

# The Effects of a 2-Stage Injection Technique on Inferior Alveolar Nerve Block Injection Pain

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The purpose of this prospective, randomized, single-blinded, crossover study was to compare the pain of a traditional 1-stage inferior alveolar nerve (IAN) block injection to a 2-stage IAN block technique. Using a crossover design, 51 subjects randomly received, in a single-blinded manner, either the traditional IAN block or the 2-stage IAN block in 2 appointments spaced at least 1 week apart. For the 2-stage injection, the needle was inserted submucosally and 0.4 mL of 2% lidocaine with epinephrine was slowly given over 1 minute. After 5 minutes, the needle was reinserted and advanced to the target site (needle placement), and 1.8 mL of 2% lidocaine with epinephrine was deposited. For the traditional IAN block, following needle penetration, the needle was advanced while depositing 0.4 mL of 2% lidocaine with epinephrine (needle placement) and then 1.8 mL of 2% lidocaine with epinephrine was deposited at the target site. A Heft-Parker visual analogue scale was used to measure the pain of needle insertion, needle placement, and anesthetic solution deposition. There were no significant differences, as analyzed by Wilcoxon matched-pairs signed-ranks test, between needle insertion and solution deposition for the 2 techniques in men or women. However, there was significantly less pain with the 2-stage injection for needle placement in women. In conclusion, the 2-stage injection significantly reduced the pain of needle placement for women when compared to the traditional IAN technique.

**Key Words:** Injection pain; Inferior alveolar nerve block; Lidocaine.

The injection of anesthetic solution for the inferior alveolar nerve (IAN) block has 3 phases: initial needle insertion through the alveolar mucosa, needle placement to the target site, and deposition of the anesthetic solution at the target site.

The inferior alveolar nerve block has been associated with pain and discomfort. For the needle insertion phase, Nusstein and Beck,<sup>1</sup> in a retrospective study of 1635 IAN blocks, reported an incidence of moderate to severe pain ranging from 14 to 22%. For the deposition of the anesthetic solution at the target site, various authors<sup>2-5</sup> have reported that the incidence of moderate

to severe pain ranged from 20 to 40%. Therefore, it would be advantageous to decrease the pain of the inferior alveolar nerve block.

The 2-stage injection has been suggested by Walton and Torabinejad<sup>6</sup> and Levine<sup>7</sup> as a way to decrease the pain of injection. This method involves initial placement of anesthetic solution just under the mucosal surface. After a wait of several minutes for regional numbness, the injection is resumed and the remaining anesthetic solution is deposited at the target site. No clinical studies have addressed the 2-stage injection technique to reduce the pain of injection.

The purpose of this prospective, randomized, single-blinded, crossover study was to compare the pain of a conventional inferior alveolar nerve block injection to that of a 2-stage inferior alveolar nerve block technique.

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## METHODS

Fifty-one adult subjects participated in this study. The subjects were in good health as determined by a written health history and oral questioning. Subjects were not taking any medications that would alter their perception of pain. All subjects were asymptomatic and volunteered for participation. The Ohio State University Human Subjects Committee approved the study, and informed consent was obtained from each subject.

The 51 blinded subjects randomly received a conventional inferior alveolar nerve block injection using 2.2 mL of 2% lidocaine with 1 : 100,000 epinephrine or a 2-stage inferior alveolar nerve block using 2.2 mL of 2% lidocaine with 1 : 100,000 epinephrine at 2 separate appointments, spaced at least 1 week apart, in a crossover design. With the crossover design, there were 102 total injections administered and each subject served as his or her own control. Fifty-four IAN block injections were administered on the right side and 48 injections were administered on the left side. The same side randomly chosen for the first injection was used again for the second injection. All injections were performed by 1 operator (G.S.).

Before the experiment, the 2 injection techniques were randomly assigned 6-digit numbers from a random number table. Each subject was randomly assigned to 1 of the 2 injection techniques to determine which technique was to be administered at each appointment. Only the random numbers were recorded on the data collection sheets to further blind the experiment.

A standard IAN block<sup>8</sup> was administered with a 27-gauge 1½-inch Luer-Lok needle (Becton Dickinson & Co, Rutherford, NJ) attached to a 5-mL Luer-Lok syringe (Becton Dickinson) with an aspirating thumb ring (Becton Dickinson). The anesthetic solution was prepared by removing the contents from 1.8-mL cartridges of 2% lidocaine with 1 : 100,000 epinephrine (Xylocaine, Dentsply Pharmaceutical, York, Pa) and adding 2.2 mL to the 5-mL Luer-Lok syringe using sterile technique. All anesthetic solution cartridges were checked to ensure that expiration dates were acceptable. All IAN blocks had topical anesthetic gel (20% benzocaine, Patterson Dental Supply Inc, St. Paul, Minn) passively placed at the IAN block injection site for 60 seconds using a cotton-tip applicator.

The conventional inferior alveolar nerve block was administered as follows. After initial needle penetration to a depth of 2–3 mm, the needle was advanced over a time period of approximately 10 seconds to the target site until bone was gently contacted. As the needle was advanced, 0.4 mL of 2% lidocaine with 1 : 100,000 epinephrine was deposited. The remaining 1.8 mL of an-

esthetic solution was then deposited at the target site over a 1-minute time period.

The 2-stage inferior alveolar nerve block was administered as follows. After initial needle penetration to a depth of 2–3 mm, 0.4 mL of 2% lidocaine with 1 : 100,000 epinephrine was deposited over a 1-minute time period and the needle was then withdrawn. During this phase, the needle was not advanced toward the target site. After a wait of 5 minutes, the needle was reinserted into the mucosa at the same location and advanced to the target site over a time period of approximately 10 seconds. No anesthetic solution was deposited during needle placement. Once the target site was reached, 1.8 mL of the anesthetic solution was deposited over a 1-minute time period.

The blinding of the injection methods was accomplished by adding an additional sham injection to the conventional inferior alveolar nerve block. Five minutes after the conventional nerve block was performed, the needle was reinserted under the mucosal tissue to a depth of 2–3 mm and an injection was mimicked by lightly pushing on the syringe handle. The syringe and needle were held in place for 1 minute and 10 seconds, thus mimicking the 2-stage injection. The needle was then removed.

Subjects rated their pain for each phase of the injection on a 170-mm Heft-Parker visual analogue scale (Figure).<sup>9</sup> The visual analogue scale was divided into 4 categories. No pain corresponded to 0 mm. Mild pain was defined as greater than 0 mm and less than or equal to 54 mm. Mild pain included the descriptors of faint, weak, and mild pain. Moderate pain was defined as greater than 54 mm and less than 114 mm. Severe pain was defined as equal to or greater than 114 mm. Severe pain included the descriptors of strong, intense, and maximum possible. The phases of the injection were initial needle insertion into the alveolar mucosa, placement of the needle to the target site, and deposition of the anesthetic solution at the target site.

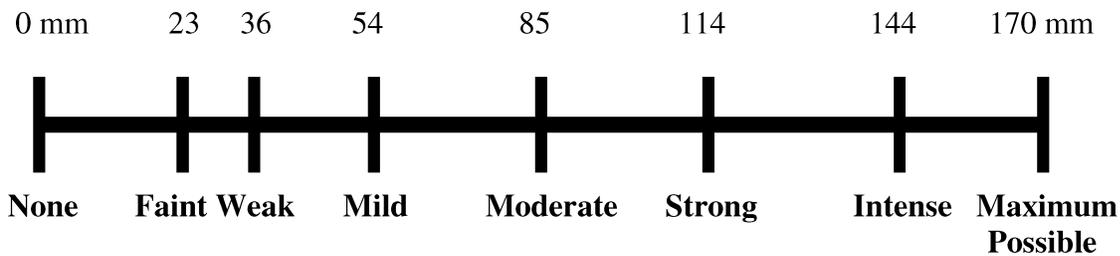
Comparisons between the 2 injection techniques for pain of the 3 phases of the injection were analyzed using multiple Wilcoxon matched-pairs signed-ranks test with step-down Bonferroni method of Holm adjustment. Comparisons were considered significant at  $P < .05$ .

## RESULTS

Fifty-one adult subjects, 28 men and 23 women aged 20–46 years with an average age of 26 years, participated.

The percentages and discomfort ratings for the 3 phases of the inferior alveolar nerve block are summarized in the Table.

**Place a mark on the line below to show the amount of pain that you feel.**



Heft-Parker visual analogue scale pain scale used for assessment of pain. The millimeter demarcations were not shown on the patients' visual analogue scale.

Needle insertion pain for women averaged 35 mm and for men ranged from 34 to 44 mm. All means were in the mild pain category. Seventeen percent to 43% of the subjects rated the pain as moderate, and none rated the pain as severe. There was no statistical difference between the 2 inferior alveolar nerve block techniques for men or women with respect to needle insertion pain.

Needle placement pain for women averaged 60 mm (moderate pain category) for the 1-stage injection and 31 mm for the 2-stage injection. The difference was statistically significant. For the 1-stage injection, 52% of the female subjects rated the pain of needle placement

as moderate and 4% reported severe pain. Pain for men ranged from 34 mm to 47 mm. Both means were in the mild pain category. There was no statistical difference between the 2 inferior alveolar nerve block techniques for men with respect to needle placement pain.

Solution deposition pain for women ranged from 28 mm to 37 mm and for men ranged from 31 to 41 mm. All means were in the mild pain category. Eighteen percent to 32% of the subjects rated the pain as moderate, and 4% rated the pain as severe. There was no statistical difference between the 2 inferior alveolar nerve block techniques for men or women.

Percentages and Discomfort Ratings by Phase of Injection and Sex†

Technique	Discomfort Rating, % (No.)				Mean‡	P Value*
	None	Mild	Moderate	Severe		
Needle insertion						
Women (n = 23)						
1-stage	9 (2)	70 (16)	22 (5)	0 (0)	35 ± 21	.9001
2-stage	4 (1)	78 (18)	17 (4)	0 (0)	35 ± 21	
Men (n = 28)						
1-stage	7 (2)	68 (19)	25 (7)	0 (0)	34 ± 20	.0708
2-stage	4 (1)	54 (15)	43 (12)	0 (0)	44 ± 21	
Needle placement						
Women						
1-stage	0 (0)	44 (10)	52 (12)	4 (1)	60 ± 29	.0015
2-stage	30 (7)	48 (11)	22 (5)	0 (0)	31 ± 36	
Men						
1-stage	0 (0)	61 (17)	39 (11)	0 (0)	47 ± 22	.0934
2-stage	25 (7)	46 (13)	29 (8)	0 (0)	34 ± 33	
Solution deposition						
Women						
1-stage	17 (4)	56 (13)	22 (5)	4 (1)	37 ± 31	.2766
2-stage	22 (5)	52 (12)	26 (6)	0 (0)	28 ± 27	
Men						
1-stage	14 (4)	68 (19)	18 (5)	0 (0)	31 ± 31	.0934
2-stage	4 (1)	64 (18)	32 (9)	0 (0)	41 ± 27	

† Women, n = 23; men, n = 28.

‡ Mean value on the visual analogue scale, ± SD.

\* There were no significant differences ( $P > .05$ ) between the techniques except when comparing needle placement pain between women ( $P < .05$ ).

## DISCUSSION

There was no significant difference between needle insertion pain for the 1-stage injection versus the 2-stage injection in either men or women (Table). During the 2-stage technique, the needle insertion ratings included deposition of 0.4 mL of solution over a 1-minute time period. Therefore, the initial deposition was no more painful than just inserting the needle in the conventional technique. Seventeen percent to 43% of the subjects rated the pain as moderate, and none rated the pain as severe (Table). In a retrospective study of 1635 injections, Nusstein and Beck<sup>1</sup> reported a 14 to 22% incidence of moderate to severe pain on needle insertion for the inferior alveolar nerve block.

The use of topical anesthesia did not eliminate needle insertion pain (Table). Nusstein et al,<sup>1</sup> Nakanishi et al,<sup>10</sup> and Meehan et al<sup>11</sup> reported that 20% benzocaine was not completely effective in reducing needle insertion pain for the inferior alveolar nerve block. Martin et al<sup>12</sup> found that if patients thought they were receiving topical anesthetic, whether they did or not, they anticipated less pain on injection. Therefore, the most important aspect of using topical anesthetic agents may not be its clinical effectiveness, but rather the psychological effect on the patient, who feels that the clinician is doing everything possible to prevent pain. Further research needs to address ways to reduce pain during needle insertion.

There was a significant difference between needle placement pain for the 1-stage technique versus the 2-stage technique in women (Table). In the 2-stage technique, placing 0.4 mL of 2% lidocaine with 1 : 100,000 epinephrine just under the alveolar mucosa and allowing for its effect for 5 minutes resulted in enough regional anesthesia to decrease the pain of needle placement. In the 1-stage technique, 0.4 mL of 2% lidocaine with 1 : 100,000 epinephrine was slowly deposited as the needle was advanced to the target site. The higher moderate to severe pain ratings in women with the 1-stage technique demonstrated that it was not as effective as the 2-stage technique. It is unknown if deposition of the anesthetic solution during needle placement results in anesthesia of the soft tissue ahead of the needle path. A comparative study of needle placement pain with deposition and no deposition of anesthetic solution would answer this question.

Regarding sex differences in pain between men and women, Liddell and Locker<sup>13</sup> found that women try to avoid pain more than men, and that they accept pain less and fear it more than men. Fillingim et al<sup>14</sup> suggested that pain responses may be more clinically relevant for women than for men. Other factors, such as sex role expectancies<sup>15</sup> and anxiety,<sup>16</sup> may also modulate differences in pain between men and women.

For the placement of the needle to the target site in a 1-stage technique, 22 to 56% of the subjects reported moderate to severe pain (Table). As far as we are aware, only 1 study<sup>17</sup> has investigated needle placement pain, and this was for the palatal–anterior superior alveolar nerve block. The 2-stage injection significantly reduced needle placement pain in women, but was not completely effective in eliminating moderate to severe pain (Table). Additionally, needle placement pain was the most painful part of the 3 phases of the injection process (Table). Further research needs to address ways to reduce pain during needle placement.

There was no significant difference between anesthetic solution deposition pain for the 1-stage injection versus the 2-stage injection in women or men (Table). Eighteen percent to 32% of the subjects rated the pain as moderate and 4% rated the pain as severe for both techniques (Table). Previous studies<sup>2–5</sup> of the 1-stage technique have reported an incidence of moderate to severe pain ranging from 20 to 40% using 2% lidocaine with 1 : 100,000 epinephrine. Apparently there was not a sufficient amount of anesthetic solution present to completely eliminate the pain of solution deposition with the 2-stage technique. Perhaps increasing the amount of anesthetic solution during the initial phase of the 2-stage injection may help to decrease the pain of needle placement and anesthetic solution deposition.

Although the rate of anesthetic solution deposition for both techniques was 1 minute to deposit 1.8 mL of solution, it did not eliminate moderate pain. Hochman et al<sup>18</sup> advocated the use of the Wand (CompuDent, Milestone Scientific, Deerfield, Ill) computer-controlled anesthetic delivery system to decrease the pain of injection. The majority of the literature on the Wand has dealt with the pain of injection with the Wand compared to that of standard injections using a syringe.<sup>19–33</sup> In general, the results have been favorable<sup>18,23–30,32,33</sup> with the Wand, with 2 studies showing no difference<sup>20,21,31</sup> and 1 study showing higher pain ratings<sup>22</sup> with the Wand. However, the system does not produce a painless injection.<sup>17,20–33</sup> Further research needs to address ways to reduce pain during anesthetic solution deposition.

Because we studied a young adult population, the results of this study may not apply to children or the elderly.

## CONCLUSION

In conclusion, the 2-stage injection significantly reduced the pain of needle placement in women when compared to the conventional inferior alveolar nerve block.

The 2-stage technique may improve the patient experience, especially for those female patients who are fearful or apprehensive of dental injections. However,

further research is indicated to reduce the pain associated with the inferior alveolar nerve block.

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