The Effectiveness of Topical Anesthesia and Vibration in Alleviating the Pain of Oral Injections

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The goal of the research was to compare the effectiveness of vibration with that of a topical anesthetic in reducing the pain of local anesthetic injections. Injections were given adjacent to maxillary premolars in four locations in 61 patients. Before injection, sites received either placebo or topical anesthetic with or without vibration. Patients rated the injection pain on a five-point scale. The topical anesthetic caused a statistically significant decrease in pain values; however, the amount of decrease was of questionable clinical significance.

Key Words: Topical anesthesia; Local anesthesia; Dental injections.

Many dental patients experience fear and anxiety concerning the pain resulting from injection of local anesthetics. One method that has been employed by dentists is the application of topical anesthetics to the mucosa in the area to be injected. Dentists do not agree on the effectiveness of the topical anesthetic approach, and clinical studies have yielded mixed results. Vibration of soft tissue has been employed for relief of pain in other areas of the body, but a search of the literature revealed no attempts to use vibration to relieve the pain of oral injections.

Adriani and Zepernick[1] reviewed the use of topical anesthetics in medicine and concluded that their effectiveness was uncertain, because no wholly satisfactory method of study was available. The only mention of vibration relieving pain that could be found in the literature was when it was considered as a possible control in an electroanesthesia study by Quarnstrom and Libed,[2] who presented no data. All of the studies cited were conducted in adults. While application times and other experimental details differed slightly, it is clear that no general agreement exists on the effectiveness of topical anesthetic agents. One defect common to all studies is that only needles were used; that is, an injection was simulated but not actually given. The objective of this research was to compare the effectiveness of tissue vibration, a topical anesthetic, and placebo in preventing the pain of dental local anesthetic injections.

METHODS

The vibration technique was developed by a local practicing dentist; a comprehensive search of the literature revealed no similar techniques. A battery-powered shaver (Windmere Corp., Miami, FL) was modified to provide the vibration. The blade was removed, and a foam sponge swab was attached as shown in Figure 1. The shaver amplitude was 20 μm, and the frequency of vibration was 136 Hz. Adult subjects received either 20% benzocaine gel or placebo treatment on a randomized double-blind basis. It was not possible to blind the vibration treatment.

Subjects were selected based on a satisfactory medical history evaluation and their agreement to provide informed consent. The tissue adjacent to the subject's first permanent maxillary premolars (either right or left side first) was dried with a sterile gauze. Topical anesthetic (20% benzocaine) or placebo was applied to a sponge swab and placed on the buccal or palatal mucosa adjacent to the maxillary first premolar for 1 min. Where vibration was employed, the tissue was vibrated for 1 min with the topical anesthetic or placebo placed on the vibrated swab: thus, all injections were given 1 min after the topical or placebo treatment. Injections employed 0.2 ml of 2% lidocaine with 1:100,000 epinephrine

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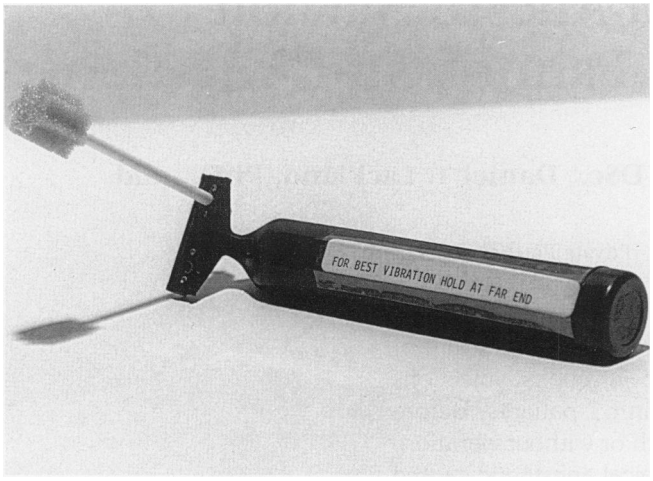

Figure 1. Vibration unit with foam swab in place.

and a 27-gauge needle penetrating 5 mm of buccal tissue and 2 mm of palatal tissue.

The measurement of pain perceived by patients was made using a five-point visual analog scale as detailed by the Iowa Cancer Pain Relief Initiative.[3] The pain scale descriptors were no pain, mild pain, moderate pain, distressing pain, horrible pain, and unbearable pain, which were assigned values of 0 to 5, respectively. The patient was asked to rate the pain after each injection. The same procedure was followed on the palatal side of the tooth and on both sides of the other maxillary first premolar, yielding a total of 244 ratings for the following conditions: placebo, placebo plus vibration, topical anesthetic, and topical anesthetic plus vibration. The location and order of each treatment was predetermined by a random number table, and neither the dentist nor the patient knew which sites received topical anesthetic and which received placebo.

Patient pain reports were categorized by treatment (anesthetic and vibration) and location of the injection (buccal and palatal). The mean value and standard deviation were calculated from the reported pain levels for each category. Univariate comparisons of pain levels for the treatment categories were completed using the z statistic. In addition, a two-way analysis of variance was completed considering anesthetic, vibration, and anesthetic combined with vibration. For this assessment, P values were considered significant if they were less than 0.05.

RESULTS

A total of 61 patients were examined, and four pain ratings were obtained from each patient. Table 1 shows the mean values and standard deviations for buccal, palatal, and combined buccal and palatal locations for each of the four conditions. The univariate comparisons detected significant ($P < 0.05$) differences in pain levels between two categories: (a) buccal: anesthetic and placebo, and (b) all sites: anesthetic and placebo. The two-way analysis of variance detected topical anesthetic treatment as significant ($P < 0.05$). Vibration and anesthetic combined with vibration were not significantly associated with the pain level. The results indicate that 20% benzocaine results in lowered pain values. Because palatal comparisons of placebo and topical anesthetic showed no significant difference, the buccal contribution to these combined data is paramount. An apparent difference can be seen between placebo and placebo plus vibration; however, the difference is not statistically significant. Topical anesthetic and topical anesthetic plus vibration exhibited no statistical or apparent differences; however, the addition of vibration to topical treatment elicited both a greater number of high values and a greater number of low values than did the topical anesthetic alone. Topical anesthetic plus vibration exhibits lower values than placebo; however, since the topical anesthetic alone reduced pain values, it can be stated only that the addition of vibration did not negate the effect of the topical anesthetic. Comparing topical anesthetic with placebo plus vibration, and placebo plus vibration with topical plus vibration, little difference is evident, and there are no statistically significant differences.

Table 1. Pain Reports by Location and Treatment

Treatment	*Number*	*Average*	*Standard Deviation*
Buccal anesthetic	33	0.90	0.54
Buccal anesthetic/vibration	34	0.95	0.83
Buccal placebo	28	1.44	0.80
Buccal placebo/vibration	26	1.14	0.73
Palatal anesthetic	25	1.56	0.66
Palatal anesthetic/vibration	31	1.51	0.69
Palatal placebo	36	1.71	0.80
Palatal placebo/vibration	29	1.58	1.00
All anesthetic	58	1.18	0.68
All anesthetic/vibration	67	1.22	0.81
All placebo	64	1.59	0.81
All placebo/vibration	55	1.37	0.90

DISCUSSION

This study was conducted in a dental school setting, and the wide variety of responses obtained for each condition is indicative of the difficulty in conducting studies of this nature. Gill and Orr[4] studied the responses of 34 dental hygienists to topical anesthetics of 22% benzocaine (Hurricane ointment), 2% tetracaine plus 18% benzocaine (Zircaine ointment), 5% lidocaine (Xylocaine ointment), and a scented placebo. A palatal location was

selected, and the pain produced by shallow insertion of a 25-gauge empty needle was rated by the subjects on a scale from 1 to 5. No significant difference was found between the placebo and any of the anesthetics. Keller[5] studied the responses of 60 dental patients, using needles and locations similar to those of Gill and Orr.[4] He found no significant difference in pain with Hurricane ointment, 180 mg benzocaine plus 10 mg benzalkonium chloride (Topicale), or a flavored placebo consisting of starch. Holst and Evers[6] studied the effects of 5% lidocaine and eutectic mixture of local anesthetics (EMLA; lidocaine-prilocaine mixture) on 30 female patients. Agents were applied in a cream formulation or by using cellulose discs. Using 27- or 30-gauge needles to simulate injections, they found that pain was reduced in the lower buccal fold but not in the palatal region. Two minutes was required for the topical agent to become effective.

Haasio et al[7] studied 10 patients and found no difference between EMLA and lidocaine in reducing the ability to sense the pain of a stimulus device. The device was applied to the gingival mucosa; analgesia was found to be at a maximum in 13 to 14 min. Rosivack et al[8] examined the effects of 20% benzocaine (Ultracaine), 5% lidocaine (Xylocaine), and a placebo consisting of the benzocaine ointment vehicle. A 27-gauge needle was inserted into the mucobuccal fold. Patients rated the amount of pain on a 100-mm visual analog scale. Both topical agents were found to reduce pain significantly compared to the placebo but were not found to be significantly different from each other.

Kincheloe et al[9] studied 77 dental patients and found that a topical anesthetic (unspecified), when applied for 3 min, was no more effective in reducing the pain of injection than was placebo.

Svensson and Kolsen-Peterson[10] examined the responses of 20 dental students to 27-gauge needle insertion in three palatal areas in which EMLA cream or a placebo of similar characteristics had been placed for 5 min. Using a 100-mm visual analog scale, they found significant pain reductions with the EMLA cream. A study of EMLA versus placebo by Vickers and Punnia-Moorthy[11] demonstrated a reduction in the pain of needle insertion in 60 subjects. A study to separate the pharmacological from the psychological effects of topical anesthetics was conducted by Martin et al.[12] In 64 subjects, a "balanced placebo" design was used to test the efficacy of topically applied 20% benzocaine in a mint-flavored polyethylene glycol base. Agents were applied for 3 min before a 25-gauge needle was inserted into the mucobuccal fold adjacent to the maxillary second premolars. No anesthetic was injected, and patients rated the pain on a visual analog scale. The investigators found that the second injection was more painful than the first regardless of agents or patient expectations and that placebo did not differ from the active topical agent. A comparison of EMLA and transcutaneous electrical nerve stimulation (TENS) was made by Meechan and Winter,[13] who concluded that while the pain of injection was reduced by the EMLA, the TENS offered no improvement over placebo.

The difference between this study and most previous studies is that injections were actually given. Although the topical anesthetic significantly reduces the pain values obtained, the clinical relevance of the reduction is not obvious. Vibration applied in the manner described appeared to have little effect; however, variations in amplitude, frequency, or time of application may prove more efficacious. The vibration might also be more effective if it were continued during the injection or if a more effective vibration transfer device than the foam swab were employed.

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