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Confidence & Barriers Faced by Dental Students in Administering Local Anesthesia

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ABSTRACT

Background: *Local anesthesia is a core clinical competency in dentistry; however, dental students frequently report reduced confidence during its administration due to limited clinical exposure and fear of complications.* ***Objective:*** *To assess dental students' confidence in administering local anesthesia and to evaluate associations between confidence and hands-on experience, perceived training adequacy, and fear of harming the patient.* ***Methods:*** *A quantitative cross-sectional observational study was conducted over two months among undergraduate dental students in Pakistan using a structured, anonymous, self-administered electronic questionnaire. Variables included demographics, hands-on experience, perceived sufficiency of training for real-patient injections, fear of harming the patient, and confidence in administering local anesthesia (5-point ordinal scale). Associations were examined using chi-square tests with effect sizes (Cramér's V).* ***Results:*** *Among 134 respondents, 61.9% were female and 76.1% were aged 21–25 years. Hands-on experience was reported by 44.8%, while 42.5% reported no experience. Overall, 55.2% reported moderate-to-high confidence and 14.2% were not confident at all. Hands-on experience was strongly associated with higher confidence ($p<0.001$; Cramér's $V=0.38$), and perceived training sufficiency showed a significant positive association ($p<0.001$; Cramér's $V=0.33$). Fear of harming the patient was inversely associated with confidence ($p=0.002$; Cramér's $V=0.26$).* ***Conclusion:*** *Dental students' confidence in local anesthesia administration is significantly shaped by practical exposure and perceived training adequacy, while fear of patient harm remains a key psychological barrier.*

Keywords: *Dental students; Local anesthesia; Confidence; Clinical training; Hands-on experience; Fear of harming patient; Barriers*

INTRODUCTION

Local anesthesia is a cornerstone of modern dental practice and is indispensable for achieving effective pain control, patient comfort, and procedural success during diagnostic and therapeutic interventions. Competent administration of local anesthetic agents not only alleviates patient anxiety and discomfort but also directly influences the clinician's efficiency and confidence during treatment. Consequently, dental education programs bear the responsibility of ensuring that undergraduate students acquire both the theoretical knowledge and the psychomotor skills necessary to administer local anesthesia safely and effectively before independent clinical practice (2). Adequate training in this domain is therefore fundamental to patient safety, quality of care, and professional development.

Despite its importance, administering local anesthesia is often perceived by dental students as one of the most challenging clinical procedures, particularly during the early phases of clinical exposure. Confidence, defined as an individual's belief in their ability to successfully perform a task without undue assistance, plays a critical role in translating knowledge into competent clinical performance (1,7). Students with higher self-confidence are more likely

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to engage actively in patient care, demonstrate sound clinical judgment, and manage procedural challenges effectively. Conversely, low confidence may lead to hesitation, overreliance on supervisors, and avoidance of clinical opportunities, ultimately limiting skill acquisition (5).

Previous literature has identified multiple factors that influence students' confidence in administering local anesthesia, including the adequacy of preclinical training, hands-on clinical exposure, quality of supervision, and psychological factors such as anxiety and fear of causing harm to the patient (6,8). Simulation-based training and peer-to-peer practice models have been shown to improve technical skills and self-efficacy; however, a substantial transition gap remains between performing injections on models and administering them to real patients (8,9). This "step from model to man" is frequently associated with heightened stress, uncertainty regarding anatomical landmarks, and fear of complications such as hematoma, trismus, facial nerve paralysis, or adverse drug reactions (7,10). These concerns may be further compounded by insufficient understanding of pharmacological principles, including anesthetic dosage, concentration, and contraindications, all of which are essential for safe clinical decision-making (11).

Psychological barriers, particularly fear of harming the patient, have been consistently reported as a dominant deterrent to confidence in local anesthesia administration. Psychogenic reactions such as vasovagal syncope, hyperventilation, nausea, and vomiting are among the most common adverse events associated with dental injections, and the anticipation of such outcomes can significantly undermine student self-assurance (5,7). Studies from different educational contexts have demonstrated that even when students possess adequate theoretical knowledge, anxiety related to patient safety may prevent them from performing procedures independently or confidently (6,12). This highlights the need to address not only technical competence but also the emotional and cognitive dimensions of clinical training.

While international studies have explored dental students' knowledge, attitudes, confidence levels, and complications related to local anesthesia administration (2,6,13), there remains a notable gap in the literature from Pakistan focusing specifically on undergraduate dental students' confidence and perceived barriers in this essential clinical skill. Existing regional research has largely emphasized technical knowledge or complication management, with limited attention to students' self-perceived preparedness, psychological concerns, and training adequacy as interconnected determinants of confidence (7,11). Given the variability in dental curricula, clinical exposure, and institutional resources across countries and even within regions, findings from other settings may not be directly generalizable to the Pakistani dental education context.

Addressing this gap is crucial for informing curriculum development and optimizing clinical training strategies. Understanding how hands-on experience, perceived sufficiency of training, and fear of harming patients interact to influence confidence can help educators design targeted interventions, such as enhanced supervised clinical exposure, structured simulation programs, and confidence-building workshops. Such measures may facilitate a smoother transition from preclinical learning to patient-based care and ultimately produce graduates who are both competent and self-assured in administering local anesthesia (14–17).

Therefore, the present study was designed to assess the confidence levels of dental students in administering local anesthesia and to identify the key barriers influencing their clinical confidence. Specifically, the study aimed to evaluate the association between hands-on experience, perceived adequacy of training, fear of harming the patient, and self-reported

confidence among undergraduate dental students. It was hypothesized that students with prior hands-on experience and those who perceive their training as sufficient would demonstrate higher confidence levels, whereas fear of harming the patient would be associated with lower confidence.

MATERIAL AND METHODS

This study was conducted using a quantitative, cross-sectional observational design, chosen to evaluate confidence levels and perceived barriers related to the administration of local anesthesia among dental students at a single point in time. A cross-sectional approach was considered appropriate as it allows for the assessment of associations between exposure variables, such as hands-on experience and perceived training adequacy, and outcome variables, such as self-reported confidence, without manipulating the study environment, in accordance with established epidemiological research practices (18).

The study was carried out across multiple dental institutions in Pakistan, encompassing both public and private sector colleges, over a two-month period. Undergraduate dental students enrolled in Bachelor of Dental Surgery programs were considered eligible for participation. Students from all academic years were included to capture variations in confidence and exposure across different stages of dental education. Participants were included if they were currently enrolled as dental students and had provided informed consent. Students who had already completed their undergraduate training or were not actively attending clinical or preclinical coursework during the data collection period were excluded to maintain population homogeneity.

Participants were selected using a convenience sampling strategy, which is commonly employed in exploratory educational research where access to a defined sampling frame is limited (19). Recruitment was conducted electronically through institutional student groups and academic communication platforms. An invitation message explaining the purpose of the study, voluntary nature of participation, and confidentiality measures was distributed along with a secure survey link. Prior to accessing the questionnaire, participants were presented with an electronic informed consent statement, and only those who agreed were permitted to proceed to the survey.

Data were collected using a structured, self-administered questionnaire specifically designed for this study based on prior literature assessing confidence, training adequacy, and barriers in clinical dental education (6,8,13). The instrument comprised three interconnected domains. The first domain captured demographic and academic characteristics, including age, gender, year of study, and type of institution. The second domain assessed confidence in administering local anesthesia using a five-point ordinal Likert scale ranging from “not confident at all” to “extremely confident,” operationalized as the primary outcome variable. The third domain evaluated potential barriers and influencing factors, including prior hands-on experience with local anesthesia, perceived sufficiency of training for real-patient injections, and fear of harming the patient, measured using agreement-based Likert responses. Prior hands-on experience was operationally defined as having administered at least one local anesthetic injection under supervision in a clinical setting.

The questionnaire underwent content validation by subject-matter experts in dental education to ensure relevance, clarity, and alignment with study objectives. To enhance data integrity and minimize information bias, the survey was anonymous, did not collect identifiable information, and restricted responses to one submission per participant through platform controls. The electronic format ensured standardized question delivery and reduced interviewer bias.

Several steps were taken to address potential sources of bias and confounding. Selection bias was partially mitigated by recruiting students from multiple academic years and institution types. Information bias was minimized through anonymous self-reporting, which may encourage honest responses. Confounding variables such as academic year, gender, and type of institution were measured a priori and accounted for in the analytical phase. The confidence outcome was analyzed both in its original ordinal form and after pre-specified category consolidation into low, moderate, and high confidence to facilitate clinically interpretable comparisons.

The sample size was determined based on feasibility considerations and alignment with similar cross-sectional studies in dental education literature, where sample sizes ranging from 100 to 200 participants have been shown to provide sufficient precision for estimating proportions and detecting moderate associations using chi-square tests (20). This sample size was considered adequate to explore associations between key exposure variables and confidence levels while allowing subgroup analyses across academic years and experience categories.

Data were exported from the online survey platform and analyzed using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics were used to summarize participant characteristics and response distributions, reported as frequencies and percentages for categorical variables.

Associations between confidence levels and explanatory variables were initially assessed using Pearson's chi-square test. Effect sizes were estimated using Cramér's V to quantify the strength of associations. Multivariable ordinal logistic regression analysis was conducted to evaluate the independent effects of hands-on experience, perceived training adequacy, and fear of harming the patient on confidence levels while adjusting for potential confounders such as academic year and gender. Missing data were minimal due to mandatory response settings and were handled using complete-case analysis. Statistical significance was set at a two-tailed p-value of less than 0.05.

Ethical approval for the study was obtained from an institutional ethical review board prior to data collection, in accordance with the principles of the Declaration of Helsinki for research involving human participants (21). Participation was voluntary, and electronic informed consent was obtained from all respondents. Confidentiality and anonymity were strictly maintained throughout the study, and data were stored securely with access limited to the research team to ensure reproducibility, transparency, and data integrity.

RESULTS

Table 1 summarizes the demographic and academic profile of the 134 participating dental students. Females comprised 61.9% (n=83) of the sample, while males represented 38.1% (n=51). Most respondents were aged 21–25 years (76.1%, n=102), followed by those under 20 years (21.6%, n=29), and a small minority above 25 years (2.2%, n=3).

Participation was distributed across all academic years, with the largest contribution from third-year students (29.1%, n=39), followed by second-year (23.1%, n=31), fourth-year (17.9%, n=24), and fifth-year students (17.9%, n=24), while first-year students constituted 11.9% (n=16). Regarding institution type, more than half of the students were from the private sector (52.2%, n=70), 40.3% (n=54) were from government institutions, 6.7% (n=9) from semi-government institutions, and 0.7% (n=1) were international students.

Table 2 describes students' exposure to local anesthesia administration, their perceived adequacy of training, fear-related barriers, and overall confidence. With respect to hands-on

experience, 44.8% (n=60) reported prior experience administering local anesthesia, 42.5% (n=57) reported no experience, and 12.7% (n=17) were unsure. Perceived training adequacy for real-patient injections showed that 48.5% (n=65) either agreed (37.3%, n=50) or strongly agreed (11.2%, n=15) that their training was sufficient, whereas 27.6% (n=37) either disagreed (20.1%, n=27) or strongly disagreed (7.5%, n=10); 23.9% (n=32) remained neutral. Fear of harming the patient was prominent: 64.1% (n=86) agreed (44.0%, n=59) or strongly agreed (20.1%, n=27) that fear reduced their confidence, while 10.4% (n=14) disagreed (6.7%, n=9) or strongly disagreed (3.7%, n=5), and 25.4% (n=34) were neutral.

Overall confidence in administering local anesthesia showed that 14.2% (n=19) were not confident at all, 25.4% (n=34) were slightly confident, 27.6% (n=37) were moderately confident, 27.6% (n=37) were quite confident, and 5.2% (n=7) were extremely confident; collectively, moderate-to-high confidence accounted for 60.4% (n=81), while low confidence (not/slightly) accounted for 39.6% (n=53).

Table 3 presents the association between prior hands-on experience and confidence level (collapsed as low: not/slightly, moderate, and high: quite/extremely). A strong and statistically significant association was observed ($p<0.001$), with a large effect size (Cramér's $V=0.38$).

Among students with hands-on experience (n=60), 60.0% (n=36) reported high confidence, 23.3% (n=14) moderate confidence, and only 16.7% (n=10) low confidence. In contrast, among students without experience (n=57), only 12.2% (n=7) reported high confidence, while the majority fell into low confidence (63.2%, n=36) and 24.6% (n=14) reported moderate confidence.

Students who were unsure about their experience (n=17) clustered predominantly in the moderate category (52.9%, n=9), with 41.2% (n=7) reporting low confidence and only 5.9% (n=1) reporting high confidence. The distribution indicates a clear gradient: exposure to administering local anesthesia aligns with markedly higher self-reported clinical confidence.

Table 1. Demographic and Academic Characteristics of Participants (n = 134)

Variable	Category	n	%
Gender	**Male**	**51**	**38.1**
	Female	**83**	**61.9**
Age (years)	**<20**	**29**	**21.6**
	21–25	**102**	**76.1**
	>25	**3**	**2.2**
Academic year	**1st**	**16**	**11.9**
	2nd	**31**	**23.1**
	3rd	**39**	**29.1**
	4th	**24**	**17.9**
	5th	**24**	**17.9**
Institution type	**Government**	**54**	**40.3**
	Private	**70**	**52.2**
	Semi-government	**9**	**6.7**
	International	**1**	**0.7**

Table 2. Experience, Perceived Training Adequacy, Fear, and Overall Confidence (n = 134)

Variable	Category	n	%
Hands-on experience	Yes	60	44.8
	No	57	42.5
	Unsure	17	12.7
Training sufficient	Strongly agree	15	11.2
	Agree	50	37.3
	Neutral	32	23.9
	Disagree	27	20.1
	Strongly disagree	10	7.5
Fear reduces confidence	Strongly agree	27	20.1
	Agree	59	44.0
	Neutral	34	25.4
	Disagree	9	6.7
	Strongly disagree	5	3.7
Confidence level	Not confident at all	19	14.2
	Slightly confident	34	25.4
	Moderately confident	37	27.6
	Quite confident	37	27.6
	Extremely confident	7	5.2

Table 3. Association Between Hands-on Experience and Confidence Level

Hands-on experience	Low confidence n (%)	Moderate confidence n (%)	High confidence n (%)	Total	p-value	Cramér's V
Yes	10 (16.7)	14 (23.3)	36 (60.0)	60	<0.001	0.38
No	36 (63.2)	14 (24.6)	7 (12.2)	57		
Unsure	7 (41.2)	9 (52.9)	1 (5.9)	17		

Table 4. Association Between Perceived Training Sufficiency and Confidence Level

Training sufficiency	Low n (%)	Moderate n (%)	High n (%)	Total	p-value	Cramér's V
Strongly agree	2 (13.3)	3 (20.0)	10 (66.7)	15	<0.001	0.33
Agree	16 (32.0)	14 (28.0)	20 (40.0)	50		
Neutral	10 (31.3)	14 (43.7)	8 (25.0)	32		
Disagree	15 (55.5)	6 (22.2)	6 (22.2)	27		
Strongly disagree	10 (100)	0 (0.0)	0 (0.0)	10		

Table 4 evaluates how perceived training sufficiency relates to confidence, again using low/moderate/high confidence groupings. The association was statistically significant ($p<0.001$) with a moderate-to-large effect size (Cramér's V=0.33). Students who strongly agreed that training was sufficient (n=15) showed the highest proportion of high confidence

at 66.7% (n=10), with 20.0% (n=3) reporting moderate confidence and 13.3% (n=2) reporting low confidence. In the "agree" group (n=50), confidence was more distributed, though high confidence remained substantial at 40.0% (n=20), with 28.0% (n=14) moderate and 32.0% (n=16) low. Among neutral respondents (n=32), the dominant category was moderate confidence at 43.7% (n=14), followed by low confidence at 31.3% (n=10) and high confidence at 25.0% (n=8). Confidence declined further among those who disagreed (n=27), where low confidence predominated at 55.5% (n=15). Notably, all students who strongly disagreed that training was sufficient (n=10) reported low confidence (100%, n=10), with none reporting moderate or high confidence, reflecting a strong dose–response pattern between perceived preparedness and confidence.

Table 5. Association Between Fear of Harming the Patient and Confidence Level

Fear reduces confidence	Low n (%)	Moderate n (%)	High n (%)	Total	p-value	Cramér's V
Strongly agree	16 (59.3)	7 (25.9)	4 (14.8)	27	0.002	0.26
Agree	26 (44.1)	18 (30.5)	15 (25.4)	59		
Neutral	7 (20.6)	11 (32.4)	16 (47.0)	34		
Disagree/Strongly disagree	4 (28.6)	1 (7.1)	9 (64.3)	14		

Table 5 examines the relationship between fear of harming the patient and confidence levels. This association was statistically significant (p=0.002) with a moderate effect size (Cramér's V=0.26). Among students who strongly agreed that fear reduces confidence (n=27), a majority reported low confidence (59.3%, n=16), while 25.9% (n=7) reported moderate confidence and only 14.8% (n=4) reported high confidence. In the "agree" group (n=59), low confidence remained common (44.1%, n=26), with 30.5% (n=18) reporting moderate confidence and 25.4% (n=15) reporting high confidence.

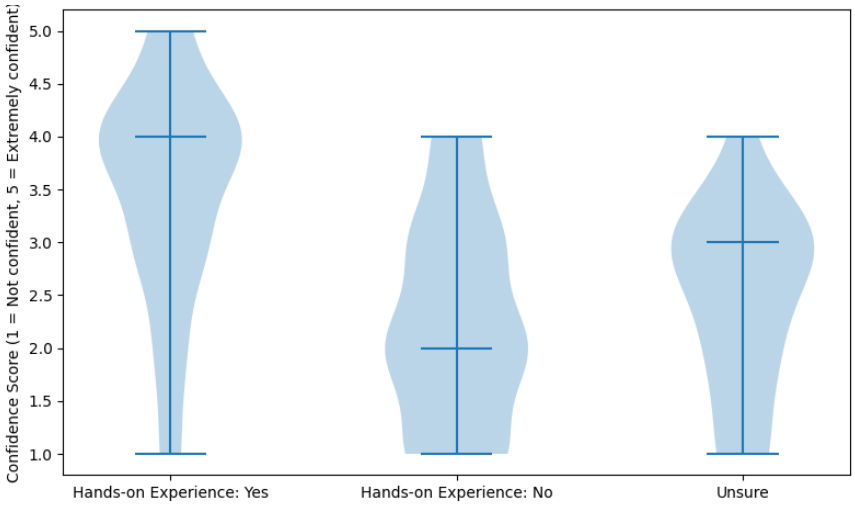

Figure 1 Distribution of Clinical Confidence by Hands-On Experience in Local Anesthesia

The pattern reversed among students who were neutral (n=34), where high confidence became the largest category (47.0%, n=16), compared with 32.4% (n=11) moderate and 20.6% (n=7) low confidence. Among those who disagreed or strongly disagreed (combined, n=14), high confidence was most prevalent (64.3%, n=9), with low confidence at 28.6% (n=4) and moderate confidence at 7.1% (n=1). Overall, decreasing endorsement of fear as a confidence-reducing factor corresponded to a shift from low toward high confidence, supporting fear as a meaningful psychological barrier in students' clinical self-assurance.

This figure illustrates the distributional shift in self-reported confidence scores (ordinal scale 1–5) across levels of hands-on experience using a violin-based density representation with median indicators. Students with hands-on experience demonstrated a right-skewed distribution centered at a median confidence score of 4, with a substantial density between scores 3 and 5 and minimal mass at the lowest confidence levels, reflecting a predominance of moderate-to-high confidence (60.0%). In contrast, students without hands-on experience showed a left-shifted and more compressed distribution with a median score of 2, dense clustering at scores 1–2, and near absence of high confidence scores, consistent with 63.2% reporting low confidence. The "unsure" group displayed an intermediate pattern, with a median score of 3 and broader dispersion across the scale, indicating transitional confidence. The asymmetric spread and separation of distributions highlight a clinically meaningful gradient whereby direct procedural exposure is associated not only with higher central confidence but also with reduced variability and fewer extreme low-confidence responses, underscoring hands-on experience as a key determinant of stable clinical self-assurance in local anesthesia administration.

DISCUSSION

The present study provides evidence that confidence in administering local anesthesia among undergraduate dental students is strongly associated with clinical exposure, perceived adequacy of training, and psychological factors, particularly fear of harming the patient. Overall, most students reported moderate levels of confidence, while a considerable proportion expressed low confidence, underscoring a persistent gap between theoretical instruction and clinical self-assurance. These findings reinforce the notion that confidence is not merely a function of knowledge acquisition but is closely linked to experiential learning and emotional readiness for patient care, which are central to clinical competence development in dentistry (22).

One of the most salient findings of this study is the strong association between hands-on experience and higher confidence levels. Students who had previously administered local anesthesia under supervision were substantially more likely to report high confidence compared with those without such experience, with a large effect size. This aligns with prior research demonstrating that direct clinical exposure enhances self-efficacy, procedural fluency, and decision-making ability in dental students (23,24). Experiential learning theories suggest that repeated performance in authentic clinical settings allows students to integrate psychomotor skills with anatomical knowledge and patient communication, thereby reducing uncertainty and reliance on supervisors (25). The pronounced distributional shift toward higher and more stable confidence among experienced students in the present study further supports the critical role of early and structured clinical exposure in local anesthesia training.

Perceived sufficiency of training emerged as another key determinant of confidence, showing a clear dose–response relationship. Students who strongly believed their training adequately prepared them for real-patient injections demonstrated the highest confidence, whereas those who perceived their training as insufficient uniformly reported low confidence. This finding is consistent with earlier studies indicating that students' subjective appraisal of their preparedness often predicts their willingness to perform procedures independently, sometimes even more strongly than objective measures of competence (26,27). Adequate training, in this context, likely reflects not only the quantity of clinical exposure but also the quality of supervision, feedback, and opportunities for progressive responsibility. These results highlight the importance of structured, competency-based

curricula that clearly define learning outcomes and provide students with tangible indicators of readiness before transitioning to independent patient care (28).

Fear of harming the patient was identified as a prominent psychological barrier negatively associated with confidence, with students who strongly endorsed this fear being significantly more likely to report low confidence. This observation is in line with existing literature showing that anxiety related to patient safety and potential complications is a common concern among dental students, particularly during invasive procedures such as injections (29,30). Anticipation of adverse events, including syncope, hematoma, or nerve injury, can heighten stress and impair performance, even in students with adequate theoretical knowledge (31). Interestingly, students who were neutral or disagreed that fear reduced their confidence demonstrated a marked shift toward higher confidence, suggesting that managing procedural anxiety may be as important as improving technical skills. Interventions such as simulation-based rehearsal, stress inoculation training, and guided reflection may therefore play a valuable role in mitigating fear-related barriers (32).

Taken together, the findings of this study suggest that confidence in local anesthesia administration develops through an interplay of experiential, cognitive, and psychological factors. While progression through academic years may naturally increase exposure and familiarity, confidence should not be left to accrue passively over time. Instead, longitudinal integration of simulation, supervised clinical practice, and structured feedback throughout the dental curriculum may facilitate a smoother transition from preclinical training to patient-based care (33,34). By addressing both skill acquisition and emotional readiness, dental education programs can better prepare students to deliver safe, effective, and patient-centered anesthesia.

The results of this study should be interpreted in light of its limitations. The cross-sectional design precludes causal inference, and the use of convenience sampling may limit generalizability beyond the participating institutions. Additionally, reliance on self-reported measures introduces the possibility of response bias. Nevertheless, the inclusion of students from multiple academic years and institution types, along with the use of effect sizes and distributional analyses, strengthens the interpretability of the findings. Future research employing longitudinal designs and objective assessments of clinical competence would be valuable to further elucidate how confidence evolves over time and how it relates to actual clinical performance (35).

In conclusion, this study demonstrates that hands-on experience and perceived training adequacy are positively associated with dental students' confidence in administering local anesthesia, while fear of harming the patient represents a significant psychological barrier. These findings emphasize the need for well-organized, experiential, and confidence-oriented training approaches within undergraduate dental education. Addressing these factors may not only enhance student confidence but also contribute to safer and more effective patient care as students transition into independent clinical practice (36).

CONCLUSION

In conclusion, the findings of this study demonstrate that dental students' confidence in administering local anesthesia is multifactorial and is strongly influenced by hands-on clinical experience, perceived adequacy of training, and psychological factors such as fear of harming the patient. Students with prior supervised injection experience and those who felt sufficiently trained consistently exhibited higher confidence levels, whereas fear-related concerns were associated with reduced self-assurance. These results highlight a critical need for dental curricula to move beyond theoretical instruction by integrating early, structured,

and supervised clinical exposure alongside targeted strategies to address anxiety and build self-efficacy. Strengthening experiential learning and confidence-building interventions may help bridge the gap between knowledge and practice, ultimately producing more competent, confident, and patient-safe dental graduates.

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DECLARATIONS

Ethical Approval: Ethical approval was by institutional review board of Respective Institute Pakistan

Informed Consent: Informed Consent was taken from participants.

Authors' Contributions:

Concept: HA, AK, LN, TB, Supervision: AZ; Design: HA, AZ; Data Collection: HA, AK, LN, TB; Analysis: HA, AZ; Drafting: HA, AK, LN, TB, AZ

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