

Research Paper: Performance of Senior Dental Students in Inferior Alveolar Nerve Block Injection: A Cross-sectional Study



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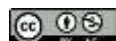
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ABSTRACT



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Keywords:

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Introduction: Dental students and interns have experienced inferior alveolar nerve block (IANB) failures in their clinical practice. The current study was designed to assess the performance of senior dental students in the injection of IANB.

Materials and Methods: This analytic cross-sectional study included 23 senior dentistry students. The dental students were included if they were willing to participate in this study and 115 patients requiring inferior alveolar nerve block injection referred to the oral and maxillofacial department of the university were enrolled in this study. The demographic data of the students and patients were recorded. After the IANB injection, pain at the entrance of the needle, the subjective onset of the injection, and the success of the injection were recorded. The data was analyzed by SPSS version 26. The independent t-test and chi-square were applied at the significance level of 0.05.

Results: The patients significantly reported “no pain” more frequently than “painful” when the needle entered the mucosa ($P=0.038$). The “good onset” was significantly reported more often than “acceptable onset” and “failed onset” ($P=0.012$, and $P=0.001$, respectively). The “acceptable onset” was more frequently recorded than the “failed onset”. ($P=0.049$) The “successful” IANB injection was significantly more frequent than “failure. ($P=0.023$) Gender and age of students had no significant relation with the overall success of IANB injection. ($P=0.683$, and $P=0.549$, respectively) Gender and age of patients also had no significant relation with the overall success of IANB injection. ($P=0.889$, and $P=0.896$, respectively)

Conclusion: The senior dental students were mainly successful in the IANB injection.

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1. Introduction

Local anesthesia is a critical part of dentistry that relieves the pain and discomfort of oral and dental procedures (1,2). In 1884, Richard and Halsted achieved mandibular anesthesia for the first time by injecting cocaine solution (3). The Inferior Alveolar Nerve Block (IANB) technique is the most important anesthesia technique in the mandible used for many dental procedures such as restorative treatments, tooth extraction, dental implant and periodontal surgeries, and endodontic procedures (4-7). In this technique, the pulp and periodontium of mandibular teeth, half of the tongue, and half of the lower lip are anesthetized (8,5).

In some studies, the failure of IANB was estimated to range between 30% to 83% (9-14). The failure of IANB often cannot be overcome by repeated injection of IANB (15). One of the causes of failure in IANB injection can be attributed to anatomical differences in different people, increased bone density in elderly patients, bifid lower alveolar nerve, presence of subsidiary nerves that are involved in the innervation of the mandible teeth, lack of access to the injection area due to masculine masseters and the biological diversity in the way of response to anesthetic drugs (16-20). Infection and inflammation in the periapical area and surrounding periodontium along with psychological factors such as fear and anxiety can increase the chances of IANB failure (21-23). Errors of the operator can be the most common cause of IANB failure (19,22). According to previous studies, many dental students and interns have experienced inferior nerve block failures in their clinical practice (24,25). Therefore, a dental practitioner needs to be familiar with the precise method of injecting IANB to achieve deep and successful local anesthetics (17,20,24).

Due to the importance and widespread use of the IANB technique and the difficulty of performing this technique, the current study was designed to assess the performance of senior dental students in the injection of IANB. The data of the current study can be used to increase knowledge and enhance the performance of dental students regarding the IANB technique to achieve deep and successful anesthesia and guarantee the patient's comfort during dental procedures.

2. Materials and Methods

This analytic cross-sectional study included 23 senior dentistry students of Guilan University of Medical Science to assess their performance in the injection of the inferior alveolar nerve block technique. The dental students were included if they were willing to participate in this study and were educated about the standard technique of IANB injection on models prior to the study. The standard technique was as following: The insertion point was on an imaginary line drawn from the deepest part of the pterygomandibular raphe to the coronoid notch. The location of the insertion point on this line was one quarter the distance towards the pterygomandibular raphe above the occlusal plane of the lower teeth; the syringe barrel should be located at the opposite site at the premolars during injection. 115 patients requiring inferior alveolar nerve block injection referred to the oral and maxillofacial department of the university were enrolled in this study. After explaining the aims of the current study, written consent was obtained from the students and the patients.

Students who were not educated about the standard technique of IANB injection on models and patients with systemic diseases (hyperthyroidism, hypertension), pathological problems, periapical infection, psychological problems, the use of psychological medicines, the use of alcohol or drugs, anatomical anomalies, or previous IANB injection in the last week were excluded from the study. Sample size was calculated to be 111 according to the study of Ghavimi et al. using the following formula at the coefficient of confidence of 95% (26).

$$n = \frac{Z_{1-\frac{\alpha}{2}}^2 p(1-p)}{d^2}$$

$$N = 1.96 * (0.83 * 0.17) / (0.05)^2$$

The IANB was performed using a cartridge containing lidocaine 2% and epinephrine 1:100.000 (Persocaine-E, Darou Pakhsh); a long (30mm) 27-gauge needle (27L, Avapezeshk); and a self-aspirating syringe. The patient was asked to open the mouth completely and the patient's ramus was determined by the student's index and thumb fingers. The thumb was placed on the anterior

border of the ramus. The index finger was placed outside the mouth at the same height as the thumb. One-third anterior from the pterygomandibular raphe or two-thirds posterior from the anterior border of the ramus was determined. The needle entered the injection site from the opposite premolar at 10 mm higher than the occlusal surface of the mandibular molar. The needle was inserted until it touched the bone, usually, two-thirds of a long needle (15-20mm) was needed to enter the tissue. After the aspiration, 1.5 ml of the solution was slowly injected for 1 minute. The injection was performed under supervision of an instructor but the instructor did not interfere with the injection process unless a danger could have happened upon the incorrect injection of the students.

The demographic data (age and gender) of the students and patients were recorded. To assess the student's performance, pain at the entrance of the needle, the subjective onset of the injection, and the success of the injection were recorded. Pain at the entrance of the needle was reported as "painful" or "no pain". The subjective onset of the injection was evaluated using an electric pulp test. Five minutes post-injection, the patient's mandibular first premolar was isolated using a cotton roll. The tip of the electric pulp test was set on the cervical one-third of the first premolar's buccal surface, and the electricity flow was slowly increased. If the patient felt no pain the subjective onset of the anesthesia was reported as positive meaning that the patient was anesthetized. If the patient felt pain the subjective onset of the anesthesia was reported as negative meaning that the patient was not anesthetized and the test was repeated three times with 5 minutes. If the patient felt no pain at the first test, the subjective onset of the injection was

recorded as "good onset"; if the patient felt no pain at the second test, the onset was recorded as "acceptable onset"; and if the patient felt no pain at the third test, the onset was recorded as "failed onset". If the patient was completely anesthetized after 20 minutes, the overall success of the injection was reported as "successful", and if not, it was reported as a "failure".

The data was analyzed by Statistical Package for the Social Sciences (SPSS) version 26 (IBM Corp, Armonk, NY, USA). The Pearson correlation coefficient, independent t-test, and ANOVA were applied at the significance level of 0.05.

3. Results

In this study, the data of 115 injections was analyzed. No data was excluded. The data distribution was normal. The mean and standard deviation of the students and patients' age was 24.96 ± 1.58 and 32.16 ± 7.42 years respectively. 52.3% of the students were female and 47.7% were male. 51.4% of the patients were female and 48.6% of the patients were male. The prevalence of females and males was significantly indifferent in students and the patients according to independent t-test. ($P=0.899$, and $P=0.965$, respectively)

According to Table 1, the patients significantly reported "no pain" more frequently than "painful" when the needle entered the mucosa according to independent t-test ($P=0.038$). Subjective onset of the injection was significantly different ($P=0.001$). According to ANOVA, the "good onset" was significantly reported more often than "acceptable onset" and "failed onset" ($P=0.012$, and $P=0.001$, respectively). The "acceptable onset" was more frequently recorded than the "failed onset". ($P=0.049$).

Table 1. The frequency of answers to the assessed parameters

Parameters		Percentage	Number	P value
Pain when the needle entered the tissue	No Pain	86.5%	99	0.038*
	Painful	13.5%	16	
Subjective onset of the injection	Good	77.5%	89	0.001*
	Acceptable	15.3%	17	
	Failed	7.2%	9	
Success of the injection	Successful	74.8%	86	0.023*
	Failure	25.2%	29	

* Significant

The "successful" IANB injection was significantly more frequent than "failure according to

independent t-test. ($P=0.023$) Gender and age of students had no significant relation with the overall success of IANB injection according to independent t-test and Pearson correlation coefficient. ($P=0.683$, and $P=0.549$, respectively) Gender and age of patients also had no significant relation with the overall success of IANB injection according to independent t-test and Pearson correlation coefficient. ($P=0.889$, and $P=0.896$, respectively).

4. Discussion

The results of this study showed that the injection was successful in the majority (74.8%) of the patients and failed only in 25.2% of the cases. Madan et al. mentioned 5 reasons for the failure of the IANB technique, which include pathological, pharmacological, physiological, anatomical factors, and the wrong technique used by the dentist (25). In the present study, the patients with systemic diseases (hyperthyroidism, hypertension), pathological problems, periapical infection, psychological problems, the use of psychological medicines, the use of alcohol or drugs, anatomical anomalies, or previous IANB injection in the last week were excluded from the study. Therefore, in the current study, the most important reason for the failure of this technique was the lack of skills of dental students.

Numerous reports indicate the prevalence of IANB injection failure. The results of Ghavimi et al. (2019) on fifth-year dental students in Tabriz showed that their success rate in injecting the IANB technique was 73.3% (26). The result of Ghavimi et al. was similar to the current study. (74.8%) Although Ghavimi et al. (2019) assessed the performance of fifth-year students and in this study, sixth-year students were enrolled, the difference in the success rate of IANB injection was not notably different (26).

In another study, Ghavimi et al. (2015) showed the success rate of the IANB technique was 93.5% and 71% with and without the use of panoramic radiography (27). The success rate of IANB without the use of panoramic radiography in the study of Ghavimi et al. (2015) was similar to the current study as radiographic guidance was not used in this study as well (27). However, the success rate of IANB with the use of panoramic radiography was higher than in this study (27). Panoramic

radiography can provide an image of the area and the anatomical variations helping the clinician to determine the notch and the entrance point of the injection needle better (28).

Hoseinitodashki et al. reported the success rate of the IANB technique in 10th-semester dental students in Tehran to be 70%, while this rate was 90% for their professors or residents of the oral and maxillofacial surgery department (29). Their results in the 10th-semester dental students were similar to the current study. (74.8%) Although Hoseinitodashki et al. (2019) assessed the performance of fifth-year students and in this study, sixth-year students were enrolled, the difference in the success rate of IANB injection was not notably different (29). However, the success rate of IANB in the professors or residents of the oral and maxillofacial surgery department was remarkably higher than in this study. This emphasizes the importance of experience in obtaining successful IANB anesthesia (30).

Haghighat et al. found the success rate of the IANB technique in dentists of Isfahan to be 80.82% which was higher than this study (31). Dentists have more working experience than senior dental students which explains why the success rate of IANB was higher in the study of Haghighat et al. than the current study (31).

Aliabadi and Keshavarz claimed that the success rate of IANB technique in dental students of Shiraz University of Medical Sciences was 47.1% for beginners without injection experience and 64.30% for students with one year of IANB injection experience (32). The results of their study were particularly lower than the current study. The students in this study were senior students with three years of experience in the injection of IANB, while, in the study of Aliabadi and Keshavarz the students had either no experience or one year of experience (32). Again, this finding draws attention to the importance of experience in performing more successful IANB injections (30).

In this study, the subjective onset of the injection was “good” in 77.5% (89) of the patients, “acceptable onset” in 15.3% (16), and “failed onset” in 7.2% (5) of the patients. The “good onset” was significantly reported more often than “acceptable

onset” and “failed onset. This was in line with the study of Kriangcherdsak et al. (2016), in which the success rate of dental students in Thailand who had never performed IANB, was evaluated and the onset time was approximately 0-5 minutes for almost half of the dentists (47.37% for subjective onset and 43.16% for objective onset) (30). These researchers reported that the only influencing factor in the success of local anesthesia is the operator of the injection (30). The discrepancy between the results may indicate the important role of proper training in reducing the failure rate of this technique. Also, since the anatomical and genetic variation is different in different societies and this variation also exists regarding the lower alveolar nerve and its different paths, the percentage of injection success can vary in different societies. According to Keetley and Moles, the skill of the dentist is one of the key factors related to anesthesia failure (33). However, other influential factors including the dentist, the injection technique, and the patient should be taken into account (4).

The results of this study showed that the success rate of IABN injection was not significantly different between male and female students. This finding was similar to the study by Ghavimi et al. (2019) that there was no significant difference in the success rate of IABN injection between male and female students in third, fourth, and fifth-year dental students (26).

One of the limitations of this study was the small sample size. Also, it should be mentioned that the performance of the students in the injection of other techniques was not assessed. For future studies, it is recommended to evaluate the performance of dental students in a larger sample size regarding IANB injection and other injection techniques and assess the performance of general dentists regarding these injection techniques.

5. Conclusion

The results of this study showed that 86.5% of the patients reported “no pain” when the needle entered the tissue and the remaining 13.5% reported “painful” when the needle entered the tissue. The subjective onset of the injection was “good” in

77.5% of the patients, “acceptable onset” in 15.3%, and “failed onset” in 7.2% of the patients. The “good onset” was significantly reported more often than “acceptable onset” and “failed onset”. The “acceptable onset” was more frequently recorded than the “failed onset”. The IANB injection was successful in 74.8% of the patients and failed only in 25.2% of the cases. Gender and age of students and patients had no significant relation with the overall success of IANB injection.

Ethical Considerations

The study has been approved by the Ethics Committee of the Research and Technology Vice-Chancellor of Guilan Faculty of Medical Sciences and Health Services (Ethics code: IR.GUMS.REC.1400.486).

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Authors' Contributions

Isa Abdi: Conceptualization, Funding Acquisition, Methodology, Writing-review & editing
Seyedeh Fatemeh Masoumi Fakhabi: Investigation, Methodology, Project administration, Writing-Original draft, Writing-review & editing
Saeid Jameei Oskoue: Conceptualization, Investigation, Methodology, Writing-Original draft, Writing-review & editing
AmirHossein SohrabiFar: Investigation, Methodology, Writing-Original draft
Samira Rostami Estabragh: Conceptualization, Investigation, Methodology, Writing-Original draft, Writing-review & editing
Dina Maleki: Formal analysis, Investigation, Project administration, Visualization, Writing-Original draft, Writing-review & editing.

Conflict of Interests

None.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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References

1. Althafy M, Sodhi GS, Khan J. Efficacy of computer-controlled local anesthesia delivery system on pain in dental anesthesia: a systematic review of randomized clinical trials. *J Dent Anesth Pain Med.* 2024;24(4):245. [DOI: 10.17245/jdapm.2024.24.4.245] [PMID] [PMCID]
2. Bani-Hani T, Al-Fodeh R, Tabnjh A, Leith R. The Use of Local Anesthesia in Pediatric Dentistry: A Survey of Specialists' Current Practices in Children and Attitudes in Relation to Articaine. *Int J Dent.* 2024;2024(1):2468502. [DOI: 10.1155/2024/2468502] [PMID] [PMCID]
3. Matas R. The story of the discovery of dental anesthesia by nerve blocking; achievements of William Stewart Halsted. *Surgery.* 1952;32(3):530-7. [PMID]
4. Noguchi T, Odaka K, Fukuda KI. Clinical Application of Inferior Alveolar Nerve Block Device for Safe and Secure IANB by Any Operator. *Pain Res Manag.* 2023;2023(1):1021918. [DOI: 10.1155/2023/1021918] [PMID] [PMCID]
5. Orafi M, Abd Elmunem H, Krishnaraaj S. Efficacy of inferior alveolar nerve block and intraligamentary anesthesia in the extraction of primary mandibular molars: A randomized controlled clinical trial. *Saudi Dent J.* 2023 ;35(5):567-73. [DOI: 10.1016/j.sdentj.2023.05.011] [PMID] [PMCID]
6. Sajadi FS, Poureslami P, Hajmohammadi S, Saeedi B, Hasheminejad J. A Comparison between Inferior Alveolar Nerve Block and Crestal Anesthesia in Children Undergoing Dental Extraction Procedure. *PBOCI.* 2023;23: e220036. [DOI:10.1590/pboci.2023.060]
7. Shah A, Siddiqui MA, Umair MS, Sukkarwalla A, Shoaib T, Qureshi MR. Pain Perception between local infiltration and inferior alveolar nerve block (IANB) injection techniques in patients undergoing orthodontic lower premolar extractions. *Medical Journal of South Punjab.* 2024 Mar 22;5(01):41-6. [DOI:10.61581/MJSP.VOL05/01/07]
8. Hashemi IS, Maleki D, Monir SE, Ebrahimi A, Tabari R, Mousavi E. Effects of Diode Low-Level Laser Therapy of 810 Nm on Pulpal Anesthesia of Maxillary Premolars: A Double-Blind Randomized Clinical Trial. *Eur Endod J.* 2021;6(2):155. [DOI: 10.14744/eej.2020.41636] [PMID] [PMCID]
9. Reisman D, Reader A, Nist R, Beck M, Weaver J. Anesthetic efficacy of the supplemental intraosseous injection of 3% mepivacaine in irreversible pulpitis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1997 ;84(6):676-82. [DOI: 10.1016/s1079-2104(97)90372-3] [PMID]
10. Nusstein J, Reader A, Nist R, Beck M, Meyers WJ. Anesthetic efficacy of the supplemental intraosseous injection of 2% lidocaine with 1: 100,000 epinephrine in irreversible pulpitis. *J Endod.* 1998;24(7):487-91. [DOI: 10.1016/S0099-2399(98)80053-8] [PMID]
11. Lindemann M, Reader A, Nusstein J, Drum M, Beck M. Effect of sublingual triazolam on the success of inferior alveolar nerve block in patients with irreversible pulpitis. *J Endod.* 2008;34(10):1167-70. [DOI: 10.1016/j.joen.2008.07.013] [PMID]
12. Kennedy S, Reader A, Nusstein J, Beck M, Weaver J. The significance of needle deflection in success of the inferior alveolar nerve block in patients with irreversible pulpitis. *J Endod.* 2003;29(10):630-3. [DOI: 10.1097/00004770-200310000-00004] [PMID]
13. Fowler S, Drum M, Reader A, Beck M. Anesthetic success of an inferior alveolar nerve block and supplemental articaine buccal infiltration for molars and premolars in patients with symptomatic irreversible pulpitis. *J Endod.* 2016;42(3):390-2. [DOI: 10.1016/j.joen.2015.12.025] [PMID]
14. Aggarwal V, Singla M, Subbiya A, Vivekanandhan P, Sharma V, Sharma R, Prakash V, Geethapriya N. Effect of preoperative pain on inferior alveolar nerve block. *Anesth Prog.* 2015;62(4):135. [DOI: 10.2344/15-00019.1] [PMID] [PMCID]
15. Wasif AS, Najeel W, Aslam M, Hassan H, Hassan M. Efficacy of Topical and Submucosal Local Anesthesia in Reducing Pain and Anxiety during Inferior Alveolar Nerve Block. *Annals of Punjab Medical College.* 2024;18(3):185-9. [DOI:10.29054/APMC/2024.1519]
16. Sakka S, Alqhtani NR, Alqahtani AS, Nabhan AB, Eid MK, Alagla M, Alfaifi K, Nassani MZ. Dental students, interns, and junior dentists' awareness and attitude toward the inferior alveolar nerve block technique and related failure. *J Dent Sci.* 2024. [DOI: 10.1016/j.jds.2024.02.008] [PMID] [PMCID]
17. Bhalla VK, Taneja S, Chockattu SJ. Failure of molar anesthesia in endodontics: a systematic review. *Saudi Endod J.* 2021;11(3):283-91. [DOI: 10.4103/sej.sej_152_20]
18. Subbiya A, Rajendran V, Anuradha B, Suresh SM. Failure of inferior alveolar nerve block and how to overcome it: a review. *Eur J Mol Clin Med.* 2020;7(5):2020. [Link]
19. Oghabi N, Renton T. Optimizing Local Anaesthetic Practice: Addressing Misconceptions and Minimizing Anaesthetic Failures. *Dental Update.* 2022;49(1):32-8. [DOI:10.12968/denu.2022.49.1.32]
20. Dias-Junior LC, Bezerra AP, Schuldt DP, Kuntze MM, de Luca Canto G, da Fonseca Roberti Garcia L, da Silveira Teixeira C, Bortoluzzi EA. Effectiveness of different anesthetic methods for mandibular posterior teeth with symptomatic irreversible pulpitis: a systematic review and meta-analysis. *Clin Oral Investig.* 2021;25(12):6477-500. [DOI: 10.1007/s00784-021-04145-7] [PMID]
21. Khalifah M. A comparative study for a novel technique for the inferior alveolar nerve block versus the conventional technique. *Egyptian Dental Journal.* 2021;67:211-8. [DOI:10.21608/edj.2020.43747.1273]
22. Gao X, Meng K. Comparison of articaine, lidocaine and mepivacaine for buccal infiltration after inferior alveolar nerve block in mandibular posterior teeth with irreversible pulpitis. *Br Dent J.* 2020;228(8):605-8. [DOI: 10.1038/s41415-020-1434-9] [PMID]
23. Saber SM, Hashem AA, Khalil DM, Pirani C, Ordinola-Zapata R. Efficacy of four local anaesthesia protocols for mandibular first molars with symptomatic irreversible pulpitis: A randomized clinical trial. *Int Endod J.* 2022;55(3):219-30. [DOI: 10.1111/iej.13667] [PMID]
24. Mohamed KM, Jadu FM, Abdelalim HM, Bayoumi AM, Jan

- AM. Impact of Methods for Teaching Inferior Alveolar Nerve Block Anesthesia on Dental Students' Efficiency. *World*. 2019;10(5):375. [DOI:10.5005/jp-journals-10015-1668]
25. Madan GA, Madan SG, Madan AD. Failure of inferior alveolar nerve block: exploring the alternatives. *The Journal of the American Dental Association*. 2002;133(7):843-6. [DOI: 10.14219/jada.archive.2002.0298] [PMID]
 26. Ghavimi MA, Arta A, Banishahabadi A, Raof A, Zadeh AG. Evaluation of Success of Inferior Alveolar Nerve Block Technique Applied by Dental Students at Different Educational Levels. *Advances in Bioscience and Clinical Medicine*. 2019;7(2):12-6. [DOI: 10.7575/aiaa.abcm.v.7n.2p.12]
 27. Ghavimi MA, Nezafati S, Arta SA, Ghoreishizadeh A, Sadeghilar N. The Success Rate of Inferior Alveolar Nerve and Mandibular Foramen Anesthesia with and without Panoramic Radiography. *Medical Journal of Tabriz University of Medical Sciences*. 2015 ;37(3):40-3. [Link]
 28. Lasemi E, Motamedi MH, Talaeipour AR, Shafaeifard S, Fard MJ, Navi F, Lasemi R, Zardi Z, Alipanah F. Panoramic radiographic relationship of the mandibular foramen to the anterior border of the ramus and occlusal plane as an aid in inferior alveolar nerve block. *Anesth prog*. 2019;66(1):20. [DOI: 10.2344/anpr-65-04-05] [PMID] [PMCID]
 29. Hoseinitodashki H, Rahmati AH. Success rate of 10th semester dental students of Tehran University of Medical students in infra-alveolar nerve block injection technique. *Journal of Dental Medicine*. 2009;21(4). [Link]
 30. Kriangcherdsak Y, Raucharernporn S, Chaiyasamut T, Wongsirichat N. Success rates of the first inferior alveolar nerve block administered by dental practitioners. *J Dent Anesth Pain Med*. 2016;16(2):111-6. [DOI: 10.17245/jdapm.2016.16.2.111] [PMID] [PMCID]
 31. Haghighat A, Jafari Z, Hashemini D, Samandari MH, Safarian V, Davoudi A. Comparison of success rate and onset time of two different anesthesia techniques. *Med Oral Patol Oral Cir Bucal*. 2015;20(4): e459. [DOI: 10.4317/medoral.20526] [PMID] [PMCID]
 32. Aliabadi E, Keshavarz E. Evaluation of knowledge and experience on the success of inferior alveolar nerve block technique. *Journal of Dental Medicine*. 2020;33(1):26-31. [Link]
 33. Keetley A, Moles DR. A clinical audit into the success rate of inferior alveolar nerve block analgesia in general dental practice. *Prim dent care*. 2001;8(4):139-42. [DOI: 10.1308/135576101322462174] [PMID]