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First Experience of an Undergraduate Dental Student with a Reciprocating System in Simulated Root Canals—A Pilot Study

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Abstract: Rotary instrumentation has been proposed in undergraduate teaching. The aim of this study was to evaluate student's performance, through the obturation quality and treatment time, in a sequential range of L-simulated root canals. A senior undergraduate dental student sequentially prepared randomly numbered canals from 1 to 40, with the WaveOne Gold glider and primary file, according to the manufacturer instructions. A gutta-percha cone matched with the finishing instrument and epoxy resin-based sealer (AH Plus) was selected for the obturation. Three independent observers evaluated the obturation quality according to both density and length. Active, total instrumentation and obturation times were also measured. Statistical analysis was obtained by Mann–Whitney and Kruskal–Wallis tests with a significance level of $p < 0.05$. The quality of the obturation was independent of the number of prepared canals with adequate length and density in 87.5% of the prepared canals. Both active and total instrumentation, as well as obturation times, reduced significantly as the number of the prepared canals by the student increased ($p < 0.05$). The use of WaveOne Gold instrumentation and matched cone obturation by an inexperienced operator provided an adequate obturation quality in most of the curved simulated canals. The working time was significantly reduced through a short learning curve.

Keywords: dental education; root canal preparation; root canal obturation; root canal therapy; undergraduate student

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1. Introduction

With increased life expectancy, root canal treatment and novel endodontic therapy proposals have emerged with a great impact, enabling the retention of natural permanent teeth that otherwise would be lost. The aim of endodontic treatment (ET) is to remove pulp tissues, dentinal debris, and microorganisms, achieving the adequate conditions that will enable a proper filling and sealing of the root canal system. To reach this purpose, effective cleaning and shaping is essential. Over the years, mechanized instruments have been developed and commercialized to overcome the difficulties inherent to the conventional and rigid stain-steel (SS) manual instrumentation, simplify procedures, reduce the time required for root canal preparation, and offer a safer approach associated with less risk of errors and complications [1]. Amongst a myriad of new instruments and devices, the reciprocating movement is one of the most recently reported. It is a single-file system producing faster and centered shaping procedures, when compared to the traditional rotary instruments [2]. Not less important, for student's safety, is the single-use (reciprocating) file's concept, preventing cross-infection or reducing cyclic and torsional fatigue, as well as instrument's corrosion by irrigating solutions [3]. Thus, it is suggested as one of the most suitable systems for inexperienced operators, namely, undergraduate students [4]. There have also been reported contradictory findings, claiming that shaping procedures with ProTaper Next instruments, for instance, removed less resin from the curvature, showing a better centering ability than the reciprocating WaveOne Classic system [5]. The authors emphasized the different taper of the instruments (WaveOne 0.08, ProTaper Next 0.06) as the main factor for the different outcome. Nevertheless, improvements in the instrument designs to obtain greater flexibility are still emerging. WaveOne Gold (WOG; Dentsply Sirona) uses the same kinematics as its predecessor, WaveOne (classic) (WO; Dentsply Sirona, Ballaigues, Switzerland), but has some differences in design, size, and taper. The Wave One Gold instrument has a parallelogram cross-sectional design with two cutting edges incorporating four instruments: 21/06 (small), 25/07 (primary), 35/06 (medium), and 45/05 (large). A new reciprocating glide path instrument, the WaveOne Gold Glider, has also been introduced, with 0.15-mm tip diameter and variable 2%–6% taper. The innovative gold treatment increases the flexibility and resistance to cyclic fatigue and improves cutting efficiency [6,7]. It also allows a more conservative preparation, while maintaining the original shape of the root canal [8]. It is reported to be less prone to dentin removal during instrumentation [9], even in canals with high curvatures [10]. In addition, it enabled a faster canal preparation compared to other nickel–titanium (Ni–Ti) instrumentation systems, such as ProTaper Next [11].

Studies evaluating non-surgical ET, performed by specialists, report success rates of over 90%, with differences between initial/primary root canal treatments compared to non-surgical retreatments [12]. Regarding undergraduate students, it has been reported that the quality of endodontic treatment is poor, with unsatisfactory success rates, particularly in multirooted teeth [13,14]. The authors were unanimous in stressing the importance of introducing new teaching methodologies, techniques, and instruments into educational pre-clinical and clinical undergraduate curricula to improve general practitioners' confidence in root canal treatments. There is a growing trend of Ni–Ti rotary techniques taught in dental schools, with reports appearing nowadays of the clinical performance of Ni–Ti instruments operated by undergraduate students. Sonntag et al. [15] observed that undergraduate dental students could achieve better canal preparations with Ni–Ti, although file separations may still be the main concern for beginners that avoid using Ni–Ti rotary systems. Results from an audit at Queen's University Belfast on technical quality of root fillings performed by undergraduate students [16] concluded that in most of the teeth the technical quality of the root filling was acceptable, and students were exposed to an appropriate case mix for endodontic training. The use of machine-driven systems for instrumentation, the selection of primary ET, as well as the exclusion of ET with post-root filling or where only manual instrumentation was used, might have influenced the results. Hence the outcomes of similar audits have conflicting results [17–19].

The European Society of Endodontology (ESE) and the Association for Dental Education in Europe (ADEE) have published curricular guidelines to define and harmonize the skills of students by the end of graduation, emphasizing the requirement of a minimum pre-clinical and clinical training that allows future professionals to achieve the necessary quality in ET performance [20–22]. Several studies on the effect of operator experience using mechanized systems concluded that, despite the good performance obtained by inexperienced operators, the associated learning curve should be highlighted; they considered it a crucial factor for establishing the minimum amount of work required for students to obtain the necessary competence for independent professional practice [16,23–26]. Regarding the use of reciprocating systems, characterized by a simple and safer protocol [4,11], there are still few studies that evaluate the quality of the treatments performed by inexperienced operators, such as, undergraduate students, and the extension of its learning curve.

In this regard, this pilot study aimed to evaluate the quality of the endodontic treatments performed by an undergraduate dental student using the reciprocating motion (WOG) and obturating with a matched gutta-percha cone and epoxy-resin-based sealer, along the sequential preparation of 40 L-simulated root canals. It also had the purpose to determine the time required for each of the following stages: active instrumentation, total instrumentation and obturation, as the number of treated canals increased. Additionally, it had the purpose of tracing a learning curve of total instrumentation times/filling quality across the sequential preparation of the 40 canals.

The null hypothesis was that there would be no differences in quality of the fillings or treatment time of students' ET, using reciprocating instrumentation and filling with matched gutta-percha cones and sealer, as the number of treated canals increased.

2. Materials and Methods

2.1. Sample Selection and Preparation

A total of 40 transparent cubes with artificial L-shaped acrylic canals were used. Before treatment, each cube was photographed using a digital camera (Canon EOS 450D + EF-S 18–55 mm IS Lens, Tokyo, Japan). The total length of the canals was determined using a 10 K file, adjusting the stop when the file's tip was visible in the apical foramen. The only operator was a final-year student of the integrated Master's in dental medicine program, University of Porto, with no previous experience in continuous rotary or reciprocating instrumentation (his curricular pre-clinical teaching only included manual files). Before the study, the student received a short training that included written instructions about the reciprocating instrumentation system WOG. He also had to learn how to check patency, create a glidepath and do an ET in an L-shaped simulated acrylic canal, using the WOG glider instrument and the primary WOG file with all the WL filling it with the matched gutta-percha point. In the experimental assay, the cubes were randomly numbered from 1 to 40, sequentially prepared and obturated, following this order (1–40). To minimize the effect of operator's fatigue, one group of ten simulated canals were prepared in each session. After obturation, each cube was photographed, again using a digital camera (Canon EOS 450D + EF-S 18–55 mm IS Lens, Tokyo, Japan).

2.2. Canal Instrumentation

Canal instrumentation was performed using the WOG reciprocating instrumentation system according to the manufacturer's instructions. The patency of the canals was previously checked by progressing with a 10 K file (Dentsply Sirona, Charlotte, NC, USA) until it was visible at the apical exit ("apex")—patency length (PL). A mechanized glidepath was then created using the WOG glider file (Dentsply Sirona, Charlotte, NC, USA) with the working length (WL), which was determined reducing 1 mm to the PL. Between each file, the canals were irrigated with 96% alcohol using a 5 mL plastic syringe and a 27 G needle. The canals were instrumented with a WOG Primary file (25.07) (Dentsply Sirona, Charlotte, NC, USA), with pecking motion, advancing the file in an apical direction until resistance was offered. The file was then removed and wiped with a damp gauze, and the canal was irrigated with alcohol. According to the instructions for use, cleaning the file is essential for maintaining the cut's effectiveness and avoiding increased pressure exerted at the apical level, which increases the risk of fracture. This process was repeated until reaching the WL. A patency file (10 K) was used between the files with the PL. The final irrigation was performed with 1 mL of alcohol, and the canal was dried with paper cones.

2.3. Canal Obturation

A calibrated gutta-percha cone, WOG Conform Fit gutta-percha Primary (Dentsply Sirona, Charlotte, NC, USA), matching the taper and size of the last file used, a WOG Primary file (25.07) with the total WL, was selected and checked, visualizing its fitting through the transparent cube. In addition, the cubes were photographed with the correspondent gutta-percha cone inside each simulated canal; then, AH Plus Jet epoxy resin sealer (Dentsply Sirona, Charlotte, NC, USA) was introduced into the canal with a paper cone. The primary gutta-percha cone was inserted with slow movements, from coronal to apical until reaching the WL. A heated burner was used to cut and remove excess coronal material (gutta-percha and sealer), and a vertical condenser (Dentsply Maillefer, Tulsa, OK, USA) compacted the gutta-percha inside the root canal. Subsequently, all excess filling material outside the canal was removed with cotton wool soaked in 96% ethyl alcohol. Figure 1 shows a schematic view of the process.

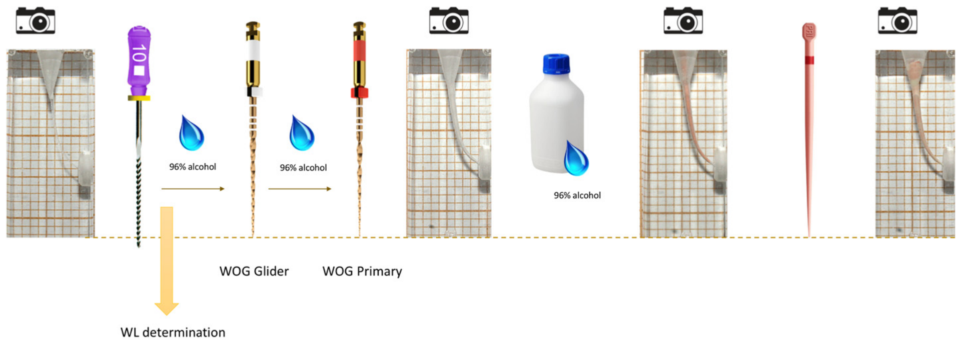

Figure 1. Schematic view of the experimental protocol.

2.4. Time Accounting

Each canal's treatment time was measured and recorded by order of preparation (1–40) in seconds, using a digital stopwatch with the help of an assistant operator. The treatment time was divided into two phases: a first phase corresponding to the biomechanical preparation (instrumentation and irrigation) and a second phase corresponding to the obturation. In the first phase, two parameters were recorded: the total and active instrumentation times. The total instrumentation time included from when the instruments began working inside the canal, to the changing and cleaning of the files and time for canal irrigation. The active instrumentation time referred only to when the instruments (10 K file, WOG Glider, and WOG Primary) were working inside the simulated canal. In the second phase of the treatment, the obturation time was recorded, including all the procedures from the main gutta-percha cone's selection and adjustment to the cut of excess gutta-percha/sealer, and canal entrance cleaning.

2.5. Obturation Quality Assessment

The obturation quality was evaluated according to the standard-of-care, density and length parameters. Density was classified as adequate in the absence of vacuoles and inadequate in the presence of vacuoles or heterogeneous canal filling. The obturation length was classified as short when more than 2 mm away from the apical exit, adequate when 0–2 mm from the apical exit, and long when material extended beyond the limits of the acrylic canal. Strict criteria were applied; that is, the obturation quality was only considered adequate when both length and density filled the requirements, and inadequate when any or both conditions were inadequate. Three independent observers assessed the obturation quality: two undergraduate senior students (final year students) and an experienced Endodontics professor. The inter-observer correlation, as well as the global agreement, were determined.

2.6. Statistical Analysis

Statistical data analysis was performed using IBM® SPSS® Statistics (SPSS® Version 26, Armonk, NY, USA). The following variables were analyzed: quantitative variables in the descriptive data study, including profile graphs and summary statistics tables; and differences in instrumentation and obturation times in the comparative study, including the Mann–Whitney and Kruskal–Wallis tests.

For the Mann–Whitney and Kruskal–Wallis tests, the sample was divided into four groups of ten canals: Group 1, canals 1 to 10; Group 2, canals 11 to 20; Group 3, canals 21 to 30; Group 4, canals 31 to 40. The decision rule consisted of detecting significant statistical evidence for probability values lower than 0.05.

3. Results

The obturation quality was adequate in 87.5% of the treatments performed, according to the established strict quality criteria (length and density) (Table 1). Table 2 shows the inter-observer and global agreement values.

Table 1. Analysis of the obturation length, density, and quality parameters.

Density (%)		Length (%)			Quality (%)	
Adequate	**Inadequate**	**Short**	**Adequate**	**Long**	**Adequate**	**Inadequate**
37 (92.5%)	3 (7.5%)	1 (2.5%)	38 (95%)	1 (2.5%)	35 (87.5%)	5 (2.5%)

Table 2. Inter-observer and global agreement.

	Global Agreement	(Obs1, Obs2)	(Obs1, Obs3)	(Obs2, Obs3)
Density	0.767	0.850	0.750	0.700
Length	0.917	0.950	0.900	0.900

The time variable showed statistically significant differences between the four groups ($p < 0.05$) (Table 3).

Table 3. Instrumentation and obturation time in seconds (s).

Time (s)		Group 1	Group 2	Group 3	Group 4	Total	*p* Value
Total instrumentation	Median	418.0	309.5	209.0	171.5	254.0	$p = 0.001$
	Min–Max	300–689	225–351	163–267	145–274	145–689	
Active instrumentation	Median	247.0	168.5	90.5	78.0	130.5	$p = 0.001$
	Min–Max	109–377	84–196	70–158	62–139	62–377	
Obturation	Median	137.5	104.5	85.0	76.5	96.5	$p = 0.001$
	Min–Max	114–167	86–135	75–98	68–83	68–167	

Multiple comparison tests between pairs of groups showed statistically significant differences between groups 1 and 3, 1 and 4, 2 and 3, and 2 and 4 regarding the total instrumentation, active instrumentation, and obturation times ($p < 0.05$) (Figures 2 and 3). As no differences were detected between groups 1 and 2, and between 3 and 4, it can be assumed that the time decreased from group 2 onwards and stabilized from group 3 onwards. Thus, the null hypothesis regarding the instrumentation time differences between the groups of prepared cubes was rejected.

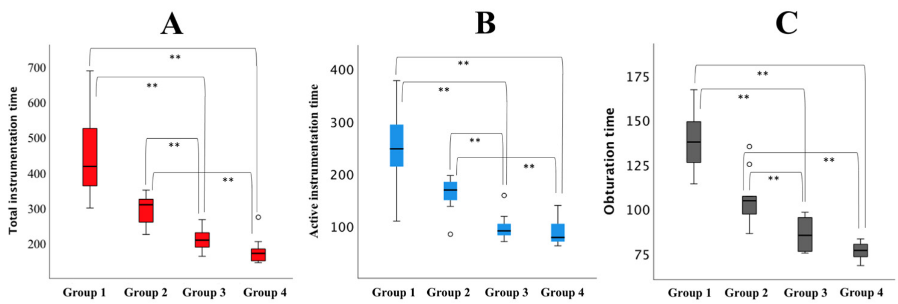

Figure 2. Multiple time comparisons between groups of 10 canals organized by preparation order. (**A**)—Total instrumentation time; (**B**)—active instrumentation time; (**C**)—obturation time. (** significant differences $p < 0.05$; "○"—outlier).

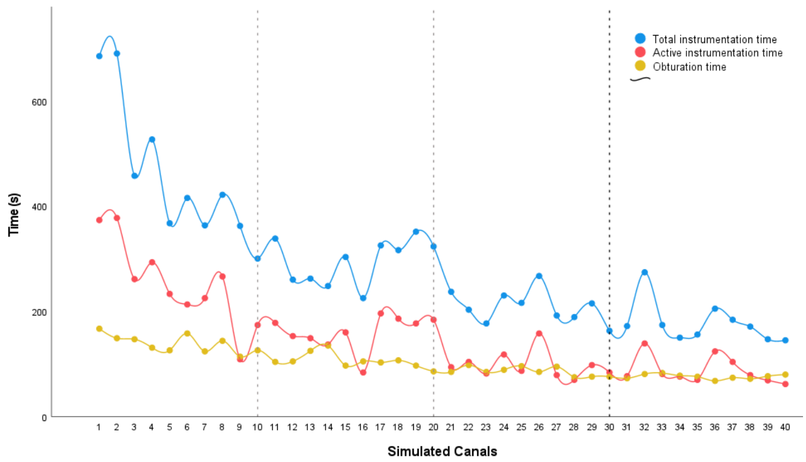

Figure 3. Profile graph of total instrumentation, active instrumentation, and obturation times per group (10 canals) by preparation order.

Concerning the obturation quality, there were no significant differences between the four groups of prepared simulated canals (1–10; 11–20; 21–30; 31–40) ($p > 0.05$), even though inadequate fillings were recorded, essentially in groups 1 and 2, associated with a longer preparation time (Figure 4). Thus, the null hypothesis regarding obturation quality differences between groups of acrylic cubes was verified.

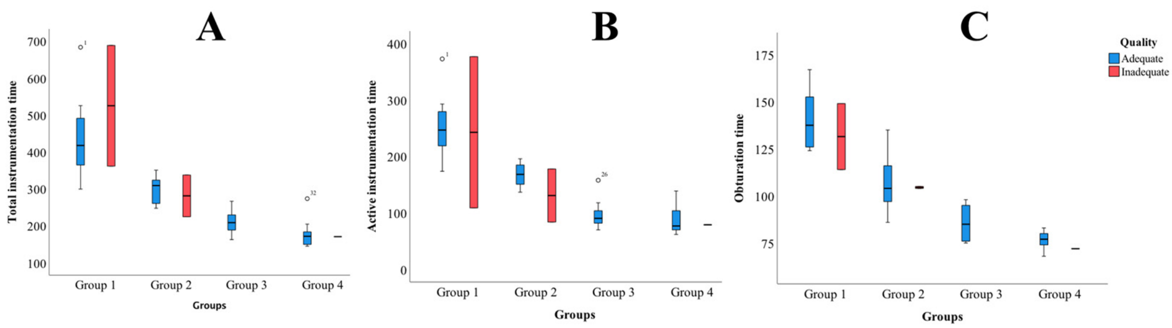

Figure 4. Multiple comparisons between treatment time and quality per group, by preparation order. (**A**)—Total instrumentation time; (**B**)—active instrumentation time; (**C**)—obturation time. ("○"—outlier).

4. Discussion

According to the guidelines provided by ESE, the assessment of the technical quality of root canal treatment focus on the length of the filling material (between 0.5 to 2 mm from the radiographic apex) and the homogeneity of filling density, with the absence of empty spaces, that must be interpreted radiographically [22]. Considering these strict criteria, 87.5% of the filling's quality performed by an undergraduate student were considered "adequate", with 95% and 92.5% presenting the required length and density, respectively. These values are relevant because the quality of the root canal fillings is associated with the root canal treatment's prognosis. Moreover, studies report that a poorer obturation quality is associated with a lower success rate, i.e., more prone to persistent post-treatment disease [27,28].

However, epidemiological evaluations of the technical quality and result/outcome of treatments performed have recognized the need to improve the performance of students and general dentists in endodontics' clinical practice [14,29,30]. Studies stress that, before graduation, students should be exposed to various clinical cases adapted to their level of training, to prepare for a future independent, but responsible, clinical practice. This will allow the acquisition of the necessary skills to adequately perform simple procedures. It is also essential that every agent know their limits and be aware of the need for continued learning throughout their lifetime [16,31]. Thus, introducing new materials and techniques in undergraduate teaching, as well as monitoring the results obtained, is imperative for a better outcome for future professionals, to provide the best and safest clinical practice for patients [14,29].

In this sense, the present investigation had the purpose of assessing novel strategies, such as the introduction of a mechanized instrumentation system within undergraduate teaching, through a pilot study, evaluating its performance in curved simulated canals. It was, thus, the specific purpose of the present investigation to evaluate ET's quality and time required for an inexperienced operator to perform root canal treatments using the reciprocating motion (WOG) and a matched gutta-percha cone associated to an epoxy-based sealer. The outcome of the 40 simulated canals, sequentially prepared, were compared. They were divided into four groups of 10, ordered from the first to the last (40th) canal prepared. With the results obtained, a profile graph was presented. It enabled an estimate of the minimum number of treated canals needed to stabilize the performance outcome of undergraduate students with reciprocating instrumentation. This could be traced only based on ET time spent by the student, as there were no differences regarding filling quality.

To increase the reliability of the results, three observers were considered, including two other final-year students of the integrated Master's in dental medicine and an Endodontics professor (observer 3). In this study, the simulated canals facilitated visualization, through photographs, evaluated by three previously calibrated observers. There was a high overall agreement between the observers, which was expected. This is because the evaluation was done through photographs of the transparent cubes, without the limitations of conventional periapical radiographs. Similar to other studies, the present investigation used artificial canals [11,26,32]. Although allowing a better standardization of shape, length, and degree of curvature, their properties are not identical to dentin, which may have influenced the results, and thus, be a limitation of the investigation. Other authors used extracted teeth and assigned scores to determine density by visualizing digital radiographs [33].

Concerning ET's evaluation, in the present study there were no significant differences regarding the obturation quality over the 40 sequentially prepared canals. Although the reduced number of canals with inadequate obturation was essentially recorded in the first two groups, i.e., amongst the first 20 filled canals, these was no significant impact on the overall obturation quality, between groups. Other authors [33] reported an increasing proportion of adequate density and length of the fillings as the number of treated canals increased. This divergence may be explained by the type of samples, such as natural extracted teeth, with the inherent anatomical variability, whereas, in the present study, the ET was performed in standard simulated curved root canals. Accordingly, Fong et al. [16], in a retrospective evaluation of clinical cases performed by students, attributed the worst result regarding lateral adaptation and obturation length to anatomical variations.

The main finding herein was that, as the number of treated canals increased, the total and active treatment and filling times decreased, showing a corresponding profile as a "learning curve". Similarly, in a previous study [11] with one senior student, regardless of the instrumentation system used and continuous or reciprocating movement, a significant decrease was reported in the time spent in active instrumentation between sequential groups of 10 teeth. In fact, in both studies, the relationship between training and learning showed a significant initial improvement (i.e., a time decrease with relevance after the first 20 canals) that stabilized along the remaining ones. This minimum number of 20 canals prepared to achieve the required competency for ET, performed by graduating students, has also been corroborated in a very controlled study with four fourth-year undergraduate dental students [33]. Using naturally extracted teeth, the results reinforced that machine-driven files result in an overall better quality of root canal treatments, independent of the Ni–Ti system used. In addition, the total treatment time was clearly reduced with increasing number of ETs, due to shorter time spent not only on preparation, but also on filling procedures. Similar to our findings, the reduction in the operation time was primarily seen from the first to the second session, i.e., from the first 20 extracted teeth treated. Additionally, before the experiment, operators participated in only one calibration session concerning the manuals of the treatment systems. Results from ex-vivo studies have also already emphasized the shorter treatment time associated with rotary instrumentation compared to manual instrumentation, particularly when using systems with fewer files (e.g., WaveOne, Reciproc) [2,25,33].

It must be emphasized that the senior student herein had a previous short training of root canal treatments in his pre-clinical curricular path, similar to other studies where they are referred to as novice [4]. Although it is advisable to expose students in their pre-clinical stage to new developments in Endodontics, such as rotary instrumentation, due to several factors (e.g., high number of students, difficulty in natural extracted teeth selection or COVID-19 impact), senior students actually are left with a short pre-clinical experience, anxious to have the opportunity to experience all sorts of advancements in Endodontics. They realize that they will need these tools in the short term, as future professionals.

In that sense, it can be assumed that the findings of the present pilot study are in line with the literature and should be considered for implementing mechanized instrumentation in undergraduate curricula in Endodontics.

Contrary to the present study, in the referred study by [33], the proportion of adequate ratings of length and adequate seal of root canal fillings also improved with increasing experience. Nevertheless, differences in the methodology in respect to the evaluation of the filling seal through radiographs and scores, as well as the use of naturally extracted teeth, might have influenced the results. It was also reported that systems using fewer files were less time-consuming. Instead, a previous study of our group did not find differences between single-file or multi-instrument systems, emphasizing that the creation of a glidepath, manual (10 K SS-file) or mechanized (ProGlider), can influence the results, [11]. Furthermore, differences in methodology, such as considering manual (K-flex stainless steel files) and several machine-driven systems, such as ProTaper Universal, ProTaper Next and Wave One, may account for the differences [16]. Additionally, apart from reporting that the manufacturer's manual was followed, there is no mention of the creation of a glidepath or maintenance of patency during the root canal preparation, as stressed in the present work. The promising findings of this pilot study justify implementing the experience with a larger number of students, to evaluate the impact of several factors, such as teaching methodology and training levels, as well as different assessment criteria for evaluation.

The existence of a short learning curve, using a reciprocating system, was evidenced in the present study, with significant time-reduction in instrumentation, after the preparation of 20 L-simulated root canals. In addition, a good filling quality was generally registered. This has been also corroborated by other investigations, either with experienced operators or students [32]. Other characteristics inherent to these systems, such as, being "single-use" systems, with a reduced risk of cross-infection and instrument fracture, improves the safety of the procedures [3,4]. Moreover, students seem to prefer the "single-file" systems with a smaller number of instruments due to their ease of learning [4].

Despite the recommended "single use" of some instrumentation systems, mechanized files are generally used, in clinical settings, in more than one canal, such as in the case of multirooted teeth, being reported as very safe instruments [6,34]. In the present investigation, the instruments, according to similar studies, were discarded after five uses, which means five simulated canals [2,34], its use reported by some studies until five teeth [33]. In any case, the lack of variability between the simulated canals anatomy did not allow to infer other factors that could influence a potential wear that could impact the treatment quality [34].

Technological advances in materials and the greater predictability of endodontic nickel–titanium instruments compared to stainless steel instruments have reduced procedural errors and complications in endodontic treatments [2,32,35]. In the present work, no iatrogenic errors were detected. Other novel materials recently proposed for root canal filling, such as the hydraulic calcium silicate-based endodontic cements [36], represent a new challenge to search for the interaction of specific materials and proper clinical protocols. The need for standardization prevented its study in the present undergraduate setting.

In the present pilot study, the emphasis on the short learning curve was directly corelated with an improvement in treatment (instrumentation and filling), concerning time. This aspect alone should not be the primary aim in the search for ET quality, even though improving any technical procedure implies training periods to acquire the needed skills. In this sense, the stabilization of the treatment time after 20 preparations supports the previous curricular guidelines for the undergraduate teaching of Endodontics [37], recommending a minimum of 20 root canal treatments before graduation, clinical or pre-clinical, to achieve the minimum competences in the ET of simple cases. Although the current guidelines [22] still value a minimum skill acquisition, they specifically emphasize that each student may require a different work effort to achieve the same skills. Thus, it may not be possible to strictly suggest an exact number, or the same number of acts required in a standardized way.

The present results have the major limitation of reflecting only the path of a single operator, besides the unique use of simulated canals in resin blocks. Therefore, the results cannot be directly extrapolated to determine a minimum number of canals prepared to achieve the stabilization of the learning curve. However, the corroboration of a previous investigation with a similar methodology [11], and the former ESE guidelines suggesting a minimum of 20 canals prepared, highlight the present pilot test results to implement mechanized instrumentation in the pre-clinical teaching of undergraduate students. Additionally, the positive clinical performance in ET by undergraduate students with mechanized systems reinforces this teaching [16].

The low quality of ET in populations may lead to the speculation that the conventional manual instrumentation needs a longer undergraduate training, not being able to produce the desired learning outcomes at the end of graduation. Thus, the introduction of more predictable instrumentation and obturation techniques should be further implemented and assessed for a better prognosis of root canal treatments in populations.

5. Conclusions

In the present conditions, the quality of the obturation performed by an inexperienced operator after NiTi reciprocating instrumentation in simulated curved canals was adequate, in most of the cases. This quality was not particularly affected by the number of canals prepared. A short learning curve translated into a decrease in total treatment time, including instrumentation and filling procedures, stabilizing after the first 20 prepared canals. Thus, the WaveOne Gold system and the obturation with a matched gutta-percha cone and epoxy resin-based sealer were presented as safe and predictable procedures, independent of the experience of the operator. Pre-clinical and clinical practice for undergraduate students should be further implemented and investigated, to improve the technical quality and outcome of the endodontic treatments performed by future professionals for the general population.

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