

The radiographic images demonstrated low radiopacity of MTA Fillapex, which impaired the visualization of filling of fabricated accessory canals, as observed in the study of Vidotto¹⁰ who compared the radiopacity of MTA Fillapex and other 3 sealers (Sealer 26, Sealapex, AH Plus), in which AH Plus was statistically more radiopaque than MTA Fillapex.

In addition to the aforementioned characteristics, the consistency of MTA Fillapex was considered very fluid, which represented a difficulty for the lateral condensation procedure, since maintenance of the sealer adhered to the gutta-percha points until insertion in the root canal was ineffective, with con-

stant loosening of material from their surfaces, even when coated with small portions of sealer, different than observed for the sealer AH Plus, which exhibited a more viscous consistency, thus allowing easier coating of the gutta-percha point and facilitating its insertion inside the root canal.

Conclusion

Considering the methodology employed and the results achieved, it was concluded that teeth obturated with sealer AH Plus presented better sealing at all thirds analyzed compared to teeth obturated with sealer MTA Fillapex.

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Correlation of the diameters and tapers of reciprocating instruments with gutta-percha points for single-cone root canal filling

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ABSTRACT

Objective: The aim of this study was to characterize the dimensions of the Reciproc R25 and X1 Blue File instruments and the gutta-percha points of Mk Life R25, Reciproc R25 and DiaDent R25 to verify which gutta-percha point better fits to the instruments preparation. **Material and methods:** Ten Reciproc R25 25/0.08v and X1Blue File 25/0.06 instruments; and ten DiaDent R25, Mk Life R25 and Reciproc R25 gutta-percha points were used. The images were obtained through a stereomicroscopic with a digital camera coupled. The measurements were obtained through the TS View program. The diameters of instruments and gutta-percha points were determined in D0 through D9 at 1.0 mm intervals, and the taper was calculated by adopting diameters D8 and D1. The results were submitted to statistical analysis using the program

Primer of biostatistics version 6.0. **Results:** Despite the greater taper of the X1Blue file instruments (0.07mm / mm), there was no statistically significant difference between the instruments in the first 3 millimeters ($p > 0.05$), the same was observed for the tapers of the gutta-percha points ($p > 0.05$). The gutta-percha points presented a statistically significant difference in all measured diameters ($p < 0.05$). **Conclusion:** Gutta-percha points and instruments have met the recommendations of their respective ANSI/ADA standards. The gutta-percha point that presented greater dimensional compatibility with the diameters of the instruments was the MK life, and VDW presented the greatest mismatch.

Keywords: Dental Instruments. Gutta-Percha points. Root Canal Obturation. Root Canal Filling Materials.

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Introduction

In an endodontic treatment, all steps are of great importance and must be properly performed for treatment success. One of them is the root canal preparation. In the past, it was executed with stainless steel hand instruments, but these instruments had little flexibility, which provided a great tendency to cause defects such as zips, steps and perforations. The success of endodontic treatment of curved root canal depended on operator experience and ability. In 1988 with the advent of the NiTi alloy the mechanical chemical preparation of canals with sharp curvatures became a less laborious and risky task.

In recent years, a great evolution occurred in endodontic instruments manufacturing. The reciprocating kinematics had a great impact on the modeling of root canals, making preparation more predictable and safer. This is one of the greatest advantages of using this new kinematics. Other advantages such as the concept of “single file” with consequent shorter preparation time and also the lower extrusion of debris in the apical third was observed.¹

One of the most used and studied instrument is the Reciproc R25 (VDW, Munich, Germany) mainly to its safety and clinical efficiency.² The Reciproc system has gutta-percha point (GP) manufactured to allow single-cone root canal filling. Companies are investing in this market and have launched different nickel-titanium (NiTi) systems, with different alloy heat treatments, with better mechanical properties. One of these systems is the X1 Blue File (Mk Life, Porto Alegre, Brazil), which presents a thermal treatment. Such as Reciproc R25, this system also provides matching for root canal filling.

The new NiTi systems allows single-cone root filling, which gives the practitioners a simpler and more practical technique. One of the disadvantages of this technique is that if the cone does not adequately fill the space prepared by the instrument, the filling can fail. Several brands of gutta-percha points are available for root canals filling prepared with this technique. Some examples are Reciproc R25 (VDW, Munich, Germany), MK R25 (Mk Life, Porto Alegre, Brazil) and Dia-Pro R A (Sunngam, Kyonggi-Do, Korea).

The verification of the diameters of the instruments and their adequacy to the standards have great importance, since the reliability of the instruments

diameters has an impact on their properties.³ Up to date, there are no studies reporting the correlation of Reciproc R25 and X1 Blue File diameters with commercially available gutta-percha points. The aim of the present study was to verify if the instruments (Reciproc R25 and X1 Blue File) and gutta-percha points meet the requirements of the standards, and determine which cone brand fits better in both instruments preparation. The tested hypotheses were: (1) the instruments and GP tested are in agreement with the ANSI / ADA 101 and ANSI / ADA 78 recommendations respectively. (2) The diameters of GP and instruments of the same company were more compatible.

Material and methods

Instruments and GP used

Ten Reciproc R25 25 / 0.08v (VDW, Munich, Germany) and ten X1Blue File 25 / 0.06 (Mk Life, Porto Alegre, Rio Grande do Sul, Brazil) were used, according to item 6.3 of ANSI / ADA No. 101. Also, ten Dia-Pro R A (Sunngam, Kyonggi-Do, Korea), ten Reciproc R25 (VDW, Munich, Germany), and ten MK life R25 (Mk Life, Porto Alegre, Brazil) GP were used. The stereomicroscopy performed according to the item 6.2.1 of ANSI / ADA number 78, and the real diameters of the gutta-percha points were determined.

Micromorphometry

The images of gutta-percha points and reciprocating instruments were obtained with the Opticam stereomicroscope attached to a digital camera. The measurements were made with TSView 7.2.1.7 software from these images (Fig. 1). The diameters of the instruments and the GP were determined in D0 through D9 with measurement intervals of 1.0 mm. The diameter at D0 was measured at 0.2 mm from the point of the tip. The taper was calculated according to item 6.3.3.2 of ANSI / ADA No. 101, adopting the diameters D3 and D0 to do it. This item establishes that the difference of two diameters be divided by their distance. Thus, the taper was calculated by the formula: $C = (D3 - D0) / 3$.

As required by the standard, the measurements were performed in a stereomicroscope with precision scale of 0.25 mm. A procedure was adopted to carry out the measurements following the recommen-

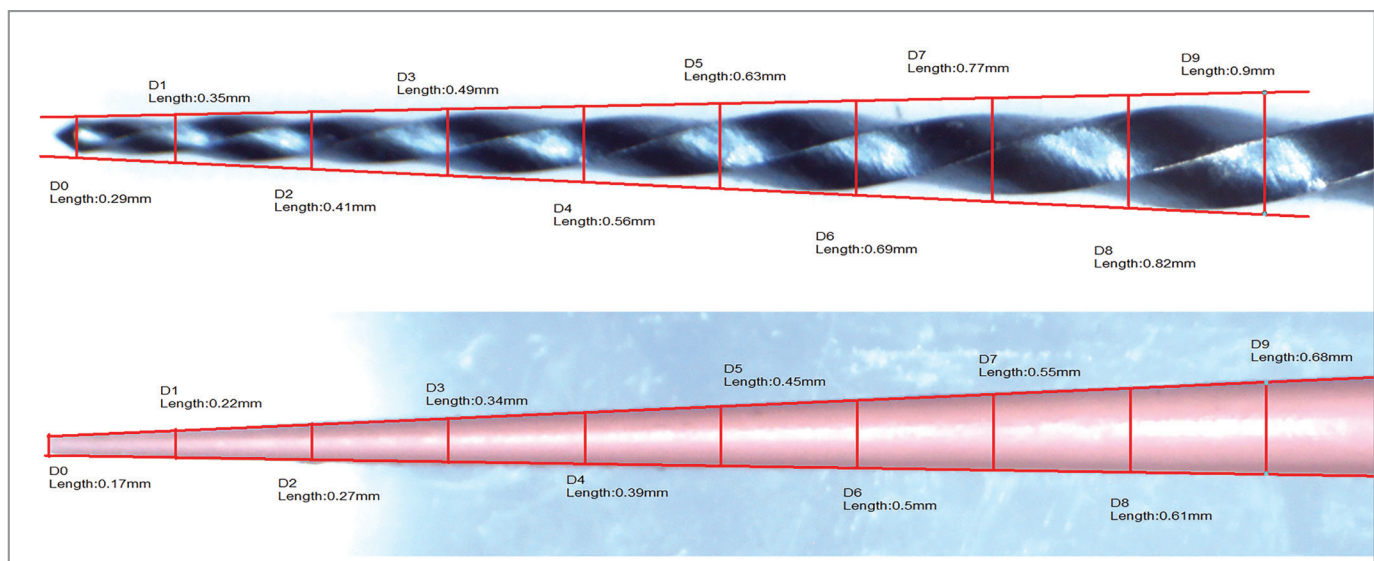


Figure 1. Methodology used to measure the diameters of instruments and gutta-percha points studied.

dations of item 6.2.4 of the standard which states that: “If all 10 points meet the standard, the product is approved.” If eight points or less passed the test, the product failed. Nine points have passed; five additional points must be tested, where these 5 extra points must meet the standard for the material to be approved in the test.”

Statistical analysis

The statistical analysis was made using the program Primer of biostatistics 6.0. The comparisons of the values of the actual diameters and tapers of the instruments were performed through t-student tests. The comparisons between gutta-percha points and gutta-percha points with the instruments were performed through the ANOVA test complemented by Student-Newman-Keuls post-hoc test when necessary. All the tests adopted a level of significance (α) of 5%.

Results

The values of the measured diameters and the

instruments taper are shown in Table 1. The comparison of these diameters was made through the t-student test. Up to the diameter D3 the X1 Blue file and R25 instruments did not present a statistical difference. The taper of the X1Blue file instruments was higher in the initial three millimeters (0.07 mm/mm) compared to the Reciproc instruments (0.06 mm/mm), but there was no statistically significant difference between them ($p < 0.05$).

The values of the measured diameters and the taper of the gutta-percha points are shown in Table 2. The results of the GP were submitted to the ANOVA, supplemented by the Student-Newman-Keuls test, and it was verified that there is difference statistic in all diameters found ($p < 0.05$). Regarding the taper, there was no significant difference between the GP of the MK-Life and Diadent systems ($p > 0.05$).

The curve of the measured diameters x distance to the tip of the instrument/GP (Fig. 2) was plotted to visualize and facilitate the perception of the mismatch between GP and space that the instruments would prepare inside the root canal.

Table 1. Mean and respective standard deviations of the diameters of the X1-Blue File and Reciproc instruments and their respective tapers. The measured diameters marked with asterisks presented a statistically significant difference.

INSTR	D0	D1	D2	D3	D4*	D5*	D6*	D7*	D8*	CON
X1	0.28	0.35	0.41	0.48	0.55	0.61	0.68	0.74	0.8	0.06
	±0.03	±0.03	±0.02	±0.02	±0.02	±0.02	±0.03	±0.03	±0.03	±0.0005
R25	0.28	0.34	0.4	0.47	0.53	0.59	0.66	0.72	0.79	0.06
	±0.02	±0.02	±0.01	±0.01	±0.01	±0.01	±0.02	±0.02	±0.03	±0.0001

Table 2. Means and respective standard deviations of the gutta-percha points diameter of the Reciproc, MK-Life and Diadent systems and their respective tapers. The groups marked with asterisks did not present a statistically significant difference.

GUTA	D0	D1	D2	D3	D4	D5	D6	D7	D8	CON
RECIPROC	0.18	0.23	0.28	0.34	0.4	0.47	0.51	0.57	0.63	0.06
	±0.02	±0.02	±0.02	±0.02	±0.02	±0.02	±0.02	±0.02	±0.02	±0.003
MK-LIFE	0.23	0.29	0.36	0.42	0.49	0.55	0.62	0.7	0.76	0.07*
	±0.02	±0.01	±0.01	±0.01	±0.01	±0.02	±0.02	±0.02	±0.02	±0.004
DIADENT	0.2	0.26	0.33	0.4	0.46	0.53	0.6	0.67	0.73	0.07*
	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01	±0.001

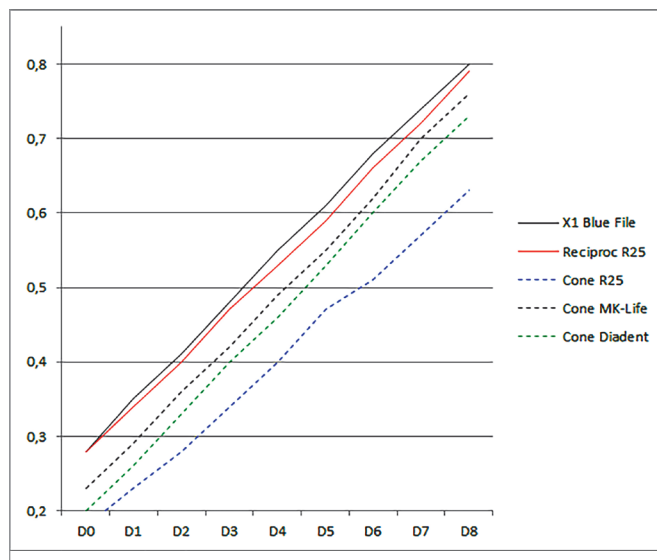


Figure 2. Curves of the measured diameters x position in relation to the tip of the instruments/gutta-percha points. It is possible to observe the degree of correspondence of the GP in relation to the studied instruments.

Discussion

One of the first studies that verified the diameters of gutta-percha points used as a methodology the profile projection.⁴ Current studies have used the digital pachymeter to measure diameters,^{5,6,7} however, this method can lead to error by the plastic deformation of the gutta-percha points or measurements within the helical channel of the instruments. Besides

that, these measurements under naked eye can generate results of low reliability. This study used a stereomicroscope with an integrated camera for image capture and the diameters obtained through software to minimize these methodological errors. A methodological alternative would be the use of stereomicroscopy.^{8,9}

All steps of endodontic treatment are important to the success. The instrumentation and filling are steps that complement each other. These steps must be carried out with the correct technique and with suitable materials, in order to obtain a good quality of the treatment. The current NiTi instrument systems have gutta-percha points compatible with the last instrument used, thus facilitating the root canal filling. In relation to X1 Blue file and Reciproc R25 instruments, there are several brands of gutta-percha points available in the market and no study has investigated the dimensional correlation of these instruments as the corresponding gutta-percha points sold (the three gutta-percha brands studied).

Regarding the diameter of the studied instruments, both comply with the recommendation of ANSI/ADA number 101. In general, both taper was 0.06mm/mm, but the Reciproc R25 instrument had varied taper and in its first 3mm, it had a taper of 0,06 (different from the nominal 0,08mm/mm). Until the