Effectiveness of 20% Benzocaine as a Topical Anesthetic for Intraoral Injections

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The use of topical anesthetics has been advocated prior to the administration of various types of anesthetic injections. Reported results have varied between studies. The purpose of this study was to compare the effectiveness of 20% benzocaine in reducing the pain of needle insertion during maxillary posterior and anterior infiltration and inferior alveolar nerve block injections. In this retrospective study, 1080 patients received 2336 injections using a 27-gauge needle. Topical anesthetic was applied prior to 720 of the injections. Patients rated pain of needle insertion using a 0–4 pain scale. Logistic regression analysis showed no differences in pain ratings between topical and no topical groups for the inferior alveolar nerve block and posterior maxillary infiltration injections. The use of topical anesthetic did reduce the pain of needle insertion with the maxillary anterior injections ($P = .0041$).

Key Words: Benzocaine; Topical anesthetic.

Fear of the needle has been reported as one of the major causes of apprehension in dental patients.[1–3] Patients have reported that the feeling of the needle being inserted into the tissue is a chief source of anxiety.[1] Empirically, it makes sense to attempt to reduce this source of anxiety and assure the patient that everything possible is being done to make their appointment comfortable. Topical anesthesia has been advocated for the reduction of a patient's anxiety and pain.

The pharmacological and psychological effects of topical anesthetics have been studied. However, the results have varied. Rosivack et al,[4] Hersch et al,[5] and Hutchins et al[6] have reported topical anesthetic to be effective in reducing the pain of needle penetration. Conversely, Gill and Orr,[7] Keller,[8] and Martin et al[9] failed to show any differences in effectiveness between a topical anesthetic and placebo in reducing needle insertion pain. Martin et al[9] also showed that topical anesthesia reduced the patients' anticipation of injection pain, but did not reduce reported pain. Kincheloe et al[10] reported that patients with high expectations of pain experienced more pain than those with low expectations, and that topical anesthesia had no effect on the pain experienced.

Nakanishi et al[11] reported that the effectiveness of topical anesthesia may be related to the location of the injection. They found that topical anesthesia reduced the pain of needle insertion in the mandibular mucobuccal fold adjacent to the canine, but failed to reduce pain in the pterygotemporal depression (lateral to the pterygomandibular raphe) where an inferior alveolar nerve block is given. Hersch et al[5] found that lidocaine patches were more successful in reducing the pain of needle insertion in the mandibular premolar buccal fold as compared with the maxillary premolar buccal mucosa.

The purpose of this study was to compare the effectiveness of a topical anesthetic (20% benzocaine) in reducing the pain of needle insertion during maxillary posterior and anterior infiltration injections and inferior alveolar nerve block injections.

MATERIALS AND METHODS

A total of 1080 adult patients participated in this study. They received a total of 2336 injections. Patients included in this retrospective study were participants in 25 independent, cross-over anesthetic research studies con-

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Table 1. Needle Insertion Pain Ratings by Area of Injection (%)

Injection	*Pain Level*	*Topical*	*No Topical*
Inferior alveolar nerve block (1635 injections)	None	124 (26)	371 (32)
	Mild	241 (51)	632 (54)
	Moderate	91 (19)	146 (13)
	Severe	14 (3)	16 (1)
Maxillary posterior infiltration (279 injections)	None	62 (51)	71 (45)
	Mild	46 (38)	60 (38)
	Moderate	12 (10)	25 (16)
	Severe	2 (2)	1 (1)
Maxillary anterior infiltration (422 injections)	None	47 (37)	81 (28)
	Mild	59 (46)	150 (51)
	Moderate	20 (16)	59 (20)
	Severe	2 (2)	4 (1)

ducted at The Ohio State University. All patients were in good health as determined by a written health history and oral questioning. No patient was taking any medication that would alter pain perception. All patients were asymptomatic and volunteered for participation in their respective studies. The Ohio State University Human Subjects Committee approved each study, and written informed consent was obtained from each patient.

Patients received either a conventional inferior alveolar nerve block, an infiltration over a maxillary lateral incisor, or a maxillary infiltration over a first molar. A 27-gauge needle was used for each injection.

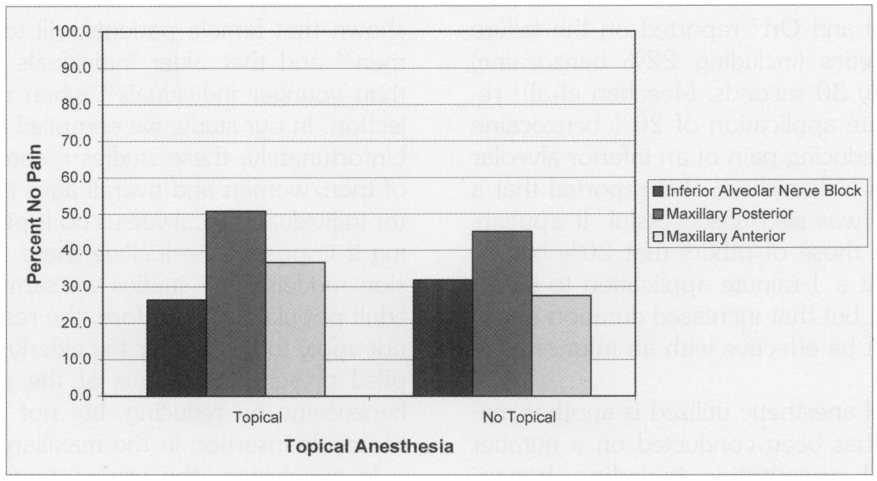
Prior to 720 injections, topical anesthetic was utilized. The remaining 1616 injections did not receive topical anesthetic. The injection site was dried with gauze and approximately 0.2 mL of topical anesthetic (Hurricaine; Beutlich Pharmaceuticals LP, Waukegan, Ill), consisting of 20% benzocaine, was applied using a cotton-tip applicator passively for 60 seconds. Prior to needle insertion, each subject was informed of the pain rating system to be employed. The scale consisted of 4 ratings: 0 = no pain; 1 = mild pain (pain that was recognizable, but not discomforting); 2 = moderate pain (pain that was discomforting, but bearable); and 3 = severe pain (pain that caused considerable discomfort and was difficult to bear). Patients were asked to hold up the appropriate number of fingers, 0–3, for the pain experienced after the 27-gauge needle was inserted 2 mm submucosally. No anesthetic solution was deposited prior to the rating. After the pain rating was noted, the needle was directed toward the injection target site and the injection was completed.

Data were analyzed nonparametrically using a logistic regression model with the generalized estimating equation to correct for each subject receiving multiple injections. A separate model was generated for each of the 3 injection areas (ie, maxillary anterior, maxillary posterior, inferior alveolar nerve block). In each model, the dependent variable was absence of insertion pain (a pain rating of 0) or presence of pain (a pain rating of 1, 2, or 3), and the independent variables were topical anesthetic use and the study (provider).

RESULTS

A total of 1080 patients with a mean age of 25 years (range 18–49 years) participated in this study and received a total of 2336 injections. There were 1635 injections (1121 men/514 women) in the inferior alveolar nerve block group with an age range of 18–49 years (mean = 25), 279 injections (197 men/82 women) in the maxillary first molar infiltration group with an age range of 19–43 years (mean = 26), and 422 injections (297 men/125 women) in the maxillary lateral incisor infiltration group with an age range of 19–43 years (mean = 26). Within the inferior alveolar nerve block group, 470 injections received topical anesthetic prior to needle insertion, whereas 1165 did not. In the maxillary lateral incisor infiltration group, 128 injections received topical anesthetic and 294 did not. In the maxillary first molar infiltration group, 122 injections received topical anesthetic prior to needle insertion and 157 received none. The age and sex of each subject, by individual injection within the topical and no topical groups, was not recorded in the original studies.

The summary of reported pain upon needle insertion for each injection site is found in Table 1. In general, less than 24% of injections were considered to be of moderate-to-severe pain regardless of whether topical anesthetic was used. The Figure shows the needle insertion pain profile (pain vs no pain) for all 3 injection sites with and without topical anesthetic. Logistic regression analysis (controlling for study) for each group (Table 2) found no significant difference in reported needle insertion pain with the use of topical anesthesia compared with nonuse for the inferior alveolar nerve



Percent of injections with no pain on needle insertion.

block group (P = .7363) and the maxillary molar infiltration injection group (P = .0994). Logistic regression analysis did find that the application of topical anesthetic significantly (P = .0041) reduced the pain of needle insertion with the maxillary lateral incisor infiltration group (Table 2).

DISCUSSION

The effectiveness of topical anesthesia to reduce needle insertion pain has been met with mixed results. In our study, topical anesthetic effectiveness was found to be related to the location of the injection. For the inferior alveolar nerve block injection (Figure), no significant difference was found between the no pain/pain ratings when topical anesthetic was used. Our results and those of Nakanishi et al[11] and Meechan et al[12] agree on the lack of effectiveness of 20% benzocaine in reducing pain during needle insertion in the pterygomandibular raphe area when using a 27-gauge needle for an inferior alveolar nerve block. Similarly, topical anesthetic did not significantly reduce the pain of needle insertion over the maxillary first molars (Figure).

The greatest effect of the topical anesthetic in our study was found in the maxillary anterior region over the maxillary lateral incisors (Figure). Here subjects reported significantly more "no pain" ratings (37%) with the use of 20% benzocaine (adjusted odds ratio; 2.35 times more likely) as compared with those not receiving the topical anesthetic (28% no pain). Thus the use of 20% benzocaine in this area may be beneficial in reducing the pain of needle insertion over the maxillary lateral incisors (P = .0041). However, some patients (18% of maxillary lateral incisor injections) still reported moderate-to-severe pain on needle insertion when topical anesthetic was used.

Our overall results agree with a number of investigators[5,6,11,13] who also found that topical anesthetics are more effective in certain locations or for specific injections (ie, the maxillary mucobuccal fold infiltrations) than in other regions/injections (inferior alveolar nerve blocks).

A variety of factors have been reported to influence the effectiveness of topical anesthetics. The duration of application is one such factor. Increasing the duration of exposure to the topical anesthetic has been related to increased effectiveness.[5,13,14] In our study, a 1-minute application was utilized. Hutchins et al[6] also reported success in the maxillary mucobuccal fold with a 1-minute application of 20% benzocaine. Vongsavan and Vongsavan[15] reported success with a 2-minute application of 20% benzocaine. Rosivack et al[4] utilized a 3-minute application of 20% benzocaine in the maxillary buccal sul-

Table 2. Logistic Regression Analysis for Topical Anesthetic Use

Injection	*Estimate*	*Standard Error*	*Adjusted Odds Ratio**	*Lower 95% Confidence Interval*	*Upper 95% Confidence Interval*	P
Mandibular block	−0.293	0.870	0.746	0.135	4.11	.7363
Maxillary posterior infiltration	0.544	0.330	1.72	0.902	3.29	.0994
Maxillary anterior infiltration	0.854	0.297	2.35	1.31	4.21	.0041

* Odds of no needle insertion pain, adjusted for study.

cus with success. Gill and Orr[7] reported on the failure of 3 topical anesthetics (including 22% benzocaine) when applied for only 30 seconds. Meechan et al[11] reported that a 2-minute application of 20% benzocaine was unsuccessful in reducing pain of an inferior alveolar nerve block, whereas Nakanishi et al.[11] reported that a 4-minute application was also unsuccessful. It appears from our results and those of others that 20% benzocaine requires at least a 1-minute application to be effective in the maxilla, but that increased duration of application may still not be effective with an inferior alveolar nerve block.

The type of topical anesthetic utilized is another major factor. Research has been conducted on a number of different topical anesthetics including benzocaine,[4,6,7,15,16] lidocaine (5%, 10%, 20%, and 60% concentrations),[4,5,7,13,16–20] and EMLA (5% eutectic mixture of lidocaine and prilocaine).[12,16,21,22] Results with these and other forms of topical anesthetics have been varied. In general, benzocaine has been found to be effective at a 20% concentration[4,6,15] when applied for at least 1 minute, but ineffective with 30-second[7] and 20-minute applications.[16] Lidocaine has been reported to be effective at concentrations of 5%,[4,13,17,18] 10% and 20% (via patch),[5,19,20] and 60%[16] when applied for 2–20 minutes. Ineffectiveness of 5% lidocaine has been reported for 30-second applications[7] and a 2.5-minute application via a patch.[5] EMLA was found to be successful after 2 and 5 minute applications.[13,17,21,22]

The placebo effect of topical anesthetics has also been investigated. Kincheloe et al[10] reported that patients expecting pain fulfilled their expectations and experienced more pain even when a topical anesthetic was applied and the patient informed of how well it worked. Martin et al[9] reported that patients receiving a topical anesthetic (20% benzocaine) anticipated less pain and therefore experienced less anxiety prior to receiving an injection. However, they reported that the use of a topical anesthetic did not reduce the reported pain experience. Differences in the manner a provider delivers an injection is another consideration related to pain of needle insertion. Initial analysis of our results showed that there was a significant difference in needle insertion pain ratings between operators ($P < .0001$). However, statistically, we were able to control for operator differences through logistic regression analysis. Levine and De Simone[23] reported that the sex of the experimenter has a differential effect on the degree of pain reported by male and female subjects. This may have played a factor in this study, as well as the differences in skills between operators and differences in group populations between the studies.

Other factors that could contribute to reported pain include the age and sex of the patient. Research has shown that female patients will tolerate pain less than men[24] and that older individuals will report less pain than younger individuals[24] when receiving a dental injection. In our study, we compiled data from 25 studies. Unfortunately, these studies recorded the total number of men/women and overall ages in each study, but not for individual topical versus no topical groups, thus making it impossible to include these factors in our regression models. The studies we sampled utilized a young adult population; therefore, the results of this study may not apply to children or the elderly. The results we compiled present indications of the effectiveness of 20% benzocaine on reducing, but not eliminating, the pain of needle insertion in the maxillary anterior region.

In conclusion, the use of topical anesthetic significantly ($P = .0041$) increased the odds of patients experiencing no needle insertion pain during maxillary anterior infiltrations. There was no significant effect ($P > .05$) for the maxillary posterior infiltration or the inferior alveolar nerve block. Although some studies[4–6,10–19] have demonstrated the effectiveness of topical anesthetic, others[7–9,22] have reported no significant pain reduction with the use of topical anesthetic. Martin et al[9] found that if the patients thought they were receiving topical, whether they did or not, they anticipated less pain. Therefore, the most important aspect of using topical anesthetic may not be its clinical effectiveness, but rather the psychological effect on the patient who feels the practitioner is doing everything possible to prevent pain.

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