Microprocessor-Controlled Local Anesthesia Versus the Conventional Syringe Technique in Hair Transplantation

Robert H. True, MD, MPH, FABFP, ABHRS and Robert M. Elliott, MD, ABHRS

Elliott and True Medical Group PC, New York, New York

BACKGROUND. Local anesthesia by the traditional injection technique is central to optimizing patient comfort during hair transplant procedures. However, even when carefully and properly performed, some patients still describe their treatment sessions as painful.

OBJECTIVE. To determine if patients undergoing hair transplantation experience less pain and discomfort when their local anesthesia is performed with the Wand (as of spring 2001, the Wand has been renamed "CompuMed™ – Featuring the Wand Handpiece"), a microprocessor pump that precisely controls the infusion rate and pressure of local anesthetic solution.

METHODS. We used combined retrospective studies and a prospective blinded study of men and women who received hair transplantation treatments between January 1999 and March 2001 at our private outpatient clinics in the United States. A total of 101 patients compared their experiences during their hair transplant sessions performed by us before and after we started using the Wand. Thirty-nine patients compared their experiences during treatments done by 32 other medical groups and when we used the Wand. In addition, 88 patients compared the Wand to injection while blinded to technique. The outcomes were measured with patient pain rating questionnaires using the Wong–Baker Faces Pain Rating Scale (0, no pain–5, severe pain).

RESULTS. Patients in all three study groups reported that anesthesia with the Wand was less painful. Wand anesthesia was overwhelmingly (68%) described as associated with none (0) or very little (1) pain. Surprisingly, Wand anesthesia was associated with superior comfort not only during the administration of anesthesia ($P = .005$), but throughout the treatment session and during the first 48 postoperative hours.

CONCLUSION. Microprocessor-controlled local anesthesia with the Wand is superior to traditional injection in consistently producing comfortable hair transplant treatments.

R. H. TRUE, MPH, FABFP, ABHRS AND R. M. ELLIOTT, ABHRS HAVE INDICATED NO SIGNIFICANT INTEREST WITH COMMERCIAL SUPPORTERS.

PAINFULNESS IS an important concern for prospective patients considering undergoing hair transplantation or other elective dermatologic surgery procedures. For many, the fear of pain during or after the procedure will prevent them from pursuing treatment. Needle phobias, also commonplace in the general population, are additional impediments.[1]

Local anesthesia is the mainstay of patient comfort during office-based dermatologic surgery. Syringe injection is the traditional technique of administration. Factors which are known to influence the painfulness of local anesthetic injection include the type of solution, pH, tissue puncture, fluid pressure, fluid temperature, and the flow rate of the solution. Control of these variables can potentially reduce or eliminate the perception of pain during anesthesia. Good injection technique is characterized by slow, controlled injection with a fine needle placed within the margin of advancing anesthesia. Buffering and warming anesthetic solutions can also reduce discomfort.[2] Nevertheless, it is not always possible with conventional techniques to achieve the ideals of anesthesia performed painlessly, maintained throughout the procedure, and associated with minimal postoperative pain.

The objective of our study was to determine if patients undergoing hair transplantation experience less pain and discomfort when their anesthesia is performed with a microprocessor pump that precisely controls the rate and pressure of infusion of local anesthetic solution. Pain with hair transplantation customarily is associated with anesthesia injection, intraoperatively if anesthesia is not complete or wears off, and during the first 48 postoperative hours. Therefore we designed our study to evaluate the impact of anesthesia technique on all three phases of potential pain.

Materials and Methods

The Wand (Milestone Scientific; as of spring 2001, the Wand has been renamed "CompuMed™ – Featuring the Wand Handpiece") has recently been approved by the U.S. Food and Drug Administration (FDA) as a local anesthesia delivery device (Figure 1). Previously the device has been used ex-

Address correspondence and reprint requests to: Robert H. True, MD, Elliott and True Medical Group PC, 18 East 50th St., 9th Floor, New York, NY 10022, or e-mail: drtrue@elliotttrue.com.

© 2002 by the American Society for Dermatologic Surgery, Inc. • Published by Blackwell Publishing, Inc.
ISSN: 1076-0512/02/$15.00/0 • Dermatol Surg 2002;28:463–468

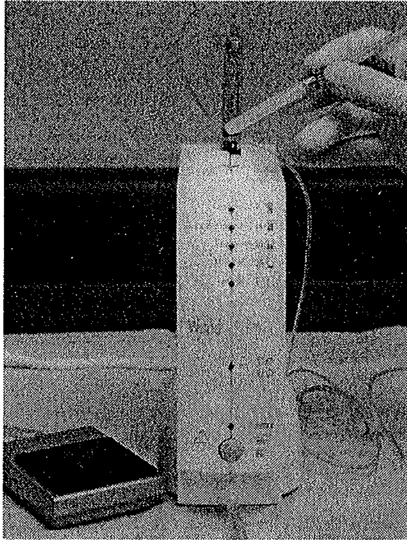


Figure 1. The Wand device.

tensively in dentistry.[3–5] Investigations of new medical and surgical applications are under way.[6] It is a microprocessor-driven injection device that delivers a controlled infusion of local anesthetic solution. It uses standard 1.8 ml glass cartridges. The microprocessor monitors and adjusts infusion pressure while delivering anesthetic solution at a controlled flow rate. Pressure and flow are set below the levels that produce pain due to tissue stretch. Anesthetic solution is delivered via sterile tubing with a cartridge receptor at one end. At the other end, the tubing forms a rigid hand-held pencil ending in a Luer-loc to which a 0.5 inch 30-gauge needle is attached. The entire apparatus is disposable. The loaded cartridge receptor locks to the pump and an electronically controlled piston pushes anesthetic solution through the Wand.

The operator controls flow via a foot pedal. There are two speeds. The slow speed, used for initial anesthesia, is associated with the least discomfort. The fast speed may be used for field infusion once basic anesthesia has been achieved. An audible tone synchronized with the flow rate informs the operator of the speed. Newer models feature a "cruise control," which maintains infusion rate without the foot pedal once the desired level has been reached.

In hair transplantation procedures, Wand use occurs only in the initial phase of anesthesia for both the donor and receptor areas. In both areas, innervation extends in a caudocephalic direction. A line of anesthesia created with the Wand across the inferior portion of the donor area or the hairline achieves 90% elimination of sensation in the scalp above the line. We then use standard injections without any patient discomfort to complete field anesthesia and achieve hemostasis. We use warmed cartridges of 2% lidocaine with epinephrine in the Wand and 1% lidocaine with epinephrine or 1:50,000 epinephrine solutions for field anesthesia and hemostasis. Later in the procedure the hairline and donor zone anesthesia is reinforced with bupivacaine to sustain the anesthesia for the 4–6 hours usually required for hair transplant sessions.

Our investigation consisted of three study groups. Group 1 is a retrospective comparison by patients who had hair transplant surgery performed by us before and after we introduced the Wand. Group 2 is a retrospective comparison by patients of hair transplant surgery performed by several other practitioners and then by us with the Wand. Group 3 is a blinded prospective comparison of conventional injection versus the Wand. We obtained informed consent from all participants and conducted the study in accordance with the 1975 Helsinki guidelines.

In all groups, we asked patients to rate the pain intensity they experienced using the Wong–Baker Faces Pain Rating Scale (0, "no pain at all"–5, "hurt as much as you can imagine"). The Wong–Baker scale (Figure 2) contains six faces depicting graduated levels of distress. Originally developed and validated as a tool for measuring pain intensity experienced by children, it has also been demonstrated to be valid and easily used by adults to assess pain and pain management.[7–9]

Although our primary interest was to compare pain during the administration of anesthesia, we decided to also determine if there would be any difference in pain experienced throughout the entire treatment session and postoperative period. Hair transplantation procedures usually take several hours. In order to be effective, local anesthesia must be comfortable not only during administration, but also must maintain comfort throughout the procedure. It is important to know if the Wand anesthesia differed from injection in providing sustained anesthesia.

During syringe injection the needle may be deflected from its path, resulting not only in pain but potentially in tissue trauma. The Wand handpiece is rotated 180° during needle insertion. This reduces needle deflection and the associated tissue damage. Perhaps this could result in less postoperative pain. It is also possible that psychologically a less painful procedure could dampen psychomediated postoperative pain response. Because most hair transplant patients experience the most pain in the first 24–48 hours postoperatively, we decided to include this period in our questionnaires.

The group 1 subjects rated pain during anesthesia, throughout the treatment session, and during the first 48 postoperative hours for their two transplant sessions—with

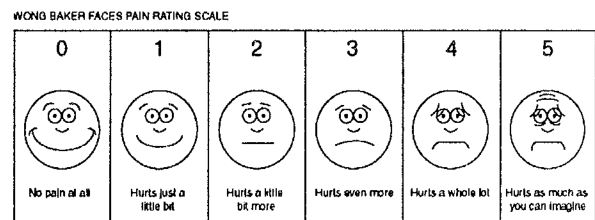


Figure 2. Wong–Baker Faces Pain Rating Scale.

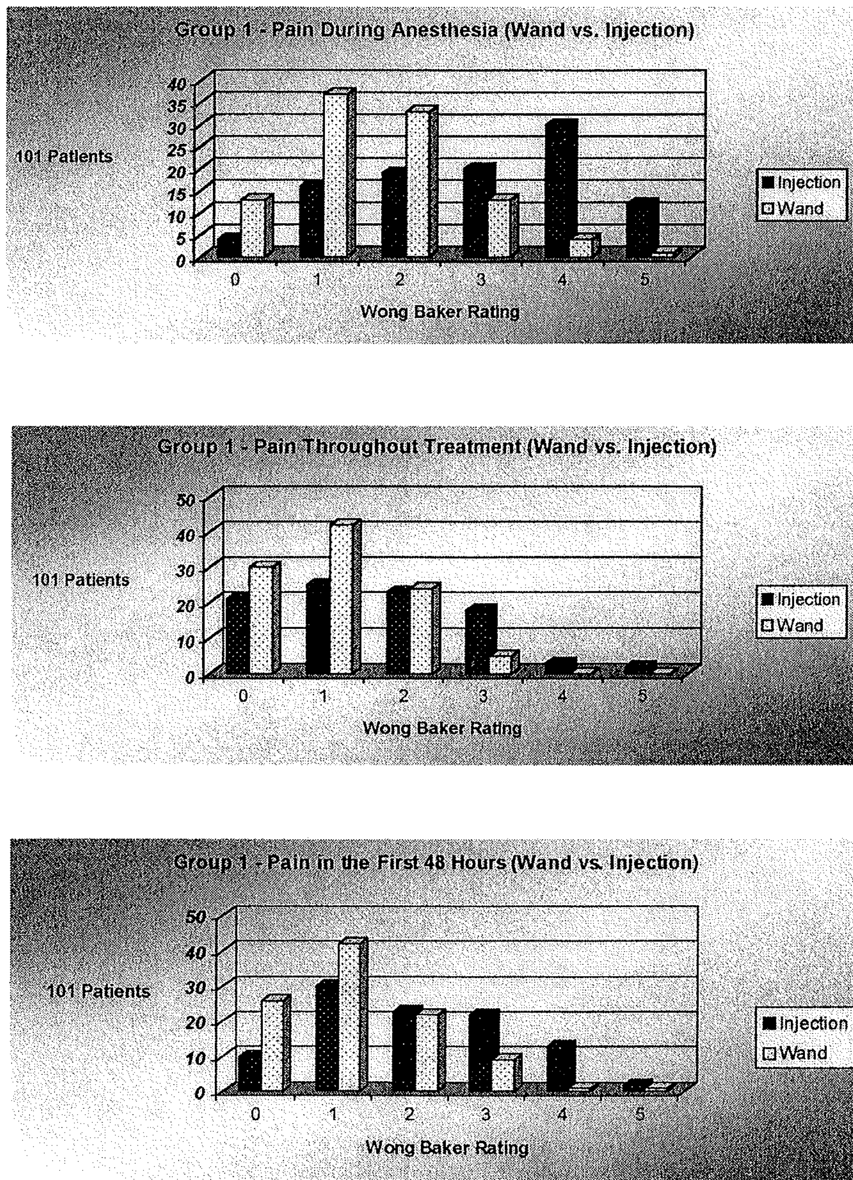


Figure 3. Results of study group 1 (Wand versus injection).

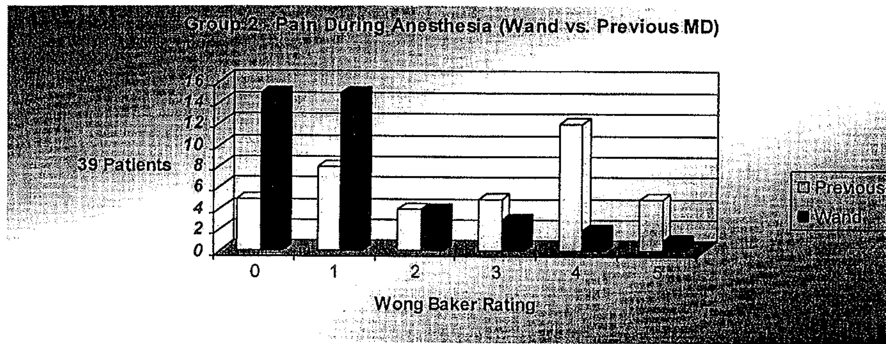
and without the Wand. The group 2 subjects performed the same ratings for treatments by other providers and by us with the Wand.

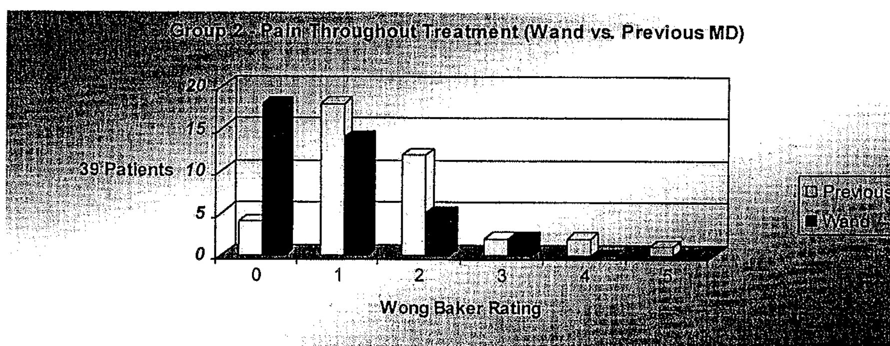
We sent rating questionnaires to 164 subjects in group 1 and 54 subjects in group 2. The response rate for group 1 was 62% and for group 2, 72%. Nonresponders did not differ in age, sex, and type or size of procedure, and sample follow-up contact revealed their experiences to be consistent with those of the responders.

In the prospective study group (3), half of the anesthetized area was done by injection and half by the Wand. When injection was given, every effort was made to give a careful "painless" injection. Patients were blind as to which technique was being used. Subjects were randomized as to the order of administration (Wand versus injection) and site (hairline versus donor zone). In order to eliminate auditory clues, the beeping tone of the Wand was maintained during both Wand infusion and syringe injection. Warmed cartridges of 2% lidocaine with epinephrine were used for both sides. Patients were given the Wong–Baker rating scale immediately upon completion of the initial phase of anesthesia.

Results

Group 1 consisted of 101 of our hair transplant patients who had a treatment session performed with local anesthesia by standard injection technique and later a treatment session with Wand local anesthesia. Fifty-one percent of our patients reported experiencing moderate to





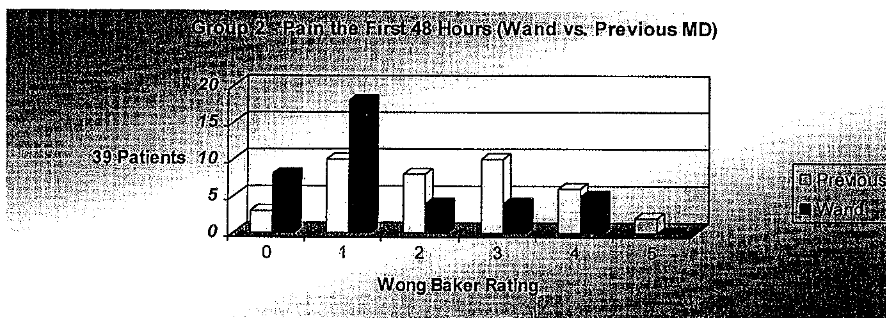


Figure 4. Results of study group 2 (Wand versus previous physician).

severe pain (Wong–Baker 4 and 5) during local anesthetic injection. This dropped to 5% with the Wand. With injection, only 19.8% reported no or very slight discomfort (Wong–Baker 0 and 1) compared to 49.5% with the Wand. The decrease in pain associated with Wand use was statistically significant (Wilcoxon signed rank test, $\alpha = 0.025$). Although the data indicate a trend in favor of the Wand for superior comfort throughout treatment sessions and in the first 48 postoperative hours, the results were not statistically significant. Figure 3 summarizes patient responses for all three periods.

Group 2 consisted of 39 patients. They all had undergone hair transplantation treatment by doctors outside of our group before having a treatment performed by us using the Wand. Thirty-two different doctors had performed their previous treatments. Figure 4 summarizes their responses as to the pain they experienced during administration of the local anesthesia, throughout the hair transplant session, and in the first 48 postoperative hours. Statistically significant reduced pain with the Wand (Wilcoxon signed rank test, $\alpha = 0.05$, $\alpha = 0.025$, $\alpha = 0.025$) was dem-

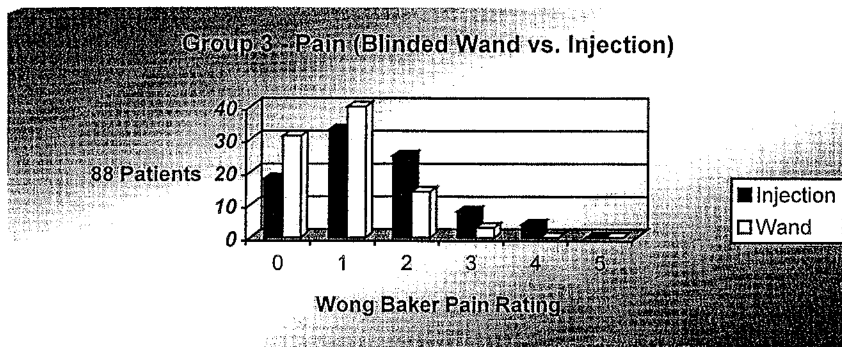


Figure 5. Results of study group 3 (blinded Wand versus injection).

onstrated not only during administration but also throughout treatment and 48 hours postoperatively.

Group 3 consisted of prospective evaluation of 88 patients with response to the Wand versus standard injection. The trial was performed on the hairline in 46 patients and on 42 patients in the donor area. Two nurses performed the anesthesia. One treated 46 patients and the other 42. In half of the cases, injection was given first; in the other half, the Wand was used first. Patient responses are summarized in Figure 5. Again, the Wand superiority was statistically significant (Wilcoxon signed rank test, $\alpha = 0.05$). There were no statistically significant differences in pain response among the subgroups of different sites, order, or administering nurse.

Combining all three study groups, 68% (152/228) of patients who received the Wand described experiencing no discomfort or very slight discomfort (Wong–Baker 0 and 1) compared with only 37% with standard injection. The results were statistically significant at $\chi^2 = 0.001$.

Discussion

The Wand has been a routine feature of our hair transplantation practice since late 1998. We have used it in more than 5000 cases. Patient response has been overwhelmingly positive.

The first group in the study confirmed that use of the Wand improved our capacity to provide comfortable treatments for our patients. Although our practice before use of the Wand incorporated all the techniques that minimize the pain of local anesthetic injection, it could be argued that the benefit of the device might not be as great in other settings. However, the patients of the second study group found the Wand more comfortable than their experiences with 32 different providers. Presumably all the physicians also tried to provide comfortable injections. It is likely therefore that our experience of meaningful improvement in patient comfort with the Wand is reproducible.

Retrospective studies can be skewed by recall bias. Nevertheless, our blinded prospective study confirmed the benefit of the Wand. Statistical significance was not as great in the prospective group ($\alpha = 0.05$ versus $\alpha = 0.005$). The two nurses who administered the anesthesia are very skilled at injections. They were instructed to take extra care to give "painless" injections to the side not treated with the Wand. They tried to match the rate and pressure of the Wand as closely as possible. This may account for the difference being less dramatic in the prospective study. However, even with optimal injection technique, the superiority of the Wand was evident.

The surprising result of our study is that patients had less pain not only during anesthesia administration, but throughout their treatment sessions and immediate postoperative period with the Wand. How does less pain during administration translate to a more comfortable experience throughout a treatment session of several hours, and moreover, to the next 2 days? Perhaps the effect is purely psychological. With a less painful experience of the anesthesia process itself, patient's anticipation and sensitivity to discomfort may be subsequently dampened. It is also possible that the benefit is physical. We have noticed that since we started using the Wand, we have been using less total anesthetic solution per case. We do not have to reinforce the anesthesia as much. Perhaps the Wand disperses the lidocaine more evenly, producing a more complete and sustained anesthesia. Possibly the reduction of needle deflection associated with the Wand handpiece results in less tissue and nerve ending trauma, thus reducing intra- and postoperative pain. A reduction in tissue damage with Wand use has been demonstrated histologically in an animal model.[10]

In group 1, consisting entirely of our own patients, we used 1% lidocaine with epinephrine for the ring block rather than the 2% lidocaine with epinephrine used with the Wand. This could be a factor in the better-sustained comfort associated with the Wand. We do not know what local anesthesia techniques and so-

Table 1. Optimal Wand Technique

- 0.5 inch 30-gauge needles
- Frequent needle changes
- Initial insertion very superficial
- Advance at slow speed
- Rotate Wand during advance
- Fast speed upon withdrawal
- Reinsert within margin of area already anesthetized
- Tap skin with finger if sensitivity present
- Reassurance and conversation throughout

lutions were used by the outside doctors in our second study group. It is safe to assume a wide variety was employed.

Technique is important with the Wand to ensure optimum comfort. A foot pedal with two speeds controls infusion rate. The slow speed must be used with needle insertion; the fast speed can be used with needle withdrawal. The optimal technique in the hair transplantation setting is summarized in Table 1.

The superior comfort with the Wand is primarily because of the controlled rate and pressure of the infusion. The ability to rotate the needle during insertion also decreases pain because of reduced needle deflection and better solution dispersion. There are also psychological aspects. A device that is so different in appearance from their negative associations reassures patients who are phobic of needles and injections.

The Wand is safe to use. Handpieces and needles are single use and disposable. The cartridge piston is autoclavable. Because 2 cc cartridges are used, sudden local anesthetic overdose is not possible. There is an aspiration mode for use near larger blood vessels.

There are a few negative aspects to the Wand. It is somewhat slower and there is some wastage of anesthetic solution, because the plunger does not completely empty each cartridge. However, the solution can be aspirated from the cartridges with a syringe and injected in a later phase of the anesthesia process. It is also a limitation that currently the only commercially available cartridge for the Wand is 2% lidocaine with epinephrine. Other solutions can be used if the physician fills the cartridges by hand. We understand from the manufacturer that the next generation of this device will allow more flexibility in the type and amount of solution.

The Wand pumps hold up well under heavy use. Despite daily use for more than 2 years, we have not had to replace any units.

Our experience is limited to hair transplantation surgery. Nevertheless, it is likely that similar benefits will occur when the Wand is used in other types of dermatologic procedures employing local anesthesia.

Conclusion

We have demonstrated that microprocessor-controlled local anesthesia with the Wand is superior to standard injection technique for ensuring patient comfort during hair transplantation procedures. The promise of procedures associated with only the slightest discomfort could make such elective procedures more appealing to prospective patients.

References

1. Hamilton JG. Needle phobias: a neglected diagnosis. J Fam Pract 1995;41:169–75.
2. Unger WP. Anesthesia. In: Unger WP, ed. Hair transplantation. New York: Marcel Dekker, 1995:165–81.
3. Krochak M, Friedman N. Using a precision-metered injection system to minimize dental injection anxiety. Compendium 1998;19:137–46.
4. Friedman MJ, Hochman MN. A 21st century computerized injection system for local pain control. Compendium 1997;18:995–1003.
5. Hochman M, Chiarello D, Hochman CB, Lopatkin R, Pergola S. Computerized local anesthetic delivery vs. traditional syringe technique. N Y State Dent J 1997;August/September:24–9.
6. Yan PY, Vukasin P, Chin ID, et al. The Wand™ local anesthetic delivery system: a more pleasant experience for anal anesthesia. Dis Colon Rectum 2001;44:868–9.
7. Shrestha M, Singh R, Moreden J, Hayes JE. Ketrolac vs. chlorpromazine in treatment of acute migraine without aura. Arch Intern Med 1996;156:1725–8.
8. Carey SJ, Turpin C, Smith J, Whatley J, Haddox D. Improving pain management in an acute care setting. The Crawford Long Hospital of Emory University experience. Orthop Nurse 1997;16(4):29–36.
9. Cason CL, Grissom NL. Ameliorating adult's acute pain during phlebotomy with a distraction technique. Appl Nurs Res 1997;10(4):168–73.
10. Froum SJ, Tarnow D, Caiazzo A, Hochman MN. Histologic response to intraligament injections using a computerized local anesthetic delivery system: a pilot study in mini-swine. J Periodontol 2000;7:1453–59.