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Original Article

Dental students, interns, and junior dentists' awareness and attitude toward the inferior alveolar nerve block technique and related failure

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Abstract *Background/purpose:* Exploration of early practicing dental professionals' awareness and attitude toward inferior alveolar nerve block IANB will directly inform efforts to improve clinical practices and ensure patient safety. The aim was to highlight the students, interns, and junior dentists' awareness and attitude toward the IANB, failure, and related complications in the Kingdom of Saudi Arabia (KSA).
Materials and methods: An open web-based survey prepared according to the Checklist for reporting results of Internet e-surveys CHERRIES recommendations was designed and carried out across different regions of the KSA. The questionnaire was composed of four main sections including the participant's details, and qualifications; inferior alveolar nerve block delivery; participants' education, and training-related questions; and attitudes toward proposed solutions to overcome the related failure and complications.
Results: 262 participants completed the questionnaire (94 dental students, 79 interns, and 89 junior dentists). There was a significant difference in the following findings: males performed

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IANBs more frequently than females ($P < 0.05$); females, students, and private practice/University type showed less attendance to workshops and seminars on IANB with more need for training ($P < 0.05$); females were more in agreement with ''continuous education courses'' and ''workshops done by specialists'' to propose solutions to overcome IANB failure ($P < 0.05$). The multivariate logistic regression analysis showed that qualification and attendance of a training course were strong predictors of participants' readiness to manage IANB complications ($P < 0.05$).

Conclusion: The findings emphasize how crucial it is for early dental practitioners to participate in continuing professional development programs to enhance their capacity to administer IANB and handle complications.

Introduction

The inferior alveolar nerve block (IANB) is frequently utilized in contemporary clinical dentistry to create local anesthesia for various dental procedures. Numerous variations on the traditional nerve block have been documented in the literature.[1] However, Failure rates from IANB injections can be high, up to 20—25%.[2] Improper technique, anatomical variations, infection, inflammation, and psychological factors including pain and anxiety have all been linked to inferior alveolar nerve block failure.[3—5] Furthermore, the inaccurate location of the mandibular foramen results in an inadequate needle setting that causes IANB failure.[6]

Reliable substitutes for the conventional IANB include the Gow-Gates mandibular nerve block and the Akinosi-Vazirani closed-mouth mandibular nerve block. Both methods are suitable for mandibular dental procedures. However, they are accommodating if the patient has a history of standard IANB failure because of anatomic variations.[7]

In dental education, students receive training in applying traditional nerve block methods. However, achieving the required undergraduate clinical competency has always been challenging for schools and students.[8] Therefore, student input is essential and crucial when designing pre-clinical courses, and it is never appropriate to minimize or disregard it. Moreover, evaluation and feedback[9] from graduate and undergraduate dental students are necessary for course providers to continuously modify training sessions to enhance the students' learning skills and ability to evaluate the quality of dental treatment that starts with effective local anesthesia.

This study aimed to highlight the students, interns, and junior dentists' awareness and attitude toward IANB and related failure in the Kingdom of Saudi Arabia (KSA).

Materials and methods

Study design and ethical consideration

The study is an open web-based survey prepared according to the Checklist for reporting results of Internet e-surveys CHERRIES recommendations[10] and published for dental students, dental interns, and junior dentists who just started their work after completing their internship program in different regions of the Kingdom of Saudi Arabia. The Committee of Bioethics Research at Prince Sattam bin Abdulaziz University (PSAU) approved the study and was assigned IRB number: (SCBR-164/2023).

Questionnaire

The designed voluntary four-page questionnaire was prepared based on an earlier published study.[11] It contained 20 questions and was carried out between October and December 2023, on a convenience sample of the above-targeted participants who were approached using the contact details available at various colleges of dentistry across different regions of the KSA.

The questionnaire was composed of four main sections with various answers. The first section consisted of the participant's details including qualifications (undergraduate fourth and fifth-year students, interns, and junior dentists), type of practice/university (private or public), and location in the KSA. The second and third sections were related to IANB delivery, education, and training-related questions. The fourth section was related to the participants' attitudes toward proposed solutions to overcome the failure of IANB.

The questionnaire was tested on 15 participants at the College of Dentistry at Prince Sattam bin Abdulaziz University (PSAU) before fielding it so that any ambiguous points were cleared and amended.

Sample size calculations

The sample size was calculated using the 3.01 version of OpenEpi (Open Source Epidemiologic Statistics for Public Health, Atlanta, GA, USA). We used 60% as the anticipated proportion, 5% as the absolute precision, and a 90% confidence interval. The calculated sample size was 260 participants.

Data analysis

Data analysis was performed using SPSS 22.0 software (The International Business Machines Corporation (IBM), Armonk,

NY, USA). Descriptive statistics were utilized to present the characteristics of the participants, and the chi-square test was employed to examine potential associations between survey items and participants' gender, qualification, and practice/university type. Furthermore, a multivariate logistic regression model was constructed with the participants' confidence in delivering an effective IANB, readiness to manage IANB complications, and the perceived need for additional training on IANB as the outcome variables. Predictors included participants' gender, qualification, practice/university type, and attendance of educational activity on the IANB technique. Odd ratios (ORs) and their 95% confidence intervals (CIs) were calculated to assess the relationships. The significance level was established at $P < 0.05$.

Results

262 participants completed the questionnaire (94 dental students, 79 interns, and 89 junior dentists). Their ages ranged from 20 to 30 with a mean age of 25.53 years (SD = 3.7). The gender distribution showed male (64.5%) and female (35.5%) responders. Most participants were from a governmental University 74.8% while those from a private University comprised 25.2%. 78.2% of the responders were from the central region (Riyadh province). The remaining participants responded from other regions of the KSA as illustrated in (Table 1).

Table 2 displays the participants' completed responses to IANB delivery questions categorized by gender, qualification, and University type. There was a significant difference between male and female participants ($P < 0.05$) where males performed IANBs more frequently. A significant difference also existed in terms of qualifications where junior dentists performed more IANBs than students or interns ($P < 0.05$) with no significant difference in terms of the practice/University type. The results also showed a significant difference in terms of the techniques used in daily local anesthesia practice where junior dentists performed the traditional IANB technique (94.4%) and other alternative techniques (5.6%) more than the students and interns who initially confined their practice to the traditional technique ($P < 0.05$). The results showed that 7.6% of the participants' sample often experienced an IANB failure where the students (10.6%) significantly indicated more failure cases than interns (6.3%) and junior students (5.3%) ($P < 0.05$). However, the results showed no significant differences between participants when answering the questions related to the most important factor contributing to the difficulties or failures in delivering the IANB. Here, the majority of students (65.3%) referred to anatomical variations as the foremost factor that contributed to IANB failure. The results also revealed that IANB complications experienced by junior dentists were significantly higher than those of students and interns ($P < 0.05$).

Table 3 shows the participants' completed responses to education-related questions concerning IANB delivery categorized by gender, qualification, and University type. There was no significant difference in the acquirement of skills and knowledge required for delivering the IANB. On the other hand, 59.2% of the participants' sample indicated no academic activities on IANB delivery were attended. In that context, there was a significant difference in all categories of participants where females, students, and private practice/University type showed less overall attendance to such activities including lectures, workshops, and seminars ($P < 0.05$). The results also showed that there was a significant difference in all categories of participants concerning confidence in delivering an effective IANB where males (72.8%), junior dentists (75.3%), and governmental practice/University (71.9%) showed more confidence ($P < 0.05$). On the other hand, no significant difference was found between males and females nor between governmental and private practice/University concerning the preparedness to manage IANB complications. However, students (44.7%) were significantly less prepared than interns (31.6%) and junior students (16.9%) to manage related complications ($P < 0.05$).

Regarding the need for further training, 61.5% of the participants' sample indicated the need for further training on IANB and the results showed a significant difference in all categories of participants, where females (71%), students (74.5%), and private practice/University (78.8%) showed more need for training ($P < 0.05$).

Table 4 illustrates the participants' attitudes toward the related failure of the IANB. Here, there was a significant difference between males and females as the latter were more in agreement with ''continuous education courses'' and ''workshops done by specialists'' to propose solutions to overcome IANB failure ($P < 0.05$). The results also showed that there was a significant difference in all categories of participants concerning the statement ''attending clinics with specialists'' where females (89.2%), interns

Table 1 Characteristics of participants (n = 262).

Age (years)	Gender	Qualification
Mean (SD) 25.53 (3.7)	Male 169 (64.5%)	Undergraduate student 94 (35.9%)
Range 25 Minimum 20 Maximum 30	Female 93 (35.5%)	Dental intern 79 (30.2%)
		Junior dentist 89 (34%)
Practice/University type	**Practice/university location in Saudi Arabia**	
Governmental 196 (74.8%)	Northern region 15 (5.7%)	Eastern region 9 (3.4%)
Private 66 (25.2%)	Central region 205 (78.2%)	Western region 23 (8.8%)
	Southern region 10 (3.8%)	

SD: Standard deviation.
n: number of participants.

Table 2 Participants' responses to IANB delivery-related questions, categorized by gender, qualification, and practice/university type (n = 262).

Question	Sample	Gender		*P*-value	Qualification			*P*-value	Practice/university type		*P*-value
		Male	Female		Student	Intern	Junior dentist		Governmental	Private	
How often do you perform the inferior alveolar block in your practice?											
Frequently (more than 10 times per week)	29.8%	36.7%	17.2%	0.003*	4.3%	29.1%	57.3%	<0.001*	30.1%	28.8%	0.893
Occasionally (2–10 times per week)	55.3%	51.5%	62.4%		66%	62%	38.2%		55.6%	54.5%	
Rarely (less than 2 times per week)	14.9%	11.8%	20.4%		29.8%	8.9%	4.5%		14.3%	16.7%	
Which technique(s) do you use for delivering the inferior alveolar block?											
Traditional IANB technique	98.1%	97.6%	98.9%	0.465	100%	100%	94.4%	0.007*	99%	95.5%	0.070
Gow-Gates technique	1.9%	2.4%	1.1%		0%	0%	5.6%		1%	4.5%	
Vazirani-Akinosi technique	0%	0%	0%		0%	0%	0%		0%	0%	
How often have you experienced IANB failure in the clinic?											
Often	7.6%	8.9%	5.4%	0.627	10.6%	6.3%	5.6%	0.003*	7.7%	7.6%	0.785
Sometimes	33.6%	31.4%	37.6%		38.3%	41.8%	21.3%		32.7%	36.4%	
Rarely	48.9%	49.7%	47.3%		36.2%	48.1%	62.9%		50.5%	43.9%	
Never	9.9%	10.1%	9.7%		14.9%	3.8%	10.1%		9.2%	12.1%	
In your experience, what is the most important factor contributing to the difficulties or failures in delivering the inferior alveolar block?											
Anatomical variations	65.3%	62.7%	69.9%	0.896	54.3%	77.2%	66.3%	0.065	66.8%	60.6%	0.528
Patient anxiety or movement	7.6%	8.3%	6.5%		7.4%	5.1%	10.1%		8.2%	6.1%	
Inadequate training or experience	20.6%	21.9%	18.3%		30.9%	12.7%	16.9%		17.9%	28.8%	
Inadequate pain control or anesthesia effectiveness	4.6%	4.7%	4.3%		6.4%	1.3%	5.6%		4.6%	4.5%	
Equipment-related issues	1.1%	1.2%	1.1%		1.1%	1.3%	1.1%		1.5%	0%	
What is the most common complication you have encountered during/after an IANB?											
Needle-related issues (e.g., breakage, deflection)	6.5%	8.3%	3.2%	0.357	1.1%	2.5%	15.7%	<0.001*	7.7%	3%	0.494
Hematoma	10.7%	11.8%	8.6%		6.4%	11.4%	14.6%		9.7%	13.6%	
Facial paralysis	3.1%	3%	3.2%		2.1%	2.5%	4.5%		3.6%	1.5%	
Trismus	11.5%	12.4%	9.7%		5.3%	22.8%	7.9%		10.7%	13.6%	
Never had complications	68.3%	64.5%	75.3%		85.1%	60.8%	57.3%		68.4%	68.2%	

* Denotes significant difference at $P < 0.05$ as indicated by the chi-square test.
IANB: Inferior alveolar nerve block.
n: number of participants.

Table 3 Participants' responses to education and training-related questions regarding IANB delivery, categorized by gender, qualification, and practice/university type (n = 262).

Question	Sample	Gender		*P*-value	Qualification			*P*-value	Practice/university type		*P*-value
		Male	Female		Student	Intern	Junior dentist		Governmental	Private	
How did you acquire the skills and knowledge required for delivering the inferior alveolar nerve block?											
Dental school curriculum	66.8%	63.3%	73.1%	0.378	77.7%	59.5%	61.8%	0.129	68.9%	60.6%	0.746
Postgraduate training or residency	6.1%	7.1%	4.3%		1.1%	11.4%	6.7%		6.1%	6.1%	
Continuing education courses	7.6%	7.7%	7.5%		5.3%	8.9%	9%		7.1%	9.1%	
Self-directed learning	10.3%	13%	5.4%		7.4%	10.1%	13.5%		8.7%	15.2%	
Mentorship by an experienced practitioner	8.4%	7.7%	9.7%		8.5%	7.6%	9%		8.2%	9.1%	
Have you attended any educational activities (workshops or seminars) on INAB technique?											
Yes	40.8%	50.3%	23.7%	<0.001*	13.8%	62%	50.6%	<0.001*	46.4%	24.2%	0.002*
No	59.2%	49.7%	76.3%		86.2%	38%	49.4%		53.6%	75.8%	
How confident are you to deliver an effective inferior alveolar nerve block?											
Not confident at all	6.1%	5.9%	6.4%	<0.001*	7.4%	5.1%	5.6%	<0.001*	4.1%	12.1%	<0.001*
Not sure	29.8%	21.3%	45.2%		46.8%	21.5%	19.1%		24%	47%	
Extremely confident	64.1%	72.8%	48.4%		45.7%	73.4%	75.3%		71.9%	40.9%	
To what extent are you prepared to manage complications of IANB?											
Not at all	31.3%	29.6%	34.4%	0.509	44.7%	31.6%	16.9%	<0.001*	31.1%	31.8%	0.516
Fairly prepared	53.8%	53.8	53.8%		50%	49.4%	61.8%		52.6%	57.6%	
Very well prepared	14.9%	16.6%	11.8%		5.3%	19%	21.3%		16.3%	10.6%	
Do you feel that you need further training on IANB?											
Yes	61.5%	56.2%	71%	0.019*	74.5%	68.4%	41.6%	<0.001*	55.6%	78.8%	0.001*
No	38.5%	43.8%	29%		25.5%	31.6%	58.4%		44.4%	21.2%	

* Denotes significant difference at $P < 0.05$ as indicated by the chi-square test.
IANB: Inferior alveolar nerve block.
n: number of participants.

Table 4 Participants' attitudes toward proposed solutions to overcome the failure of IANB, categorized by gender, qualification, and practice/university type (n = 262).

Statement	% of "Strongly Agree/Agree" responses based on gender, qualification, and practice/university type										
	Sample	Gender		*P*-value	Qualification			*P*-value	Practice/university type		*P*-value
		Male	Female		Student	Intern	Junior dentist		Governmental	Private	
Workshops done by specialists (oral surgeons).	79%	76.9%	82.8%	0.030*	78.7%	82.3%	76.4%	0.875	81.6%	71.2%	0.182
Attending clinics with specialists.	84.4%	81.7%	89.2%	0.012*	83%	88.6%	82%	0.016*	85.2%	81.8%	0.045*
Continuing education courses on IANB techniques.	76.4%	73.3%	81.7%	0.015*	73.4%	84.8%	71.9%	0.335	78.5%	69.7%	0.590
Standardized anatomical assessment protocols.	68.4%	66.9%	70.9%	0.076	71.3%	60.8%	71.9%	0.255	69.4%	65.1%	0.706
Patient anxiety management techniques.	59.9%	57.4%	64.5%	0.356	78.1%	43%	66.3%	0.051	61.7%	54.5%	0.067
Peer review and case discussion forums.	44.3%	43.2%	46.3%	0.535	47.9%	32.9%	50.6%	0.332	44.9%	42.5%	0.670
Research and development for improved local anesthesia techniques.	54.9%	55%	54.8%	0.900	52.2%	54.4%	58.4%	0.399	54%	57.6%	0.745

* Significant difference at $P < 0.05$.
IANB: Inferior alveolar nerve block.
n: number of participants.

(88.6%), and government practice/University (85.2%) agreed more with that statement as a solution to overcome IANB failure ($P < 0.05$). On the other hand, the results showed no significant difference in all participants' categories concerning the agreement with other statements such as ''anatomical assessment protocols'', ''anxiety management techniques'', ''peer reviews'', and ''research activities''.

The multivariate logistic regression analysis (Table 5) aligned with the results shown in Table 3 in which higher confidence in delivering an effective IANB was significantly associated with males, junior dentist experience, and practicing/studying in a governmental setting ($P < 0.05$). Furthermore, qualification and attendance of a training course were strong predictors of participants' readiness to manage IANB complications ($P < 0.05$). Moreover, the perceived need for additional training on managing IANB complications was significantly associated with participants' qualifications, practice/University type, and attendance of an educational program on the topic ($P < 0.05$) (Table 5).

Discussion

Achieving the required local anesthesia is imperative for an effective dental treatment, and dental surgeons may face challenging situations including variant inferior alveolar nerves.[12] Several reasons have been linked to the IANB failure.[3,13,14] Thus, when assessing the IANB technique's success, teaching and learning the proper injection technique in university during practical sessions is very important. This research comes in this context to thoroughly understand dental students' and junior dentists' awareness and attitudes towards the IANB technique and its associated risks. This exploration will directly inform efforts to improve clinical practices and ensure patient safety.

In the current study, 7.5% of the overall sample often denoted IANB failure, which is fairly less than in other studies.[11,15] However, failure was noticed slightly more often in the students' sample (10.6%) who participated less in seminars and workshops on IANB delivery than interns and junior dentists. This highlights the importance of clinical experience and academic activities in achieving higher success rates for IANB.[8]

The results of the current study referred to junior dentists (5.6%) who were performing alternative techniques such as Gow-Gates. The latter technique, in addition to other techniques such as Vazirzni-Akinosi, is theoretically taught during undergraduate studies as part of the dental curriculum in KSA. However, the traditional IANB is preferred, perhaps due to the lack of training in other alternative techniques requiring highly skilled professionals.[1]

The results of the current study indicated that anatomical variations were cited by the majority of participants (65.3%) as the primary cause of IANB failure. These variations of the mandibular nerve and its branches are present in several patients, and they can be correlated to many clinical situations.[16]

The complications of IANB may include pain and trismus due to ripping of the mucosa during injection,[17] needle

Table 5 Predictors of participants' confidence in delivering an effective IANB, readiness to manage IANB complications, and the need for further training on IANB.

Predictors	Confident to deliver an effective IANB	Ready to manage IANB complications	Feel the need for further training on IANB
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Gender			
Female	**Ref**	**Ref**	**Ref**
Male	2.03 (1.12–3.66) *	0.95 (0.52–1.72)	0.88 (0.47–1.64)
Qualification			
Undergraduate student	**Ref**	**Ref**	**Ref**
Dental intern	2.89 (1.38–6.04) *	1.2 (0.6–2.4)	1.4 (0.64–3.04)
Junior dentist	4.36 (2.08–9.15) *	3.12 (1.51–6.43) *	0.28 (0.13–0.56) *
Practice/university type			
Private	**Ref**	**Ref**	**Ref**
Governmental	3.83 (1.96–7.49) *	1.03 (0.53–1.99)	0.28 (0.13–0.6) *
Attendance of an educational activity (workshop or seminar) on the IANB technique)			
No	**Ref**	**Ref**	**Ref**
Yes	1.18 (0.61–2.3)	2.28 (1.17–4.45) *	0.36 (0.19–0.68) *

The odds ratio and 95% confidence interval were calculated by a multivariate binary logistic model: * Significant difference at $P < 0.05$.
CI: Confidence interval.
Ref: Reference.
IANB: Inferior alveolar nerve block.

fracture at injection site,[18] and facial paralysis brought on by the anesthetic solution deposited in the parotid region. This problem primarily arises when the needle is aimed more posteriorly near the mandibular posterior boundary.[19] In addition, hematomas may arise from intravascular injections of anesthetic solution or from injury to blood vessels in the region to be anesthetized.[20] The current study revealed that junior dentists had the previous complications significantly more than interns and dental students who have direct instructors' supervision during practical sessions which may generally minimize complications. On the other hand, although the students had fewer complications, they significantly showed less preparedness to deal with complications as they happened. Moreover, given that the study's findings indicated that students attended notably fewer educational events on IANB, the authors are urged to arrange for and encourage students to attend workshops and seminars on the management of IANB complications including lectures, and dental simulator mannequin heads training.

The results of the current study showed that students are significantly less confident in delivering an effective IANB than interns and junior students. Here, preclinical training activities involving students administering the initial local anesthetic injection to one another are highly appreciated.[21] The impact on the student's level of anxiety and confidence in giving their first injections to patients is so important considering that the essential components of student learning are the application of theoretical information and the capacity to administer injections safely and competently. Moreover, females exhibited notably lower confidence levels than males, and the regression analysis indicated that greater confidence in administering IANB is linked to male gender. In that context, anxiety might play a role here. A previous comparative study showed that female students were more anxious about giving local anesthetic injections than male students.[22] Another study found that female dentists experienced more personal stress and were more inclined to discuss their problems.[23] Future qualitative research might offer a more in-depth understanding of such findings, thereby informing dental educators about the best ways to address lower confidence in administering the IANB among female dental professionals.

The current study also showed that the participants' attitudes toward solutions to overcome the failure of IANB were diverse. On the one hand, the participants showed non-significant differences in agreement with peer reviews, research and development, and anatomical assessment protocols. On the other hand, females showed significantly more agreement with workshops and courses done by specialists. A key finding in this study is that attending an educational activity on the IANB technique strongly predicted dental professionals' readiness to manage IANB complications. Additionally, attending such academic activities has been associated with a less self-perceived need for further training. These findings emphasize the significance of continuous professional development courses[24] in enhancing dental professionals' skills in administering IANB and related complications, especially for early practicing dentists.[8]

Finally, the result of this study showed that participants from the governmental practice/university were more confident in delivering IANB than those of private practice/university who signaled significantly more need for further training on IANB. Therefore, more in-depth educational studies with a larger sample size of participants are required to conclusively explain these differences.

The current study's findings suggest that alternative local anesthetic techniques for use in the event of IANB failure should be practically enhanced in the KSA universities' dental curricula. The results highlight the

importance of ongoing professional development programs for improving early dental practitioners' abilities to administer IANB and manage associated complications.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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