Original Article

Comparison of Inferior Alveolar Nerve Block Anesthesia Using Direct and Indirect Techniques in terms of Blood Aspiration Probability

Mahdi Gholami[1], Hakimeh Alemi[2], Ali Labafchi[3]

[1] Associate Professor, Department of Oral and maxillofacial surgery, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran
[2]Dentists, Mashhad, Iran
[3]Student Research Committee, Mashhad University of Medical Sciences, Mashhad, Iran

Received 5 November 2021 and Accepted 11 May 2022

Abstract

Introduction: This prospective double-blinded clinical trial study aimed to compare the direct and indirect techniques of inferior alveolar nerve block (IANB) anesthesia regarding positive aspiration and success rate.

Methods: This study included all 250 healthy patients who were referred to the Oral and Maxillofacial Surgery Department, Mashhad Dental School, Mashhad, Iran, for lower teeth extraction. The patients were randomly assigned to two groups. In total, 126 patients were subjected to IANB by a direct technique, and an indirect technique was utilized to perform IANB on the others. The primary and secondary outcomes were positive aspiration and anesthetic success, respectively. The data were statistically analyzed with SPSS software (version 19) using the Chi-square test. **Results:** The positive aspiration rates were 23 (18.3%) and 7 (5.6%) in the direct and indirect groups, respectively, which was statistically significant (P=0.002). The incidence rates of positive aspiration on the right and left sides were 13 (11%) and 17 (12.9%), respectively, which had no significant difference (P=0.651). Moreover, the success rates of direct and indirect techniques were 106 (84.1%) and 93 (75%) respectively, which was not statistically significant. It is worth mentioning that the success rates were similar on the right (79.7%) and left (79.5%) sides.

Conclusion: According to the established results, the indirect technique of IANB has a significantly less positive aspiration rate, compared to the direct technique. This advantage is especially valuable in high-risk patients undergoing inadvertent intravascular injection of an anesthetic drug, which can lead to catastrophic complications.

Keywords: Aspiration, Inferior alveolar nerve block, Local Anesthetic, Mandible

---

Gholami M, Alemi H, Labafchi A. Comparison of Inferior Alveolar Nerve Block Anesthesia Using Direct and Indirect Techniques in terms of Blood Aspiration Probability. J Dent Mater Tech 2022; 11(3): 152-157.

Introduction

Appropriate administration of local anesthesia is the initial step in most dental procedures. Aspiration before injection of the anesthetic substance is one of the most important steps that is often neglected. Strict adherence to performing aspiration can prevent possible systemic complications and medical emergencies associated with intravascular anesthetic substance injection. Several factors, such as age, weight, psychological state, vascular density in the area of injection, technique and speed of injection, as well as the vasoconstrictors which are added to anesthetics cartridges, increase the chances of anesthetic toxicity (1-5).

An aspirating syringe should be used to avoid intravascular injection. There is a relationship between positive aspiration and the site of injection. The standard inferior alveolar nerve block (IANB) and mental nerve block are the most frequent techniques with positive aspiration (6, 7). The standard IANB which is very common and popular among dentists is used for anesthetizing teeth and soft tissue on one side of the mandible and also the anterior part of the tongue. The common causes of standard IANB failure include some anatomical variations in the mandibular foramen and nerve branches, the presence of cysts or abscess in the area, chronic alcoholism and incorrect implementation of the injection technique, which is actually considered the

major cause. There are several techniques for implementing IANB, the most prevalent of which are the direct and indirect techniques (8-12).

The literature describes a variety of strategies for blocking the inferior alveolar nerve, each with its own benefits and drawbacks. While some techniques are widely used across the world, dentists are still unfamiliar with other newly modified and recently published approaches. There are two techniques in the literature, namely indirect and direct, to reach the inferior alveolar nerve where it enters the mandibular canal. These techniques differ in the number of movements required (13). Malamed's direct technique is the most commonly used technique in dentistry. The needle is inserted in the area of the mandibular foramen, where the inferior alveolar nerve is positioned before it enters the foramen in order to block the inferior alveolar nerve (11).

In the indirect technique which is a modified version of Malamed's direct technique, the needle is inserted 1 cm above the occlusal plane with the syringe barrel located at the occlusal surface at the same site. After touching the bone on the medial surface of the coronoid notch, the syringe is moved away from the bone and the needle is advanced while it is in contact with the bone at a distance of 30-34 mm. After the second bone contact at this depth, aspiration is performed, and if negative, the entire cartridge is administered within 1 minute of time (14).

In light of the aforementioned issues, the present study aimed to compare the incidence of positive aspiration between direct and indirect IANB. Moreover, it was attempted to identify which technique is more efficient and leads to fewer complications. The hypothesis of the present study is that there is no difference in this respect between the two techniques.

Materials and Methods

This randomized double-blinded clinical trial study was performed in the Oral and Maxillofacial Surgery Department, Mashhad Dental School, Mashhad, Iran, from September 2017 to June 2018. The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran (IR.mums.sd.REC.1394.264). Moreover, this trial was registered in the Iranian Registry of Clinical Trials (IRCT20170603034304N2).

This study included 250 healthy systemic male and female patients with an American Society of Anesthesiologist (ASA) status I or II, within the age range of 16-70 years who required IANB for extraction of one or mandibular teeth. The exclusion criteria entailed the presence of trismus or local infection at the injection site, hemophilia and allergies to amide anesthetic substances.

After obtaining written informed consent, the patients were randomly assigned to two equivalent groups of direct and indirect IANB using the table of random numbers. According to the Consort guidelines, random codes were applied based on the number of patients so that each patient was randomly assigned a code. It should be noted that the participants and statistics consultants were blinded to the group allocation.

Patients received IANB using 2% lidocaine with 1:100,000 epinephrine. Mandibular molar tooth extraction began after ensuring the subjective and objective signs of anesthesia in all patients (15). Regarding the standard (direct) technique of IANB, the nerve was approached from the opposite side of the mouth over the contralateral premolars. The medial surface of the bone was touched after piercing the mandibular tissue 1 cm above the occlusal plane on the medial border of the mandibular ramus within the pterygomandibular space. The needle was withdrawn 2 mm, and aspiration was then performed before the local anesthetic was deposited. The penetration depth of the needle usually ranges from 19-25 mm, and inserting the needle more than 25 mm may indicate that its position is more posterior towards the posterior border of the mandible. A premature touch of the bone indicates an anterior position of the needle (14).

Aspirable syringes with 34 mm length and 27-gauge needle (AVA, Iran) were used in this study. All anesthesia was achieved with 2% lidocaine with 1:100,000 epinephrine. A right-hand dominant oral and maxillofacial surgeon performed all IANBs, while following the principles of injection. Any blood observed in the anesthetic cartridge during aspirating was considered a positive case for aspiration and was recorded in a corresponding form for each patient. Moreover, the success of both IANB techniques was checked 3-5 minutes after injection was completed. In unsuccessful cases, re-injection was carried out 5 minutes later. Due to the fact that soft tissue damage during the first injection could possibly cause false positive aspiration during the second injection; therefore cases who required another injection were excluded from the study.

Patients were instructed to rate any discomfort during extraction using a Heft-Parker visual analog scale (HP VAS). Regarding the pain severity, this 170-mm HP VAS was classified into four categories, including no pain (0 mm), mild (greater than 0 mm and less than or equal to 54 mm), moderate (greater than 54 mm and less than 114 mm), and severe (greater than or equal to 114

mm). It should be noted that mild pain included descriptors of faintness and weakness. The achievement of the IANB was determined as the ability to extract the tooth without pain (VAS score of zero) or just mild pain (VAS rating ≤54 mm).

The demographic characteristics of the patients (i.e., age and gender) were also recorded in this study. The data were analyzed with SPSS software (version 19) (SPSS Inc., Chicago, IL) using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

Results

In total, 250 participants were included in this study, the majority of whom were female (n=131, 52.4%). The mean age of the participants was 35.9±13.4 years (age range: 16-70 years). Subsequently, participants were assigned to two groups of direct (63 males and 63 females with a mean age of 37.8±14.5 years) and indirect (56 males and 68 females with a mean age of 34.0±11.8 years). Out of 250 injections, 118 (47.2%) and 132 (52.8%) injections were performed on the right and left sides of the mandible, respectively.

Positive aspirations were observed in 23 (18.3%) and 7 (5.6%) participants in the direct and indirect groups, respectively. This difference was considered statistically significant. Moreover, the number of positive aspirations on the right and left sides were 13 (11%) and 17 (12.9%), respectively. The distribution of positive aspiration was not significantly different between the two sides (Table I).

Table I. Frequency (percent) of aspiration in groups (direct and indirect) and sides (left and right)

Variables		Aspiration N (%)		
		+	-	P-value
Technique	Direct	23 (18.3)	103 (81.7)	0.002
	Indirect	7 (5.6)	117 (94.4)	
Side	Left	13 (11)	105 (89)	0.651
	Right	17 (12.9)	115 (87.1)	

The anesthesia success rates were 106 (84.1%) and 93 (75%) in the direct and indirect techniques, respectively; nonetheless, the difference was not significant. Considering the success rate on both sides, 94 (79.7 %) and 105 (79.5%) successful IANBs were observed on the right and left sides, respectively. In general, there was no significant difference between both sides regarding the success of IANB anesthesia (Table II).

Table II. Frequency (percent) of anesthesia in groups (direct and indirect) and sides (left and right)

Variables		Aspiration N (%)		
		+	-	P-value
Technique	Direct	106 (84.1)	20 (15.9)	0.073
	Indirect	93 (75)	31(25)	
Side	Left	105 (79.5)	27 (20.5)	0.982
	Right	94 (79.7)	24 (20.3)	

As illustrated in Table III, on the right side, 76.8% (n=43) and 82.3% (n=51) of the patients were anesthetized by direct and indirect techniques, respectively, with no statistically significant difference between them in this regard. On the other hand, a significant difference was

observed on the left side between the patients who were anesthetized by direct technique (n=63, 90%) and those who underwent the indirect technique (n=42, 67.7%) (Table III).

Table III. Comparison of the frequency (percent) distribution of anesthesia between direct and indirect groups regarding the left and right side

Side	Technique	Aspiration N (%)		Total N (%)	P-value
		+	-		
Right	Direct	43 (76.8)	13 (23.2)	56	0.461
	Indirect	51 (82.3)	11 (17.7)	62	
Left	Direct	63 (90.0)	7 (10.0)	70	0.002
	Indirect	42 (67.7)	20 (32.3)	62	

Discussion

The rate of positive aspiration was significantly lower in the indirect technique (5.6%), compared to that in the direct technique (18.3 %) (P=0.444). Moreover, the success rate of anesthesia was higher in the direct technique; however, the difference was not significant. Furthermore, an experienced clinician performed all injections with a single type of aspirating syringe and standard needle in order to eliminate the confounding factors and standardize the study.

Delgado-Molina et al. (1999) used three different syringes and two IANB methods in their study. According to their results, there was no significant difference between the two techniques in terms of aspiration rate (16). Moreover, the results of the aforementioned study were not consistent with the findings of the present research, which may be due to the use of multiple syringes. In addition, in line with the results of this study, Todorovic et al. compared three IANB methods (i.e., Direct, Akinosi, and Gow-Gates) and reported that the direct technique demonstrated the highest positive aspiration rate (17).

The number of participants was equal in both groups (i.e., direct and indirect techniques) in order to achieve more precise results (125 subjects per group). This signifies the reliability of the results of this research, compared to those obtained in another study conducted by Zenous et al. who performed direct and indirect techniques on 88% and 12% of the participants, respectively (4). They observed no significant difference between the two methods regarding the rate of aspiration. The inconsistency between the results of the mentioned research and the findings of this study can be attributed to the fact that three different clinicians performed the injections, as well as the inequal number of injections per clinician. Moreover, since this study included a larger sample size (n=350) compared to the present study (n=250), the results may be contradictory (4).

Both groups were evaluated regarding the applied injection technique, age, and gender. It is noteworthy that no significant difference was observed between the groups in this regard. Consistent with the findings of the present research, these factors were also reviewed in the studies conducted by Delgado-Molina et al., Mclean et al., and Taghavi Zenouz et al.(4, 18, 19). Furthermore, there was no significant difference between the two different IANB methods regarding anesthetic success rates. This finding has been confirmed in several similar studies (19-21).

One of the reasons for high IANB failure rates was anatomical variations. One of the factors contributing to the success rate is the determination of the anatomical position of the mandibular foramen and the prominence of the lingula. Accordingly, studies recommend using Gow-Gates and Vazirani-Akinosi techniques instead of IANB. Moreover, Ghoddusi et al. found no significant difference between Gow-Gates and IANB in terms of heart rate or positive aspiration (1, 22, 23). The anesthetic solution used in the present study was a 2% lidocaine cartridge (with epinephrine 1: 100,000) which is the most commonly used anesthetic solution worldwide. Various volumes (i.e., 1.8, and 3.6 cc) and different concentrations (i.e., 2% and 4%) of lidocaine were used in a study conducted by Vreeland et al.

In a similar vein, Mclean et al. compared IANB with lidocaine 2% (with epinephrine 1: 100,000) to Prilocaine 4% (with epinephrine 1: 200,000) and Mepivacaine 2% (with levonordefrin 1: 200000). The findings of the cited

study pointed out that the type, concentration, and volume of the anesthetic drugs were not directly associated with the success of anesthesia, compared to the results of the present study (18, 24). Moreover, Milani et al. found that the use of 1.8-3.6 mL of anesthetic agent significantly increased the success rate of IANB (25).

Conclusion

Although the indirect IANB technique demonstrated a lower success rate compared to the direct technique; the main advantage of this technique was a significantly lower positive aspiration rate, which differs it from the direct technique. This advantage is of great clinical value, especially in patients who are at a higher risk of intravascular injection of anesthetic drugs.

Conflicts of Interest

The authors have no conflict of interest to declare.

Acknowledgments

The authors would like to appreciate the continued support of the Research Council of Mashhad University of Medical Sciences and the Student Research Committee of Mashhad University of Medical Sciences, Mashhad, Iran.

References

1. Prabhu Nakkeeran K, Ravi P, Doss GT, Raja KK. Is the Vazirani-Akinosi Nerve Block a Better Technique Than the Conventional Inferior Alveolar Nerve Block for Beginners? J Oral Maxillofac Surg. 2019;77(3):489-492.

2. Kim C, Hwang KG, Park CJ. Local anesthesia for mandibular third molar extraction. J Dent Anesth Pain Med. 2018;18(5):287-294.

3. Pourkazemi M, Erfanparast L, Sheykhgermchi S, Ghanizadeh M. Is Inferior Alveolar Nerve Block Sufficient for Routine Dental Treatment in 4- to 6-year-old Children? Int J Clin Pediatr Dent. 2017;10(4):369-372.

4. Zenouz AT, Ebrahimi H, Mahdipour M, Pourshahidi S, Amini P, Vatankhah M. The incidence of intravascular needle entrance during inferior alveolar nerve block injection. J Dent Res Dent Clin Dent Prospects. 2008;2(1):38-41.

5. Shahakbari R, Labafchi A, Salami S, Samieirad S. Piezotome versus surgical bur: which is more effective in reducing the postoperative pain and edema following open sinus lift surgery? J Maxillofac Oral Surg. 2021;20(4):642-648.

6. Ghasemi D, Rajaei s, Aghasizadeh E. Comparison of Inferior Dental Nerve Block Injections in Child Patients Using 30-Gauge and 27-Gauge Short Needles. J Dent Mater Tech. 2014;3(2):71-76.

7. Shaban B, Moradi E, Nejat AH, Sabzali Zanjanhkhah S, Vaezi T. Hemodynamic Effect of 2% Lidocaine with 1:80,000 Epinephrine Infiltration in Maxillofacial Surgeries under General Anesthesia. J Dent Mater Tech. 2013;2(1):17-20.

8. Wong G, Apthorpe HC, Ruiz K, Nanayakkara S. Student-to-Student Dental Local Anesthetic Preclinical Training: Impact on Students' Confidence and Anxiety in Clinical Practice. J Dent Educ. 2019;83(1):56-63.

9. Yilmaz K, Tunga U, Ozyurek T. Buccal infiltration versus inferior alveolar nerve block in mandibular 2(nd) premolars with irreversible pulpitis. Niger J Clin Pract. 2018;21(4):473-477.

10. Haas DA. Alternative mandibular nerve block techniques: a review of the Gow-Gates and Akinosi-Vazirani closed-mouth mandibular nerve block techniques. J Am Dent Assoc. 2011;142 Suppl 3:8s-12s.

11. Vasconcelos BC, Freitas KC, Canuto MR. Frequency of positive aspirations in anesthesia of the inferior alveolar nerve by the direct technique. Med Oral Patol Oral Cir Bucal. 2008;13(6):E371-374.

12. Biocic J, Brajdic D, Peric B, Danic P, Salaric I, Macan D. A Large Cheek Hematoma as a Complication of Local Anesthesia: Case Report. Acta Stomatol Croat. 2018;52(2):156-159.

13. Palti DG, Almeida CMd, Rodrigues AdC, Andreo JC, Lima JEO. Anesthetic technique for inferior alveolar nerve block: a new approach. J Appl Oral Sci. 2011;19(1):11-15.

14. Khalil H. A basic review on the inferior alveolar nerve block techniques. Anesth Essays Res. 2014;8(1):3-8.

15. Heft MW, Parker SR. An experimental basis for revising the graphic rating scale for pain. Pain. 1984;19(2):153-161.

16. Delgado-Molina E, Bueno-Lafuente S, Berini-Aytes L, Gay-Escoda C. Comparative study of different syringes in positive aspiration during inferior alveolar

nerve block. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1999;88(5):557-560.

17. Todorovic L, Stajcic Z, Petrovic V. Mandibular versus inferior dental anaesthesia: clinical assessment of 3 different techniques. Int J Oral Maxillofac Surg. 1986;15(6):733-738.

18. McLean C, Reader A, Beck M, Meryers WJ. An evaluation of 4% prilocaine and 3% mepivacaine compared with 2% lidocaine (1:100,000 epinephrine) for inferior alveolar nerve block. J Endod. 1993;19(3):146-150.

19. Delgado-Molina E, Tamarit-Borras M, Berini-Aytes L, Gay-Escoda C. Evaluation and comparison of 2 needle models in terms of blood aspiration during truncal block of the inferior alveolar nerve. J Oral Maxillofac Surg. 2003;61(9):1011-1015.

20. Delgado-Molina E, Tamarit-Borras M, Berini-Aytes L, Gay-Escoda C. Comparative study of two needle models in terms of deflection during inferior alveolar nerve block. Med Oral Patol Oral Cir Bucal. 2009;14(9):e440-444.

21. Aggarwal V, Jain A, Kabi D. Anesthetic efficacy of supplemental buccal and lingual infiltrations of articaine and lidocaine after an inferior alveolar nerve block in patients with irreversible pulpitis. J Endod. 2009;35(7):925-929.

22. Ghoddusi J, Zarrabi MH, Daneshvar F, Naghavi N. Efficacy of IANB and Gow-Gates Techniques in Mandibular Molars with Symptomatic Irreversible Pulpitis: A Prospective Randomized Double Blind Clinical Study. Iran Endod J. 2018;13(2):143-148.

23. Khalil H. A basic review on the inferior alveolar nerve block techniques. Anesth Essays Res. 2014;8(1):3-8.

24. Vreeland DL, Reader A, Beck M, Meyers W, Weaver J. An evaluation of volumes and concentrations of lidocaine in human inferior alveolar nerve block. J Endod. 1989;15(1):6-12.

25. Milani AS, Froughreyhani M, Rahimi S, Zand V, Jafarabadi MA. Volume of Anesthetic Agents and IANB Success: A Systematic Review. Anesth Prog. 2018;65(1):16-23.

Corresponding Author
Ali Labafchi
Dental student at MUMS, Student Research Committee, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran
Tell: +989158903237
Email: labafchiali@yahoo.com