

FIRST EXPERIENCES, CONFIDENCE AND QUALITY OF UNDERGRADUATE STUDENTS' ENDODONTIC TREATMENTS USING MECHANIZED NITI INSTRUMENTS: A PROSPECTIVE LONGITUDINAL STUDY

Primeiras experiências, confiança e qualidade dos tratamentos
endodônticos realizados por alunos de graduação utilizando
instrumentos mecanizados de niti: um estudo longitudinal prospectivo

 Mauricio Denicol Anastacio^a

 Leonardo Thomasi Jahnke^b

 Camila Hélen Grock^c

 Pedro Henrique Marks Duarte^c

 Gabriel Barcellos Só^b

 Angela Longo do Nascimento^c

 Ricardo Abreu da Rosa^d

 Marcus Vinícius Reis Só^d

^aMestre, Programa de Pós-Graduação em Odontologia, Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, RS, Brasil.

^bDiscente, Programa de Pós-Graduação em Odontologia nível Doutorado, Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, RS, Brasil.

^cDoutor, Programa de Pós-Graduação em Odontologia, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brasil.

^dDocente, Faculdade de Odontologia, Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, RS, Brasil

Autor de correspondência: Leonardo Thomasi Jahnke E-mail: leothomasi@hotmail.com

Data de envio: 30/09/2024 Data de aceite: 19/06/2026



ABSTRACT

Aim: This study describes the experiences, confidence, competence, and quality of endodontic treatments performed by undergraduate students using niquel-titanium instruments for the first time. **Materials and Methods:** a prospective longitudinal study of two cohorts was performed. The evaluation consisted of applying a self-confidence questionnaire and two focal groups, and radiographic parameters of the cases performed by undergraduate students were assessed. Twenty-four students participated in the survey. **Results:** most of the participants showed confidence or were very confident in the steps of "coronal opening", "working length determination", "chemomechanical preparation", "adaptation of the master cone", and "root canal obturation". About 95% of students had more facility in learning mechanized instrumentation, and 88% felt safer with this method than with manual instrumentation. Around 38% of participants would choose both methods (mechanized and manual instrumentation) for their academic education, 29% would choose the mechanized instrumentation method, and 33% would choose the manual method for their academic education. Regarding the quality of root canal filling, there was a significative difference when evaluating two criteria: apical length and taper of the root canal filling ($p < 0.05$ – Qui-squared test). **Conclusions:** mechanized instrumentation to perform endodontic treatments were the main factors in increasing the confidence and the quality of the treatments. The student's self-confidence in performing different steps was uniform, and the method of choice that the students had more security and was easier to learn was the mechanized method. Students showed a higher level of competence when performing endodontic treatments using mechanized NiTi instruments for root canal preparation.

Keywords: Endodontics, Education, Dental; Students, Dental; Root canal obturation.

RESUMO

Objetivo: Este estudo descreve as experiências, confiança, competência e qualidade dos tratamentos endodônticos realizados por alunos de graduação utilizando instrumentos de níquel-titânio rotatórios e reciprocantes pela primeira vez (SRF e X1).

Materiais e Métodos: Foi realizado um estudo longitudinal prospectivo com duas coortes. A avaliação consistiu na aplicação de um questionário de autoconfiança em dois grupos focais, além da análise de parâmetros radiográficos dos casos realizados pelos alunos de graduação. Vinte e quatro alunos participaram da pesquisa.

Resultados: A maioria dos participantes demonstrou confiança nas etapas de "abertura coronária", "determinação do comprimento de trabalho", "preparo químico-mecânico", "adaptação do cone principal" e "obturaç o do canal radicular". Cerca de 95% dos alunos tiveram mais facilidade em aprender a instrumentaç o mecanizada, e 88% se sentiram mais seguros com este m todo do que com a instrumentaç o manual. Aproximadamente 38% dos participantes escolheriam ambos os m todos (instrumentaç o mecanizada e manual) para sua formaç o acad mica, 29% escolheriam o m todo de instrumentaç o mecanizada e 33% optariam pelo m todo manual. Em rela  o   qualidade da obtura  o do canal radicular, houve uma diferen a significativa ao avaliar dois crit rios: comprimento apical e conicidade da obtura  o do canal radicular ($p < 0,05$ – teste do qui-quadrado). **Conclus es:** A instrumentaç o mecanizada foi um dos principais fatores para aumentar a confian a e a qualidade dos tratamentos. A autoconfian a dos alunos foi uniforme, e o m todo mecanizado foi considerado mais seguro e f cil de aprender. Os alunos demonstraram maior compet ncia ao utilizar instrumentos de NiTi mecanizados.

Palavras-chave: Endodontia; Educa  o em odontologia; Estudantes de odontologia; Obtura  o do canal radicular.

INTRODUCTION

Endodontic treatment can be challenging and stressful for generalist dentists and for undergraduate students^{1,2}. The endodontic learning process by undergraduate students have been discussed in the last years³. Dental students do not feel confident and competent to carry out an endodontic treatment, indicating that there is a possibility to increase and improve teaching in endodontics⁴. Furthermore, the confidence level decreases when multirooted teeth must be treated³. However, confidence levels tend to increase over the years⁴.

The undergraduate students referred to Endodontics as a field of Dentistry of more incredible technical difficulty to carry out clinical procedures, and they were not confident to carry out certain stages of endodontic treatment, such as pulpotomy/pulpectomy and coronal opening². Therefore, the opinion of students regarding the teaching process related to Endodontics must be considered in the teaching-learning process⁵. The changes must be acceptable and satisfactory to those involved, including students, teachers, faculty, and patients. In this sense, the perception of the students is fundamental to providing reliable feedback regarding the efficiency and acceptability of the educational methods proposals⁶.

According to the European Society of Endodontics, a student must endodontically treat twenty teeth during its course⁷. However, the practice required for successful preparation may vary from student to student according to individual skills. Therefore, using automated systems in Endodontics provides agility and reduced working time and could favor the student to carry out a more significant number of cases during its formation. Nevertheless, such a claim may only be made by assessing students' learning curve through the automated instrumentation technique.

Evidence suggests that nickel-titanium (NiTi) instruments generate a more predicable canal preparation with lower incidence of pain, postoperative discomfort, or accidents, such as canal deviation and root perforation^{8,9}. When complications in the endodontic treatment performed by undergraduate dental students were assessed, 31.1% of the teeth prepared with hand presented some type of procedural error, such as loss of the working length (WL), overfilling, inadequate filling compaction, separate files, perforation, and apical transportation¹⁰. On the other hand, when performing endodontic treatments for the first time, undergraduate students prepared faster and

more accurately root canals using nickel-titanium (NiTi) instruments than stainless steel hand files¹¹.

Rotary motion consists of continuous 360-degree rotation of the instrument in a single direction, allowing efficient dentin cutting and uniform canal shaping. In contrast, reciprocating motion involves alternating clockwise and counterclockwise movements with unequal angles, enabling the instrument to periodically disengage from the canal walls. Rotary and reciprocating systems show comparable canal transportation and centering ability, with no significant differences in surface area or volume changes. Additionally, the presence of untouched canal walls and debris accumulation remains inconclusive, and no association was found between the type of kinematics and the formation of dentinal cracks¹².

Thus, this study aims to investigate not only the technical aspects related to the quality of the endodontic treatment, but also the experiences, confidence, and competence of undergraduate students when performing endodontic treatments using NiTi instruments for canal preparation for the first time.

MATERIALS AND METHODS

Study design

This study followed a sequential explanatory mixed-methods design, in which quantitative data were collected and analyzed first, followed by qualitative data collection to further explore and explain the quantitative findings.

The use of a mixed-methods approach was justified by the need to combine objective clinical outcomes and structured questionnaire data (quantitative component) with in-depth exploration of students' perceptions and experiences (qualitative component). This integration enabled a more comprehensive understanding of the learning process in endodontic education than either method alone.

A prospective longitudinal study of two cohorts was conducted. This study was approved by the Research Ethics Committee of the Federal University of Rio Grande do Sul (Protocol n 97390718.5.0000.5347).

Participants and sampling

The study included undergraduate students from the School of Dentistry at the Federal University of Rio Grande do Sul, Brazil, aged over 18 years old, enrolled in the Clinical Endodontics with Rotary Systems course during 2019.

A non-probabilistic convenience sampling strategy was adopted. All students enrolled in the course during the first and second semesters of 2019 were invited to participate. Those who agreed signed an informed consent form.

The estimated number of students per semester was twelve, resulting in a total sample of 24 participants.

Quantitative component

Clinical procedures

Endodontic treatments were performed under rubber dam isolation using the crown-down technique with rotary and reciprocating instruments (SRF and X1 systems; MK Life, Brazil), following the manufacturer's instructions, powered by an electric motor (X-Smart Plus; Dentsply-Sirona, Switzerland).

Working length was determined using electronic apex locators (E-Pex Pro; MK Life, Brazil). Treatments were performed in two or more sessions, with calcium hydroxide (UltraCal XS; Ultradent, Brazil) used as intracanal medication. Root canal obturation was performed using warm vertical compaction of gutta-percha and Sealer Plus sealer (MK Life, Brazil).

Radiographs were obtained using a digital system (RVG 5200; Carestream Dental, USA). After treatment completion, teeth were restored with composite resin (Z350; 3M ESPE).

Outcome assessment

Filling quality

Radiographic evaluation followed the criteria proposed by Balto et al. One examiner assessed all images twice (15-day interval) to ensure reliability. Parameters evaluated:

- Apical limit
- Compaction
- Taper

Assessments were performed under 20× magnification using Adobe Photoshop® 5.5.

Adverse events

Adverse events (e.g., perforations, ledges, deviations, instrument fractures) were assessed under 32× magnification and recorded according to location and type.

Questionnaire data

Quantitative data also included:

- Demographic questionnaire (age and gender)
- Confidence questionnaire (based on Grock, 2016)
- Multiple-choice questionnaire on rotary instrumentation (Sonntag et al., 2003)

Qualitative component

Data collection

Qualitative data were collected through focus groups conducted at the end of each semester.

Participants were randomly selected using Microsoft Excel and grouped into a single focus group per cohort. A semi-structured guide was used to explore:

- Students' perceptions
- Difficulties during training
- Positive and negative aspects of the course

Sessions lasted approximately 30 minutes, were audio-recorded, and fully transcribed. Participants were anonymized (A1–A12).

Data analysis

Qualitative data were analyzed using thematic content analysis.

Transcripts were coded using NVivo software (version 12). A coding framework was developed including:

- Locator (difficulty, ease)
- Mechanized technique (difficulty, ease, confidence, security, fear)

Themes were generated through iterative analysis and interpretation of participants' narratives.

Integration of quantitative and qualitative data

Integration occurred at the interpretation stage, using a connecting and merging approach.

Quantitative results (clinical outcomes and questionnaire data) informed the qualitative exploration, guiding the development of focus group discussions. Subsequently, qualitative findings were used to explain, expand, and contextualize quantitative results.

This integration enabled the generation of meta-inferences, providing a deeper understanding of the relationship between students' clinical performance, confidence levels, and perceived learning challenges.

Statistical analysis

Quantitative data were analyzed using GraphPad Prism 5.0 and SPSS 18.0.

- Chi-square test was used to assess associations between variables
- Significance level: 5%
- Descriptive statistics were expressed as absolute frequencies

Due to the ordinal nature of the data, non-normal distribution was assumed.

Methodological limitations related to mixed methods

Potential limitations include the use of convenience sampling and the subjective nature of qualitative self-reported data, which may influence the interpretation of quantitative findings.

Additionally, the integration of data from different sources may introduce interpretative bias, particularly during the generation of meta-inferences.

RESULTS

Sample characteristics

A total of 24 students answered the questionnaire, among whom five were male and 19 were female.

Degree of confidence attributed to different stages of endodontic treatment

According to the descriptive analysis of the questionnaires (Figure 1), most participants (eighteen of twenty-four) reported being confident or very confident in the coronal opening stage. For the radiographic assessment and chemical-mechanical preparation, 19 and 21 participants reported being confident or very confident, respectively. Finally, in the obturation stage, 20 participants reported being confident or very confident.

Figure 1 - Degree of confidence attributed to different stages of endodontic treatment

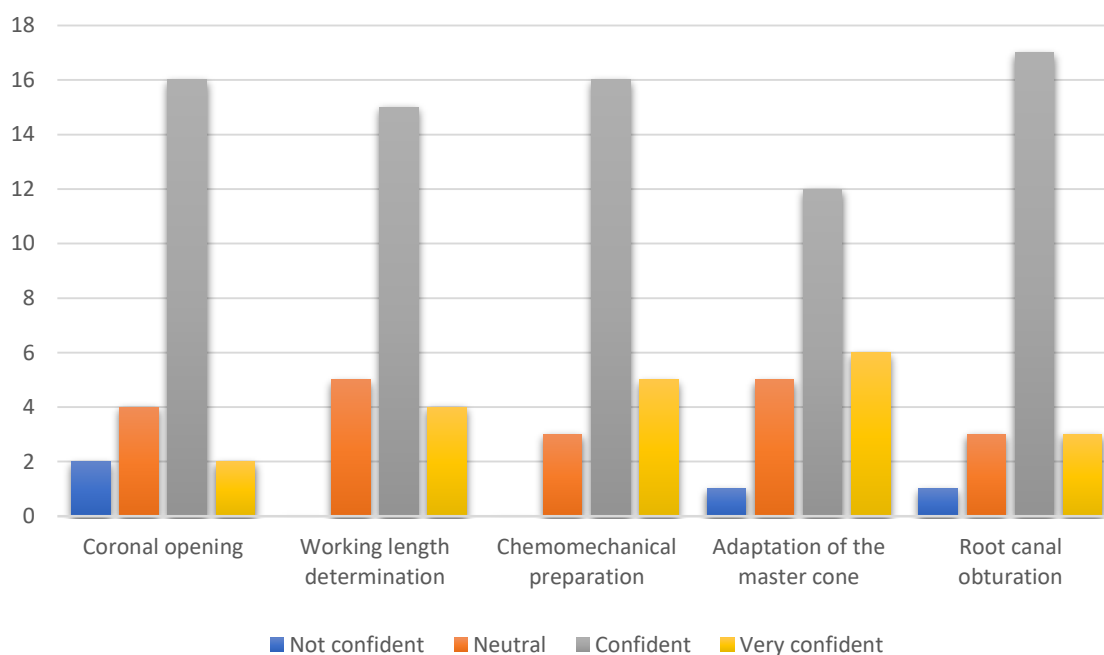
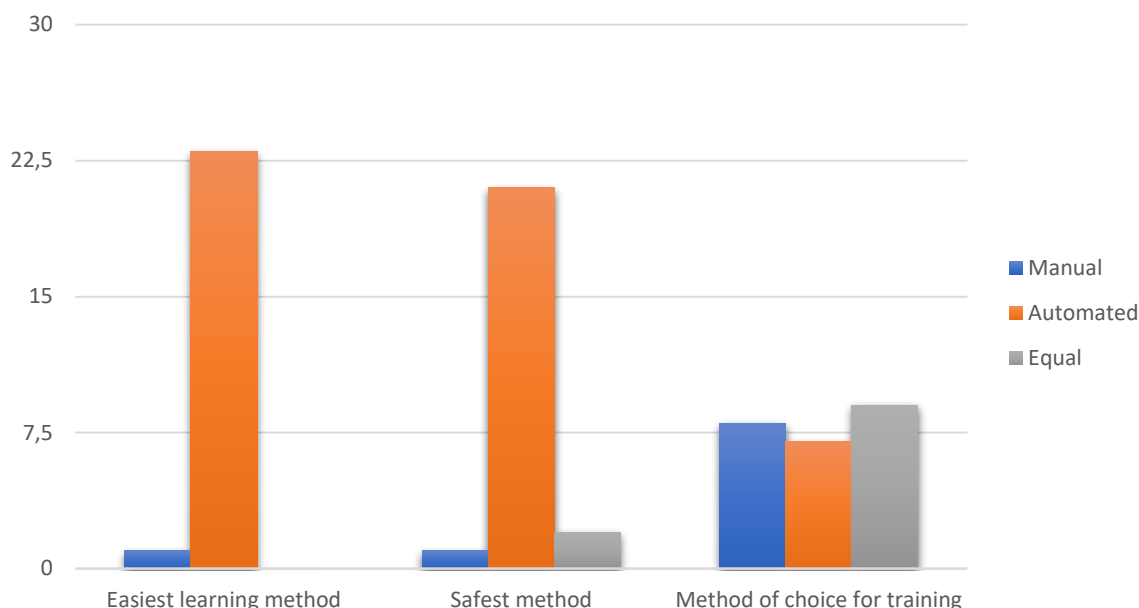


Figure 2 shows that 95% of the students had an easier time-learning using rotary instruments for canal reparation and 88% felt more confident applying the rotary preparation. Finally, it was observed that 38% would choose both methods for their education, 29% would choose the rotary preparation, and 33% would choose the preparation with hand stainless steel files.

Figure 2 - Comparison of root canal preparation methods



Focus groups

Participants reported feeling more confident and think that rotary instruments are easier to perform endodontic treatment when compared to stainless steel hand files used in previous semesters of the course.

"... I think the rotary instrument helps a lot. Especially in this grinding part, it gives more confidence. I used to be very, very, very afraid of using the rotary instrument inside the canal. I thought everything would fracture, and I thought I could puncture something. I think then you realize that it's not that sensitive, you know, you don't need to be that afraid. But I think it gave me a little more confidence, actually." (A8)

"I felt much more confident performing the mechanized technique than the manual treatment." (A6)

"I think that using the rotary instrument is easier, but even so, it still has some problems that we also have with the manual technique. I don't know if it's because we're inexperienced and haven't had much contact with mechanized instrumentation, but the problems don't just go away. It's not the salvation of the world, really." (B4)

At times, there were reports questioning whether they felt capable of performing a treatment with rotary instrumentation.

"I think it depends a lot on the case. I don't think the fact that it's rotary or manual excuses you from reflecting before starting treatment, whether you can treat that case or not. I don't think it's the salvation of the world like that. I think the part where you look at the radiography and see if you can do it is a step that cannot be excluded." (B6)

"I would take the risk, but it also depends on the case." (B4).

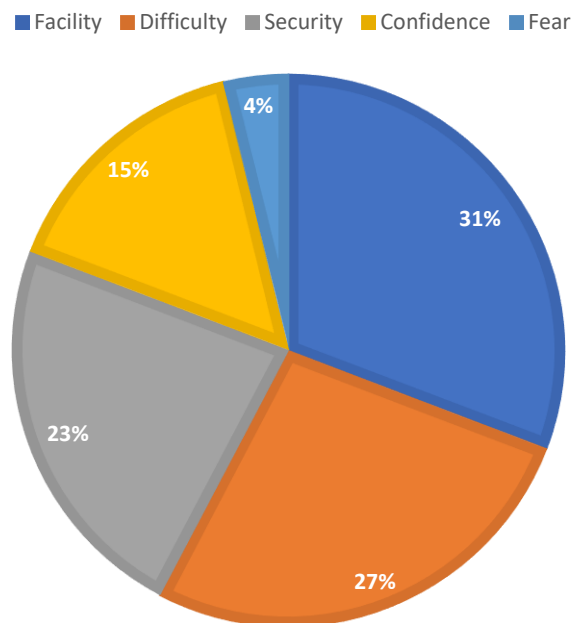
Feelings such as fear and insecurity were present in the students' speeches, probably associated with introducing a new technique.

"I was insecure, I am naturally like that, but on the first day, I was very nervous. It was like I didn't even know what endodontics was. It was like the first time doing it in my life. So maybe if we had a little more, or if at the end, a class before going to the clinic to summarize and clarify any doubts the class may have had. I think it would help." (B4)

"But we don't have complete control, you know, so we are afraid, it takes longer. Sometimes I think it takes longer than if we did it manually, we don't have complete control." (A6)

Despite reporting that the use of mechanized instrumentation greatly facilitates the treatment, it was a consensus that manual instrumentation could not be excluded. The information described above is illustrated in Figure 3, by analyzing the number of citations of words associated with categories of sentiment regarding the mechanized technique in the coding nodes.

Figure 3 - Matrix coding chart: count of codings related to mechanized technique



The word cloud (Figure 4) indicates the most frequently detected words in the focus group transcriptions. The words "manual", "rotary", "clinic", "root length determination", and "instrumentation" predominate. In the background, we have words such as "locator", "mechanized", "technique", "difficult", "canal", and "easy". In addition, some words border the visual tool, such as difficulty, patient, work, and treatment.

Figure 4 - Word cloud generated from focus group analysis.



Evaluation of the quality of the obturation of the performed treatments

According to the analysis, there was a significant difference in the quality of the obturation regarding the factor apical limit compared to the overall analysis of the treatment performed ($P < 0.0098$), which analyzed the three factors together (compaction, apical limit, and taper). Treatments were considered adequate in 72% of the cases and in 28% were considered regular.

DISCUSSION

The assessment of undergraduate students' is crucial to validate the quality of education. An increased self-confidence can improve the competency in clinical practice¹³. Therefore, the objective of this study was to evaluate and discuss the development of aspects related to competency, confidence, and perception of undergraduate dental students after introducing and using NiTi instrumentation. The choice of kinematics was based on institutional availability and the student's preference when performing the case.

Cohort studies present good evidence from a population evaluated who share a common experience¹⁴. The study consisted of two cohorts that followed two groups of undergraduate students. Each group was followed for six months, resulting in a total period of 12 months. Quantitative data were evaluated, followed by qualitative data. Mixed methods, which combine qualitative and quantitative analyses, were used in this study to generate a deeper understanding of the data. Mixed-methods research have been common in Dentistry. Wong et al.¹⁵ used a mixed-methods approach to evaluate the anxiety and self-confidence of dental students when performing local anesthesia. Grock et al.² evaluated undergraduate students' experience and anxiety levels when performing emergency procedures in Endodontics. Fine et al.¹⁶ characterized aspects of the impact of confidence on dental clinical practice. Luz et al.¹⁷ used mixed methods to determine the degree of confidence and anxiety in performing endodontic procedures in undergraduate students. These studies reported no limitations regarding mixed methods, demonstrating its ability to produce an extensive understanding of the evaluated factors. The integration of methodologies verifies the consistency of quantitative results and increases the interpretive capacity of qualitative results¹⁵.

The present study used questionnaires to quantitatively analyze students' self-confidence after using NiTi. Observations regarding students' perceptions related to NiTi instruments and foraminal locators were made qualitatively through the focus groups. As for competence, quantitative data were obtained through the final radiographic analysis of treatments performed by the students.

Collecting self-confidence through questionnaires is a safe parameter for evaluating self-confidence and the limitations of its use are not associated with the method itself but with the reduction of response rates that may occur in longitudinal studies^{15,18,19}.

The methodology of interviews with focus groups is beneficial for gathering perceptions, habits, beliefs, values, taboos, myths, and prejudices²⁰. Therefore, it can be a tool of interest in evaluating the perception and feelings of undergraduate dental students regarding the teaching-learning process in the field of Endodontics. Focus group technique is an excellent methodology for complementing the quantitative data from the questionnaires¹⁵. However, this technique allows some students' experiences to influence others' responses. This fact was possible to notice at some moments in the present study.

Donnelly, Coffey, and Duncan²¹ evaluated the quality of endodontic treatments using technologies such as the apex locator and automatized canal preparation. According to the authors, changes in teaching strategies and the introduction of new technologies significantly increased the quality of endodontic treatments, especially in multi-rooted teeth. Additionally, changes in teaching endodontics and continuous evaluations of the teaching-learning process are invaluable to ensure a standard of competence among students and to stimulate new changes²¹. We also found an increase in the quality of obturation, mainly due to the use of automatized canal preparation. Using a qualitative analysis, it was possible to perceive that student felt more confident and secure when using new technologies for root canal preparation, stating that manual and mechanized techniques should be taught during graduation. These findings demonstrate the need for changes in teaching endodontics to increase the standard of competence among students.

When dental students were asked about the most incredible scientific and technological innovation in Endodontics, Tanalp, Güven, and Oktay¹⁹ reported that most of them answered the use of rotary instruments. Moreover, they noticed the desire of almost all students to use this technology in their future practice. Our study also perceived this reality through focus groups, where students reported a significant advancement when using rotary and reciprocating instruments and showed a willingness to use them after graduation.

According to Donnelly, Coffey, and Duncan²¹, the quality of obturation increased from 18.75% to 45.2%, mainly in the filling extension, after introducing new technologies. In our study, a significant difference was observed when this aspect was evaluated, as the results indicated a deficiency in this stage when analyzing the quality of obturation. In this study, we noticed that students reported some difficulty in using the apex locator, which may be related to the deficiency in reaching the ideal working length in some cases. Moreover, the need to demonstrate how to use the apex locator during pre-clinic activities was pointed out so that students could feel familiar when using it in patients. For this reason, our results did not show similar improvements.

After analyzing the focus groups, a word cloud was also generated. With this approach, the words displayed in the cloud gain different dimensions according to their frequency of occurrence²². Thus, more prominent words in the image represent words that were mentioned more frequently by the participants. It can be observed that the

words "manual", "rotary", "clinic", "root length determination", and "instrumentation" predominate. In the background, we have words such as "locator", "mechanized", "technique", "difficult", "canal", and "easy". In addition, some words bordering the visual tool include difficulty, patient, work, and treatment.

Although some European countries recognize endodontics as a specialty, most endodontic procedures are performed by general practitioners²³. Therefore, it is crucial to ensure dental students gain adequate confidence and competence to perform satisfactory endodontic treatment on single- and multi-rooted teeth. It is widely known that the time and resources dedicated by dental schools to endodontic training vary greatly, and there is no minimum level of knowledge or clinical skills contribution that can be considered acceptable²³. This highlights the importance of regularly examining students' work to ensure an adequate standard of treatment. Introducing new technologies improves these standards, and the curriculum is flexible enough to introduce changes rapidly. Thus, the constant need to evaluate the teaching-learning process in dentistry and implement measures that can contribute to its growth is evident.

CONCLUSION

Based on the results and limitations of the present study, it was reasonable to conclude that using automatized instrumentation to perform endodontic treatments were the main factors that modulated an increase in confidence and quality of the treatments performed. The students' self-confidence in performing the different stages was uniform, and the method of choice that provided greater security and ease of learning was the mechanized method. The students showed greater competence when performing endodontic treatments using mechanized NiTi instruments for root canal preparation.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

REFERENCES

1. Dahlström L, Lindwall O, Rystedt H, Reit C. "Working in the dark": Swedish general dental practitioners on the complexity of root canal treatment. *Int Endod J*. [Internet]. 2017 [acesso 2019 fev 19];50(7):636-645. Disponível em: <https://doi.org/10.1111/IEJ.12675>.
2. Grock CH, Luz LB, Oliveira VF, et al. Experiences during the execution of emergency endodontic treatment and levels of anxiety in dental students. *Eur J Dent Educ*. [Internet]. 2018 [acesso 2019 fev 19];22(4):e715-e723. Disponível em: <https://doi.org/10.1111/EJE.12385>.
3. Seijo MOS, Ferreira EF, Sobrinho APR, Paiva SM, Martins RC. Learning Experience in Endodontics: Brazilian Students' Perceptions. *J Dent Educ*. [Internet]. 2013 [acesso 2019 fev 19];77(5):648-655. Disponível em: <https://doi.org/10.1002/J.0022-0337.2013.77.5.TB05515.X>.
4. Davey J, Bryant ST, Dummer PMH. The confidence of undergraduate dental students when performing root canal treatment and their perception of the quality of endodontic education. *Eur J Dent Educ*. [Internet]. 2015 [acesso 2019 fev 19];19(4):229-234. Disponível em: <https://doi.org/10.1111/EJE.12130>.
5. Henzi D, Davis E, Jasinevicius R, Hendricson W, Cintron L, Isaacs M. Appraisal of the Dental School Learning Environment: The Students' View. *J Dent Educ*. [Internet]. 2005 [acesso 2019 fev 19];69(10):1137-1147. Disponível em: <https://doi.org/10.1002/j.0022-0337.2005.69.10.tb04015.x>.
6. Divaris K, Barlow PJ, Chendea SA, et al. The academic environment: the students' perspective. *Eur J Dent Educ*. [Internet]. 2008 [acesso 2019 fev 22];12 Suppl 1(SUPPL. 1):120-130. Disponível em: <https://doi.org/10.1111/J.1600-0579.2007.00494.X>.
7. The European Society of Endodontology - Home. Accessed April 19, 2023. Disponível em: <https://www.e-s-e.eu/>.
8. Lynch CD, Burke FM. Quality of root canal fillings performed by undergraduate dental students on single-rooted teeth. *Eur J Dent Educ*. [Internet]. 2006 [acesso 2019 fev 22];10(2):67-72. Disponível em: <https://doi.org/10.1111/J.1600-0579.2006.00397.X>.
9. Wei X, Lin Z, Peng S. The effect of root canal preparation with nickel-titanium rotary instruments in reducing post-operative pain. *Odontostomatologie Tropicale*. [Internet]. 2008 [acesso 2019 fev 22];31:5-11. Disponível em: <https://europepmc.org/article/med/12898763>.
10. AlRahabi MK. Evaluation of complications of root canal treatment performed by undergraduate dental students. *Libyan J Med*. [Internet]. 2017 [acesso 2019 fev 22];12(1). Disponível em: <https://doi.org/10.1080/19932820.2017.1345582>.
11. Abu-Tahun I, Al-Rabab'ah MA, Hammad M, Khraisat A. Technical quality of root canal treatment of posterior teeth after rotary or hand preparation by fifth year undergraduate students, The University of Jordan. *Aust Endod J*.

- [Internet]. 2014 [acesso 2019 fev 22];40(3):123-130. Disponível em: <https://doi.org/10.1111/AEJ.12069>.
12. Nagendrababu V, Ahmed HMA. Shaping properties and outcomes of nickel-titanium rotary and reciprocation systems using micro-computed tomography: A systematic review. *Quintessence Int (Berl)*. [Internet]. 2019;50(3) [acesso 2019 fev 22]. Disponível em: <https://doi.org/10.3290/J.QI.A41977>.
 13. Elzubeir MA, Rizk DEE. Assessing confidence and competence of senior medical students in an obstetrics and gynaecology clerkship using an OSCE. *Educ Health (Abingdon)*. [Internet]. 2001 [acesso 2019 fev 22];14(3):373-382. Disponível em: <https://doi.org/10.1080/13576280110082231>.
 14. Parente RCM, Oliveira MAP de, Celeste RK. Case Reports and Case Series in the Era of Evidence-Based Medicine Relatos e Série de Casos na Era da Medicina Baseada em Evidência. *Brazilian Journal of Videoendoscopic Surgery*. [Internet]. Published online 2010. [acesso 2019 fev 22]. Disponível em: https://www.sobracil.org.br/revista/jv030302/bjvs030302_063A.pdf.
 15. Wong G, Apthorpe HC, Ruiz K, Nanayakkara S. Student-to-Student Dental Local Anesthetic Preclinical Training: Impact on Students' Confidence and Anxiety in Clinical Practice. *J Dent Educ*. [Internet]. 2019 [acesso 2019 fev 22];83(1):56-63. Disponível em: <https://doi.org/10.21815/JDE.019.007>.
 16. Fine P, Leung A, Bentall C, Louca C. The impact of confidence on clinical dental practice. *Eur J Dent Educ*. [Internet]. 2019 [acesso 2019 fev 22];23(2):159-167. Disponível em: <https://doi.org/10.1111/EJE.12415>.
 17. Luz LB, Grock CH, Oliveira VF, et al. Self-reported confidence and anxiety over endodontic procedures in undergraduate students-Quantitative and qualitative study. *Eur J Dent Educ*. [Internet]. 2019 [acesso 2019 fev 25];23(4):482-490. Disponível em: <https://doi.org/10.1111/EJE.12456>.
 18. Mirza MB. Difficulties Encountered during Transition from Preclinical to Clinical Endodontics among Salman bin Abdul Aziz University Dental Students. *J Int Oral Health*. [Internet]. 2015 [acesso 2019 fev 25];7(Suppl 1):22. Accessed April 19, 2023. Disponível em: <https://pmc.ncbi.nlm.nih.gov/articles/PMC4516078/>.
 19. Tanalp J, Güven EP, Oktay I. Evaluation of dental students' perception and self-confidence levels regarding endodontic treatment. *Eur J Dent*. [Internet]. 2013 [acesso 2019 fev 25];7(2):218-224. Disponível em: <https://doi.org/10.4103/1305-7456.110189>.
 20. Nunes ED. O desafio do conhecimento: pesquisa qualitativa em saúde. *Cien Saude Colet*. [Internet]. 2007 [acesso 2019 fev 25];12(4):1087-1088. Disponível em: <https://doi.org/10.1590/S1413-81232007000400030>.
 21. Donnelly A, Coffey D, Duncan HF. A re-audit of the technical quality of undergraduate root canal treatment after the introduction of new technology and teaching practices. *Int Endod J*. [Internet]. 2017 [acesso 2019 fev 25];50(10):941-950. Disponível em: <https://doi.org/10.1111/IEJ.12727>.
 22. Barbisan DB. Experiências relacionadas à simulação de tratamentos endodônticos em pré-clínica por alunos de graduação em Odontologia.

Published online 2018. [Internet]. Accessed April 19, 2023. [acesso 2019 fev 25]. Disponível em: <https://lume.ufrgs.br/handle/10183/173610>.

23. De Moor R, Hülsmann M, Kirkevang LL, Tanalp J, Whitworth J. Undergraduate curriculum guidelines for endodontology. Int Endod J. [Internet]. 2013 [acesso 2019 fev 25];46(12):1105-1114. Disponível em: <https://doi.org/10.1111/IEJ.12186>.