revista docência do ensino superior

VOLUME 16
2026
ISSN: 2237-5864

DOI: https://doi.org/10.35699/2237-5864.2026.58475

SECTION: ARTICLES

Laboratory teaching in endodontics and the development of technical competencies: an analysis of the quality of root canal fillings performed by Dentistry students at UFC-Sobral[1]

Ensino laboratorial de endodontia e desenvolvimento de competências técnicas: uma análise da qualidade das obturações realizadas por estudantes de Odontologia da UFC-Sobral

Enseñanza laboratorial de endodoncia y desarrollo de competencias técnicas: un análisis de la calidad de las obturaciones realizadas por estudiantes de Odontología de la UFC-Sobral

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ABSTRACT

Practical dental education activities permeate the academic trajectory in an integrated and interdisciplinary manner, fostering the development of specific competencies and skills. In the endodontics discipline, preclinical training is essential for student learning. This study aimed to evaluate the quality of root canal fillings performed by dentistry students at the

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Received on: 19/08/2025 *Approved on: 17/11/2025* *Published on: 13/03/2026*

Federal University of Ceará, Sobral campus, during the Endodontics Laboratory course. A total of 177 extracted human teeth filled by the classes of 2023 and 2024 were evaluated. The teeth were numbered, separated by tooth groups, and digitally radiographed. For filling analysis, the parameters of filling extension, conicity, and filling density were considered. The items were classified as adequate or inadequate according to predefined criteria. Two evaluators were calibrated intra- and inter-examiner (Kappa index 0.8 and 0.87, respectively). The chi-square test showed a significant association between the evaluated parameters and filling quality ($p \leq 0.001$). In 71.6% of the teeth, the filling was considered adequate. The most deficient criterion was filling density (53.7%), followed by canal conicity (24.9%). Molars were the teeth with the highest incidence of filling density failure (66.7%). The results show that students generally perform adequate fillings. Only the item related to filling density, particularly in the molar dental group, presented significant flaws, indicating the need for specific interventions in the course's didactic and pedagogical approaches to improve performance.

Keywords: undergraduate education; endodontics; preclinical laboratory; root canal filling.

RESUMO

As atividades práticas de ensino odontológico permeiam a trajetória acadêmica de maneira integrada e interdisciplinar, proporcionando o desenvolvimento de competências e habilidades específicas. Na disciplina de endodontia, o treinamento pré-clínico é fundamental para o aprendizado dos estudantes. Este estudo objetivou avaliar a qualidade das obturações de canais radiculares realizadas por estudantes do curso de Odontologia da Universidade Federal do Ceará, campus Sobral, durante a disciplina de Laboratório de Endodontia. Foram avaliados 177 dentes humanos extraídos, obturados pelas turmas de 2023 e 2024. Os dentes foram numerados, separados por grupos dentais e radiografados digitalmente. Para análise da obturação, foram considerados os parâmetros de extensão da obturação, conicidade e densidade de preenchimento. Os quesitos foram classificados em adequado ou inadequado, de acordo com critérios pré-definidos. Dois avaliadores foram calibrados intra e interexaminadores (índice Kappa 0.8 e 0.87, respectivamente). O teste qui-quadrado apresentou significativa associação entre os parâmetros avaliados e a qualidade das obturações ($p \leq 0.001$). Em 71,6% dos dentes, a obturação foi considerada adequada. O critério mais deficiente foi a densidade da obturação (53,7%), seguido da conicidade do canal (24,9%). Os molares foram os dentes com maiores inferências de falha na densidade das obturações (66,7%). Os resultados obtidos retratam que os discentes realizam, de maneira geral, adequadas obturações. Apenas o item relacionado à densidade das obturações, principalmente no grupo dental de molares, apresentou falhas consideráveis, indicando a necessidade de intervenções pontuais nas abordagens didáticas e pedagógicas da disciplina para que correspondam a um melhor desempenho.

Palavras-chave: ensino de graduação; endodontia; laboratório pré-clínico; obturação de canal radicular.

RESUMEN

Las actividades prácticas de formación odontológica permean la trayectoria académica de forma integrada e interdisciplinaria, fomentando el desarrollo de competencias y habilidades específicas. En la disciplina de endodoncia, la formación preclínica es esencial para el aprendizaje del estudiante. Este estudio tuvo como objetivo evaluar la calidad de las obturaciones de conductos radiculares realizadas por estudiantes de Odontología de la Universidad Federal de Ceará, campus Sobral, durante el curso de Laboratorio de Endodoncia. Se evaluaron 177 dientes humanos extraídos, obturados por las clases 2023 y 2024. Los dientes fueron numerados, separados por grupo dentario y radiografiados digitalmente. El análisis de la obturación consideró los parámetros de longitud, conicidad y densidad de la obturación. Los ítems se clasificaron como adecuados o inadecuados según criterios predefinidos. Dos evaluadores fueron calibrados intra e interexaminadores (índice Kappa 0,8 y 0,87, respectivamente). La prueba de chi-cuadrado mostró una asociación significativa entre los parámetros evaluados y la calidad de las obturaciones ($p \leq 0,001$). En el 71,6% de los dientes, la obturación se consideró adecuada. El criterio más deficiente fue la densidad de obturación (53,7%), seguido de la conicidad del conducto (24,9%). Los molares fueron los dientes con mayor incidencia de deficiencia en la densidad de obturación (66,7%). Los resultados muestran que los estudiantes, en general, realizan obturaciones adecuadas. Solamente el ítem relacionado con la densidad de obturación, especialmente en el grupo de molares, presentó fallas significativas, lo que indica la necesidad de intervenciones específicas en los enfoques didáctico y pedagógicos del curso para mejorar el desempeño.

Palabras clave: educación de pregrado; endodoncia; laboratorio preclínico; obturación de conductos radiculares.

INTRODUCTION

The National Curriculum Guidelines (NCG) for the Dentistry course guide the pedagogical projects of the courses, establishing the principles, foundations, and specifics for academic training. The ability to perform dental procedures aimed at the prevention and treatment of oral diseases and conditions, as well as the rehabilitation and maintenance of the balance of the stomatognathic system and oral health, are among the specific competencies foreseen in the NCG. The student must base their work on scientific evidence and incorporate available technological innovations into the practice of the profession, understanding the individual in their entirety in the different phases of the life cycle (Brasil, 2021).

Practical dental teaching activities occur from the beginning of training and permeate the entire trajectory, in an integrated and interdisciplinary way, articulating practice and theory, providing the development of specific skills and abilities. Practical classes are developed in different scenarios, according to the objective of each discipline. The main practice locations are laboratories, professional facilities (clinics on the course premises or in affiliated health units) and social spaces. The pedagogical profile of the Dentistry course requires a constant updating of the methodological dynamics regarding the performance of theoretical-practical activities (Federal University of Ceará, 2019). Currently, the Dentistry course at the Federal University of Ceará (UFC) Sobral campus has achieved the maximum score (5) for the fifth consecutive time in the National Student Performance Examination (NSPE), ranking 1st in the state of Ceará and among the best in the country (Federal University of Ceará, 2025).

The discipline of endodontics addresses, in its syllabus, the diagnosis and treatment of diseases affecting the pulp and periradicular tissue. The steps involved in endodontic treatment require training for students so that they are better prepared and able to obtain satisfactory results in real clinical situations (Baaij; Ozok, 2018; Brasil, 2021; Fritz et al., 2021; Ganji et al., 2022; Leonardi et al., 2012; Tavares et al., 2019). However, some studies have observed that dental academics and general dentists do not offer high-standard endodontic care (Elsayed; Abu-Bakr; Ibrahim, 2011; Er et al., 2006; Khabbaz; Protogerou; Douka, 2010; Khamuani; Ross; Robertson, 2022; Rafeek et al., 2012; Ribeiro et al., 2018). Although there may be several causes that contribute to this deficiency, such as setting a relatively high number of treatments as a discipline goal (Er et al., 2006; Rafeek et al., 2012) or even the possible lack of supervision during treatment (Rafeek et al., 2012), a significant portion is attributed to deficiencies in the learning of undergraduate dental students during preclinical endodontic training (Al-Anesi et al., 2019; Ribeiro et al., 2018). This may be due to the continued use of traditional instructional approaches in most dental schools.

The need for the correct execution of endodontic treatment requires skills and competencies that involve the process of acquiring theoretical and practical knowledge (Haupt; Kanzow, 2023; Sacha et al., 2021). All stages of treatment are essential and

interdependent. The prior study of the internal anatomy of the teeth, the correct execution of access to the pulp chamber and root canal system, in addition to the cleaning and shaping of the root canal system, whether manual or mechanized, and its adequate obturation and coronal sealing, are essential steps for significantly reducing the bacterial population, but are not sufficient to eliminate it completely. The use of intracanal medication (IM) is considered an option for reducing or eliminating these microorganisms, thus providing a more favorable environment for repair of the periapical tissue (Mamat; Ghani, 2023; Siqueira Junior et al., 2018).

Procedural errors occurring during the instrumentation phase, such as the formation of blocks, perforations of the root floor, instrument fractures, among others, could hinder the proper completion of intracanal procedures and, consequently, compromise the success of the treatment. There is a high potential for endodontic treatment failure when procedural errors occur during its execution, especially in necrotic teeth, given the greater difficulty in eliminating infected debris (Elsayed; Abu-Bakr; Ibrahim, 2011; Estrela et al., 2017; Silva et al., 2018). To avoid and overcome these possible failures arising from the process of building the learning curve, the pre-clinical discipline includes moments involving problem-based learning (PBL) exercises, case studies, digital information and communication technologies (DICT) such as podcasts and applications, in addition to the skills worked on by Glasser's (2001) pyramid concept for education, which progressively includes learning through the senses.

The evaluation of the technical quality of the obturation process involves the radiographic evaluation of three criteria, as recommended by the American Association of Endodontists (AAE, 2009). These parameters include the extent of the obturation, the taper, and the density of the root canal obturation. According to the guidelines established by the European Society of Endodontics (SEE) on the radiographic evaluation of root canal obturations, it is imperative to ensure complete and perfect obturation of the root canal, without any gaps or voids between the obturation material and the canal wall. In addition, it is recommended that the obturation be placed at a distance of 0.5-2mm from the radiographic apex (Baaij et al., 2024; European Society of Endodontology, 2006).

This study aimed to radiographically evaluate the quality of endodontic treatments performed by undergraduate students of the Dentistry course at the Federal University of Ceará, Sobral Campus, on human teeth extracted during the pre-clinical Endodontics Laboratory (EL) course in the 2023 and 2024 classes, verifying the parameters related to the length, density, and taper of the canal.

THEORETICAL FRAMEWORK

Curriculum Guidelines for Higher Education

The National Curriculum Guidelines (NCG) in Brazilian higher education aim to guide educational institutions in the construction of pedagogical projects without, however, subtracting from the institutions their autonomy to decide what, how and when to teach and establish the set of skills and competencies desired for graduates of each course (Teixeira Junior, 2020). Resolution CNE/CES No. 3, of June 21, 2021, is the most recent NCG for the undergraduate course in Dentistry and establishes that the graduate must have a general profile that includes a generalist dental surgeon, endowed with solid technical-scientific training and active in permanent professional development in function of advances in knowledge, humanistic and ethical, attentive to the dignity of the human person and to individual and collective needs (Brasil, 2021).

The essential curricular contents of the undergraduate course in Dentistry must be related to the health-disease process of the individual, the family and the population, in the different life cycles, referenced in the epidemiological and professional reality, and will be composed of programmatic contents of biological and health sciences, human and social sciences and dental sciences, which must be interconnected and developed in an integrated manner, aiming at the comprehensive care of the individual, in the areas of their practice (Brasil, 2021).

Endodontics Laboratory (EL)

The EL discipline of the Dentistry course at Federal University of Ceará at Sobral campus is offered annually and has a syllabus that includes theoretical content that underpins training in this specialty. As pedagogical resources available, in addition to expository theoretical classes, there is the encouragement of critical and active thinking through strategies that involve greater engagement and autonomy of students, such as problem-based learning, which allows students to practice learning from challenges. The scenarios can suggest technical or subjective situations, in which different skills are needed.

Whether technical or emotional, such skills are rarely assimilated through books or manuals. Another proposed resource uses case studies. Here, students are exposed to real problems, analyze them in their entirety and, among themselves, discuss the possibilities of solving them. These cases are reports constructed in such a way as to stimulate analytical and systemic thinking. They are like exercises in a test, but more contextualized and comprehensive.

Another type of active learning methodology proposed in the discipline is the promotion of seminars and discussions among students. Normally, the teacher proposes a topic for general discussion, so that students must present and position themselves in relation to it. It is a way to, among other things, develop argumentative potential, exposing them to different points of view and placing them in situations outside their intellectual comfort zone.

The use of DICT has been an important strategy that has been added to teaching-learning methodologies. The expansion of our means of interaction has provided greater communication links and considerably expanded the possibilities of pedagogical interfaces (Freitas et al., 2009; Garbin, Carvajal, Guilherme, 2024; Schleyer et al., 2012; Zitzmann et al., 2020). In the specific area of endodontics, knowledge shared through digital tools provides a more dynamic and interesting learning experience for the student, generating greater connection and commitment.

The critical assimilation of the content foreseen in the disciplines has been a constant challenge (Santos, 2011; Suprapti; Suharto; Nugroho, 2022). Currently, it is necessary for the teacher to go beyond the fragmented technical foundation, so that they can act in new and problematic situations where the progression of learning can be stimulated, as proposed in Glasser's (2001) learning pyramid, where teachers act as guides, encouraging student autonomy, instead of just memorizing the content.

Currently, monitoring student progress is generally limited to analyzing performance through grades obtained in theoretical and practical assessments, without the content of a qualitative/quantitative research that denotes the performance achieved.

Laboratory endodontic treatment

The discipline uses human dental specimens extracted for pathological reasons that are independent of the pedagogical model adopted. They are previously disinfected in 0.1% thymol, agitated in an ultrasonic bath, cleaned, and autoclaved in an oven at 121ºC for 15 minutes. All teeth are digitally radiographed for anatomical analysis and definition of the apparent length of the tooth (CAD). Then, the teeth are accessed with high-speed spherical tips (SS White Dental, New Jersey, USA) with diameters compatible with the pulp chamber. In manual instrumentation, cervical preparation is performed using Gates Gliden burs (Dentsply Sirona, Tulsa, Oklahoma, USA) for subsequent definition of the odontometry – actual tooth length (ATL) and working length (WL). K-type files 0.02 (Dentsply Sirona, Tulsa, Oklahoma, USA) are used in biomechanical preparation applying the crown-to-apex technique. The canals are irrigated with distilled water. The discipline requires that reciprocating mechanized instrumentation be performed on at least one molar. In these

cases, after defining the odontometry, a Reciproc® file (VDW, Germany) is selected according to the diameter of the apical foramen. For obturation, gutta-percha cones (Meta Biomed, South Korea) associated with endodontic cement (Endofill, Dentsply Sirona, Tulsa, Oklahoma, USA) are used. The obturation technique applied to the evaluated specimens was the Tagger Hybrid or Modified Tagger Hybrid.

Evaluation criteria

The course typically uses traditional written exam methods through two partial assessments (PA) and evaluation of practical performance. Occasionally, the OSCE (Objective and Structured Clinical Examination) takes place. Criteria such as attendance, punctuality, biosecurity, organization, theoretical knowledge, practical performance, and daily goal are evaluated by the course professors. The average to be achieved for success in the course is 7. If the student does not reach the average and has a grade of 4, they will take the final assessment (FA).

METHODOLOGY

Type of study

This is a retrospective cross-sectional study designed to evaluate the technical quality of root canal obturations completed by fifth-semester students of the Dentistry course at the Federal University of Ceará, Sobral campus, during the academic years of 2023 and 2024. The research aims to analyze a randomly selected sample of final radiographs of endodontically treated teeth during practical classes in the Endodontics Laboratory. This study was approved by the Ethics and Research Committee of the Vale do Acaraú State University (protocol no. 83439224.0.0000.5053).

Sample calculation and sample selection

For the sample calculation, the total number of teeth planned was considered as the minimum target for the discipline. Knowing that the proposed interval includes two classes and that at least five teeth are required (two anterior, two premolars, and one molar), the minimum total population would be 325 teeth. Inferring a confidence level of 95% and a margin of error of 5%, the sample size was determined to be 177 teeth. In the sample, only filled teeth with fully formed roots and no fractures were included. The teeth were numbered, randomized, and digitally radiographed (Dabi Atlante, Spectro 70X), digital sensor (Digital X-Ray System, Dabi Atlante).

Parameters evaluated

The criteria used to evaluate the quality of endodontic treatment encompass the skills developed by the student, acquired through theoretical knowledge and pre-clinical training routine. According to the literature, the parameters that comprise this evaluation are mainly: the length of the canal extension filled with obturation material, the density of the filling, and the taper of the preparation (Al-Anesi et al., 2019; Er et al., 2006; Madfa et al., 2024). The criteria were classified as adequate or inadequate, according to predefined criteria described in Table 1.

Table 1 – Criteria used in this study to evaluate the technical quality of root canal obturations.

Definition	Criteria	Parameters
Extent	Adequate	Root canal obturation 0-2 mm short of the radiographic apex.
	Inadequate	Root canal obturation beyond the radiographic apex (Over-obturation) or root canal obturation > 2 mm short of the radiographic apex.
Density	Adequate	Homogeneous obturation of the root canal, good condensation, without visible defects or voids.
	Inadequate	Non-homogeneous obturation of the root canal, condensation with defects or voids present.
Taper	Adequate	Consistent and uniform taper from the coronal to the apical area reflecting the original shape of the canal.
	Inadequate	Inconsistent taper.

Source: adapted from Madfa et al., 2024.

Intra and inter-examiner calibration

For the calibration test of the two evaluators, 30 radiographic images, equivalent to 15% of the sample, were evaluated at two distinct times. Cohen's Kappa test was used for intra- and inter-examiner agreement, taking into account each criterion and considering a Kappa of 0.8 acceptable. Inter-examiner reliability showed a Kappa value of 0.8, and intra-examiner reliability of 0.87 for both examiners. The discordant items were re-analyzed and discussed between the examiners until a consensus was reached. Dental units were considered to determine the classification as acceptable or unacceptable.

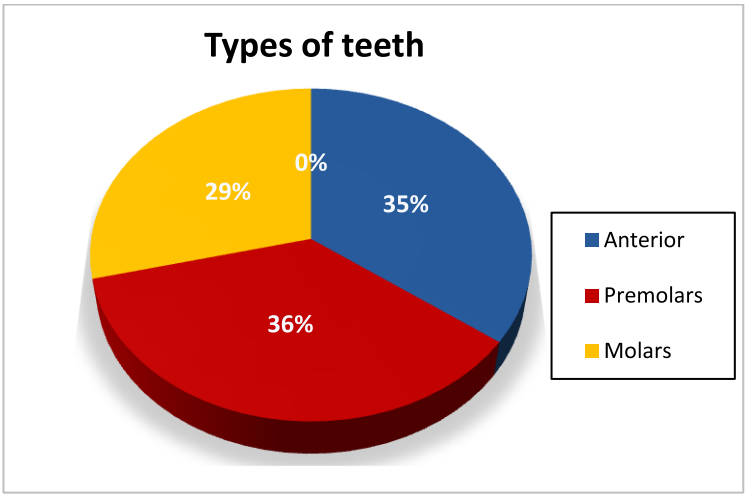
Data analysis

The JAMOVI software (Jamovi, 2022) was used to analyze contingency tables and chi-square comparison tests between the categorical independent variables of the study. The significance level adopted was defined as $P < 0.05$.

RESULTS AND DISCUSSION

The sample of the present study consisted of 177 extracted human teeth, distributed according to the type of dental group, as illustrated in Graph 1.

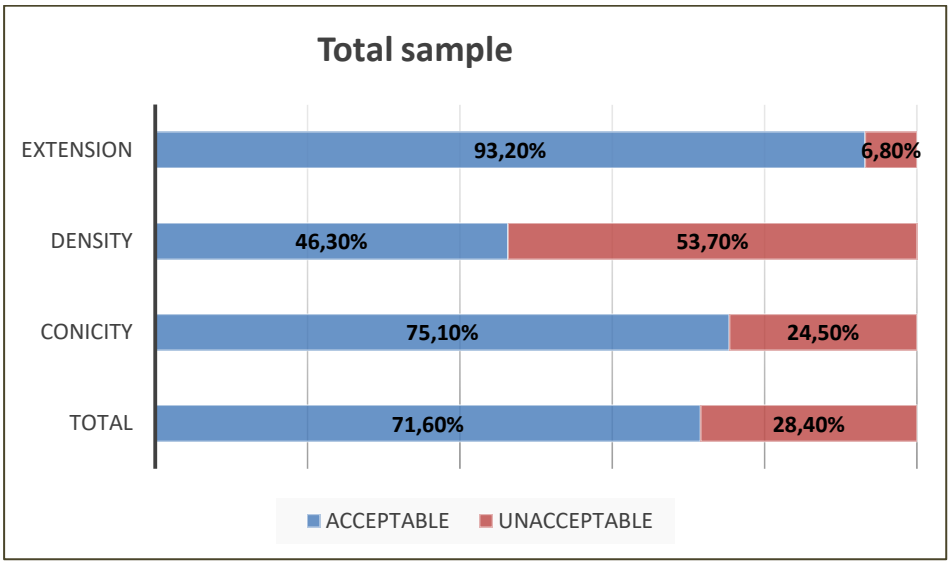
Graph 1 – Distribution of the study sample.



Source: prepared by the authors.

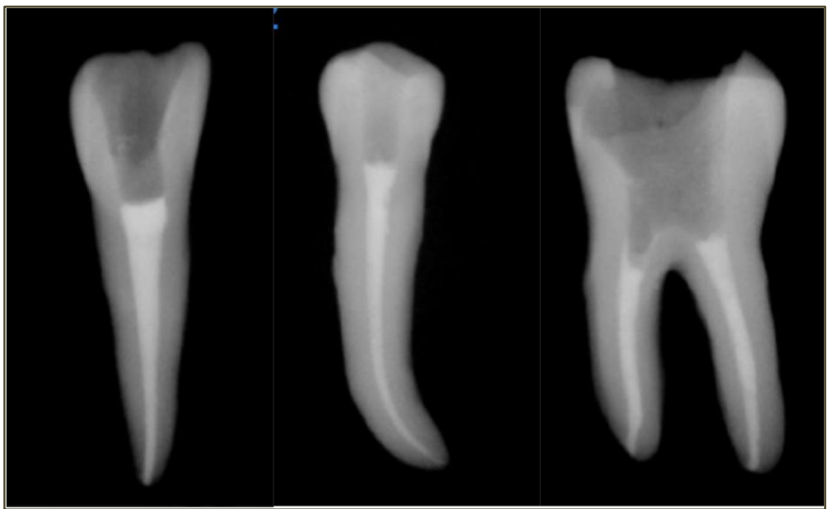
The most prevalent teeth were premolars 64 (36.16%), followed by anterior teeth 62 (35.05%) and molars 51 (28.81%). In Graph 2 we observe that, of the 177 teeth evaluated, 165 (93.2%) presented acceptable extensions and only 12 (6.8%) were classified as unacceptable. Regarding taper, 133 (75.1%) teeth were evaluated as acceptable and 44 (24.9%) as unacceptable. In the density criterion, 82 teeth (46.3%) were classified as acceptable, however, 95 (53.7%) were identified as unacceptable. Figures 1 and 2 represent radiographic images of the evaluated sample.

Graph 2 – Classification of the total sample according to the criteria of length, density and taper as acceptable or unacceptable.



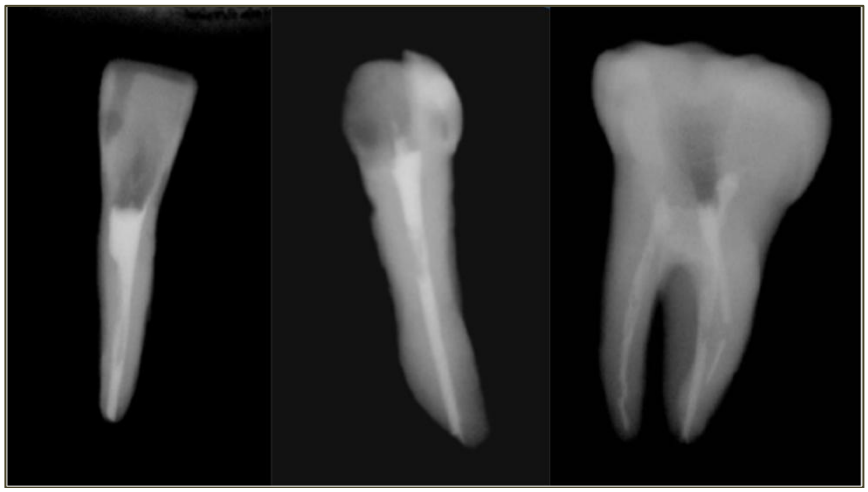
Source: prepared by the authors.

Figure 1 – Radiographic representations of the dental groups evaluated with adequate fillings.



Source: digital radiographs from EL (UFC-Sobral).

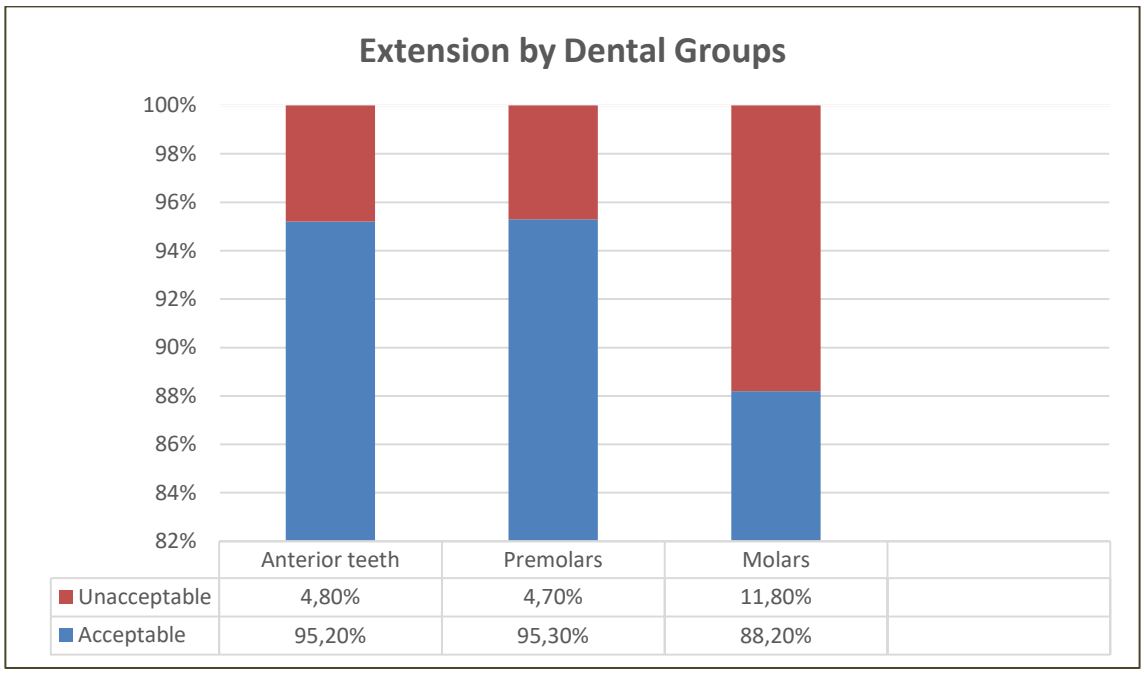
Figure 2 – Radiographic representations of the dental groups evaluated with inadequate fillings.



Source: digital radiographs from EL (UFC-Sobral).

Graph 3 presents the comparison between the dental groups and the extension parameter evaluated in the study. Premolar teeth presented the best indices in this category, with 95.3% considered acceptable.

Graph 3 – Distribution of the extension parameter by dental groups.

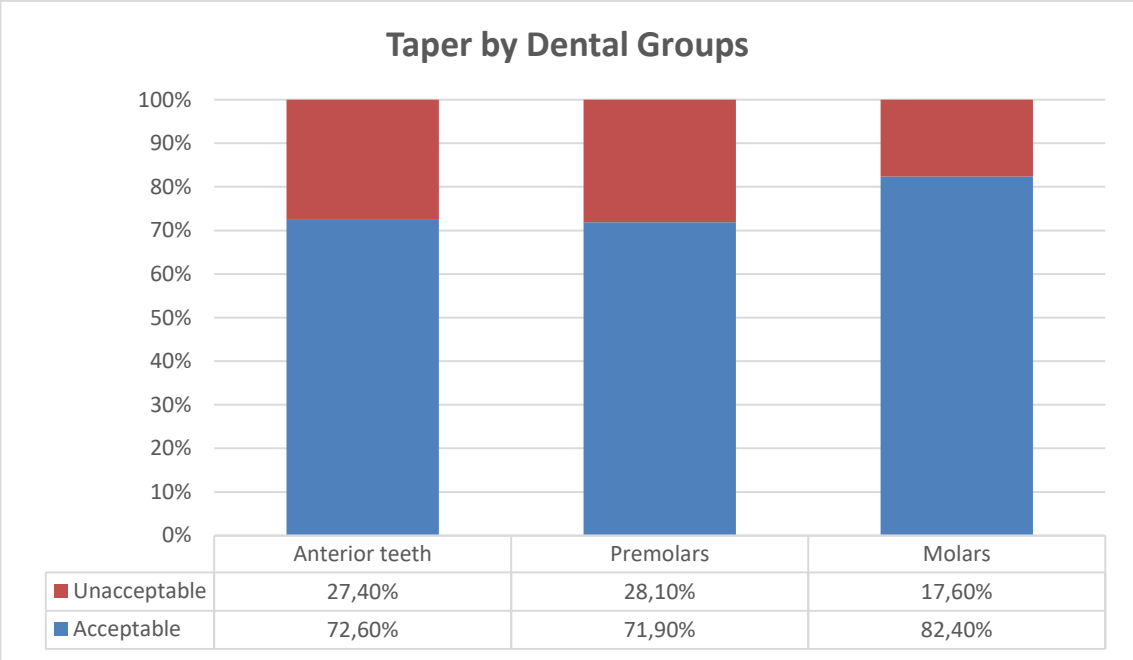


	Anterior teeth	Premolars	Molars	
Unacceptable	4,80%	4,70%	11,80%	
Acceptable	95,20%	95,30%	88,20%	

Source: prepared by the authors.

The comparison between the dental groups regarding taper is shown in Graph 4. The results indicated that the molars were classified as acceptable (82.4%) and unacceptable (17.6%).

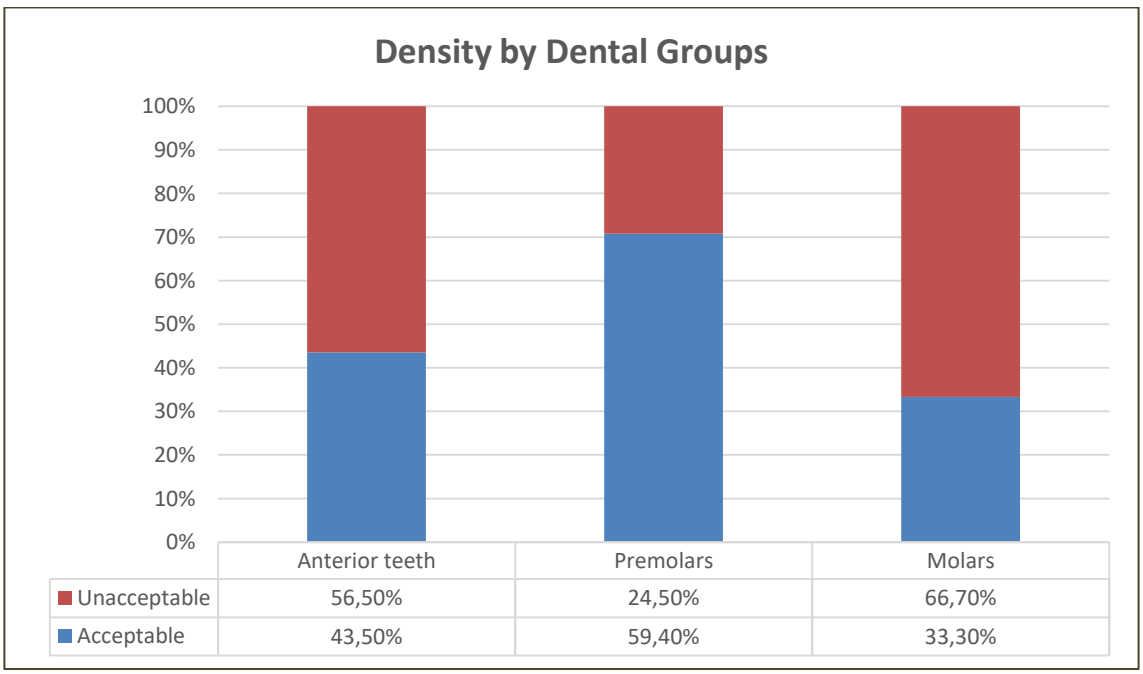
Graph 4 – Distribution of the taper parameter by dental groups.



Source: prepared by the authors.

Density was the classification that presented the most deficient results in this study. As illustrated in Graph 5, fillings of anterior teeth, premolars and molars were unacceptable in 56.5%, 24.5% and 66.7% respectively.

Graph 5 – Distribution of the density parameter by dental groups



Source: prepared by the authors.

This study presents the importance of a local self-assessment of the technical quality of root canal fillings performed on human teeth by undergraduate students at the Endodontics Laboratory (LE) of the Federal University of Ceará, Sobral campus, through radiographic evaluation.

The results indicated that the LE discipline has an acceptable overall average of teeth with satisfactory fillings. The evaluation of filling quality, proposed by the European Society of Endodontology (2006), contributes to the identification of difficulties and problems faced by students during the teaching-learning process in endodontics, subsequently facilitating the correction and adjustment of these flaws. This process is essential for the training of dentists. The radiographic criteria used in this study were the same as those used in previous studies (Elsayed; Abu-Bakr; Ibrahim, 2011; European Society of Endodontology, 2006; Khabbaz; Protogerou; Douka, 2010).

The frequency of teeth with acceptable obturation extension was higher than that reported in other studies (AlRahabi, 2017; Er et al., 2006). The percentage was similar among the dental groups, except for molars, which presented a slightly lower rate. The anatomical complexity inherent in molars may, in itself, justify the difficulties in performing endodontic treatment. This factor, combined with the students' inexperience in applying specific techniques to overcome such challenges, contributes to a greater risk of failure in this dental group.

Regarding taper, the results obtained differed from the studies by AlRahabi (2017) and from the data from a systematic review observed by Ribeiro et al. (2018), in which the adequacy of taper decreased as one progressed to the posterior dental groups. The comparison between the studies is complex, considering variables such as sample size, type of study (clinical or pre-clinical) and evaluation criteria adopted. The taper achieved in endodontic treatment is directly related to the instruments and techniques employed during instrumentation. The protocol adopted by the Dentistry course at UFC-Sobral advocates the crown-to-apex instrumentation technique, using Gates Glidden type instruments (Maillefer, Dentsply Sirona) for the preparation of the cervical third of the root canals (Morgan and Montgomery, 1984; Schilder, 1974). This approach requires precise instrument handling, combined with anatomical direction of the canals, in order to prevent deviations and perforations that may be caused by its handling. When used improperly, the use of the Gates Glidden instrument can directly compromise the taper of the preparation, consequently affecting the quality of the obturation.

The introduction of rotary instruments for the preparation of the cervical third of the root canal system (RCS) in endodontic laboratory teaching has become increasingly frequent, due to their characteristics such as the larger tapper, allowing for more favorable instrumentation of the RCS, with a conical shape (Khamuani; Ross; Robertson, 2022).

However, the use of traditional instruments, recognized for their efficiency, remains a relevant approach, contributing to the development of students' precision in the treatment of teeth with more complex anatomy. Some universities advocate the full use of mechanized systems, while others limit the introduction of mechanized files in endodontic laboratory teaching (Khamuani; Ross; Robertson, 2022; Unal et al. 2012). Therefore, the evolution of endodontic instruments must be integrated into the teaching process, balancing technological innovation and technical development.

In the present study, the use of Reciproc® type mechanized files in molar teeth of the sample contributed to the best result of the SCR taper, as the preparation results in a standardized taper according to the selected file. This factor favors the obturation technique and considerably reduces the problems frequently associated with manual instrumentation (Khamuani; Ross; Robertson, 2022; Unal et al. 2012). The quality of the execution of endodontic techniques varies according to the experience and knowledge of the operator. Thus, students in the Endodontics Laboratory course, when performing endodontic treatment for the first time, present limitations inherent to the learning process. In the problem-based learning (PBL) model, the conduct of practical laboratory classes encourages students to confront and seek solutions to the difficulties encountered, with the guidance of teachers, monitors, and graduate students, who assist in critical and creative reasoning for solving cases.

The results regarding taper showed satisfactory indices compared to the studies by AlRahabi (2017), Elsayed, Abu-Bakr and Ibrahim (2011), Er et al. (2006) and Ribeiro et al. (2018), presenting a peculiar condition of better quality in molars. This finding can be partially justified by the laboratory environment providing approaches that stimulate the gradualness of learning through the perception of the senses (hearing, seeing, discussing and doing), and thus, the cognitive process is more easily assimilated (Glasser, 2001). In this context, a schedule for obturation is also proposed that follows a sequence from the anterior segment (less complex) to the posterior segment (more complex), allowing students to gain experience with obturation techniques in anterior teeth and premolars before applying them to molars. In addition to these points, the student has access to the use of modern mechanized file systems, facilitating the achievement of correct taper in the preparations.

The density of the obturation analyzed in this study proved to be the criterion with the most deficient results. This finding corroborates the studies of AlRahabi (2017), Er et al. (2006) and Ribeiro et al. (2018), indicating that molars are, indeed, the teeth with the greatest anatomical complexity and, consequently, the highest degree of difficulty in carrying out the steps of their treatment. This specific failure implies the need for a more focused approach to this phase, implying greater teaching support that allows for the inclusion of more training possibilities, adopting approaches where the doing is not merely technical, but

generates positive self-criticism, generating more confidence in the execution of the obturation.

In the Dentistry course at UFC-Sobral, the obturation techniques, internationally recommended, involve the thermoplasticization of gutta-percha (Tagger Hybrid and Modified Tagger Hybrid), according to Cohen (2021) and Estrela et al. (2017). The routine use of the Mac Spaden thermoplasticization device (Maillefer, Dentsply Sirona) demands from students a technical understanding and adequate training for its correct handling, which is progressively acquired during laboratory and clinical practice. This factor, associated with the limitations previously mentioned, may justify the deficient result among the pre-established criteria. Furthermore, the empty spaces and/or defects present in the obturation of the root canal contradict the established principles of hermeticity and three-dimensionality (Cohen, 2021).

Approaches in the teaching-learning process that allow the student to understand and grasp not only technical performance, but also the experience of situations that make them co-responsible for the acquired knowledge and their future practice in patients, are viable strategies to improve the perception of the parameters of an adequate root canal obturation, as well as to optimize the handling of the instruments used in this stage of endodontic treatment, minimizing failures such as those found in the evaluation of density, especially in teeth with more complex anatomies. In addition to problem-based learning, the laboratory environment is quite conducive to reinforcing methodologies that implement, in addition to active listening, the learning pyramid strategy model (Glasser, 2001).

In this study, radiographic evaluation was performed on extracted and endodontically treated teeth, subjected to strictly laboratory procedures. However, cases classified as unacceptable would possibly require reintervention if they were analyzed in a clinical setting, in order to meet the established principles for SCR obturation.

FINAL CONSIDERATIONS

This study presents a local overview of the technical quality of obturations performed by students in the Endodontics Laboratory (LE) course of the Dentistry program at the Federal University of Ceará, Sobral campus. The results demonstrated the students' adequate performance, bringing relevance to the study, since the excellence of academic training is a well-known reference for professional life. Although the initial research profile was eminently technical, the study indirectly generated concerns about the didactic approach currently used. Although of a specific nature, the need for improvements inherent to learning, evidenced in this investigation, reflects the importance of longitudinal self-evaluative inferences and confirms the limitation of retrospective records, given the absence of previous analyses. This observation does not necessarily imply changes in the course

curriculum, but it encourages the faculty to better plan didactics, especially for the root canal system obturation stage. The availability of greater technical support offering more detailed instructions on the use of instruments and materials, more possibilities for training and didactic-visual stimulation were some of the proposals suggested to the teachers involved in the discipline.

DECLARATION OF USE OF GENERATIVE IA

No generative artificial intelligence tools were used in any of the stages of construction of this work.

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How to cite this document – ABNT
SOUSA, Igor Maia de; TEIXEIRA, Alrieta Henrique. Laboratory teaching in endodontics and the development of technical skills: an analysis of the quality of fillings performed by dental students at UFC-Sobral. *Revista Docência do Ensino Superior*, Belo Horizonte, v. 16, e058475, p. 1-23, 2026. DOI: https://doi.org/10.35699/2237-5864.2026.58475.