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## Introduction

Fine-motor skills, hand-eye coordination, and spatial perception are some of the important skills that dentists must acquire throughout the preclinical years of dental education to conduct accurate dental treatments (1). Consequently, dental students tend to be more susceptible to stress than students from other colleges, such as

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# The Impact of Physiological Hand Tremor and Anxiety on Students' Performance during their First Local Anesthesia Practice in Oral Surgery Clinic

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## Abstract

*Most students experience low self-confidence and anxiety* when performing their first local anesthesia injection despite the methods of their training. This study intends to evaluate the effect of physiological hand tremor and anxiety on students' performance during their first local anesthesia practice. Third-year students (n=130) participated in this study. The study group comprised (77 students) that had manikin training, then observed their colleagues administer local anesthesia on each other, and then practiced it themselves. The control group was (53) students transitioned from manikin training to clinical practice on each other without observation. The physiological hand tremor, instrument handling and technique were assessed by two faculty members, and then the students answered a questionnaire with the Interval Scale of Anxiety Response (ISAR). In the study group, (41.6%) had a physiological hand tremor compared to (51%) in the control group, and a higher percentage of students' responses on the anxiety scale in the study group (61%) were calm and relaxed than in the control group (49%). A statistically significant weak negative correlation was found between physiological hand tremor and technique/instrument handling ( $r_s = -0.333$ ,  $p < 0.05$ ) and ( $r_s = -0.238$ ,  $P < 0.05$ ), respectively, as well as between anxiety levels and technique ( $r_s = -0.210$ ,  $p < 0.05$ ). Physiological hand tremor was a significant negative predictor for instrument handling ( $p < 0.05$ ), but anxiety level was not ( $p > 0.05$ ). Both physiological hand tremor and anxiety level were significant negative predictors for correct technique ( $p < 0.001$  and  $p = 0.05$ , respectively). In conclusion, decreased hand tremors and reduced anxiety levels independently enhanced students' performance. Thus, to improve the development of psychomotor skills, training methods must target both factors as independent yet complementary pathways.

**Keywords:** Physiological hand tremor, Anxiety, Students' performance, Local anesthesia, Dental education.



medical students (2). An important step in preclinical dental education is local anesthesia administration that must be taught and practiced correctly. Several training approaches exist, including cadaver models, laboratory simulators with sensors, virtual reality, and student-to-student training. Up to the present time, student-to-student training is still the most popular training method in many dental colleges, as it helps in the development of confidence and empathy in students in spite of the associated anxiety of students and potential medicolegal, moral, and ethical consequences(3,4). Students practicing local anesthesia, especially inferior alveolar nerve block (IANB), for the first time on humans initially find it intimidating because it is an occasionally blind technique that requires deep insertion of the needle with both local and systemic complications. Students should receive instructional support and additional practical training, which might help them feel less nervous about administering a local anesthetic (5). The effectiveness of preclinical training can be compromised by anxiety, which may impact learning, critical thinking, and clinical practice. While a high level of anxiety might impair learning and performance, a low level of anxiety can enhance awareness, increase situation response, and facilitate concentration (6). Humans normally experience physiological hand tremors, which can be increased more during stressful situations. The specific cause of physiological hand tremor is unknown, despite the presence of several theories regarding possible triggers causing hand tremors (7-9). The physiological hand tremor can affect fine motor skills for delicate operations, even though it frequently does not affect daily motor function (10). However, there is insufficient evidence about the combined effect of physiological hand tremor and anxiety on students' technical performance during their initial clinical encounter with local anesthesia. This study addresses a significant knowledge gap by going beyond simplistic explanations and allowing for evidence-based adjustments in simulation design as well as student supervision and evaluation. The outcome is students who can successfully manage high-anxiety, fine-motor tasks, such as local anesthesia, with confidence and competence. This study designed to investigate the effect of physiological hand tremor and anxiety on students' performance during their first student-to-student local anesthesia practice in the oral surgery clinic.

## Materials and methods

All 130 third-year students enrolled in the Oral Surgery Clinic at College of Dentistry/Mustansiriyah University participated in this prospective quasi-experimental study. The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with participants' written informed consent before the sample was taken. The study protocol, the subject information, and the consent form were reviewed and approved by a local ethics committee according to the document number (202607) on 9 February 2026.

All of the 130 students had no previous formal clinical practice in local anesthesia injections. All the students had attended a twelve-hour theoretical lectures on local anesthesia for the past three months of their academic year. The theoretical part discussed pharmacology, surgical anatomy, instruments, techniques and possible



complications of local anesthetics. All the students had four hours of practical training on manikins, skull bones and clinical demonstration. The laboratory courses ended with assessment exams.

Students were randomly selected to study or control groups by the use of the RESEARCH RANDOMIZER web site (11). For the control group, exclusion criteria were used to ensure a uniform baseline (absence of prior simulation experience, no self-reported high anxiety), leading to a reduced final group size (n = 53), in contrast to the study group (n = 77). The students in the control group received training on manikin and then student-to-student injection of IANB with 0.5 mL 2% lidocaine with 1:100,000 epinephrine. While the students in the study group received training on a manikins and then observed their colleagues administer local anesthesia on each other, they then practiced it themselves, one on another. All the practical parts were supervised by two faculty members (oral surgery specialists) to give instructions to the students and answer any questions and mark their performance from a numeric rating scale (12) of 1-10, including physiological hand tremor, preparation of syringe, instrument handling, dentist's position and technique. Scores below 5 are considered as poor performance, and above 5 (including 5) are regarded as good performance.

The average scores of the two faculty members were recorded. After the training all the students answered a questionnaire containing the Interval Scale of Anxiety Response (ISAR) (13) based on seven descriptors as follows: calm and relaxed, a little nervous, tense and upset, afraid, very afraid, panicked and terrified regarding their anxiety levels during injection administration.

The collected data were entered in a Microsoft Excel spreadsheet, and the statistical analysis was performed through IBM SPSS Statistics for Windows, version 24.0 (IBM Corp., Armonk, USA). The data were analysed with descriptive, Spearman's rho and linear multiple regression tests. Statistical significance was set at  $p \leq 0.05$ .

## Results

The results showed that about 41.6% of the students in the study group had a physiological hand tremor compared to 50.9 % of the control group. The majority of the students (98.7% and 90.9% in the study group, 92.5% and 96.2% in the control group) had no difficulty in preparing the dental syringe and handling the instruments for the first time (Table 1). Most of the students in the study group (96.1%, 77.9%) and in the control group (88.7%, 81.1%) showed the correct dentist's position and were able to perform the IANB technique without any problems (Table. 1).

**Table.1:** Students' performance in IANB first clinical injection, by numbers and percentages

Students' performance	Assessment	All		Control		Study	
		Number	Percent	Number	Percent	Number	Percent
Physiological hand tremor	Yes	59	45.4%	27	50.9%	32	41.6%
	No	71	54.6%	26	49.1%	45	58.4%

	<b>Total</b>	130	100%	53	100%	77	100%
<b>Preparation of the syringe</b>	<b>Yes</b>	125	96.2%	49	92.5%	76	98.7 %
	<b>No</b>	5	3.8%	4	7.5%	1	1.3%
	<b>Total</b>	130	100%	53	100%	77	100%
<b>Dentists' position</b>	<b>Yes</b>	121	93.1%	47	88.7%	74	96.1 %
	<b>No</b>	9	6.9%	6	11.3%	3	3.9%
	<b>Total</b>	130	100%	53	100%	77	100%
<b>Technique</b>	<b>Yes</b>	103	79.2%	43	81.1%	60	77.9 %
	<b>No</b>	27	20.8%	10	18.9%	17	22.1 %
	<b>Total</b>	130	100%	53	100%	77	100%
<b>Handling of instruments</b>	<b>Yes</b>	121	93.1%	51	96.2%	70	90.9 %
	<b>No</b>	9	6.9%	2	3.8%	7	9.1%
	<b>Total</b>	130	100%	53	100%	77	100%

From the study group, about 61% reported being calm and relaxed on the anxiety scale compared to 49% from the control group, while 28.3% from the control group reported being a little nervous compared to 20.8% from the study group. Also about 22.7% from the control group reported being terrified, panicked, afraid and tense compared to 18.2% from the study group (Table.2).

**Table.2:** Distribution of students' responses on anxiety scale during IANB injection, by number and percentage in each condition

Anxiety scale	All		Control		Study	
	Number	Percent	Number	Percent	Number	Percent
<b>Calm, Relaxed</b>	73	56.2%	26	49%	47	61%
<b>Little Nervous</b>	31	23.8%	15	28.3%	16	20.8%
<b>Tense, Upset</b>	6	4.6%	3	5.7%	3	3.9%
<b>Afraid and very afraid</b>	17	13.1%	8	15.1%	9	11.7%
<b>Panicked</b>	1	0.8%	0%	0%	1	1.3%
<b>Terrified</b>	2	1.5%	1	1.9%	1	1.3%
<b>Total</b>	130	100%	53	100%	77	100%

As shown in Table 3, there were no statistically significant differences between the study and the control groups in regard to physiological hand tremor, preparation of the syringe, instrument handling, dentist's position, technique and anxiety scale.

Regardless of the groups, the results showed a weak but statistically significant negative correlation between physiological hand tremor and handling of instruments and technique ( $P < 0.05$ ), while there was no statistically significant correlation when comparing the physiological hand tremor with the anxiety scale (Table 3). Also, the results indicated a weak but statistically significant negative correlation between the anxiety scale and technique ( $P < 0.05$ ). Meanwhile there was no statistically significant correlation between the anxiety scale and physiological hand tremor and instrument handling (Table. 3).

**Table. 3:** Bivariate correlation between the groups and students’ performance and anxiety scale (Correlation Coefficient ( $r_s$ ) and Sig.)

Correlation	Groups		Physiological hand tremor		Preparation of the syringe		Dentists’ position		Technique		Handling of instruments	
	$r_s$	p-value	$r_s$	p-value	$r_s$	p-value	$r_s$	p-value	$r_s$	p-value	$r_s$	p-value
Groups	-		0.093	0.295	-0.160	0.070	0.144	0.103	0.039	0.660	0.103	0.244
Physiological hand tremor	0.093	0.295	-		-0.139	0.115	-0.177	0.051	-0.333 <sup>a</sup>	0.000 <sup>b</sup>	-0.238 <sup>a</sup>	0.006 <sup>b</sup>
Anxiety scale	0.125	0.158	-		-0.073	0.409	-0.026	0.769	-0.210 <sup>a</sup>	0.017 <sup>b</sup>	-0.129	0.142

<sup>a</sup> Correlation Coefficient, <sup>b</sup> Significant  $p \leq 0.05$  level using spearman’s rho

Multiple linear regression was used to study the relationship of handling of instruments as a dependent variable with anxiety scale and physiological hand tremor

as predictors. The model was statistically significant ( $F(2, 1270) = 5.046, p = 0.008$ ) and accounted for 7.4% of the variance in instrument handling ( $R^2 = 0.074$ ). Physiological hand tremor was found to be a significant negative predictor ( $\beta = -.229, p < 0.05$ ), but anxiety level was not significant ( $\beta = -.130, p > 0.05$ ) (Table. 4).

The model studying the relationship of correct technique as a dependent variable with the anxiety scale and physiological hand tremor as predictors was statistically significant ( $F(2, 127) = 10.14, p = 0.000$ ) and explained 13.8% of the variance in technique ( $R^2 = 0.138$ ). Both predictors were negatively related to technique. Physiological hand tremor significantly predicted poorer technique ( $\beta = -0.321, p < 0.001$ ), though the anxiety level only approached significance ( $\beta = -.164, p = 0.05$ ) (Table. 4).

**Table. 4:** Multiple linear regression predicting handling of instruments and technique

Model	Predictor	Unstandardized B	Std. Error	Standardized Beta	t	Sig.
a. <b>Dependent Variable: Handling of instruments</b> b. <b>Predictors: (Constant), Anxiety scale, Physiological hand tremor</b>	(Constant)	1.407	0.121	-	11.590	<b>.000</b>
	Physiological hand tremor	-0.117	0.044	-.229-	-2.670	<b>.009*</b>
	Anxiety scale	-0.026	0.017	-.130-	-1.519	.131
a. <b>Dependent Variable: Technique</b> b. <b>Predictors: (Constant), Anxiety scale, Physiological hand tremor</b>	(Constant)	1.929	0.187	-	10.307	<b>.000*</b>
	Physiological hand tremor	-0.262	0.067	-.321-	-3.885-	<b>.000*</b>
	Anxiety scale	-0.052	0.026	-.164-	-1.983-	<b>.050*</b>

\* Statistical significance was set at  $p \leq 0.05$ .

## Discussion

Successful administration of local anesthetic might be frightening to the students because it takes precise manual skills to accomplish it painlessly. It can be difficult to advance from didactic training to administering dental local anesthesia on a patient for the first time. (6) The observed difference in the percentage of physiological hand tremor between the control group and the study group (being lower in this study) suggests that adding observation of other students performing local anesthesia on human patients (not just on manikins) gave the students more confidence and control. Local anesthesia administered from student to student is a suitable way to replicate a real-world scenario in a dental office and enhance dental students' self-confidence. (14, 15).

The current study revealed a significant potential relationship between decreased physiological hand tremor, irrelevant to anxiety levels, and good instrument handling and correct technique. This relationship could be attributed to the demonstration



before the training, so the students became accustomed to the instruments, and the simulation practice aided in applying their theoretical knowledge and increased their confidence before their student-to-student practice.(13, 16) Comparable results were found in several studies about student-to-student first administration of local anesthesia conducted by Wong *et al.*, (2019) Shettar *et al.*, (2024) and Cugati *et al.*, (2014), who reported 62%, 42.9% and 46.9% of their students, respectively, did not experience any hand shivering during their first injection (6, 17, 18). Meanwhile, the current findings differed from those reported by Chandrasekaran *et al.*, (2014) who reported that only 33% of their students had a steady hand during injection, whereas Sánchez-Garcés *et al.*, (2020) reported that the majority of their students did not experience any hand shivering (13, 14).

The current findings are in agreement with López-Cabrera *et al.*, (2017), who stated that students' perceptions of their technical skills were affected by local anesthesia teaching methods (simulation-based). They compared two groups (one with full theoretical lectures, demonstration and simulation and the other with only theoretical lectures and demonstration), and both groups then performed the anterior superior alveolar nerve infiltrative anaesthesia technique.

The first group showed a higher average perception of hand control (using the syringe without shivering) compared to the second group (19). Most of the students in both groups had no problems in the practical aspect of local anesthesia including preparing the dental syringe, handling the instruments, assuming the correct dentist's position and locating the landmarks and performing the IANB technique, indicating that both the theoretical and the practical parts (including demonstrations, simulations and student-to-student practice) of local anesthesia training are more than sufficient to give them the knowledge and the ability to perform the anesthesia directly on human patients. This effective framework facilitates the shifting of students from preclinical education to clinical practice by supporting adaptable learning strategies and prompting calibrated teaching practice (5, 20-22).

Additionally, Mohamed *et al.* (2020) divided the students' training on IANB administration techniques into a control group that was trained with the student-to-student method and a study group that was trained with the student-to-student and peer-assisted learning (PAL) methods. Their findings indicated that the majority of the students in both groups demonstrated correct dentist and patient position and appropriate armamentarium preparation. They also found that the PAL approach had a positive impact on anatomy recognition and the injection process, with more students receiving proficient scores and fewer receiving incompetent ones in the study group.(16) These results were consistent with the results in the current study . The findings of Wong *et al.*, (2019) were in line with the findings in this study, where a large percentage of the students in their study (after student-to-student training on infiltration and IANB) had a realistic picture about the angle, depth and point of insertion for various local anaesthesia procedures and were able to identify the landmarks and perform the injection without difficulty (6).

The study of Knipfer *et al.*, (2018) showed partial agreement with the current findings. Comparable outcomes were observed, where most of their students completed the assignments accurately with no significant issues with the dentist's position, syringe preparation and instrument handling. However, the contradiction in the outcomes regarding the correct IANB technique revealed that only 69.4% and



72.2% of the students performed the injection correctly on the manikin and during student-to-student practice, respectively, mostly due to confusion about the proper needle insertion position (23). In contrast with the current results, Sánchez-Garcés *et al.*, (2020) Chandrasekaran *et al.*, (2014) and Cugati *et al.*, (2014) studies showed 47.8%, 42.9% and 60.9% of their students having a hard time identifying the insertion point of IANB and supraperiosteal injections, respectively (13, 14, 18). Also, Brand *et al.*, (2011) stated that for their first human injection, many students felt unprepared and that anatomical knowledge and anesthetic complications were often cited as areas where students felt unprepared (24).

The responses on the anxiety scale during injection of the study group showed more students reporting feeling calm and relaxed and fewer students reporting feeling afraid and terrified compared to the control group. The study results liked the low anxiety levels with correct technique. While, there was no link between the anxiety levels and physiological hand tremor. These findings imply that physiological hand tremor in the present study was not significantly explained by self-reported anxiety alone, despite the fact that anxiety is frequently logically associated with tremor or hand instability. Fatigue, ergonomics, caffeine, and neuromuscular control are a few examples of other variables that might be more significant in this case (7-9).

These results are compatible with the study of Sánchez-Garcés *et al.*, (2020), who reported that only one of the 71 participants was terrified, whereas, almost all of the participants were either calm or slightly nervous before and during local anesthesia administration of IANB (14). The current study results were in partial agreement with those of Wong *et al.*, (2019) with consistency observed in the percentage of students reported being panicked, very afraid and afraid (15% in their study), while the findings were inconsistent with their findings that none of the students were calm and a great percentage of them were a little nervous before giving IANB injection (6). In contrast to the present study, Chandrasekaran *et al.*, (2014) found that before and during the injection, 46% of the operators were reported to be very nervous. Following the injection, the majority of the students felt calm and relaxed (13). Also, Cugati *et al.*, (2014) reported most of their students were tense, upset or afraid during their first IANB injection, and only one fifth of their students were calm during the injection (18).

In terms of physiological hand tremor, syringe preparation, instrument handling, dentist position, technique, and anxiety scale, the results showed no statistically significant differences between the study and control groups, indicating that students' task performance is mostly influenced by manual ability and continuous practice once they enter the autonomous phase of skill learning in the training course (25). López-Cabrera *et al.*, (2017) found that students' knowledge of anatomical landmarks and their ability to manage infiltration anesthesia were statistically non-significant when comparing simulation and non-simulation groups (19).

The findings suggest that physiological hand tremor was a significant negative predictor of instrument handling and technique individually, upon further assessment of the effect of physiological hand tremor and anxiety level as predictors against handling of instruments and technique as the dependent variable. On the other hand, anxiety level was a predictor for technique but not for instruments handling. This findings mean that the physiological hand tremor is not essentially caused by high anxiety levels, and it is significantly affecting the instrument handling, while



physiological hand tremor and anxiety are significantly affecting technique performance. This might be due to students' awareness of their inexperience causing high levels of stress and anxiety when performing local anesthesia for the first time on humans (13). New experiences, such as conducting a procedure for the first time, can create substantial levels of anxiety and stress for both learner and experienced medical professionals (26). According to the survey conducted by Malghani *et al.*, (2021) most of their undergraduate students experience some degree of clinical anxiety, and about one third of the students considered administering local anesthesia as one of the anxiety-provoking situations. Anxiety problems were already recognized in about 19.8% of students, who may or may not be receiving appropriate treatment (27). Książek *et al.*, (2015) stated that about 58% of dental students think of themselves as being under stress, and the most frequently occurring symptoms during stress are abdominal pain, palpitations and hand tremors (28).

Moreover, Bathla *et al.*, (2015) concluded that the rise in depression, anxiety, and suicide ideas among undergraduate dental students highlights the need for a more effective teaching system and timely support to promote psychological well-being in the future (29).

The limitations of this study was the exclusion criteria mainly for the control group post-randomization, which might introduced selection bias. Future research should implement exclusion criteria prior to randomization or employ intention-to-treat analysis. Also the inclusion of only the students of one dental college. Further studies should be conducted with the inclusion of different dental colleges with a larger sample size. The author also recommends a comparison of students' performance between learner and experienced students (third year vs final year) and measuring anxiety levels before and after anaesthesia administration. Based on the study findings, recommended educational interventions to improve psychomotor skills and reduce anxiety during local anesthesia training such as clinical exposure under close supervision, virtual reality simulation, video-assisted demonstrations, ergonomic and hand stabilization training and stress management training.

## Conclusion

The findings indicate that decreased hand tremors are associated with improved instrument handling and proper technique, regardless of anxiety levels. Reduced anxiety levels are associated with the successful technique performance. This indicates that hand tremor and anxiety affect technical performance via independent pathways. Therefore, successful training strategies must address both physiological hand tremor and anxiety management as distinct yet complementary ways to enhance technical skill development. When it comes to acquiring the fundamentals of local anesthesia, the integration of theoretical lectures, practical simulation training, demonstrations and observations appears to be the most effective way.



## Declarations

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### Ethics statement

The author approved that this research follows the journal's attached Ethic Approval guidelines as they appeared on the journal's author guidelines page.

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### Competing interest's statement

The author declare that there is no conflict of interest regarding the publication of this paper.

### Author contributions

The author did all the work, starting from the conception and design of the study, methodology, manuscript writing and handled the submission and revision process.

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