Comparative study of the odontometric reliability of endodontic rulers of different brands

Estudo comparativo da confiabilidade odontométrica de réguas endodônticas de diferentes marcas

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Abstract

Introduction: Odontometry is the stage of endodontic treatment that determines the working limit for the endodontist. However, regardless of the method used, the millimetered endodontic ruler is a fundamental tool. Through it, the transfer of the working length is relayed to other instruments, avoiding possible measurement errors. Objective: To assess the accuracy and precision in measurements of millimetered endodontic rulers from different commercial brands for odontometry, in order to analyze their reliability in performing treatments. Methods: 50 rulers from five brands - Maquira, Angelus, KG Sorensen, Preven, and unbranded - were grouped, each with 10 samples. The measurement of 30 mm was pre-established as the target value to be found in all rulers when subjected to measurement analysis using a digital caliper. Results: The marks evaluated in this study were inaccurate and imprecise. Conclusion: It is therefore important for the professional to use the same ruler throughout the endodontic treatment, in order to avoid errors when transferring measurements to instruments and, as a result, jeopardize the success of the treatment.

Keywords: Dental Instruments; Endodontics; Odontometry.

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Introduction

One of the main stages of endodontic treatment is odontometry, it is through odontometry that the limit in which the endodontic files must be worked by the professional inside the canal is determined[1]. Among the techniques used, electronic and manual stand out. However, regardless of the technique used, there is a need for an indispensable and fundamental tool for odontometry: the endodontic millimeter ruler[2].

Such an instrument is used throughout the treatment to record and transfer lengths used in the instrumentation and obturation steps[3]. Obtaining wrong values can bring damages such as underinstrumentation, overinstrumentation, underfilling and/or overfilling, which may cause the procedure to fail[4]. Currently, many rulers of multiple brands and different materials are sold, which leads us to several questions about the precision and accuracy of their measurements[3].

Chances of error in odontometry are numerous and may be associated with radiographic errors, chosen technique and measuring. The latter stands out for presenting the most diverse difficulties, as it is a relative act and, therefore, prone to human errors, ratifying the need for an adequate evaluation means to minimize the chances of iatrogenic events[3].

Thus, researching the odontometric reliability of these endodontic rulers is of great relevance, since few studies have been executed to evaluate this hypothesis. Moreover, this study aimed to evaluate the accuracy and precision in the measurements of endodontic millimeter rulers of different commercial brands for odontometry, in order to analyze their quality for performing endodontic treatments.

Materials and methods

This study is an experimental, observational, descriptive and quantitative Laboratory Test of the reliability of endodontic rulers of different brands in which there are few studies seeking to evaluate them. The research was conducted at the Dental Materials Laboratory of the Dentistry course, on the premises of the University Center of João Pessoa – UNIPÊ.

To perform the experiment, fifty endodontic millimeter rulers were used, being grouped according to their commercial brand, into five experimental groups of 10 rulers each. The groups formed were from the brands Maquira (Maquira Ind. Prod. Odont. Ltda., Maringá – Paraná, Brazil) (Figure 1), Angelus (Angelus Soluções Odontológicas, Londrina – Paraná, Brazil) (Figure 1: B and C), KG Sorensen (KG Sorensen Industria e Comércio LTDA, Cotia – São Paulo, Brazil) (Figure 1), Preven (Preven Ind. e Com. de Produtos Odontológicas EIRELI EPP, Guapirama – Paraná, Brazil) (Figure 1) andwith no commercialbrand.

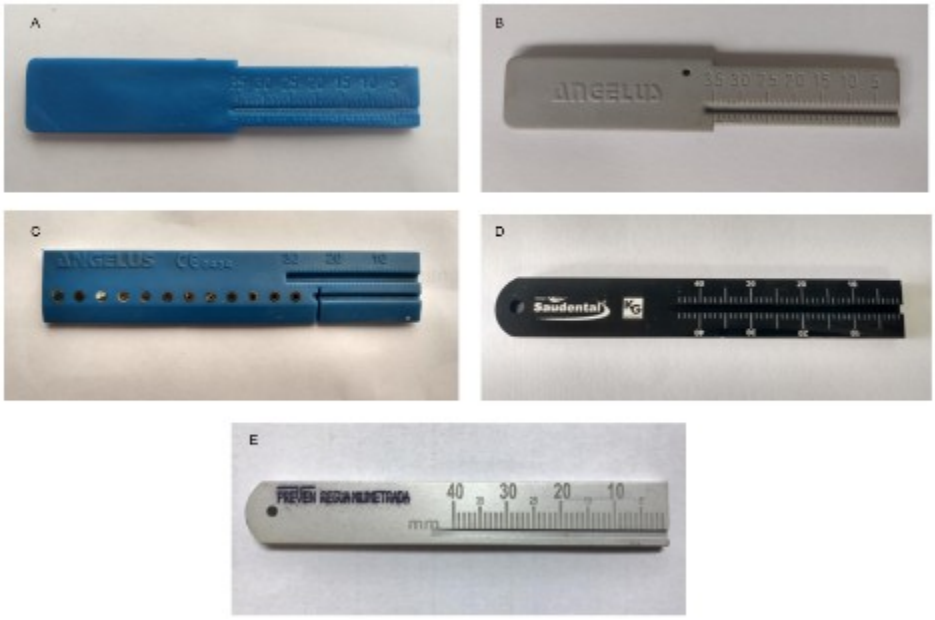

Figure 1- Commercial brands of endodontic rulers.

*(1A) Maquira millimeter ruler (polymer). (1B) Angelus millimeter ruler (polymer). (1C) Angelus millimeter ruler calibrator (polymer). (1D) KG Sorensen millimeter ruler (metal). (1E) Preven millimeter ruler (metal). Source: Own photograp, 2020.

As inclusion criteria, the rulers should be at least 30 mm and were collected from dentistry professionals, dental students from the 5th, 9th and 10th semester of the University Center of João Pessoa - UNIPÊ in laboratory and clinical practice, and from dental supply stores in the city of João Pessoa – PB. Damaged rulers which make it impossible to observe the measurements have been excluded.

All rulers were submitted to measurement analysis using a digital caliper, from the brand MTX, made of stainless steel and with measurement range of up to 150 mm (Figure 2). A length of 30 mm was established for the analysis of

each ruler in the sample. Thus, the caliper was adjusted to the 30 mm measure for each ruler (Figure 2) and the result obtained by the display of the digital equipment was recorded on the data collection form. At the end of each measuring process, the caliper was again set to zero to start another measurement.

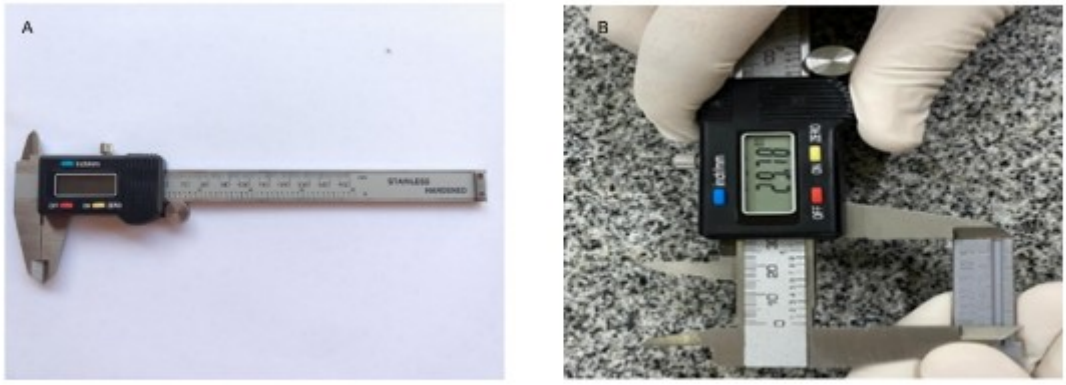

Figure 2– Digital calipers

*(2A) Digital caliper. (2B) Measurement analysis on endodontic ruler. Source: Own photograph, 2020.

The entire procedure, including the measurements, was performed by the same evaluator, in addition to using the same materials and conditions for measurement in order to avoid failures and discrepancies in the measurements.

After obtaining the measurements, the results were submitted to a descriptive statistical analysis to characterize the sample. The measurements of the endodontic millimeter rulers, obtained using the digital caliper, were compared by group (brands), through the ANOVA and Tukey's test, the latter used as a post-test, given p-values < 0.05 in the ANOVA test. All tests were performed using the Statistical Package for the Social Sciences software (SPSS for Windows, version 20.0, SPSS Inc, Chicago, IL, USA), with significance level of 5% (α=0.05).

Results

This study evaluated the accuracy, in order to compare measurements of rulers obtained by the digital caliper with a preestablished measure of 30 mm, and the precision of the rulers within each group, to verify if they have a constant measure, regardless of the target measure. Results obtained through measurement with the digital caliper, with a preestablished measurement of 30 mm, can be seen in Table 1.

Table 1 – Measurements of endodontic millimeter rulers obtained from a caliper.

Group1 Maquira	Group2 Angelus	Group3 KG Sorensen	Group4 Preven	Group5 No brand
29.08 mm	29.78 mm	29.82 mm	30.28 mm	30.05 mm
29.11 mm	29.78 mm	29.98 mm	29.98 mm	30.01 mm
28.95 mm	29.79 mm	30.21 mm	29.98 mm	30.08 mm
28.91 mm	29.78 mm	30.02 mm	29.95 mm	30.11 mm
28.89 mm	29.75 mm	30.07 mm	30.09 mm	29.96 mm
28.89 mm	29.79 mm	30.13 mm	29.96 mm	29.49 mm
29.07 mm	29.77 mm	30.11 mm	30.08 mm	30.15 mm
29.11 mm	29.77 mm	29.89 mm	29.88 mm	30.16 mm
29.16 mm	29.81 mm	30.20 mm	29.97 mm	30.15 mm
29.09 mm	29.78 mm	29.92 mm	29.97 mm	30.18 mm

Source: Own data, 2020.

After measuring the rulers, it was verified a difference in the measurements obtained with the predetermined measurement of 30 mm, with a minimum value found of 28.89 mm and maximum of 30.28 mm.

To assess whether there was a significant difference among the groups of rulers, normality (Shapiro-Wilk) was first analyzed. As groups 1, 2 and 3 obtained a normal distribution, the normality test was continued, using a parametric test, ANOVA.

When evaluating the p-value, we can deduce that there is a significant variance with the distribution of at least one group of rulers, as the value of 0.000 is lower than the established significance level of 0.05, that is, the average of one or more groups was different from the others, thus, there was a statistically significant difference among the values found in the groups (Table 2).

Table 2 – Comparison of measurements of endodontic millimeter rulers according to brands (groups).

Groups	Minimum	Maximum	Average +/- Standard deviation	P-value*
Group1	28.89 mm	29.16 mm	29.026 mm – 0.10394 mm [a]	0.000*
Group2	29.75 mm	29.81 mm	29.78 mm – 0.01563 mm [b]	
Group3	29.82 mm	30.21 mm	30.035 mm – 0.13227 mm [c]	
Group4	29.88 mm	30.28 mm	30.014 mm – 0.11157 mm [c]	
Group5	29.49 mm	30.18 mm	30.034 mm – 0.20392 mm [c]	

*ANOVA test with (α=0.05). The same lowercase letters indicate that there is no significant statistical difference in the measurements of the endodontic millimeter rulers with the preestablished measure (Tukey test with α=0.05).

According to the data, endodontic rulers of group 4, Preven, had the highest accuracy for presenting the average closest to the preestablished value and the lowest average error value (0.01 mm). On the other hand, group 1, Maquira, showed the lowest accuracy (average error of 0.97 mm).

Regarding precision, group 2, Angelus, was the most precise, because the lower the standard deviation, the greater the precision. As a result, the most imprecise was group 5, unbranded.

Discussion

Endodontic treatment consists of technical phases, which in turn must follow an order because they are interdependent. Failure in one of them can cause errors in the others, resulting in an imperfect treatment[5].

Based on this concept, it is the duty of the professional who is qualified in this area to know every step by step, often considered complex. Compliance with all steps, which include diagnosis, sterilization, coronary access, odontometry, chemical-mechanical preparation, filling and follow-up, positively influences the success of the treatment, thus reducing the chances of failure and the need for a future retreatment[6].

From this perspective, odontometry is the step that establishes the extent to which the dentist can work throughout the chemical-mechanical preparation in order to repair and heal the periapical tissues[7-8].

To determine the measurement of the real working length (CRT) more effectively, odontometry must associate two techniques: radiographic and electronic[3]. However, despite the many disadvantages of radiographs, including the fact that the radiographic film provides a two-dimensional image of a three-dimensional object, it can interfere with the interpretation of images and thus generate faulty odontometry. However, its use by authors to obtain

CRT is still highly relevant[9]. Therefore, the use of electronic foraminal locators is being widespread because they are instruments that bring greater confidence to the technique[10].

However, regardless of which technique is adopted to determine the CRT, the endodontic millimeter ruler is the main tool to be used, because it is through this instrument that the transfer of measurements to the endodontic instrument, measurement of the irrigation needle insertion and determination of length of absorbent paper cones and gutta-percha occurs[11].

For this reason, it is essential that these rulers show quality in their measurements. For this reason, it was necessary to evaluate accuracy and precision, which are terms with different meanings. Accuracy refers to the proximity of the measurement to its target value or gold standard, on the other hand, precision refers to the dispersion of the measurement when repeated under the same conditions, therefore, the objective of precision is to evaluate how constant the measures of the same group are, disregarding the preestablished measure[12].

Therefore, with regard to the precision and standardization of millimetre endodontic rulers, the study by Dadalti et al.[13] evaluated five endodontic rulers of different brands that were used to measure working length. The analysis was carried out using a digital electronic caliper. Only one brand was accurate out of all the rulers analyzed, indicating that there is a lack of standardization between them. They also highlighted the need for quality control and standardization in the manufacture of endodontic rulers.

Macedo et al.[11] also executed a study with the objective of evaluating the standardization and precision of three endodontic rulers from different brands. In the study, 30 endodontic rulers were evaluated and divided equally into 3 groups, according to the brand of each one. Both were analyzed using a digital electronic caliper in addition to the aid of an optical microscope with 10x magnification. Using points from 15 mm to 30 mm as references. Thus, after statistical analysis using the student t test ($p< 0.05$), it was concluded that there was no standardization between the brands evaluated, showing inaccuracy in their established lengths.Victorino et al.[14], similarly to the previous ones, also carried out a work with the objective of estimating the precision of the Brazilian market of endodontic millimeter rulers. As a methodology, four groups of rulers were used, containing 10 of each. The measurement of 20 mm of each instrument in question was verified by an electronic digital caliper and the results were statistically tested using Analysis of Variance (ANOVA) followed by the Tukey test with $p < 0.05$. Results showed that the average measurements of the rulers are not exact and there was no significant difference among the analyzed brands.

A study performed by Lins et al.[3] similarly aimed to evaluate the accuracy and precision of millimeter rulers commercialized in Brazil and used during endodontic procedures, as well as to evaluate the use and preference of this instrument by professionals in the area. First, specialists and postgraduate students in endodontics were consulted regarding the use and brand preference of the ruler. After that, 100 rulers were selected and divided into 10 groups with equal amounts of instrument, taking into account the manufacturer and type of material used. In each ruler, the measurement of 30 mm was measured using an electronic digital caliper, with the accuracy analyzed by comparing the rulers with a gold standard ruler from the Metrology laboratory – MEC-Q/BA. Regarding precision, the results were compared with the units of each group. Results obtained showed that, through a questionnaire, a little more than 19% of respondents were unable to answer which brand they prefer and about 23% reported that they used more than one type of ruler brand during the same endodontic treatment. It was concluded that, as well as the other works, rulers of different brands are neither precise nor exact, and the professional must use the same instrument throughout the therapy.

More recently, Yücel et al.[15] investigated the precision of endometrial scale and calibration holes of two endodontic rulers, one of which was manufactured in Turkey where the study was carried out, *Resident (Kibar Dental, Istanbul, Turkey)*, and another of international manufacture, *Mini- Endo-Bloc (Dentsply-Maillefer, Ballaigues, Switzerland)*. With an electronic caliper with precision of 0.01 mm, the millimeter lines of the rulers were measured directly through the nozzle of the measuring instrument; the depth of the holes was measured with the aid of a K-file, size 40. The digital display of the caliper was covered until the measurement was completed so that the evaluator was not biased. Each measurement was repeated five times by the same researcher and at the end a statistical analysis was performed. Results showed the precision of the ruler and the calibration holes of the national manufacturer is outside the specification limits for some values, whereas the one of international manufacture is completely within the specification limits.

In the post-test of the present study, groups 1 and 2 of the rulers differ from each other and from all other groups, as both had p-values lower than 0.05. The average of groups 3, 4 and 5 showed no significant difference among them. Thus, group 1 ruler, which corresponds to the Maquira brand, obtained an average of 29 mm, which means that if a treatment starts with this ruler, it cannot be replaced by any ruler of the other groups, as it has a significant difference. The rulers of group 2, Angelus, despite having an average of 29.78 mm, also present a significant difference with the other brands evaluated. So, as with the rulers of group 1, if the endodontic treatment is

started with the Angelus ruler, it will also have to be finished with it. On the other hand, groups 3, 4 and 5, which correspond, respectively, to the rulers of the brands KG Sorensen, Preven and unbranded, which have an average close to 30 mm, did not obtain a significant difference among them. Consequently, if odontometry is started with the KG Sorensen ruler, rulers from groups 4 and/or 5 can be used during the rest of the treatment, and vice versa. However, although the rules of these groups do not have a significant difference between them, this does not mean they are exact.

To assess the accuracy, the average and average error of each group were compared with the preestablished value. Therefore, the smaller the value of the average error, the greater the accuracy of the group, as this means the average is closer to the target value. Furthermore, there is no accuracy among brands analyzed in the present study, corroborating the studies by Dadalti et al.[13], Macêdo et al.[11], Victorino et al.[14] and Lins et al.[3]. In spite of that, the most accurate group of rulers, for presenting the average closest to the pre-established value and the lowest average error value (0.01 mm), is from the Preven brand, group 4. In the research by Yücel et al.[15], one of the brands evaluated (Dentsply-Maillefer, Ballaigues, Switzerland) presented the quality standards required in the measurement of the research, however the authors suggest that more studies are carried out with this brand, since the sample consisted of only three rulers of that brand.

The most inaccurate group of rulers in the current study was the Maquira brand, group 1 (average error of 0.97 mm), in agreement with the study by Lins et al.[3]. In both works, the Maquira ruler, produced by polymeric material, presented the average with the lowest proximity to the predetermined standard value and with the highest average error.

For Lins et al.[3] the correct nomenclature to designate the evaluation of the measurements of the rulers with the target value is "accuracy" and not the term "standardization", thus considered, by these authors, the inappropriate use in the studies by Dadalti et al.[13], Macêdo et al.[11] and Victorino et al.[14].

Regarding the precision of the rulers, we took into account the standard deviation. In this way, the smaller the value of the standard deviation, the smaller the variation and the more precise the measurement of a given group. Although all the rulers proved to be imprecise, group 5 presented the highest standard deviation value, which means that the measurements of the rulers of this group were the ones that showed the greatest variation. This can be explained by the fact that the group was formed by rulers that had no identification of any brand, although, regardless of the brand, this imprecision should not exist. The Angelus brand, on the other hand, had the lowest standard

deviation, making it the most precise ruler. The study by Victorino et al.[15] confirms the same result, since Angelus had a standard deviation of 0.07469, obtaining the lowest value when compared to the other brands analyzed, Jon, Microdont and Ice.

Lins et al.[3] also consider incorrect the term “precision” used in the studies by Alencar et al.[6], Dadalti et al.[13], Macêdo et al.[11] and Victorino et al.[14], because this nomenclature gives, in the studies, the sense of accuracy.

Studies by Lins et al.[3], Macêdo et al.[11] and Victorino et al.[14] concluded and warned that, because the rulers do not present accurate and precise measurements, it is necessary the professional performs the entire treatment with the same endodontic ruler.

Regarding the material used to make the rulers, it was observed that rulers that showed greater accuracy were those produced with metallic material (groups 3 and 4). The most precise were formed by groups 1 and 2, consisting of polymers. But, in the work by Lins et al.[3], the authors state that the type of material does not interfere with accuracy or precision, because just as the most accurate and precise rulers were made of polymer, the ruler that presented the lowest accuracy and precision was also made of this material.

Another aspect of this is that the measurement, even being carried out by the same evaluator, is susceptible to the most diverse difficulties, as it is a relative act and, therefore, subject to human error. Consequently, it is valid to resort to techniques considered more reliable, such as the electronic apex locator during odontometry [4,16] in order to overcome the millimeter failures of different brands of endodontic rulers.

Therefore, it is worth remembering that the work area of an endodontist is restricted to the dentinal canal, and the objective of odontometry is to measure this region. On the other hand, the portion of the cemental canal is understood only as the patency area, being also the safety region. According to Lopes and Siqueira [2], the length of the cement canal varies from 0.5 mm to 1.5 mm. For this reason, these values show that endodontic millimeter rulers with inaccuracy of up to 0.5 mm are within the limits of the canal. Thus, analyzing the data from this research, the only ruler that did not have a measure within the limits considered acceptable is from the Maquira brand. From a clinical point of view, the Maquira ruler, which has an average of 29 mm, presented a variation of 1 mm, meaning that in an endodontic treatment that makes use of this ruler, under-instrumentation can occur, since the ruler does not follow the given measure.

Nevertheless, some limitations were found to carry out the study, such as the acquisition of rulers due to the fact that at the time the research was carried out we were facing a health crisis, with the advent of the COVID-19

pandemic. In addition, the bibliographic collection available in the literature about the subject of this study is still scarce, requiring further exploration with larger samples so that the results can be compared and studied by students, researchers and by endodontic ruler manufacturers.

Conclusions

Even with some groups not showing significant variations among themselves, the accuracy and precision of all groups of endodontic millimeter rulers presented flaws. Thus, it is important the professional maintains the use of the same ruler throughout the course of endodontic treatment, in order to avoid errors during treatment. It is also necessary to record in the medical record of the patient at least the brand used in primary therapy, so that in future interventions, such as in cases of retreatment needs or placement of intraradicular posts, professionals use the same brand. In addition, it is important to use the apex locator so as to reduce chances of failure in the face of different measurements of endodontic rulers. Therefore, it is also up to the rulers manufacturers to make adjustments so that the lack of accuracy and precision in these instruments does not compromise the success of endodontic treatment.

Resumo

Introdução: Odontometria é a etapa do tratamento endodôntico que determina o limite de trabalho do endodontista. No entanto, independe de qual método for utilizado, a régua endodôntica milimetrada é instrumento fundamental. Através dela a transferência do comprimento de trabalho é repassada para os demais instrumentais evitando possíveis erros de mensuração. Objetivo: Avaliar a exatidão e precisão nas medições das réguas endodônticas milimetradas de diferentes marcas comerciais para odontometria, a fim de analisar a sua confiabilidade na realização de tratamentos. Materiais e métodos: Foram agrupadas 50 réguas pertencentes a cinco marcas: Maquira, Angelus, KG Sorensen, Preven e sem marca, cada grupo com 10 amostras. A medida de 30 mm foi pré-estabelecida como valor alvo a ser encontrado em todas as réguas quando foram submetidas à análise de medição através do paquímetro digital. Resultados: As marcas avaliadas neste estudo se apresentaram inexatas e imprecisas. Conclusão: Dessa maneira, é importante que o profissional mantenha durante todo o percurso do tratamento endodôntico a utilização da mesma régua, a fim de evitar erros na transferência de medidas para instrumentais e, em consequência disso, comprometa o sucesso do tratamento.

Palavras-chave: Instrumentos Odontológicos; Endodontia; Odontometria.

References

1. Maachar DF, Silva PG, Barros RMG, Pereira KFS. Avaliação da precisão do localizador apical Novapex: estudo in vitro. Rev. Odontol. Unesp 2008; 1: 41-46.

2. Lopes HP, Siqueira JF. Endodontia: Biologia e Técnica. 5 ed. Rio de Janeiro: Elsevier; 2020..

3.Lins PR, Menezes LVP, Araújo RPC, Silva SJA, Mendes CMC. Exatidão e precisão das réguas milimetradas utilizadas durante procedimentos endodônticos. Rev Ciênc Biol 2015.

4. Santos JF, Silva PAA. Confiabilidade odontométrica dos localizadores foraminais na terapia endodôntica. Revisão de literature. Rev Uningá 2018; 55:81-100.

5. Miranda LH, Dantas WCF, Mattar C. Técnicas avançadas de obturação endodôntica. Rev FAIPE 2017; 3: 46-60.

6. Oliveira MVL, Balbino CM, Souza MMT, Silvino ZR, Passos JP. Perfil, demanda de atendimento das intercorrências odontológicas e de retratação endodôntica. Revista Pró-UniverSUS; 2016; 7: 03-09

7. Kojima K, Inamoto K, Nagamatsu K, et al. Success rate of endodontic treatment of teeth with vital and nonvital pulps: a meta-analysis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2004; 97:95 –9.

8. Peres AVS, Decurcio DA, Silva JAS, Morais ALG, Alencar AHG. Discrepância entre método convencional de odontometria com referência padrão. Rev Odontol Bras Central; 2010; 19:168-171.

9. Paiva HC, Borelli AL, Almeida MO, Sá DP, Akisue E, Santos RLO. Odontometria eletrônica em dentes decíduos: revisão de literatura e relato de caso. Rev da Faculdade de Odontologia de Porto Alegre. 2022; 63(1), 98-105.

10. Bolam M, Costa FLM, Barasuol JC, Felippe GS, Felippe MCS, Felippe WT. Estudo comparativo de três localizadores apicais eletrônicos na determinação do comprimento de trabalho. Dental Press Endod. 2018; 8:42-46.

11. Macêdo DT, Sousa IMMA, Lima LR, Falcão CAM, Feitosa GT. Padronização e exatidão de réguas endodônticas milimetradas. Research, Society and Development, 2023; *12*(5).

12. Lima Júnior P, Silva MTX, Silveira FL, Veit EA. Laboratório de mecânica: subsídios para o Ensino de física experimental. Porto Alegre: UFRGS, Instituto de Física; 2015, 3-4 p.

13. Dadalti MTDSA, Dias BDM, Bruno AMV, Riso PDA. Precisão de réguas endodônticas milimetradas e orifício calibrador, e avaliação da regularidade da superfície do orifício calibrador. *Dent. press endod*. 2021; 40-45.

14. Victorino FR, Lustosa-Pereira A, Bernardineli N, Garcia RB, Moraes IG, Bramante CM. Analysis of accuracy of endodontic milimeter rulers of different commercial brands. Rev Gaúch Odontol. 2012; 60:305-308.

15. Yücel O, Saricam E, Altunkaynak B, Kayaoglu G. İki farklı endodontik cetvelin (endoblok) cetvel ve kalibrasyon deliklerinin ölçüm doğruluklarının incelenmesi. Acta Odontologica Turcica 2020; 37:84-90.

16. Gonçalves MCW, Fontana CE, Stringheta CP, Bueno CES, Rocha DGP, Pinheiro SL, Pelegrini RA, Chiesa WMM, De Martin AS, Kato AS. Avaliação da acurácia de quatro localizadores apicais durante o retratamento endodôntico. Rev Assoc Paul Cir Dent. 2017; 71:36-40.

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