# RESEARCH



# Evaluation of confidence levels of undergraduate dental students in various stages of root canal treatment



Idil Ozden<sup>1\*</sup>, Merve Gokyar<sup>1</sup>, Mustafa Enes Ozden<sup>2</sup> and Hesna Sazak Ovecoglu<sup>1</sup>

# Abstract

**Introduction** The objective of this study is to assess the confidence levels of 4th- and 5th-year dental students in relation to root canal treatment (RCT). Additionally, the study aims to examine how these levels fluctuate in response to various procedures, tooth types, and gender.

**Methods** This cross-sectional, survey-based study was conducted with 4th- and 5th-year dental students. The students were requested to evaluate their confidence levels in relation to a number of endodontic procedures, including anesthesia administration, rubber dam placement, canal preparation, irrigation, filling, retreatment and the management of complications. The survey results were analysed using the Mann-Whitney U test and the Friedman test in order to evaluate the existence of any differences in confidence levels as a function of procedure, tooth type and gender.

**Results** The findings indicated that 4th-year students demonstrated higher levels of confidence in most procedures. The lowest levels of confidence were observed in the management of complications, including perforations, broken instruments, and the extrusion of irrigants apically. Male students reported significantly higher levels of confidence than female students across all procedures and tooth types.

**Conclusion** The findings of this study indicate that there are significant variations in the confidence levels of dental students during RCT procedures, depending on the specific procedure, tooth type, and gender. The findings of this study demonstrate that dental students' confidence levels during RCT procedures vary significantly depending on the type of procedure, tooth type, and gender. Deficits in confidence were particularly evident in challenging procedures, such as the management of complications.

Keywords Endodontic skill acquisition, Dental education, Self-assessment, Selfconfidence, Student

\*Correspondence: Idil Ozden idil.akman94@gmail.com <sup>1</sup>Faculty of Dentistry, Department of Endodontics, Marmara University, Istanbul, Turkey <sup>2</sup>Republic of Turkey, Ministry of Health Kahramankazan District Health Administration, Ankara, Turkey



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

## Introduction

Dentistry encompasses a wide range of specialties in which students must achieve proficiency before graduation. One of these specialties, endodontics is often considered by many students as one of the most challenging disciplines [1-3]. This perception is not unfounded, as endodontics requires not only technical precision but also the ability to manage a variety of clinical scenarios effectively. Endodontic procedures are extremely intricate and demand a comprehensive understanding of tooth anatomy, pathology, and advanced clinical techniques.

The literature highlights the limited confidence and competence among multiple students in performing endodontic procedures after graduation [3, 4]. Numerous reasons that can be attributed to students' lack of confidence in endodontics include factors such as difficulties in patient communication, the complexity of root canal anatomy, efficient pain management, the challenges of taking radiographs with rubber dam isolation, diagnosis, root canal treatment (RCT) of multi-rooted teeth, precise determination of the working length, the interdependence of procedural steps and the possibility of irreversible complications [2, 5, 6]. Each of these factors demands a high level of clinical expertise and coordination, which can overwhelm students during their training. As a result, the stress associated with mastering these procedures may negatively impact their ability to deliver optimal treatment outcomes [7].

The primary objective of undergraduate endodontic education is to develop a student's competence in all aspects of endodontic diagnosis and treatment to ensure that they are capable of performing high-quality endodontic procedures and delivering proficient care upon graduation [2, 8]. As in all areas of healthcare, dental services are also a field where human resources are limited. Furthermore, it is of the utmost importance to prevent the highly trained specialists, who are already overburdened with complex cases, from being occupied with procedures that primary care dentists could manage. The initial step in addressing this issue includes an assessment of the competencies and confidence levels of dental students for performing these procedures. In conclusion, a "successful" dental graduate should possess the confidence to perform clinical duties competently and independently [9].

A key factor in assessing the competence of students is the quality of the RCT they perform [10]. The effectiveness of education is measured by the confidence and competence of students [11, 12]. Studies [13, 14] indicate that a significant proportion of RCTs performed by students fall short of preset standards, raising concerns about the quality of their education. While studies evaluating the quality of education often use objective competence criteria, it is noted that student's self-perceived confidence may influence their ability to demonstrate competence, thus serving as a useful secondary outcome metric [15, 16]. Improving the confidence of dental students is expected to enhance the quality of care they provide, as it directly influences their ability to perform clinical duties effectively and independently. Despite the critical role of confidence in dentistry, there is a paucity of research focusing specifically on students' self-perceived confidence during endodontic procedures. While numerous studies [2, 14, 17, 18] have investigated the technical quality and outcomes of RCT performed by dental students, limited attention has been given to their confidence levels during different stages of the procedure and across various tooth types. Understanding this aspect is crucial for designing targeted interventions to bridge gaps in endodontic education.

This study aims to evaluate and compare the confidence levels of 4th- and 5th-year dental students during different stages of RCT. It also aims to compare their confidence in performing different procedural steps across diverse tooth types. The first hypothesis of the study posits that students' confidence levels in performing root canal treatment (RCT) will demonstrate significant variations across the various stages of the procedure and between different tooth types. The second hypothesis suggests that the students' experiences may influence these confidence levels.

## **Materials and methods**

The present cross-sectional study was conducted between 2023 and 2024 at the Marmara University Faculty of Dentistry, involving 4th- and 5th-year dental students. Written informed consent was obtained from all participants involved in this study. All procedures were approved by the relevant ethics committee and conducted in accordance with the principles of the Declaration of Helsinki. The inclusion criterion for participation was enrollment at the institution in the 4th or 5th year of the 2023–2024 academic term. During the specified period, there were 236 students in total (136 from the 4th year and 130 from the 5th year), out of which 233 (133 from the 4th year and 130 from the 5th year) volunteered to participate (98.87%).

A survey was administered to assess students' self-confidence at various stages of RCT. The survey questions were adapted from a previous study by Murray et al. [3] and further refined by the authors to address the specific procedures involved in RCT. The finalized questions are provided as supplementary material. For each procedural stage, students were asked to rate their level of confidence on a 5-point Likert scale (1 = not confident at all, 5 = very confident). The RCT stages were classified as anesthesia administration, rubber dam placement, access cavity preparation, periapical radiography, canal preparation, irrigation, filling, retreatment, restoration, and the management of potential complications. Furthermore, the impact of these procedures on maxillary and mandibular teeth, as well as on molars, premolars, and anterior teeth, was evaluated separately. The overall self-confidence scores were also calculated based on tooth position (anterior, premolar, and molar) to provide a comprehensive evaluation. Students were then categorized according to their level of experience (4th or 5th year), gender, and the specific RCT stages. Ethical approval for this study was obtained from the Marmara University Health Sciences Faculty Ethics Committee.

#### Statistical analysis

The SPSS v29 program (IBM SPSS Statistics, Armonk, USA) was used for data analysis and visualization. Median and interquartile percentiles (25th-75th) were presented as descriptive data, and the Mann-Whitney U test was used for pairwise comparison of scores between grades. Related Samples Friedman's Test was used to compare the total scores given by the students according to the position of the teeth. In all statistical analyses, a type 1 error of 0.05 was accepted.

#### Results

The distribution of students' self-confidence scores for each clinical procedure according to their grades is presented in Table 1. It was observed that 4th-year students reported statistically significantly higher self-confidence scores than 5th-year students in all clinical stages where self-confidence was assessed (for each variable). However, no statistically significant difference was found in self-confidence scores during radiograph capturing in premolars and molars, as well as retreatment in molars (p=0.154, p=0.244, p=0.943, respectively). The findings of this study also revealed a statistically significant difference in the confidence scores attained during procedures performed on maxillary teeth that were higher in comparison to those performed on mandibular teeth (p<0.001).

The distribution of total self-confidence scores was analyzed according to the grade (Table 2; Fig. 1) and gender (Table 3) of the participants. For both grades, the highest total score was observed in anterior teeth, and the lowest score was observed in molars. The difference in total scores was found to be statistically significant in comparisons (Related Samples Friedman's Test, p < 0.001 for both grades). All pairwise comparisons showed a statistically significant difference for both grades except between anterior teeth and premolars (Mann-Whitney U Test, p = 0.101 for 4th-year and p = 0.517 for 5th-year). Additionally, the total self-confidence score for all tooth positions was found to be statistically significantly higher in male participants compared to their female counterparts.

## Discussion

The curriculum guidelines established by the European Society of Endodontology and the "Profile and Competences for the Graduating European Dentist" report, published by the Association for Dental Education in Europe (ADEE), delineate the foundational principles of dental education. These guidelines recommend that all students gain sufficient experience in the treatment of anterior, premolar, and molar teeth in both preclinical and clinical settings. Furthermore, clinical education should be structured based on competencies rather than merely focusing on the number of procedures performed. It is emphasized that students should be able to evaluate all treatment options, assess the restorative potential and complexity of the treatment, and make appropriate referrals to specialists when necessary. The term "competence at the time of graduation" is defined as the level of essential professional behavior, knowledge, and skills that are required to respond to any situation encountered in general professional practice. Achieving this level of competence is linked to students' ability to take responsibility for their clinical performance and to demonstrate an awareness of the need to manage their learning processes [19, 20].

The objective of this study is to assess the confidence levels of 4th- and 5th-year dental students in their ability to perform the various stages of RCT. In the context of dental education, the continuous assessment of the curriculum and the incorporation of student feedback are of paramount importance for the improvement of educational quality and the identification of areas requiring improvement [21]. The self-assessment of students in relation to their competencies serves as a valuable tool for the realistic evaluation of the effectiveness of the dental curriculum and specific courses [22, 23].

This study employs a survey as the data collection method to identify the challenges faced by 4th- and 5th-year dental students. The surveys yielded invaluable insights into the educational requirements of the students and furnished data that could inform curriculum development. The dental school where the study was conducted offers a comprehensive curriculum that integrates clinical practice with theoretical knowledge. The final 2 years of the undergraduate program, the 4th- and 5th-year, represent a critical period of transition for students towards independent clinical practice, with a strong emphasis on the clinical components of the curriculum. This systematic approach guarantees that students are well-prepared to fulfill their professional obligations after graduation.

A total of 98.73% of students enrolled in 4th and 5th- years consented to participate in the survey and completed all the survey questions in their entirety. Such a high response rate was deemed adequate for

# Table 1 Distribution of student's responses to self-confidence questions according to their grades

Confidence Level During Endodontic Procedures	4th Year (n = 133) Median (25th- 75th percentile)	5th Year (n = 130) Median (25th- 75th percentile)	p value*
Confidence level during endodontic treatment on an adult patient			
Maxillary teeth	4.0 (3.0-4.0)	3.0 (2.0-3.0)	< 0.001
Mandibular teeth	4.0 (3.0-4.0)	4.0 (3.0-4.0)	0.001**
Confidence level during local anesthesia administration prior to endodontic treatment			
Patients with systemic diseases	3.0 (3.0-4.0)	3.0 (2.0-3.0)	< 0.001
Patients without systemic diseases	5.0 (4.0-5.0)	4.0 (3.0-5.0)	< 0.001
Confidence level during rubber dam placement			
Anterior teeth	4.0 (4.0-5.0)	3.0 (2.75-4.0)	< 0.001
Premolar teeth	4.0 (4.0-5.0)	3.0 (3.0-4.0)	< 0.001
Molar teeth	4.0 (4.0-5.0)	3.0 (2.0-4.0)	< 0.001
Confidence level during cavity preparation			
Anterior teeth	4.0 (3.0–5.0)	4.0 (3.0-5.0)	0.004**
Premolar teeth	4.0 (4.0-5.0)	4.0 (3.0-5.0)	< 0.001
Molar teeth	4.0 (3.0-4.75)	3.0 (3.0-4.0)	0.001
Confidence level during radiographic imaging			
Anterior teeth	5.0 (4.0–5.0)	4.0 (3.0-5.0)	< 0.001
Premolar teeth	4.0 (4.0-5.0)	4.0 (3.0-5.0)	0.154
Molar teeth	4.0 (3.0-5.0)	4.0 (3.0-5.0)	0.244
Confidence level during canal preparation (using hand instruments)	(	(	
Anterior teeth	40(40-50)	40(30-40)	< 0.001
Premolar teeth	40(30-50)	30(30-40)	< 0.001
Molar teeth	30(30-40)	30(20-30)	< 0.001
Confidence level during irrigation	5.6 (5.6 1.6)	5.0 (2.0 5.0)	
Anterior teeth	45 (40-50)	40(30-40)	< 0.001
Premolar teeth	40 (40-50)	40(30-40)	< 0.001
Molar teeth	4.0 (4.0-5.0)	3.0 (3.0-4.0)	< 0.001
Confidence level during root canal obturation	1.0 (1.0 5.0)	5.0 (5.0 1.0)	0.001
Anterior teeth	50(40-50)	40(30-40)	< 0.001
Premolar teeth	4.0 (3.25-5.0)	3.0 (3.0-4.0)	< 0.001
Molar teeth	3.0 (3.0-4.0)	3.0 (2.0-4.0)	0.007
Confidence level in cases of existing restorations during endodontic/retreatment	5.0 (5.0 +.0)	5.0 (2.0 4.0)	0.002
procedures			
Presence of amalgam restoration	3.0 (3.0-4.0)	2.0 (1.0-3.0)	< 0.001
Presence of composite restoration	40(30-50)	30(30-40)	< 0.001
Presence of crown	30(30-40)	20(20-30)	< 0.001
Presence of intracanal post	25(10-30)	2.0 (1.0-3.0)	0.010**
Presence of previous root canal filling	3.0 (2.0-4.0)	2.0 (1.0-3.0)	0.009
Confidence level during removal of previous root canal filling	5.6 (2.6 1.6)	2.0 (1.0 5.0)	0.005
Anterior teeth	30(30-40)	3 0 (2 0-4 0)	< 0.001
Premolar teeth	3.0 (3.0 4.0)	3.0 (2.0 4.0)	0.005**
Molar teeth	2.0 (2.0 4.0)	2.0 (1.0-3.0)	0.005
Confidence level during complications arising during endodentic treatment	2.0 (1.0-5.0)	2.0 (1.0-3.0)	0.945
	30(20 40)	20(20 30)	< 0.001
Perforation	2.0 (2.0 4.0)	2.0 (2.0 3.0)	< 0.001 0 008**
Riockage of the root canal by debris	2.0 (1.0-3.0)	2.0 (1.0-2.0)	0.000
Eventual of the root carrier by debits	2.0(2.0-4.0)	2.0(2.0-3.0)	0.002
Instrument fracture	2.0 (1.0-3.0)	2.0(1.0-3.0)	0.002
	2.0 (1.0-3.0)	2.0(1.0-3.0)	<0.052 <sup></sup>
Uvernieu iUUL (dildi Linderfilled/chert reet canal	2.0 (2.0−2.0) 2.0 (2.0−4.0)	∠.∪ (1.U=3.U)	< 0.001
undernied/sholt 100t Callal	J.U (Z.U-4.U)	2.0 (2.0-3.0)	0.017

\*Mann-Whitney U Test

\*\*Although the median and IQR are identical between grades, the Mann-Whitney U test examines the rank distribution of all observations, allowing subtle differences in data to yield significant results

Teeth Group	4th grade	5th grade	p value*	
(max score = 35)	(n = 133) Median score (25th-75th percentile)	( <i>n</i> = 130)		
		Median score (25th-75th percentile)		
Anterior	29.0 (25.0–32.0)	25.0 (21.0–28.0)	< 0.001	
Premolar	28.0 (25.0–32.0)	24.0 (21.00-27.25)	< 0.001	
Molar	25.0 (21.25-28.0)	21.5 (18.0–25.0)	< 0.001	
p value**	< 0.001	< 0.001		

**Table 2** Distribution of student's total self-confidence scores in procedures in anterior, premolar and molar teeth groups according to their grades

\*Mann-Whitney U Test

\*\*Related Samples Friedman's Test



Fig. 1 Distribution of students' total self-confidence scores in procedures in anterior, premolar and molar teeth groups according to their grades

**Table 3** Distribution of student's total self-confidence scores in procedures in anterior, premolar and molar teeth groups according to their gender

Teeth Group	Female	Male	p value*		
(max score = 35)	( <i>n</i> = 173)	(n = 88)			
	Median score (25th-75th percentile)	Median score (25th-75th percentile)			
Anterior	26 (22–25)	29 (25–32)	< 0.001		
Premolar	25 (22–29)	28 (23–31)	0.004		
Molar	23 (19–26)	25 (19–29)	0.013		

\*Mann-Whitney U Test

the procurement of reliable data. Prior research indicates that response rates for surveys range from 47 to 100%, with these rates being influenced by factors such as the method of distribution [7, 11]. It can be reasonably assumed that the administration of the survey in a clinical setting encouraged higher levels of participation, prompting motivation and willingness among students to contribute. Furthermore, to reduce potential bias and ensure impartiality, the surveys were administered at the conclusion of each clinical rotation after the final grades had been released.

The existing literature indicates that students frequently experience anxiety during dental procedures [2, 3, 6]. Nevertheless, it is essential to ascertain the specific factors that contribute to this anxiety. Accordingly, the objective of this study is to concentrate on endodontics and its associated clinical procedures. We contend that this study will contribute to providing a general overview of how students evaluate themselves in a field that is likely to be integral to their future professional practices when they begin to serve the community. Prior research [13] has identified a number of factors that can influence students' confidence levels in clinical dental practice. One of the limitations in developing clinical confidence has been identified as insufficient clinical exposure in the undergraduate curriculum. Furthermore, insufficient patient numbers, physical space limitations in dental schools, challenges posed by a rigorous curriculum, and a lack of adequately trained staff have been identified as significant obstacles to attaining high levels of clinical confidence [13]. However, in the dental school where this study was conducted, it is not believed that these factors contribute to lower confidence levels in performing RCT. This is due to the availability of a sufficient number of dental units, allowing students to rotate daily to meet their practical training needs, as well as the high patient turnover for dental care. As a result, confidence levels can be more directly correlated with the complexity of the procedures themselves rather than the extrinsic factors.

Based on the results obtained, the study's hypothesis that "students' confidence levels in performing RCT may be influenced by their experiences" can be partially supported by the results. Upon examination of the study results, it was determined that 4th-year students demonstrated a statistically significant increase in confidence levels across all variables (except for radiography of premolar and molar teeth and retreatment of molars) in comparison to 5th-year students, indicating that the students' level of experience influenced confidence levels. However, contrary to expectations, less experienced students were found to be more confident. This finding is not consistent with the results of previous studies, which have generally demonstrated a concurrent increase in confidence levels as students progress through their undergraduate years [11, 24]. Numerous studies [11, 25] have demonstrated that low confidence is often reflected in disciplines or procedures where clinical exposure is limited. However, Hattar et al. [26] observed that increased exposure to cases does not necessarily result in higher confidence. Additionally, a similar study [27] reported that 4th- and 5th-year students reported confidence in most basic endodontic clinical procedures, with no statistically significant difference in confidence levels observed between the two educational cohorts. This discrepancy may be attributed to the variations in curriculum design across countries in which the two studies were conducted. Moreover, while the previous study broadly assessed fundamental endodontic clinical procedures, the present study evaluated each clinical step in detail, which may potentially contribute to the variations in the findings. Furthermore, other factors, such as the environment in which the clinical procedure is performed, the time allocated to the students, and the quality of prior education, also have a significant impact. Students who are new to clinical practice tend to experience elevated stress levels due to their limited practical experience. Furthermore, while positive experiences can enhance self-efficacy, negative experiences, particularly those occurring at an early stage or in the absence of adequate positive experiences, can have the opposite effect by undermining confidence [28]. This situation may explain why 5th-year students, who are more frequently exposed to complex cases and potential complications, report lower confidence levels compared to 4th-year students. Additionally, within the curriculum at our faculty of the dental school in this study, 4th-year students are required to complete root canal treatments on four molars, two premolars, and four anterior teeth during their academic year. For 5th-year students, these requirements are include seven molars, one premolar, and three anterior teeth, respectively. Although the overall number of cases treated appears similar, the higher proportion of molar treatments required for 5th-year students may contribute to the observed higher confidence levels among 4th-year students. From another perspective, these results could also be attributed to the uncertainty experienced by 5th-year students regarding their professional competence in performing RCTs post-graduation. This concern, together with their increased exposure to difficult clinical settings, may explain the observed confidence gap between the two cohorts.

The study's hypothesis that "students' confidence levels in performing RCT will demonstrate significant differences across the various stages of the procedure and between different tooth types" has been verified and accepted. This study identified that molar teeth present the greatest challenge during RCT procedures. This finding is not surprising, as numerous studies [23, 29–31] have described RCT of molar teeth as one of the most challenging procedures for dental students. Both 4thand 5th-year students exhibited lower confidence levels when performing procedures on maxillary teeth. This may be attributed to the anatomical complexity and physical positioning of maxillary molars, which pose significant challenges during RCT.

The presence of a systemic illness in patients undergoing local anesthesia prior to RCT was found to reduce confidence levels across all student cohorts. This finding may be explained by the increased anxiety among students, which likely stems from concerns about potential interactions between the patient's regularly administered medications and the anesthetic solution, as well as the risk of toxic reactions induced by the anesthetic solution [32–33].

The use of a rubber dam during RCT has been identified as one of the situations in which 5th-year students

reported the lowest levels of confidence. Additionally, during rubber dam application, 4th-year students reported similar levels of self-confidence across all tooth groups (anterior, premolar, molar), while 5th-year students indicated lower self-confidence scores specifically when applying rubber dams to molar teeth. The literature presents mixed results regarding the use of rubber dams. Some studies [3, 27, 34] report very high levels of confidence in the use of rubber dams (95-100%). However, other studies [5, 35] suggest that students do not sufficiently accept the use of rubber dams and demonstrate resistance to their use, owing to the perceived difficulty of the procedure and patient discomfort. Despite these challenges, the rubber dam is an essential part of modern endodontic practice and is both an ethical and legal requirement in dentistry. Consequently, in the institution where this study was conducted, the use of a rubber dam is mandatory, and students are not allowed to complete their treatment without using rubber dams. In light of this finding, improving students' proficiency in rubber dam application should be prioritized by the faculty and teaching staff to ensure that students attain technical competence and report higher levels of confidence in the future.

A study conducted in Brazil identified the primary challenges faced by students in preclinical and clinical endodontic practice. These challenges include the application of radiographic techniques, cavity preparation, use of rubber dams, identification of the root canal, instrument handling, and issues related to root canal filling [36]. Another study [21] indicated that the most significant difficulties encountered by students during RCT occur during the mechanical preparation phase. Consequently, the survey included questions addressing these challenges. In this study, both 4th- and 5th-year students reported lower self-confidence scores for molar teeth during access cavity preparation, cavity preparation, and root canal obturation. Additionally, it was determined that retreatment procedures in molar teeth and the presence of intracanal posts were among the most challenging situations. This finding is consistent with the findings of similar methodologies in which students evaluated their self-confidence levels in performing endodontic treatments from their perspectives [34, 37].

A notable finding is that student's confidence in performing RCT procedures is generally low, with a particular prevalence in the management of complications. The management of perforations is identified as the area where students exhibit the lowest levels of confidence, followed closely by the management of broken instruments and the extrusion of irrigants into the apical region. The management of errors occurring during endodontic procedures poses a considerable challenge, particularly for inexperienced dental students. It is reasonable to hypothesise that students will have low confidence in independently managing such complications, and that the referral of certain cases to a specialist is an indisputable necessity. However, it should be noted that dental education encompasses not only practical training but also the development of independent clinical decision-making skills required after graduation. For this reason, all potential clinical scenarios are theoretically trained. Given that general dentists who do not pursue specialist training may also encounter such complications in their clinical practice, it is of critical importance that students acquire theoretical knowledge on how to manage these situations. In this context, the evaluation of students' knowledge regarding procedural error management has been considered essential, as it contributes to enhancing their clinical competence following graduation. Among the most frequently encountered challenges in clinical practice, perforations are reported to occur with greater frequency than other complications [38]. Perforations are recognized as complications that significantly increase the complexity of RCT and demand advanced clinical skills. The management of such errors can have a detrimental impact on student's confidence in their clinical skills and decision-making abilities, further highlighting the critical significance of specialized training in this discipline.

Similarly, the management of broken instruments is a highly complex procedure that can give rise to feelings of anxiety and a fear of making mistakes among students, which may subsequently result in a loss of confidence. Such challenges may result in elevated stress levels during clinical experiences, which could negatively impact student's clinical performance. Indeed, the removal of broken instruments from the root canal is often a challenging procedure, frequently associated with elevated stress levels and diminished confidence among students [39].

Furthermore, the extrusion of irrigants into the apical region not only tests the technical abilities of students but also has the potential to significantly erode their confidence due to the possibility of adverse reactions from patients. In the event of such a complication, patients may experience pain, swelling, or other adverse effects [40]. Such negative patient responses can intensify feelings of guilt and inadequacy in students, thereby further eroding their confidence in their clinical abilities and self-assurance. Therefore, the low confidence levels observed in our study are consistent with the findings of previous research [41], as managing these types of complications is typically expected within the scope of postgraduate clinics, where students often have limited hands-on experience and primarily rely on theoretical knowledge.

Finally, an analysis of confidence levels in RCT procedures based on gender revealed that male students consistently reported higher confidence levels than their female counterparts across all academic years and treatment stages. Similar gender differences have been documented in previous studies, with male students reporting greater subjective confidence when performing complex endodontic procedures [42, 43]. Similarly, comparable gender-based disparities have been observed among medical students, with female students consistently reporting lower levels of confidence than their male counterparts [44, 45].

The educational significance of this study lies in its evaluation of dental students' confidence levels in performing endodontic procedures, thereby identifying the effectiveness of the curriculum and identifying areas requiring improvement to better address the needs of students for their professional preparation. It is noteworthy that deficiencies in confidence, specifically in challenging areas such as molar RCT, rubber dam application, and complication management, highlight inadequacies in the educational process. This underscores the necessity for targeted curriculum development in these domains. By examining the relationship between clinical experience and confidence, the study provides insights into the factors contributing to student anxiety and suggests strategies to mitigate these challenges effectively. A further potential avenue for future research would be a comparison of these findings with similar studies conducted at other institutions, which might provide insights into global trends in dental education. While this study offers valuable insights into student's confidence levels in endodontic procedures, it has certain limitations. Firstly, due to the cross-sectional nature of the study, it is not possible to track changes in student's confidence levels over time. Although this approach provides insight into confidence at a specific point in time, it offers a limited perspective on the manner in which confidence develops or declines throughout the entire educational process. Accordingly, a longitudinal follow-up study could provide more comprehensive information on the development of confidence and the factors influencing it over time. Secondly, the study's findings are limited by its focus on students from a single university, which may restrict the generalizability of the results. It must be acknowledged that the experiences and curricula of students at the university under study may not be fully representative of those encountered at other universities or educational programs. Furthermore the use of the Likert scale to assess confidence levels, whereas alternative scales, such as the Academic Behavioral Confidence Scale, could have also been utilized for a more comprehensive evaluation. Consequently, future research should aim to include students from multiple institutions and employ longitudinal study designs to gain a more comprehensive understanding of the progression of confidence in endodontic procedures throughout dental education. Additionally, the use of diverse assessment tools could further enhance the accuracy and depth of confidence evaluations. And lastly, the confidence levels assessed in this study are reflective of students' self-perceived self-efficacy as opposed to their objective clinical competencies. Therefore, a direct correspondence with actual clinical performance should not be expected. In future studies, the implementation of longitudinal and observational research would be advantageous in determining the extent to which students' confidence levels align with their actual clinical success.

# Conclusion

The findings revealed that confidence levels varied according to the specific procedures, tooth types, and gender of the students. It was observed that deficits in confidence were more pronounced in complex procedures, such as the management of complications. In light of the study's limitations, future research should adopt a long-term, comprehensive, and multi-center approach to gain a more nuanced understanding of the development of students' confidence levels, thereby enhancing the validity and generalizability of the findings for the ultimate augmentation of dental education.

#### Supplementary Information

The online version contains supplementary material available at https://doi.or g/10.1186/s12909-025-07174-y.

Supplementary Material 1

#### Acknowledgements

Not applicable.

#### Author contributions

IO: Conceptualization, Methodology, Writing– Original Draft Preparation, and Visualization. MG: Data Curation, Formal Analysis, Investigation, Resources, and Writing. MEO: Statistical Analysis, Software, Data Analysis, Validation, and Writing– Review & Editing. HSO: Supervision, and Writing– Review & Editing. All authors have read and approved the final version of the manuscript.

#### Funding

No funding.

#### Data availability

The datasets used in the current study are available from the corresponding author upon reasonable request.

#### Declarations

#### Ethics approval and consent to participate

The study was conducted in accordance with the ethical standards of the 2008 Declaration of Helsinki and approved by the Ethics Committee for Non-Interventional Research at the Faculty of Health Sciences, Marmara University (Approval No: 28092023/95). Written informed consent was obtained from all participants involved in this study.

#### Consent for publication

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

# Clinical trial number

Not applicable.

Received: 31 December 2024 / Accepted: 11 April 2025 Published online: 17 April 2025

#### References

- Mocny-Pachońska K, Doniec RJ, Wójcik S, Sieciński S, Piaseczna NJ, Duraj KM, Tkacz EJ. Evaluation of the most stressful dental treatment procedures of Conservative dentistry among Polish dental students. Int J Environ Res Public Health. 2021;18(9):4448.
- Tanalp J, Güven EP, Oktay I. Evaluation of dental students' perception and self-confidence levels regarding endodontic treatment. Eur J Dent. 2013;7(2):218–24.
- Murray CM, Chandler NP. Undergraduate endodontic teaching in new Zealand: students' experience, perceptions and self-confidence levels. Aust Endod J. 2014;40(3):116–22.
- Elani HW, Bedos C, Allison PJ. Sources of stress in Canadian dental students: a prospective mixed methods study. J Dent Educ. 2013;77(11):1488–97.
- 5. Alrahabi M. The confidence of undergraduate dental students in Saudi Arabia in performing endodontic treatment. Eur J Dent. 2017;11(1):17–21.
- Rolland S, Hobson R, Hanwell S. Clinical competency exercises: some student perceptions. Eur J Dent Educ. 2007;11(3):184–91.
- Martins RC, Seijo MO, Ferreira EF, Paiva SM, Ribeiro Sobrinho AP. Dental students' perceptions about the endodontic treatments performed using NiTi rotary instruments and hand stainless steel files. Braz Dent J. 2012;23(6):729–36.
- Tavares LG, Lima SMF, Lima MG, Arruda MP, Menegazzi TC, Rezende TMB. Undergraduate dentistry students' perception of difficulties regarding endodontic treatment. Aust Endod J. 2019;45(1):98–105.
- Attar S, Bowles WR, Baisden MK, Hodges JS, McClanahan SB. Evaluation of pretreatment analgesia and endodontic treatment for postoperative endodontic pain. J Endod. 2008;34(6):652–5.
- Ilgüy D, Ilgüy M, Fisekçioglu E, Ersan N, Tanalp J, Dölekoglu S. Assessment of root Canal treatment outcomes performed by Turkish dental students: results after two years. J Dent Educ. 2013;77(4):502–9.
- Davey J, Bryant ST, Dummer PM. The confidence of undergraduate dental students when performing root Canal treatment and their perception of the quality of endodontic education. Eur J Dent Educ. 2015;19(4):229–34.
- Kukulu K, Korukcu O, Ozdemir Y, Bezci A, Calik C. Self-confidence, gender and academic achievement of undergraduate nursing students. J Psychiatr Ment Health Nurs. 2013;20(4):330–5.
- Lynch CD, Burke FM. Quality of root Canal fillings performed by undergraduate dental students on single-rooted teeth. Eur J Dent Educ. 2006;10(2):67–72.
- 14. Ayhan T, Barut G, Tanalp J. The self-confidence levels of senior dental students during endodontic treatment procedures. Turk Endod J. 2006;1(1):1922.
- Gabbard T, Romanelli F. The accuracy of health professions students' Self-Assessments compared to objective measures of competence. Am J Pharm Educ. 2021;85(4):8405.
- Hay I, Ashman A, van Kraayenoord CE. Investigating the influence of achievement on self-concept using an intra-class design and a comparison of the PASS and SDQ-1 self-concept tests. Br J Educ Psychol. 1997;67(Pt 3):311–21. discussion 339–343.
- Luz LB, Grock CH, Oliveira VF, Bizarro L, Ardenghi TM, Ferreira MBC, Montagner F. Self-reported confidence and anxiety over endodontic procedures in undergraduate students—Quantitative and qualitative study. Eur J Dent Educ. 2019;23(4):482–90.
- Grock CH, Luz LB, Oliveira VF, Ardenghi TM, Bizarro L, Ferreira MBC, Montagner F. Experiences during the execution of emergency endodontic treatment and levels of anxiety in dental students. Eur J Dent Educ. 2018;22(4):e715–23.
- Cowpe J, Plasschaert A, Harzer W, Vinkka-Puhakka H, Walmsley AD. Profile and competences for the graduating European dentist - update 2009. Eur J Dent Educ. 2010;14(4):193–202.

- Mirza MB. Difficulties encountered during transition from preclinical to clinical endodontics among Salman Bin Abdul Aziz university dental students. J Int Oral Health. 2015;7(Suppl 1):22–7.
- 22. Greenwood LF, Lewis DW, Burgess RC. How competent do our graduates feel? J Dent Educ. 1998;62(4):307–13.
- 23. Holmes DC, Diaz-Arnold AM, Williams VD. Alumni self-perception of competence at time of dental school graduation. J Dent Educ. 1997;61(6):465–72.
- Puryer J, Woods K, Terry J, Sandy J, Ireland AJ. The confidence of undergraduate dental students when carrying out prosthodontic treatment and their perception of the quality of prosthodontic education. Eur J Dent Educ. 2018;22(1):e142–8.
- Walley S, Bailey JR, Albadri S, Mackie IC, Gilchrist F, Rodd HD. Undergraduates' self-reported clinical experience, confidence and perspectives of hospital and outreach paediatric dentistry: a three-year multi-centre evaluation. Br Dent J. 2014;216(5):251–6.
- Hattar S, AlHadidi A, Altarawneh S, Hamdan AAS, Shaini FJ, Wahab FK. Dental students' experience and perceived confidence level in different restorative procedures. Eur J Dent Educ. 2021;25(1):207–14.
- 27. Almohaimede A. Clinical undergraduate endodontic teaching in King Saud University: student's experience, perception, and self-confidence levels. Int J Dent Oral Health. 2018;4(3):1–5.
- Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev. 1977;84(2):191–215.
- Patel J, Fox K, Grieveson B, Youngson CC. Undergraduate training as Preparation for vocational training in England: a survey of vocational dental practitioners' and their trainers' views. Br Dent J. 2006;Suppl:9–15.
- Bartlett DW, Coward PY, Wilson R, Goodsman D, Darby J. Experiences and perceptions of vocational training reported by the 1999 cohort of vocational dental practitioners and their trainers in England and Wales. Br Dent J. 2001;191(5):265–70.
- Honey J, Lynch CD, Burke FM, Gilmour AS. Ready for practice? A study of confidence levels of final year dental students at Cardiff university and university college Cork. Eur J Dent Educ. 2011;15(2):98–103.
- Finder RL, Moore PA. Adverse drug reactions to local anesthesia. Dent Clin North Am. 2002;46(4):747–57.
- 33. Naftalin LW, Yagiela JA. Vasoconstrictors: indications and precautions. Dent Clin North Am. 2002;46(4):733–46.
- Javed MQ, Khan AM, Bhatti UA. Evaluation of undergraduate dental students self-perceived confidence level regarding endodontic procedures: a questionnaire survey. Saudi Endod J. 2021;11(2):228–34.
- 35. Udoye Cl, Jafarzadeh H. Rubber dam use among a subpopulation of Nigerian dentists. J Oral Sci. 2010;52(2):245–9.
- Seijo MO, Ferreira EF, Ribeiro Sobrinho AP, Paiva SM, Martins RC. Learning experience in endodontics: Brazilian students' perceptions. J Dent Educ. 2013;77(5):648–55.
- Ramlan N, Kamarulzaman M, Norzelan N, Yusri N. Student's confidence level in performing root Canal treatment and its correlation with encountered errors. Int J Oral Health Dent. 2023;9(2):114–8.
- Altorisy A, Ahmad MZ. Assessing confidence levels in endodontic procedures among senior undergraduate dental students at Qassim university, Saudi Arabia: A Cross-Sectional observational study. Cureus. 2023;15(8):e43649.
- Terauchi Y, Ali WT, Abielhassan MM. Present status and future directions: removal of fractured instruments. Int Endod J. 2022;55(Suppl 3):685–709.
- Laslami K, Khaldoune S, Sy A, Drouri S, Benkiran I. Apical extrusion: is it an inherent occurrence during every endodontic treatment?? Cureus. 2023;15(9):e45211.
- Terauchi Y, Sexton C, Bakland LK, Bogen G. Factors affecting the removal time of separated instruments. J Endod. 2021;47(8):1245–52.
- Javed MQ, Bhatti UA. Students' performance in clinics and self-perceived confidence in performing endodontic procedures: A correlation study. Pak J Med Sci. 2023;39(1):203–8.
- Haug SR, Linde BR, Christensen HQ, Vilhjalmsson VH, Bårdsen A. An investigation into security, self-confidence and gender differences related to undergraduate education in endodontics. Int Endod J. 2021;54(5):802–11.
- 44. Blanch DC, Hall JA, Roter DL, Frankel RM. Medical student gender and issues of confidence. Patient Educ Couns. 2008;72(3):374–81.

 Qamar R, Noor N, Khan Q, Jalees M, Manzoor MA, Abbasi S. Evaluation of house officers confidence level in performing endodontic treatment. Pak Oral Dent J. 2018;38(2):268–73.

## **Publisher's note**

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.