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A COMPARATIVE STUDY FOR THE EFFECTIVENESS OF A NOVEL TECHNIQUE FOR INFERIOR ALVEOLAR NERVE BLOCK VERSUS THE CONVENTIONAL TECHNIQUE

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ABSTRACT

Although conventional (Halsted) inferior alveolar nerve block is the most applied nerve block in Dentistry, it is still the most frustrating with high failure rates up to13% or even higher due to inconsistent intraoral landmarks. So, the current study aims at comparing a novel technique for the inferior alveolar nerve block (IANB) depending on extraoral landmarks with the conventional technique. The study group patients received IANB employing the novel technique. The novel technique depended entirely on extraoral consistent landmarks which were the base of the columella, the outer canthus of the right and the left eye, and the upper lip. In the control group, the conventional technique was applied. The success rate and the onset, the duration, and the depth of anaesthesia were assessed. Complications were recorded. While the novel technique achieved higher success rate (98.68%) than the conventional technique (88.16%), the differences with regards with all other parameters to assess the local anaesthesia were statistically insignificant. The novel technique provides the clinicians with a new tool that might be a reliable substitute for the conventional technique since the former depends entirely on extraoral consistent landmarks, which also might account for its simplicity, accuracy, and high success rate.

KEY WORDS: block, extraoral landmarks, Inferior alveolar, novel, technique

INTRODUCTION

Inferior alveolar nerve block (IANB) might be the most frequently used block technique and the most important dental injection technique. Although Halsted technique was the first technique introduced to perform IANB, it is still the most widely applied technique. However, it is associated with the highest failure rate among other blocks even when properly performed.[1–4] Failure rates reported with IANB ranged from 3% to 13%, or even higher.[1,5–8] Inconsistent landmarks such as teeth and pterygomandibular raphe are one pivotal cause of that high failure rate. Anatomical variations in regards to the width, length, and divergence of the ascending ramus is another complicating factor to accurately identify the coronoid notch.[8,9]

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Edentulous patients are a special challenge in that concern.[9] Therefore, various techniques have been introduced including Gaw-Gates[10] and Vazirani-Akinosi[9] techniques. Despite the claims that some of these techniques might have a higher success rate than the conventional (Halsted) technique, none has no drawbacks[8]. Various techniques have been introduced as alternatives for Halsted technique; however, all these techniques depended upon intraoral landmarks. [11–14]

Therefore, the current study aimed at introducing a novel intraoral technique for the inferior alveolar nerve block that entirely depended on extraoral landmarks and to compare it with the conventional technique.

MATERIAL AND METHODS

Sample size

The sample size was determined to be 152 patients equally divided into two groups using power analysis at α= 0.05, β= 0.05, enrollment ratio=1, a dichotomous primary endpoint and assumed success rates of 80% and 98% for the control and study groups respectively. A post hoc power analysis showed a 95.1% level of power at α= 0.05 and 76 patients allocated for each group.

Subjects

A total of 152 otherwise healthy patients (American Society of Anesthesiologists class I (ASA I)) from the outpatient department of the Oral and Maxillofacial Surgery department with similar demographics within the age range of 18 to 60 years were included in the current study within the period from September 2019 through July 2020. Moreover, inclusion criteria included the need for IANB (such as the need to manipulate more than one tooth in a quadrant) and patient cooperation. Exclusion criteria included allergy to articaine or any of the contents of the local anaesthetic cartridge, bleeding disorders such as haemophilia, severe renal or hepatic dysfunction, and presence of infection in the pathway of needle penetration. Moreover, exclusion criteria included the presence of tenderness of the tooth in question to percussion and the need for lengthy or complicated procedures such as dental impaction surgeries or surgical extractions. Patients were randomly divided into two equal groups using a computer permuted block stratified randomization generator (randomization.com).

Study design and injection administration

All injections were carried out using Articaine HCl 4% with epinephrine 1:100,000 (Artpharmadent, Artpharma Co., Cairo, Egypt) and 27-gauge 35mm dental needle (C-K Ject Premium, CK Dental Industry Co., Gyeonggi-DO, Korea). For every patient, a 1.5ml of the solution was deposited. The author (a right-handed operator) performed all injections.

Subjects in group I (the control group) received IANB applying the conventional Halsted technique[8]. Group II patients (the study group) received the IANB applying the novel technique. Reinjection was performed when the first injection failed whatever was the technique applied. About 0.2ml of the solution was deposited against each tooth in question whatever it was by infiltration technique by advancing the needle at about 45 degrees to the long axis of the tooth in question till it penetrated the mucobuccal fold by about 1-2 mm.

This study complied with the Declaration of Helsinki (revised in 1975), the regional ethical review board, and with CONSORT (Consolidated Standards of Reporting Trials) principles. All patients provided informed consent.

The conventional Halsted technique

For the right side, the operator stood at the 8 o'clock position in front of the patient, where for the left side, the operator stood at 10 o'clock position facing in the same direction as the patient.

The patient was positioned in a semi-supine position. The patient was asked to maximally open his mouth. The coronoid notch was located by the index finger of the non-injecting hand on the anterior border of the ramus. An imaginary line connecting the center of the coronoid notch to the deepest portion of the pterygomandibular raphe as it ascends vertically toward the palate after coursing horizontally was then divided into a medial one quarter and lateral three quarters. The later line was about 10mm coronal to the posterior mandibular occlusal plane. The needle was advanced from the contralateral side over the premolars till gently touched the bone at about 25-30mm depth of penetration. The needle was then withdrawn for 1mm and the solution was deposited over two minutes after negative aspiration in two perpendicular planes.[8]

The novel technique

The novel technique for the left side (Fig 1) was performed as follows. The operator stood approximately at 7 O'clock in front of the patient. The patient was positioned in a semi-supine position and was asked to maximally open his mouth and to tilt his head towards the operator (to be approximately at 6:30 O'clock) until the operator saw the patient's base of columella lies on the same line with the outer canthus of the left eye. The syringe was advanced parallel to that line beneath the base of the columella at the same distance from it to the lower margin of the upper lip until gently touched the bone (at about 25- 30mm depth of penetration). About 1.6ml was deposited over two minutes after negative aspiration in two perpendicular planes. For the right side (Fig 2), the same applied except for using the outer canthus of the right eye instead of the left.

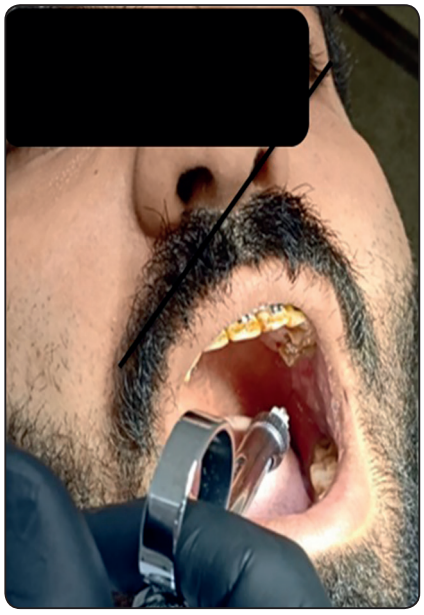

Fig. (1): The novel technique for the left side.

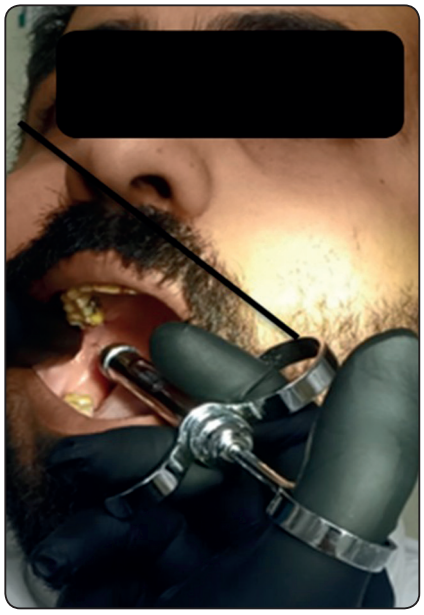

Fig. (2): The novel technique for the right side.

Investigated parameters of anaesthesia

Four parameters were evaluated which were the success, the onset, the duration and the depth of anaesthesia. Evaluation of the success (the anesthetic effect) was subjectively and objectively carried out. Subjective assessment was performed by two methods. In the first, the patient was asked to encircle the number that best corresponded to his pain during the procedure (if any) on a numeric scale (NS) form (with a 10cm line with equally spaced numbered markings from 0 to 10, where 0

represented no pain and 10 represented the worst possible pain).[15] Failure was recorded if the patient recorded any value over 0. The numbness of the ipsilateral lower lip and ipsilateral side of the tongue was checked as the second method to subjectively evaluate the success. Objectively, an electric pulp tester (Vitality scanner™, Kerr Co., Brea, Canada) (EPT) was used to assess the anaesthetic effect in the tooth in question before performing any procedures to the tooth. A negative result (successful case) was recorded if there was no response to maximal output (80/80) on two consecutive tests 3 minutes apart.

The second parameter to evaluate was the onset of anaesthesia (OA). Time in seconds was measured from the moment of syringe withdrawal to the moment of the beginning of the numbness.

Duration of anaesthesia (DUA) was measured in minutes from the onset of the anaesthesia to the moment of numbness cessation. However, the depth of anaesthesia (DEA) was evaluated using a novel scale. The scale addressed only cases in which anaesthetic effect took place. The case was assigned 1 if a single injection resulted in no pain during the procedure. 2 was designated if pain existed after a single injection but did not necessitate a second injection to complete the procedure. 3 was designated if pain existed after a single injection and necessitated a second injection to complete the procedure. 4 was designated if pain existed after the second injection but did not necessitate a third injection to complete the procedure. 5 was designated if pain existed after the second injection and necessitated a third injection or more.

Intra and post-operative complications of the local anaesthesia such as the positive aspiration, nausea and vomiting, haematoma, etc. were recorded.

A GP dentist evaluated the four mentioned parameters of the anaesthesia and the incidence of any complication.

Statistical analysis

Statistics were performed with SPSS software (version 19, IBM Co, USA).

RESULTS

A total of 152 patients were included in the current study. While the mean age of the study group was 36.11 ± 7.4 years, it was 35.78 ± 5.1 years in the control group (the difference was statistically insignificant: unpaired t value= 0.32 and two tailed P= 0.749 at α level= 0.05). Although gender distribution for the study group was 34 males and 42 females, it was 29 males and 47 females in the control group (statistically insignificant difference: P= 0.51, Chi square with Yates' correction= 0.434).

As table 1 depicts, the most common cause to seek the local anaesthesia for both groups was multiple endodontic treatment (within the same quadrant) followed by dental extraction (the differences were statistically insignificant).

Table 2 shows that the success rates for the study group were greater than that of the control groups (98.68% and 88.16% respectively) and the difference was statistically significant. However, table 3 shows that the differences between the two groups were statistically insignificant with regards to the onset, duration and depth of anaesthesia. Failure cases were omitted from testing other anaesthesia parameters. The Positive aspiration and nausea were the only recorded local anaesthetic complications (table 4). Although positive aspiration ratios for the study and the control groups were 10.53% and 13.16% and nausea rates were 0% and 1.32% (in order), the differences were statistically insignificant.

TABLE (1) Procedures required the administration of the local anaesthetic

Procedure	Study group	Control group	P value Two tailed Fisher's exact test
Multiple endodontic treatment	35 (46.05%)	41 (53.95%)	0.567 (insignificant difference)
Tooth extraction (single/multiple)	22 (28.95%)	23(30.26%)	1 (insignificant difference)
Alveoloplasty	2 (2.63%)	0	0.5 (insignificant difference)
Periodontics	17 (22.37%)	12 (15.79%)	0.46 (insignificant difference)

TABLE (2) Success rates for the study and control groups

	(NS) †		Numbness		EPT ‡	
	Success	Failure	Success	Failure	Success	Failure
Study group	75	1	75	1	75	1
Control group	67	9	66	10	67	9
Two tailed Fisher's exact test P value	0.0176 (significant difference)		0.009 (significant difference)		0.0176 (significant difference)	
† NS: numeric scale	***‡ EPT: Electric pulp test***					

TABLE (3) Depth, onset, and duration of anaesthesia

	Depth of anaesthesia scale values †					Onset of anaesthesia mean ± SD ‡ (seconds)	Duration of anaesthesia mean ± SD ‡ (minutes)
	1	2	3	4	5		
Study group	74	1	0	0	0	115.3 ± 33.08	198.3 ± 41
Control group	67	0	0	0	0	120.08 ± 12.3	199.57 ± 28.6
	P= 0.736 (insignificant difference) Two tailed Fisher's exact test					unpaired t = 1.181 two tailed P= 0.24 insignificant difference	unpaired t = 0.222 two tailed P= 0.83 insignificant difference

† 1: single injection resulted in no pain during the procedure, 2: pain existed after a single injection but did not necessitate a second injection to complete the procedure, 3: pain existed after a single injection and necessitated a second injection to complete the procedure, 4: pain existed after the second injection but did not necessitate a third injection to complete the procedure, 5: pain existed after the second injection and necessitated a third injection or more.

‡ SD: Standard deviation

TABLE (4) Pre and post-anaesthetic complication

	Positive aspiration		Nausea	
	Occurred	Did Not Occur	Occurred	Did not occur
Study group	8	68	0	76
Control group	10	66	1	75
Statistical test	Chi squared with Yate's correction = 0.063 P= 0.801(insignificant difference)		P= 1(insignificant difference) Two tailed Fisher's exact test	

DISCUSSION

Although inferior alveolar nerve block is by far one of the most applied maneuvers in Dentistry[1–4], high failure rates reaching 13% or even more have been reported.[1,5–8] That high failure rate might be attributed to the inconsistent landmarks.[8,9] The conventional (Halsted) technique relies entirely on intraoral landmarks which are the occlusal plane (and therefore, the teeth), the pterygomandibular raphe, and the coronoid notch. These landmarks are inconsistent due to teeth loss (which themselves are one landmark) and subsequent bone resorption. Individual variations add another obstacle. Such individual variations include alterations in the angulation of the ascending ramus and the height of the coronoid notch. Among various alternative techniques that depend on intraoral landmarks, the Vazirani-Akinosi technique gained some popularity. However, alveolar bone resorption affects the level of mucogingival junction upon which the Vazirani-Akinosi technique depends. Other techniques did not gain popularity and some of them recorded success rates lower than those achieved by the conventional technique. [11–14] On the other hand, the Gaw-Gates technique uses a mixture of intraoral and extraoral landmarks. Intraoral landmarks include the maxillary second molar (or third molar if present in occlusion) and its mesio-palatal cusp. Extraoral landmarks are the contralateral corner of the mouth, the ipsilateral intertragic notch, and the angle of the ipsilateral auricle to the face.[8,10] Loss of maxillary posterior teeth critically jeopardizes the efficacy of that technique. Moreover, multiple extraoral landmarks are to some extent difficult to take into consideration at the same time; a factor that adds to the technique complexity. Consequently, it seems that all intraoral techniques inherit the same "Achilles heel" of dependence on inconsistent landmarks.

In the current study, the age range of 18 to 60 years was considered to allow for a better patient's cooperation, moreover avoiding pediatric patients with the undesired soft tissue anaesthesia. In spite of the fact that the author performed all injections, another person who was a GP dentist evaluated the anaesthetic effect to avoid bias. To allow for homogeneity of the study population as far as possible, all patients were selected to be otherwise healthy; so that there are no diseases might affect the nerve physiology, whole body physiology, or the local anaesthetic drug pharmaco-dynamics. Moreover, the nature of the procedures necessitated the local anaesthesia lacked the mixture of the simple and complicated procedures, so that nerve stimuli are comparable in all cases. Furthermore, tooth tenderness to percussion was an exclusion criterion to exclude cases of incomparable noxious stimuli which alters patient's response to local anaesthesia and his pain reaction level.

As the results of the current study indicated; success rate of the novel technique (98.68%) was higher than that of the conventional Halsted technique (88.16%). The novel technique depends exclusively on very few extraoral landmarks that are more or less stable and are not affected by teeth loss or alveolar bone resorption either in the maxilla or the mandible. These landmarks could be easily and concurrently visualized. That might justify the simplicity and the high success rate of the novel technique.

Both techniques did not show statistically significant differences with regards to the anaesthesia onset, duration, and depth. The anaesthetic onset is related to the amount of the solution deposited, the nature of the solution, the type of the tissues, the distance to the nerve trunk, and the targeted area of the trunk. The former three factors are the same for both techniques as the study design dictated. Thus, it seems that both techniques targeted the same area of the nerve from the same deposition point; so that when both techniques succeed, the same area of solution deposition was approached. Therefore, the dependence on consistent landmarks raised the

success rate of the novel technique in comparison with the conventional technique. The same hypothesis might accounts for the similarity of the results of the duration and depth of anaesthesia.

The positive aspiration recorded for both techniques was not surprising. Basically, both techniques are closed (blind) techniques target the pterygomandibular fossa that already contains large vessels in addition to the small tributaries that might exist and are subject to various anatomical variations. These factors might account for that positive aspiration phenomenon. The literature conveyed similar results [8]. Nausea might be attributed to the psychological stress the patients suffer due to pain, the dental procedures, and other factors such as prolonged waiting before commencing the visit. None of these complications prohibited the pursuance of the procedures nor had any residual effect given that positive aspiration necessitated altering the deposition site.

Strengths and weaknesses of the study

One strength factor in the study was the trial to limit the study to a homogenous population to obtain reliable data. Moreover, assessment criteria were set to be as sharp as possible. However, on the other hand, weaknesses might included the objective nature of the main study point which is the pain. Pain and consequently, local anaesthesia assessment depended by far on patient's judgment. Psychological aspect which affects patient's pain threshold, perception, and reaction might had its impact on the results. Since the current study is a trial to introduce a novel technique that might provide the clinicians with a new tool with some merits, further studied are required.

CONCLUSION

Although the conventional inferior alveolar nerve block is the most applied nerve block technique in Dentistry, it remains the most frustrating. Inconsistent landmarks might account for its relatively high failure rate. While the novel technique achieved higher success rate (98.68%) than the conventional technique (88.16%), all other local anaesthesia assessment parameters were comparable. This conveys a message that the novel technique might be a good substitute to the conventional technique. The novel technique depends on relatively few, consistent, and easy to concurrently visualize extraoral landmarks, which might account for its simplicity, accuracy, and high success rate.

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None.

Declaration of Competing Interest

The Author declares no conflict of interest.

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