

Clinical Evaluation of Inferior Alveolar Nerve Block by Injection Into the Pterygomandibular Space Anterior to the Mandibular Foramen

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The conventional inferior alveolar nerve block (conventional technique) has potential risks of neural and vascular injuries. We studied a method of inferior alveolar nerve block by injecting a local anesthetic solution into the pterygomandibular space anterior to the mandibular foramen (anterior technique) with the purpose of avoiding such complications. The insertion angle of the anterior technique and the estimation of anesthesia in the anterior technique were examined. The predicted insertion angle measured on computed tomographic images was $60.1 \pm 7.1^\circ$ from the median, with the syringe end lying on the contralateral mandibular first molar, and the insertion depth was approximately 10 mm. We applied the anterior technique to 100 patients for mandibular molar extraction and assessed the anesthetic effects. A success rate of 74% was obtained. This is similar to that reported for the conventional technique but without the accompanying risks for inferior alveolar neural and vascular complications.

Key Words: Anterior technique; Inferior alveolar nerve block; Pterygomandibular space.

The conventional inferior alveolar nerve block technique (conventional technique) is generally delivered by inserting the needle tip toward and immediately above the mandibular sulcus or lingula. According to several reports, the needle tip must reach the proximity of the inferior alveolar nerve to ensure an anesthetic effect.¹⁻⁵ However, the conventional technique is associated with risks and complications such as neural or vascular injury and intravascular injection.⁶⁻¹¹

We hypothesized that, by injecting a local anesthetic solution into the pterygomandibular space anterior to the mandibular foramen, where no large nerve or vessel is present, the anesthetic solution would diffuse inside the space and reach the inferior alveolar nerve, producing a sufficient inferior alveolar nerve block. In this

study, we measured the insertion angle on computed tomographic (CT) images to confirm the direction of the anterior technique and applied this technique to mandibular molar extraction and assessed its clinical effects.

SUBJECTS AND METHODS

Insertion Angle

The insertion angles in the conventional and anterior techniques were measured using CT images of the head and neck region of patients (27 males and 38 females) stored in the Nippon Dental University Hospital. The CT images at the level near the mandibular foramen, excluding image abnormalities, were examined in 61 sites on the right and 64 sites on the left, totaling 125 sites. The predicted insertion angle in the anterior technique was determined by measuring the inside angle between the median sagittal plane and a line joining the latero-anterior border of the medial pterygoid muscle and the distal margin of the deep tendon of the tem-

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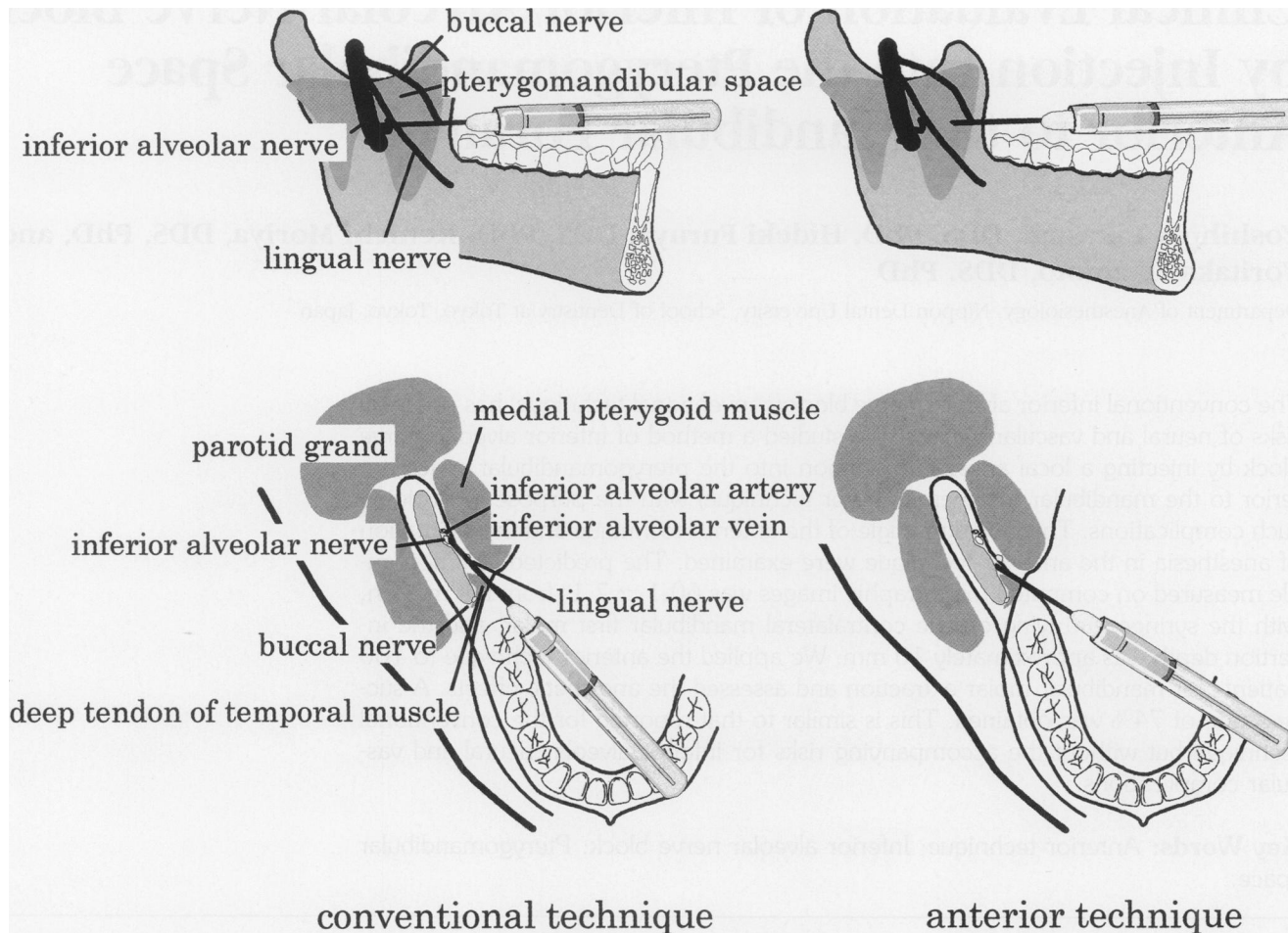


Figure 1. Schematic diagrams show the relationship of the pterygomandibular space and the landmarks for the insertion and the angles of the syringe in the anterior technique and conventional technique. In the anterior technique, the needle tip can be placed posterior to the deep tendon of temporal muscle in the pterygomandibular space in the direction of the first molar to the lateral to the pterygomandibular raphe, with the depth of penetration approximately 10 mm.

poral muscle for the insertion site on the medial side of the ramus. The predicted insertion angle in the conventional technique was determined by measuring the inside angle between the median sagittal plane and the line joining the latero-anterior border of the medial pterygoid muscle and the center of the mandibular ramus, corresponding to the mandibular foramen.

Clinical Evaluation

This study was approved by the Ethical Committee of the Nippon Dental University, School of Dentistry at Tokyo. Informed consent was obtained from 100 patients who participated in the study. The anterior technique was performed once in each patient who was scheduled for mandibular molar extraction at the anesthesiology or oral surgery outpatient departments at our affiliated hospital. The authors and 16 other oral sur-

geons who had received oral instruction for the technique participated in the clinical study.

To estimate the postural effects during the anesthetic procedure, the patients were randomly assigned into 1 of 2 groups, ie, the supine group (47 patients) or the sitting group (53 patients). The anterior technique was performed using a dental cartridge syringe (Self-Aspirating Syringe, ASTRA), a 30-gauge, 21-mm disposable needle, and a dental anesthetic cartridge consisting of 1.8 ml of 2% lidocaine containing 1:80,000 epinephrine. The syringe was positioned with the insertion point at the lateral side of the pterygomandibular fold approximately 10 mm above the occlusal plane and was placed over the contralateral mandibular first molar. The needle was inserted to a depth of 10 mm. After ensuring no blood aspiration, 1.8 ml of anesthetic solution was injected (Figure 1). After the patient reported numbness of the tongue and lower lip, the stick test was performed

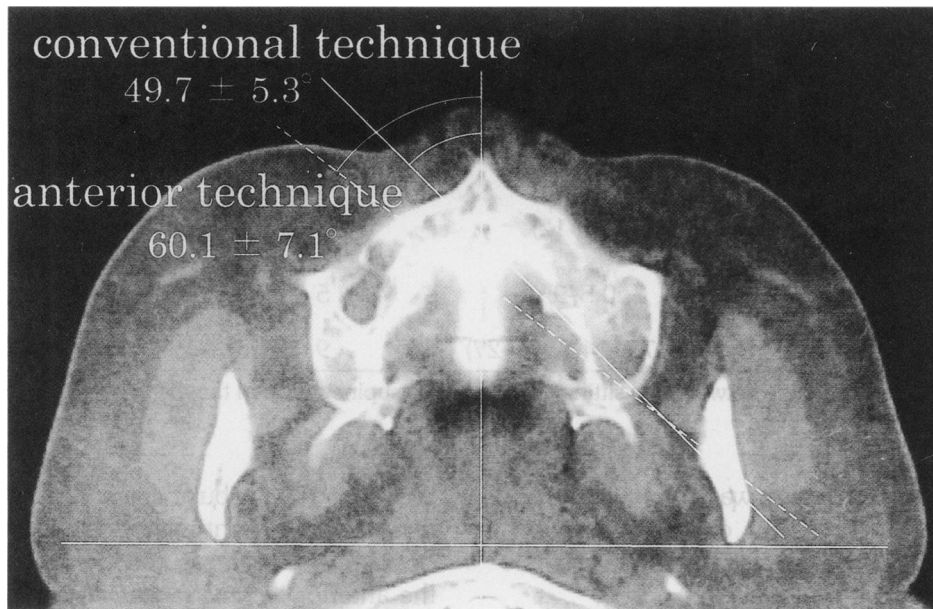


Figure 2. Comparison of the insertion angles in the anterior technique and conventional technique on the computed tomographic image. A dotted line traces the conventional technique and a solid line traces the direction of the anterior technique. The angles between the insertion and sagittal plane were measured as $49.7 \pm 5.3^\circ$ in the conventional technique and $60.1 \pm 7.1^\circ$ in the anterior technique.

in the lower lip to confirm anesthesia. The infiltration of anesthetic to the buccal gingiva was performed and the tooth extraction commenced. If the anesthetic effect was not observed within 10 minutes, an alternate insertion angle and insertion depth was considered by the attending anesthetist.

The duration from the end of nerve block administration to the onset of numbness in the tongue and lower lip and analgesia in the lower lip, the time when tooth extraction started, and the status of supplemental injections were all recorded. The estimation of anesthetic effect was evaluated according to Dobbs and De Vier.¹² The postural effect of the patients during anesthesia procedure was also studied.

Statistical analyses were performed using Statistica for

Table 1. Clinical results of the anterior technique (number of patients in parentheses); grade A, completely satisfactory analgesia; grade B, subject feels slight pain but does not require reinforcement; grade C, feeble analgesia, another injection required; there was no significant difference between the groups

	All Patients (n = 100) (%)	Sitting Group (n = 53) (%)	Supine Group (n = 47) (%)
Grade A	64	62 (33)	66 (31)
Grade B	12	15 (8)	9 (4)
Successful grades: A + B	76	77 (41)	75 (35)
Grade C	23	21 (11)	26 (12)
No symptoms	1	2 (1)	0 (0)

MS Windows Ver. 5.05J (StatSoft) on a standard personal computer. The insertion angles were analyzed with Student's *t* test, and the differences in anesthesia grade and onset time between groups were examined by the Mann-Whitney's *U* test. The critical level of significance was set at $P = .05$. Values of clinical evaluation were presented as median and range.

RESULTS

Insertion Angle

The predicted insertion angles were $60.1 \pm 7.1^\circ$ (mean \pm SD) in the anterior technique and $49.7 \pm 5.3^\circ$ in the conventional technique. There was a significant difference (Figure 2).

Clinical Evaluation

Sixty-four percent of the patients were evaluated as grade A, 12% as grade B, and 24% as grade C (no anesthetic effect in one patient), with a success rate (grades A and B) of 76%. No significant differences between the two postural groups were detected (Table 1).

In patients with grades A and B, the median onset time of numbness in the tongue was 2 minutes (30 seconds–9 minutes), numbness in the lower lip was 3 minutes (30 seconds–12 minutes), and the onset time of analgesia in the lower lip was 4 minutes (30 seconds–19 minutes). Median time lapse between the initial in-

Table 2. Onset time of the anterior technique in grades A and B; values are median (25th percentile, 75th percentile, range)

	All Patients (n = 76) (minutes)	Sitting Group (n = 41) (minutes)	Supine Group (n = 35) (minutes)
Subjective			
Tongue numbness	2 (1, 3, 0.5-9)	2 (2, 3, 0.5-9)	2 (1, 2, 1-4)
Lower lip numbness*	3 (2, 5, 0.5-12)	3 (2, 6, 0.5-12)	2 (1, 4, 1-10)
Stick test (complete numbness of lower lip)	4 (2, 7, 0.5-9)	5 (2, 7, 0.5-13)	3 (2, 6, 1-19)
Time lapse between the initial injection and the start of surgery	9 (6.75, 14.25, 3-27)	9 (7, 11, 3-19)	10 (6.5, 18, 3-27)

* There was a significant difference between the sitting group and the supine group in the mean onset time of lower lip numbness ($P < .05$).

jection and the start of extraction was 9 minutes (3-27 minutes). There was a significant difference between groups in the onset time of lower lip numbness (Table 2).

DISCUSSION

Local anesthesia should produce a desirable anesthetic effect without unnecessary injury. The inferior alveolar nerve, vein, and artery are found near the mandibular foramen, and the pterygoid plexus is located posteriorly and superiorly. Therefore, the conventional technique, which aims the needle toward the mandibular foramen, is accompanied by risks for complications such as vascular or neural injury, intravascular injection, and muscular injury. An incidence of blood aspiration of 2.9 to 22% has been reported for the conventional technique.^{4,6-8,13,14} Although the reported incidence of permanent neuroparalysis in patients receiving the conventional technique is not frequent, 3:2573 administrations by Saitoh et al¹⁵ or between 1:26,762 and 1:160,571 by Pogrel et al,¹⁶ the electric shock sensation that often accompanies nerve involvement has been reported as 3,¹⁷ 7,¹⁶ and 8%.¹⁴ Furthermore, muscle trismus has been reported as a significantly frequent side effect of the conventional technique because of penetration of the needle into the medial pterygoid and temporal muscle.^{2,13}

Our anatomical study of the pterygomandibular space using the CT images confirmed a space between the medial pterygoid muscle and the deep tendon of the temporal muscle near the anterior border of the mandibular ramus. We hypothesized that a local anesthetic solution injected into the pterygomandibular space should diffuse and reach the inferior alveolar nerve, even if the injection site is distant from the mandibular foramen. In the anterior technique, the needle tip should be placed into the gap between the medial pterygoid muscle and the deep tendon of the temporal muscle in

the pterygomandibular space anterior to the mandibular foramen to prevent injury to the inferior alveolar nerve or vessels. The measured predicted insertion angle in the anterior technique was approximately 60° with the direction from over the contralateral mandibular first molar, and an insertion depth of 1 cm is desirable to penetrate the submucosal layer that contains the buccal fat pad, which is of variable thickness. These insertion angles and depths are presumed to diminish the risk of injury to the lingual nerve or the medial pterygoid muscle.

The reported success rates of the conventional technique vary from approximately 55 to 95%,^{4,13,14,18-22} and the success rate of the anterior technique in our study was evaluated to be more than 75% in both postural groups. In the conventional technique, Sisk²³ reported that the mean onset time was 5.08 minutes and Petersen² reported that the mean time lapse between the injection and the start of surgery was 23 minutes. In our study, the median onset time of complete numbness of lower lip and the median time lapse between the injection and the start of surgery in the anterior technique were 4 minutes and 9 minutes, respectively. Our results suggest that the effectiveness of the anterior technique is not lower than that of the conventional technique and that the postural difference did not influence the anesthetic effect in the anterior technique.

In conclusion, the anterior technique is able to achieve anesthesia of the inferior alveolar nerve with low risk of inferior alveolar neural and vascular complications. It should be considered as an alternative to the conventional technique.

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