The efficacy of six local anesthetic formulations used for posterior mandibular buccal infiltration anesthesia

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Practicing dentists are continually searching for effective methods of delivering pain-free treatment for their patients. For most restorative and surgical procedures, dentists are able to manage operative pain and discomfort by using intraorally administered local anesthetics. Anesthetic administration techniques for intraoral anesthesia in dentistry commonly rely on either infiltration or nerve block injection. Agents commonly used in the United States include the following amide anesthetic formulations:

- 2 percent lidocaine with 1:100,000 epinephrine (L100);
- 4 percent articaine with 1:200,000 epinephrine (A200);
- 4 percent articaine with 1:100,000 epinephrine (A100);
- 4 percent prilocaine with 1:200,000 epinephrine (P200);
- 3 percent mepivacaine without vasoconstrictor (Mw/o);
- 0.5 percent bupivacaine with 1:200,000 epinephrine (B200).

The anesthetic formulation most often used for oral surgical procedures and considered the

ABSTRACT

Objective. The authors conducted a randomized, double-blind clinical trial to evaluate pulpal anesthesia achieved after mandibular infiltration of five commonly marketed dental local anesthetic formulations as compared with a control formulation of lidocaine with epinephrine.

Methods. The authors evaluated 2 percent lidocaine with 1:100,000 epinephrine (L100) against 4 percent articaine with 1:100,000 epinephrine (A100), 4 percent articaine with 1:200,000 epinephrine (A200), 4 percent prilocaine with 1:200,000 epinephrine (P200), 3 percent mepivacaine without vasoconstrictor (Mw/o) and 0.5 percent bupivacaine with 1:200,000 epinephrine (B200). This repeated-treatment trial involved 18 healthy participants. The investigators administered mandibular infiltration injections (six sessions per participant) of 0.9 milliliters of anesthetic into the buccal fold adjacent to the distal root of the mandibular first molar. The authors determined anesthetic efficacy across a 20-minute period by measuring changes in sensory threshold to electrical pulp test (EPT) stimulation.

Results. Twelve female and six male participants (mean age, 24.9 years; range, 18-53 years) completed the study. The maximum mean increase from baseline of EPT measurements for the six formulations were 43.5 percent for L100, 44.8 percent for B200, 51.2 percent for P200, 66.9 percent for A200, 68.3 percent for Mw/o and 77.3 percent for A100 (A100 versus L100, $P = .029$). Adverse reactions were minor and not formulation dependent.

Conclusions and Clinical Implications. The authors found that mandibular infiltration with 0.9 mL of the tested dental anesthetics could induce only partial pulpal anesthesia, a level likely to be inadequate for most dental procedures. When compared with L100, only the A100 induced statistically greater pulpal anesthesia after mandibular buccal infiltration.

Key Words. Local anesthetics; lidocaine; mandible; molar.

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gold standard in the United States is L100.[1]

Practicing dentists have developed considerable interest in inducing mandibular pulpal anesthesia by means of administering buccal infiltration injections of anesthetic solutions adjacent to molars. Because the mandible has dense, thick cortical bone, the efficacy of infiltration anesthesia for mandibular molars for dental procedures traditionally has been considered inadequate.[2-4] Although practicing dentists have provided anecdotal reports of successful infiltration anesthesia for restorative procedures of mandibular molars with articaine, early clinical trials provided few scientific data to support their clinical impressions.[5,6]

In recent years, however, two separate investigative teams have published findings indicating that A100, when compared with L100, had statistically significant mandibular anesthetic properties when administered via buccal infiltration.[7,8] Researchers had not found this apparent advantage when comparing A200 with P200.[5,6] It is unclear if the differences reported are methodological or represent relative differences in the efficacy of the anesthetic formulations tested. The availability of several alternative local anesthetic formulations may lead to confusion among practicing dentists when they attempt to evaluate the agents' potential superiority and appropriate indications for dental infiltration anesthesia.

Clinicians would benefit from knowing the relative efficacy of the commonly available local anesthetic formulations for achieving pulpal anesthesia after mandibular buccal infiltration. Therefore, we initiated a study to evaluate the pulpal anesthetic characteristics of five commonly used local anesthetic formulations when used for mandibular infiltration anesthetic injections and compare their efficacy with that of L100. We also assessed side effects and adverse drug reactions.

PARTICIPANTS, MATERIALS AND METHODS

To characterize the pulpal anesthetic properties resulting from mandibular infiltration of common dental local anesthetic formulations, we performed a randomized, double-blind, controlled clinical trial comparing L100 with five other marketed local anesthetic formulations: A200, A100, P200, Mw/o and B200. Using posted announcements within the University of Pittsburgh School of Dental Medicine clinics, we recruited and enrolled 18 healthy male and female participants in this repeated-treatment study.

For each participant, the trial consisted of a one-hour screening visit and six 90-minute treatment visits, with a follow-up by telephone 24 hours after each visit. Participants who met the inclusion criteria at the screening were scheduled for their first treatment visit within eight days. Subsequent treatment sessions were scheduled at intervals no shorter than one week and no longer than three weeks. No dental care was provided as part of this investigation.

We used the following inclusion criteria for enrollment in the study: age of 18 to 65 years, a mandibular first molar without a dental restoration or detectable caries, a normal electrical pulp test (EPT) sensitivity value between 10 and 50 units, the ability to sign an informed consent form before undergoing any study procedures and the ability to understand and agree to cooperate with study requirements. Participants were not eligible for participation if they met any of the following exclusion criteria: evidence of soft-tissue infection near the proposed injection site; known or suspected allergies or sensitivities to sulfites or amide-type local anesthetics; history of significant cardiac, neurological or psychiatric disorders; treated or untreated hypertension equal to or greater than 140 millimeters of mercury (Hg) systolic or 90 mm Hg diastolic; bronchial asthma; lactation or pregnancy; or current use of β-blockers, monoamine oxidase inhibitors, tricyclic antidepressants, phenothiazine, butyrophenones, vasopressors or ergot-type oxytocic drugs. We also excluded potential participants who had taken acetaminophen, nonsteroidal anti-inflammatory drugs, opioids or other analgesic agents within 24 hours of administration of study medication; had taken an investigational drug or participated in another study within the preceding four weeks; or required sedation therapy to tolerate the injection procedure. We asked female participants of childbearing age to verify the specific birth control method they or their partner had used (such as

ABBREVIATION KEY. A100: 4 percent articaine with 1:100,000 epinephrine. **A200:** 4 percent articaine with 1:200,000 epinephrine. **B200:** 0.5 percent bupivacaine with 1:200,000 epinephrine. **EPT:** Electrical pulp test. **Hg:** Mercury. **L100:** 2 percent lidocaine with 1:100,000 epinephrine. **Mw/o:** 3 percent mepivacaine without vasoconstrictor. **pK_a:** Acid dissociation constant. **P200:** 4 percent prilocaine with 1:200,000 epinephrine. **VAS:** Visual analog scale.