administered immediately after treatment (postoperative) and at the patient's next appointment or 2 weeks later by mail (follow-up).

DENTAL INJECTION SENSITIVITY SURVEY
Wand Injection Device (Postoperative and Follow-up)

Now that you have experienced the Wand injection, please respond to the following situations using the statement options again.

STATEMENT OPTIONS: (use any one to respond to the situations below)

0. Not anxious (nervous), completely calm.
1. Mildly anxious (nervous), hardly bothered.
2. Somewhat anxious (nervous), in control.
3. Very anxious (nervous), continuous negative thoughts.
4. Extremely anxious (nervous), near panic.

SITUATIONS: (place a number beside each statement which reflects how you feel)

I believe I may need a Wand injection at my next appointment.____
When I arrive, the receptionist confirms I need a Wand injection.____
Sitting in the dental chair and I see the Wand injection device.____
Dentist is preparing to administer a Wand injection.____
Dentist carefully administers the Wand injection.____
Numbness is inadequate and the dentist needs to administer an additional Wand injection.____

COMMENTS:_____

tions accompany the manual component. A topical anesthetic is applied to the site of penetration to avoid pain that may accompany needle insertion. The mucosa is penetrated to the depth of the bevel, and a few drops of the anesthetic are deposited. The needle is advanced into an anesthetized area until the target area is reached, and the major part of the anesthetization is accomplished.

Although slow injections are possible in many circumstances, the mechanics are difficult. Slow injections can be regulated more precisely by a computer-controlled instrument than by hand with a conventional syringe. A computer-controlled injection process also can compensate for varying tissue-resistance levels in different areas and different patients.

A precision-metered injection system called the Wand Local Anesthesia System[a] (the Wand) has been developed to address the shortcomings of conventional dental syringes (Figure 1). This device is a computer-automated injection system that provides the precision flow-rate necessary for predictably painless injections. An anesthetic cartridge is placed in a disposable plastic sleeve that couples to the system. The computer-controlled system drives a plunger that expresses the anesthetic solution through microintravenous tubing. The tubing is connected to the Wand handpiece, which is essentially a plastic handle with a needle attached.

This system has many advantages. The penlike design is less threatening to patients than a syringe. More comfortable placement of the needle is possible because the dentist can hold the Wand within inches of the needle and use a finger pen-grasp as used with other dental instruments. The system also maintains a constant positive pressure on the flow of anesthetic solution, which means a drop of solution can be expressed coincidental to the path of the needle. When advanced slowly, the drops of solution anesthetize the tissue ahead of the needle, thereby yielding a virtually pain-free needle insertion.

Because this system appears to provide a virtually pain-free, predictable injection, it has the potential of desensitizing patients to their fears of injections. The study described below was designed to test this hypothesis.

[a] Milestone Scientific, Livingston, NJ 07039

Materials and Methods

A Dental Injection Sensitivity Survey (Figures 2A and 2B) was developed to quantify and measure patients' anxiety levels regarding dental injections. This survey was used with 80 patients during routine dental visits; 48 respondents were women and 32 were men. Ages ranged from 24 years to 80 years. Each patient was asked preoperatively to respond to the written questionnaire.

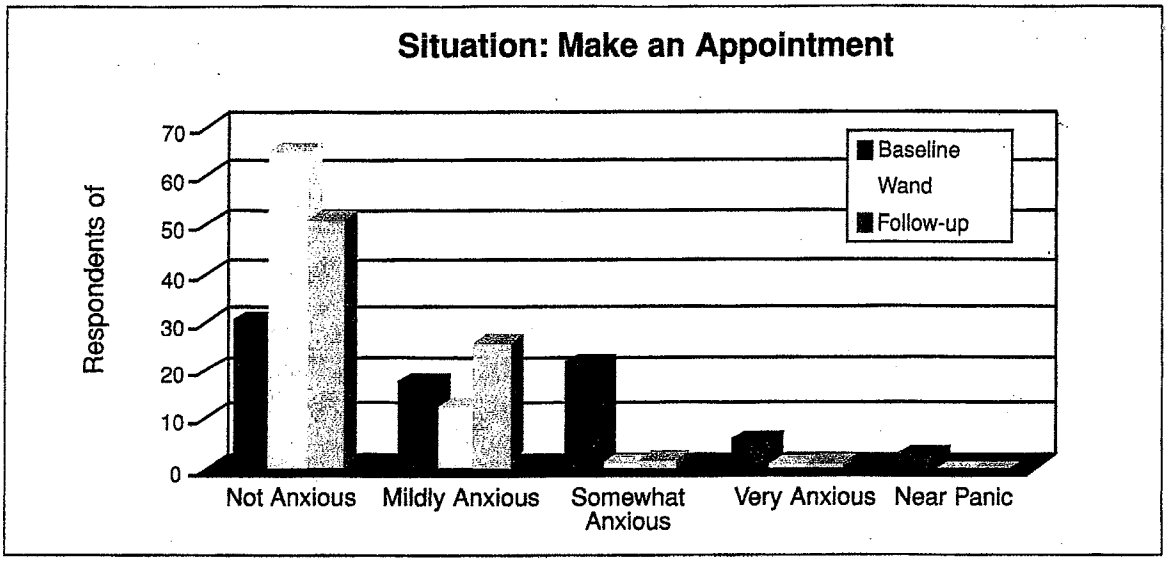
A verbal informed consent was obtained by asking the patients if they would be willing to try an alternate injection technique, one that still used a needle and the same anesthetic solution. All patients who completed the preoperative questionnaire agreed to participate. The described precision-metered injection system was then used to administer the local anesthetic.

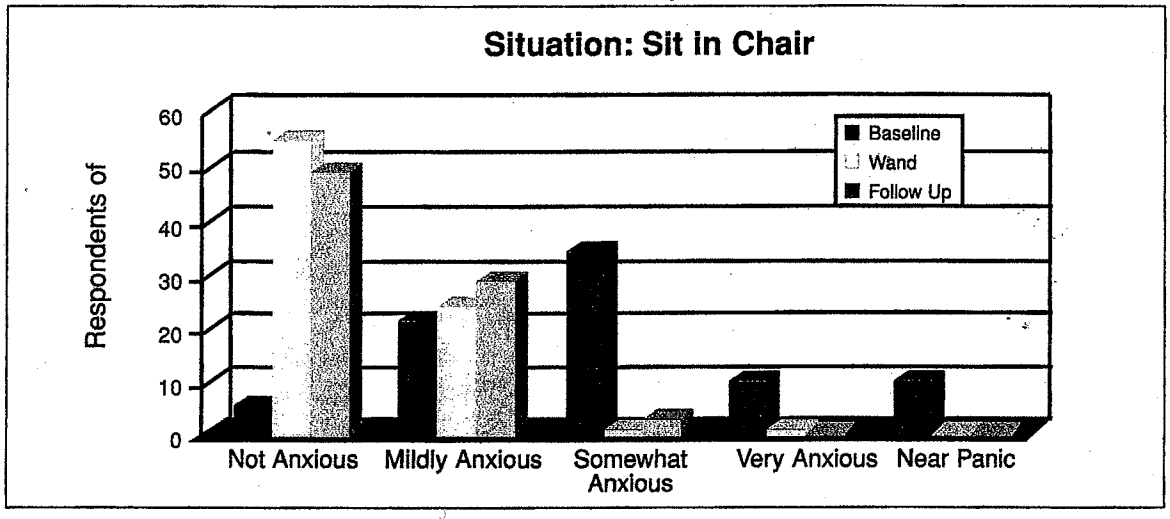
The standard anesthetic used was 2% lidocaine with epinephrine 1:100,000 (Xylocaine®[,b]), unless medical history revealed the

Table 1—Mean, Standard Deviation, and Percentage Change Values for Survey Responses

Situation	Baseline Survey Mean	Baseline Survey ± SD	Wand Survey Mean	Wand Survey ± SD	Follow-up Survey Mean	Follow-up Survey ± SD	% Change Baseline to Wand	% Change Baseline to Follow-up
Appointment	1.15	1.24	0.23	0.56	0.43	0.61	-79.9%	-68.0%
Arrive	1.34	1.03	0.26	0.54	0.41	0.54	-80.8%	-69.2%
Sit in Chair	1.99	1.07	0.36	0.58	0.43	0.67	-81.8%	-78.3%
Prepare	3.06	0.82	0.54	0.59	0.68	0.66	-73.9%	-67.3%
Administer	12.01	0.92	0.58	0.67	0.58	0.63	-73.6%	-75.1%
Inadequate Numb	2.13	1.15	0.33	0.62	0.58	0.76	-75.4%	-68.0%

Legend: 0 = Not Anxious; SD = standard deviation
1 = Mildly Anxious
2 = Somewhat Anxious
3 = Very Anxious
4 = Near Panic





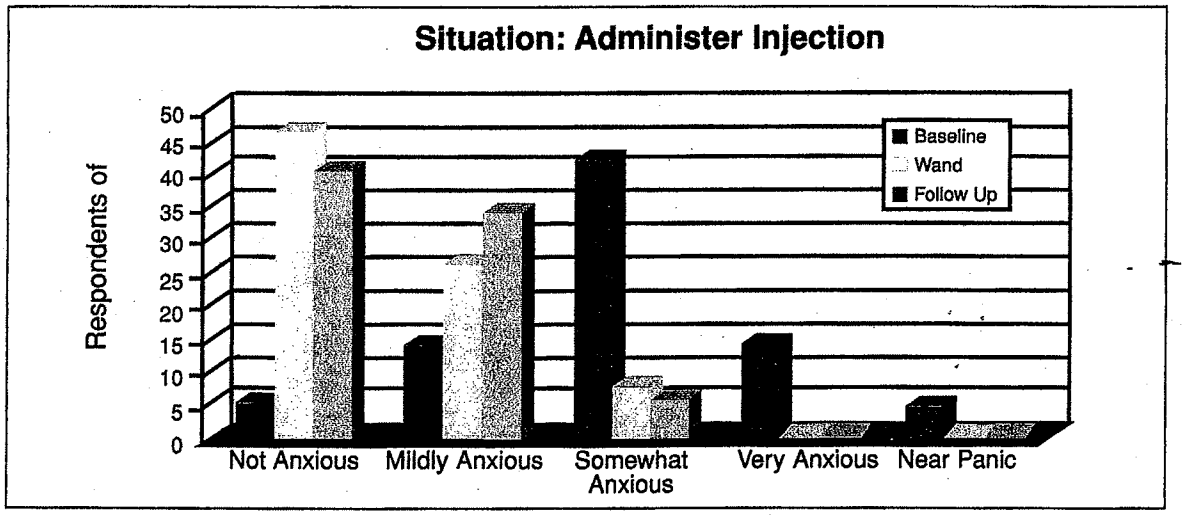


Figure 3—Distribution of reponses to three survey questions for the baseline, Wand, and follow-up surveys.

need to avoid vasoconstrictors, in which case 3% mepivacaine (Polocaine®,[b]) without a vasoconstrictor was used. Mandibular blocks, maxillary infiltrations, and PDL injections were used depending on the dental procedure required.

[b]Astra USA, Inc, Westborough, MA 01581

Immediately after the dental appointment in which the Wand was used, patients were given another survey. This survey was identical to the first, except the situations to be rated for anxiety level by the patient were now based on anticipating use of the new injection device

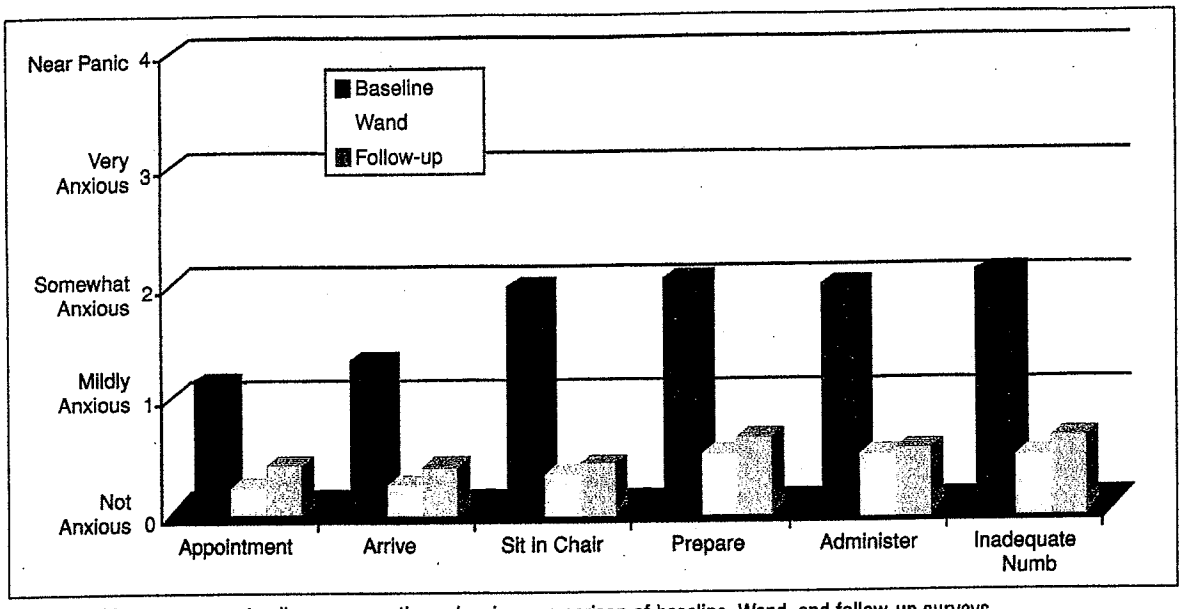


Figure 4—Mean responses to all survey questions showing comparison of baseline, Wand, and follow-up surveys.

instead of the usual syringe injection (Figure 2B). The change in scoring for the two surveys would measure desensitization to anxiety about injections resulting from a single exposure to the new device. A follow-up survey (Figure 2B) was administered at the patient's next visit, or one was mailed 2 weeks postoperatively for the patient to return by mail. This third survey attempted to measure how long the desensitization effect lasted after one exposure to the Wand.

Results

The graphs in Figure 3 show the distribution of patient responses to three of the situations rated for anxiety level in the preoperative survey. (The preoperative survey results are labeled "baseline" in each graph.) As the first graph indicates, most responses about anxiety levels experienced when making a dental appointment were "not anxious" or "mildly anxious" (31 and 18 responses, respectively). As the patients progressed to sitting in the dental chair (second graph) and the actual administration of the injection (third graph), most survey responses moved into the "somewhat anxious" category (34 for sitting in the chair and 42 for administration of the injection), with a significant number of patients reporting that they were "very anxious" or "near panic."

In the baseline survey, 42 of the 80 patients responded that they were "somewhat anxious" when the doctor administers the injection (third graph of Figure 3). Fourteen patients said they were "mildly anxious" or "very anxious," five reported they were "near panic," and five said they were "not anxious."

The distribution of baseline responses to the injection administration question fell into a perfect bell-shaped curve. In the postoperative Wand survey (labeled "Wand" on the graphs), the distribution of responses to this question shifted significantly toward the "not anxious" category. The responses of "very anxious" and "near panic" were eliminated. Of the 80 participants in the postoperative Wand survey, 39 responded with at least a two-step improvement in desensitization. One-step improvements were seen in the responses of 27 participants, and 14 indicated no change in desensitization. Most respondents, 73 out of 80, fell into the "not anxious" and "mildly anxious" categories after exposure to the Wand injection system.

Follow-up survey results (Figure 3) compared with the baseline responses show a similar shift in the distribution of responses toward the "not anxious" and "mildly anxious" categories.

Table 1 summarizes the survey results statistically with mean values and their standard deviations and percentage change data. Mean values are based on a scale of 0 to 4, with 0 representing "not anxious" and 4 representing "near panic." Mean values are shown for each of the six situations from the questionnaires (Figures 2A and 2B) and for all three survey administrations (baseline, Wand, follow-up). In the last two columns are the percentage changes in responses seen when baseline

patient responses in a bar graph that provides an easy comparison of all three surveys.

The percentage change in responses postoperatively (Table 1) were universally statistically significant for all questions for both the Wand and follow-up surveys (Analysis of Variance [ANOVA] test, α=.01). The decrease in anxiety immediately after the first visit, indicated in the Wand survey results, ranged from 73.6% to 81.8% for all questions asked. The decrease in anxiety, as indicated in the follow-up survey responses, ranged from 63% to 78.3% for all questions asked.

Discussion

Anxiety about dental injections is one of the most common obstacles to dental treatment. It is a problem for patients and dentists, and clinicians must deal with it on a daily basis. The surveys used in this study were designed to verify and quantify this anxiety. The baseline survey measured patients' anxiety from their cumulative lifetime exposure to conventional dental injections. The first three questions (about making an appointment, arriving at the office, and sitting in the dental chair) measure anticipatory anxiety before the injection. As expected, this anticipatory anxiety increased as the patient approached the moment of the injection. This is evident in Figures 3 and 4.

After only one exposure to the precision-metered injection system, patients were significantly desensitized to their anxiety about injections as evidenced by the postoperative Wand survey responses (Table 1). Anxiety levels dropped by percentage amounts ranging from 73% to 82%. These percentages are well beyond statistical significance (ANOVA test, α=.01) and are truly remarkable because the desensitization (to anxiety) process usually is based on multiple exposures to the feared stimulus.[2,5,6-8,10-14]

A more accurate assessment of desensitization was accomplished with the follow-up survey. The percentage decreases in anxiety seen in the follow-up survey responses compared to the baseline results were between 63% and 79% for all questions. This may indicate that, not only were patients desensitized immediately on experiencing the new precision-metered injection system, but that they maintained the level of desensitization with only a slight rebound in anxiety levels from the immediate postoperative experience. It seems reasonable to presume that continued use of this new injection system could lead to the virtual elimination, or at least the minimization, of dental injection anxiety for most patients.

Conclusions

Anxiety about dental injections, though variable in degree from person to person, is almost universal. Injection anxiety often creates a barrier to dental care, causing many patients to avoid or delay treatment.

A state-of-the-art, computer-controlled, precision-metered injection system has been described. It appears to be a preferred alternative to the traditional syringe in providing a predictable and virtually pain-free injection. Results from three patient surveys demonstrated that respondents with anxiety about dental injections were successfully desensitized to their anxiety when the Wand system was used. Further studies are indicated to confirm long-term desensitization to anxiety about dental injections using this system.

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