

Evaluation of the tip of standardized D_0 gutta percha cones of four Rotary systems, by means of an endodontic ruler

Avaliação da adaptação de cones estandardizados de gutta-percha de quatro sistemas mecanizados por meio de uma régua endodôntica calibradora

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ABSTRACT

Objective

This study aimed to evaluate the D_0 diameter of standardized gutta-percha cones for four mechanized systems: ProTaper Universal®, Mtwo®, Wave One® and Reciproc®.

Methods

An endodontic calibrator ruler was used to measure the D_0 diameter of 60 main cones of the above systems. Measurements were made according 3 scores as follows: gutta-percha cone fits exactly into the same hole as the endodontic ruler gauge (score 1), cone falls short of the ruler gauge whole size (score 2); or exceeding the ruler gauge hole size (score 3). The diameters D_0 obtained were compared with the values reported by manufacturers. All data were analyzed by means of T Test, at 1% level of significance.

Results

The average value measured was significantly higher than the measures established by manufacturers ($p < 0.001$).

Conclusion

The gutta-percha cones of ProTaper Universal® systems Mtwo®, Wave One® and Reciproc® were not standardized, except for R40 cone of the Reciproc® system (Reciproc®). The trend was for variation in the D_0 Diameter towards increasing measurement values.

Indexing terms: Dimensional measurement accuracy. Endodontics. Gutta-percha. Root canal obturation.

RESUMO

Objetivo

Avaliar o diâmetro D_0 de cones estandardizados de gutta-percha de quatro sistemas mecanizados: ProTaper Universal®, Mtwo®, Wave One® e Reciproc®.

Métodos

Por meio de uma régua endodôntica calibradora, foi aferido o diâmetro D_0 de sessenta cones principais dos sistemas supracitados. A aferição foi realizada de acordo com os três escores a seguir: o cone de gutta-percha se adapta exatamente no mesmo calibre de orifício da régua endodôntica (escore 1), o cone fica aquém ao calibre de orifício da régua (escore 2) ou além do respectivo calibre do orifício da régua (escore 3). Os diâmetros em D_0 obtidos foram comparados aos valores divulgados pelos fabricantes. Todos os dados foram tratados por meio do Teste T, ao nível de significância de 1%.

Resultados

As médias aferidas foram significativamente maiores do que as medidas estabelecidas pelos fabricantes ($p < 0,001$). Somente os cones R40 do sistema Reciproc® estiveram no padrão.

Conclusão

Os cones de gutta-percha dos sistemas ProTaper Universal®, Mtwo®, Wave One® e Reciproc® não apresentam padronização, à exceção do cone R40 (Reciproc®). Houve uma tendência de variação do diâmetro D_0 para uma maior medida.

Termos de indexação: Precisão da medição dimensional. Endodontia. Guta-percha. Obtenção do Canal Radicular.

INTRODUCTION

One of the factors related to successful endodontic treatment is hermetic sealing of the root

canal, performed during the filling stage¹. The correct choice of the main gutta percha cone is essential to obtain a close fit to the dentin walls and interlocking it at the working length. Correct adaptation of the gutta

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percha cone to the apical region is fundamentally known to depend on perfect coincidence of its D_0 diameter with that of the instrument used for apical preparation².

Diverse studies analyzing the diameter and morphology of gutta percha cones have warned about the lack of standardization in the manufacturing process³⁻⁶. This reality harms the objectives of standardizing materials, and consequently, makes clinical practice difficult.

Due to the difficulties with handling gutta percha, it is believed that there is practically no uniformity of their calibers. For example, according to Mayne et al.⁷ and Goldberg et al.⁸, among the contents of a box of N°40 gutta percha cones, variations in their diameter range from Number 35 to 45, demonstrating imprecision in the entire sample analyzed.

Parallel to this condition, new materials used for root canal filling have appeared, bearing in mind the evolution of various mechanized root preparation systems. Filling techniques with a single cone have been recommended⁹⁻¹⁰. Therefore, the rotary system and its respective gutta percha cone must be carefully measured.

This being the case, the aim of this study was to use an endodontic calibration ruler to evaluate the fit in D_0 of the gutta percha cones of the ProTaper Universal®, Mtwo®, WaveOne® and Reciproc® systems.

METHODS

In total, 60 gutta percha cones of the following systems were used: Protaper Universal® - F1, F2 and F3 (Dentsply/Maillefer Instruments S.A., Ballaigues, Switzerland), Mtwo® - 25.06, 30.05, 35.04, 40.04 and 25.07 (VDW® Endodontic Synergy, Munich, Germany), Wave One® - Small, Primary and Large (Dentsply/Maillefer Instruments S.A., Ballaigues, Switzerland) and Reciproc® - R25, R40 and R50 (VDW® Endodontic Synergy, Munich, Germany). To detect a difference in the means of the measurements observed in the groups, attaining a statistical power of 90%, and a 1% level of significance, the need for 60 gutta percha cones for each of the systems was calculated. The boxes of cones of each of the systems belonged to the same manufacturing lot.

To verify the fit of the cones in D_0 , an endodontic calibrating ruler (Dentsply/Maillefer Instruments S.A., Ballaigues, Switzerland) was used. The diameter of the holes in the ruler were previously measured and considered correctly calibrated, by mean of *Image Tool*® software.

Three distinct situations were taken into consideration during verification of adaptation of the cones. In the first situation, the gutta percha cone fitted exactly into the same caliber hole as that of the endodontic ruler, generating score 1 (Figure 1).

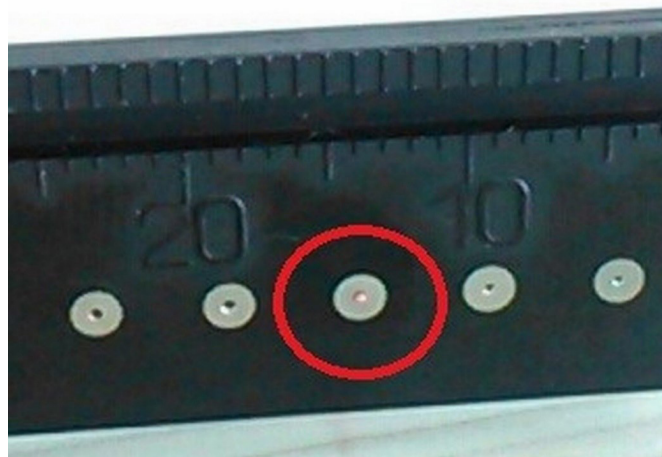


Figure 1. D_0 of gutta-percha cone fitted into hole of the Maillefer® endodontic calibrating ruler.

In the second situation, the gutta percha cone was smaller than the hole of the calibrating rule, and was tested in the previous hole in the sequence. This act was repeated until the cone fitted perfectly, thereby generating Score 2.

Whereas, in the third situation, the gutta percha cone exceeded the size of the hole of the calibrating rule, and was tested in the subsequent hole in the sequence. This act was repeated until the cone fitted perfectly, thereby generating Score 3 (Figure 2).

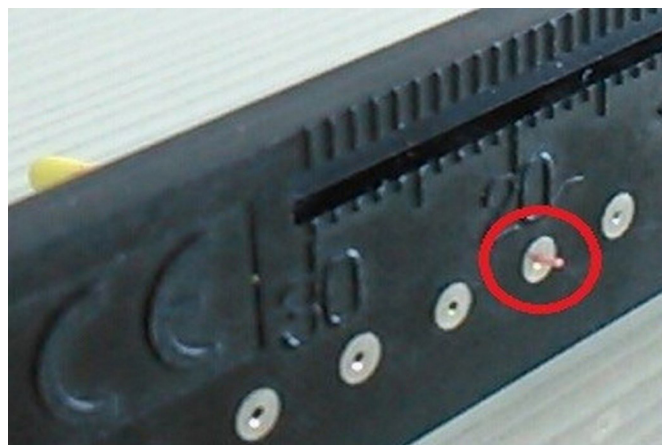


Figure 2. D_0 of gutta-percha cone exceeding the hole diameter equivalent of the Maillefer® endodontic calibrating ruler.

A single, previously trained operator verified the fit of the gutta percha cones with the aid of a magnifying glass providing 4x magnification (Bio-Art Equipamentos Odontológicos Ltda., São Carlos, São Paulo, Brazil).

The data obtained in analysis of the cones were statistically treated by means of the paired T test at a 1% level of significance. For analysis the program SPSS version 22.0 (SPSS Inc, Chicago, IL) was used.

RESULTS

Table 1 presents the results obtained for the gutta percha cones in relation to the endodontic calibrating ruler.

Table 1. Table with means and standard deviations relative to cross-matching the sizes of the gutta percha cones with the holes of the endodontic calibrating ruler.

Cone of system	Reference instrument	D ₀ Diameter of Instrument	Mean D ₀ cone	Standard deviation	p
Protaper Universal®	F1	20.00	34.00	2.03	<0.001
	F2	25.00	35.25	1.10	<0.001
	F3	30.00	40.00	0.00	-
Mtwo®	25.06	25.00	32.63	2.53	<0.001
	30.05	30.00	35.25	1.12	<0.001
	35.04	35.00	38.75	2.22	<0.001
	40.04	40.00	46.75	3.35	<0.001
	25.07	25.00	29.50	1.54	<0.001
WaveOne	Primary	25.00	34.25	4.61	<0.001
	Small	21.00	30.13	0.79	<0.001
	Large	30.00	44.63	3.28	<0.001
Reciproc®	R25	25.00	28.58	2.27	<0.001
	R40	40.00	40.00	0.00	-
	R50	50.00	55.00	0.00	-

The means shown in Table 1 denoted values significantly higher than those of the measurements established by the manufacturers (p<0.001). Only cones R40 of the Reciproc® system maintained the standard.

DISCUSSION

The lack of uniformity and standardization of gutta percha cones are fundamental factors for perfect root canal system sealing¹¹⁻¹³.

The choice of analyzing position D₀ of the gutta percha cones was because this is a critical region, responsible for its fit into the apical limit of the prepared root canal. The mistaken choice of gutta percha cone, such as for example, when it exceeds the limit of the working length established

by odontometry, may frequently lead to endodontic treatment failure.

The authors opted to verify the fit of gutta percha cones by means of an endodontic calibrating ruler (Gutta Percha Gauge), because it is a resource the orthodontist frequently uses to verify or correct the diameter of cones during clinical attendance, because it is a method that is easy to handle and to acquire.

Although the literature reports other resources for checking the diameter of gutta percha cones, such as the use of a microscope or profilometer, the use of the calibrating ruler when compared with other previously mentioned methodologies, has shown similar results^{3,8,14-15}.

During analysis of the results, the authors found that the majority of gutta percha cones, whether with reference to continuous rotary or reciprocating instruments, did not follow any standardization relative to their diameter at D₀.

Specification No. 28 of the ADA has admitted that there is a discrepancy of up to 0.02 mm between the standard measurements. This tolerance is perfectly understandable when considering the complexity involved in manufacturing such delicate products. However, when dealing with a plastic material with a multiplicity of compositions, we need to question whether the gutta percha could undergo dimensional changes derived from factors such as, for example, storage conditions and ambient temperature from the time of their measurement up to their acquisition.

The data obtained in the study of Capar et al.¹⁹ are in agreement with those presented in our study. The authors also verified various degrees of imprecision in the gutta-percha cones of the *Protaper Next*®, *Twisted File Adaptive*®, *OneShape*®, *Protaper Universal*®, *WaveOne*® and *Reciproc*® systems.

According to some authors, this imprecision in the D₀ diameter of the cones reinforces the importance of using thermoplasticized gutta-percha techniques, with the purpose of correcting defects or faults that may arise during the stage of performing root canal filling¹⁶⁻¹⁸.

In view of these findings, we must place great value on the clinical tactile sensitivity of the operator who checks locking of the main cone. The professional who imagines using the main cone adequately, as being related only to the final instrument, is a candidate for leaving empty spaces or some filled only with endodontic cement in the apical region.

CONCLUSION

According to the results obtained, it was possible

to conclude that the gutta percha cones of the *ProTaper Universal*[®], *Mtwo*[®], *Wave One*[®] and *Reciproc*[®] systems showed no standardization, with the exception of cone R40 (*Reciproc*[®]). The trend was for variation in the D₀ Diameter towards increasing measurement values.

Collaborators

JPT BUENO, This article is part of your Course

Completion Work. Participated in all stages of the work. TAF MELO, is a endodontics teacher. Coauthor of work. Helped and participated in the accomplishment of all the experimental stages of the work. Participated in the review of the written part of the article. GG KUNERT, He was coauthor and ad-viser of the students in the development and preparation of the Course Completion Work. Participated in the orientation, execution of the experiment and the writing of the article.

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