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Maintenance Evaluation of the Original Anatomy of the Root Canal Diameters Instrumented with Mtwo and BioRace Systems

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ABSTRACT

Objective: *The aim of the present study was to evaluate maintenance of the original anatomy of the root canal diameters instrumented with the Mtwo rotary instruments and BioRace file systems.*

Material and method: *Acrylic resin blocks with 160 simulated root canals with an angle curvature 15°-30° were taken into consideration in the present comparative study. The 160 simulated root canals were divided into two groups, each of them containing 80 acrylic resin blocks. Each group was divided into two subgroups (n=40 canals each). The simulated root canals subgroups were prepared with Mtwo and BioRace rotary nickel–titanium instruments. The results were scrutinized using analysis of variance (ANOVA)-test and Tukey's test. The significance level was set at P < 0.05.*

Results: *No significant difference was noted between the Mtwo rotary instruments and BioRace files as they both had equal value in the coronal section (P=.000) in S1 (D1) and S1 (Dpi). The results of Tukey's test revealed a significant difference between the Mtwo rotary instruments and BioRace files in middle and apical section with the value (P=.003) in S3 (Dpi) and S4 (Dpi). The results of Tukey's test found out a significant difference between the Mtwo rotary instruments and BioRace files in the middle and apical section with the respective values (P=.003) in S3 (Ai) and (P=.006) in S4 (Ai).*

Conclusion: *ccording to the findings of the present study, enlargement of the root canal diameters resulted to be better on the middle and apical section of the canal prepared with Mtwo instruments in comparison with BioRace instruments. Thus, Mtwo instruments will increase the rate of success of endodontic therapy.*

Keywords: BioRace, Mtwo, resin blocks, root canal diameters, rotary instruments.

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INTRODUCTION

Shaping of the root canal system is known as the most significant stage in root canal preparation. Canal shaping is an essential phase for endodontic treatment, especially in the curved canals. Preparing the root canal system is performed through removal of necrotic tissues from the root canal in order to prevent attack from microbiota within the tooth (1-3).

Mtwo rotary nickel-titanium instruments are suitable for preparing curved root canals (4). The basic set of Mtwo rotary files includes four instruments with variable tip sizes ranging from no. 10 to no. 25, tapers ranging from .04 to .06–.07 and two lengths: 21 and 25 mm. Moreover, file tips range in size from 30, 35, 40 and tapers of 0.5, 0.4 and 0.7 have a large usage (5). According to Bürklein *et al*., using the Mtwo instruments respects the root canal anatomy in the apical region (6).

Mtwo instruments are used in a single length technique without early coronal enlargement. The file will selectively remove the interferences and advance towards the apex without apical pressure, because of its lateral pressing movements, and the tooth will undergo a circumferential cut (7).

Rotary Mtwo system has a lower risk of instrument fracture and is able to shape symmetrically the root canal curvatures, because of the S-shaped cross-section which preserves the original shape of the root canal anatomy (8).

The specific design and flexibility of Mtwo instruments make them more effective and safer regarding the root canal anatomy (9).

The design of Mtwo instruments has two functions: the first one is to eliminate threading and binding in continuous rotation and the second one to reduce the transportation of debris towards the apex (10, 11).

BioRace instruments have an electropolished surface and a triangular alternating cross-sectional cutting, which reduces intraoperative torque values (12).

The physical characteristics of the BioRace system are similar to those of Race system. It was presented to the market and is different from the regular RaCe instruments in size, taper, sequence and shank codes. Changes in sequence of sizes and tapers have allowed the required apical sizes to be achieved with fewer instruments (13).

The basic BioRace set is used in root canals with common diameters and curvature. It comprises the following instruments: BR0 (#25.08), BR1 (#15.05), BR2 (#25.04), BR3 (#25.06), BR4 (#35.04), and BR5 (#40.04).

The special BioRace set is used to complement instrumentation and includes the following instruments: BR4C (#35.02) and BR5C (#40.02) for severely curved root canals, and BR6 (#50.04) and BR7 (#60.02) for large root canals (14, 15). Based on the root canal anatomy, the final apical instrumentation can be attained by making use of fewer instruments (16).

The objective of this study is to evaluate the efficiency of Mtwo rotary instruments and BioRace rotary system in maintaining and respecting the root canal anatomy and its diameters. ❑

MATERIAL AND METHOD

Acrylic resin blocks with 160 simulated root canals with an angle curvature of 15°-30° were taken into consideration in the present comparative study.

The 160 simulated root canals were divided into two groups, where each group consisted of 80 acrylic resin blocks. Each group was divided into two subgroups (n=40 canals each). During preparation, the blocks were fixed using a container.

The simulated root canal subgroups were prepared with Mtwo and BioRace rotary nickel–titanium instruments. All resin samples were photographed before and after instrumentation. The simulated root canals were measured at four different points of reference, starting at 13 mm from the orifice.

Simulated canals

Simulated root canal preparations were performed using Mtwo rotary instruments and BioRace files. Each instrument was used to shape only four simulated canals, using the crown down technique. Before usage, each instrument was coated with glycerine, which served as a lubricant. A copious irrigation with water was also done after the use of each instrument. Two clinicians conducted the measurements of canals. After preparation of the access cavity, the apical patency of the canals was

examined using #10 and #15 K-files (Mani Co., Tokyo, Japan).

Group 1 was divided into two subgroups (n= 40). In the first subgroup, the canals were prepared using Mtwo rotary system (VDW, Munich, Germany). The following Mtwo instruments sequences were used: 10/0.04, 15/0.05, 20/0.06 and 25/0.06. The Mtwo rotary instruments entered in the full length of the canal. Each file was rotated in the canal until it reached the apical point.

The Mtwo NiTi rotary instruments were applied in a 16: 1 handpiece (Anthogyr, Sallanches, France), simultaneously with a high torque endodontic electric motor (E-Go; Sweden & Martina, Padova, Italy) at a speed of 280 rpm and 3 Nm torque.

Subgroup 2 served as a control group (n=40) with its simulated root canals.

Group 2 included 80 teeth that were also divided into two subgroups (n=40). In the first subgroup, root canals were prepared by BioRace rotary instruments. The following BioRace files sequences were used: BR0 25/0.08, BR1 15/ 0.05, BR2 25/ 0.04, and BR3 25/0.06.

The BR1, BR 2, and BR 3 instruments were inserted to the working length (WL).

Files were inserted on an electric handpiece (TCM Endo; Nouvag, Goldach, Switzerland) with a set speed of 500 rpm and 1 Nm torque. Subgroup 2 served as a control group (n=40) with its simulated root canals. The examiners took images of the instrumented sample using an optical microscope at a magnification power of 50 xs with the help of a Mitutoyo Profile Projector. Afterwards, images were compared using the AutoCAD program, in order to evaluate the differences before and after instrumentation at the four different lengths of the canals.

The current study evaluated the shaping ability of root canal diameters after being prepared with Mtwo rotary instruments and BioRace files. The distance of the instrumented axis compared to the axis of the unprepared canal is (Ai) and it shows the difference between the original medial line of the acrylic block and the axis created through instrumentation.

The diameter of the canal that is perpendicular to the vertical at various lengths is (Di). The perpendicular direction with the axis of the prepared canal and with the various lengths of the right and left margin of the canal is (Dpi). Root canal diameters were evaluated after instrumentation with Mtwo rotary instruments and BioRace files. Meanwhile, unprepared canals served as the control group.

In the present research, the standardized sample took into consideration 80 canal blocks simulated, which were not instrumented.

The standardized sample compared the effects of instrumentation on the root canal diameters after being prepared with Mtwo rotary system and BioRace files, as it was highly significant for the research. Standardization was useful to assess the differences between Mtwo and BioRace rotary instruments, so that precise evaluation of the instrument could be achieved. The root canal was divided into four heights (S1=13 mm, S2=10 mm, S3=4 mm, and S4=3 mm) and root canal diameters were evaluated at the four heights in order to determine the greatest change.

Statistical analysis

Data were recorded using SPSS version 23 software (Microsoft, IL, USA). Means and standard deviations (SD) were obtained for each group in order to find out the differences between the two groups. The results were scrutinized using analysis of variance (ANOVA)-test and Tukey's test. The significance level was set at $P < 0.05$. ❑

RESULTS

Table 1 reveals the mean and SD of the Dpi prepared with Mtwo instruments that varies from 0.018 in S1 to 0.014 in S4, while the mean and the SD of Dpi prepared with BioRace instruments varies from 0.039 in S1 to 0.024 in S4.

Data about the mean and SD of the distance of the axis compared to the axis of the unprepared canal showed that the amplitude of the deviations obtained during treatment with Mtwo rotary instruments was lower than that obtained during treatment with BioRace instruments. BioRace rotary instruments presented more apical deviations compared to Mtwo rotary files.

No significant difference was noted between the Mtwo rotary instruments and BioRace files, as the value was (P=.000) in S1 (D1) and S1 (Dpi) in the two groups of instruments.

The results of Tukey's test revealed a significant difference between Mtwo rotary instruments and BioRace files in middle and apical section, as the value was (P=.003) in S3 (Dpi) and S4 (Dpi).

TABLE 1. The Mean and the standard deviation of canal's diameter prepared with Mtwo instruments and BioRace rotary files

Mtwo BioRace	Mean	SD	P value
S1 Mtwo Di	1.08	.019	.000
S1 BioRace Di	1.32	.023	
S2 Mtwo Di	0.91	.013	.001
S2 BioRace Di	1.13	.028	
S3 Mtwo Di	0.62	.014	.002
S3 BioRace Di	0.77	.027	
S4 Mtwo Di	0.60	.011	.002
S4 BioRace Di	0.72	.025	
S1 Mtwo Dpi	1.12	.018	.000
S1 BioRace Dpi	1.33	.039	
S2 Mtwo Dpi	0.93	.017	.001
S2 BioRace Dpi	1.12	.037	
S3 Mtwo Dpi	0.60	.015	.003
S3 BioRace Dpi	0.69	.032	
S4 Mtwo Dpi	0.21	.014	.003
S4 BioRace Dpi	0.30	.024	

TABLE 2. Comparison of mean and standard deviation (SD) between the distances of the axis of the prepared canal with the axis of the unprepared canal

Mtwo BioRace	Mean	SD	P value
S1 Mtwo Ai	0.02	.008	.001
S1 BioRace Ai	0.14	0.013	
S2 Mtwo Ai	0.05	.009	.002
S2 BioRace Ai	0.15	0.016	
S3 Mtwo Ai	0.66	0.014	.003
S3 BioRace Ai	0.77	0.029	
S4 Mtwo Ai	1.21	0.019	.006
S4 BioRace Ai	1.32	0.035	

Table 2 reveals the mean and SD of the distance of the axis of the prepared canal with Mtwo instruments and Biorace files compared to the axis of unprepared canal. Mtwo instruments extend the canal diameter and operate according to the first radiography of the canal, in order to respect its anatomy. If the instruments enter deeper in the canal, from S1 to S4, the diameter of the root canal decreases. BioRace instruments showed the largest amplitude of deviations in the root canal diameters, indicating that BioRace files did not respect the root canal axis.

Considering the results of the current experimental study about the root canal diameters, we came to the conclusion that Mtwo instruments preserve the tooth structure for longer time periods than BioRace files.

Due to the use of Mtwo instruments, errors were fewer when preparation of the root canal diameter was done with Mtwo rotary system in comparison with BioRace instruments.

The results of Tukey's test found out a significant difference between the Mtwo rotary instruments and BioRace files in the middle and apical section with the respective values (P=.003) in S3 (Ai) and (P=.006) in S4 (Ai). ❑

DISCUSSION

The present study compared the abilities of NiTi rotary instruments in the preparation of curved canals (17). The rotary NiTi instruments used in the current research are Mtwo and BioRace files.

Mtwo rotary instruments and BioRace files are two of the technological advancements achieved during the recent years. These instruments brought progress in endodontic therapy (18). Successful endodontic treatment mainly consists on preserving the original anatomy of the root canal. The present study was conducted on simulated root canals in resin blocks by using simulated root canals, which is an effective method for comparing different instruments (19). During a root canal preparation, it is very important to maintain the curvature of the root canal and determination of the root anatomical diameters (20). The selection of an appropriate rotary Ni-Ti instrument for the preparation of root canal diameters is one of the most important stages for the success of root canal treatment.

A wide range of diameters exist in the root canals and diameter decreases apically (21). Based on the results of the present study, Mtwo instruments were able to prepare all diameters and working lengths of the root canals. Similar results

were obtained by Hamze *et al*, who showed that the original root canal anatomy was respected using Mtwo instruments (22).

The results obtained and the analysis conducted in the current study led to the conclusion that Mtwo instruments removed less dentine from the root canal than BioRace files, which makes them more efficient and safer. Similar results were reported by Rodrigues al (23).

In their research, Cumbo *et al* (25) found out that the area after root canal instrumentation with Mtwo rotary instruments was 5.6 times larger on the coronal section, 7.2 times larger on the middle section and 70.5 times larger on the apical section, compared to the areas before canal instrumentation (24). In their study, the area after canal instrumentation with BioRace rotary files was 5.9 times larger on the coronal sections, 11.3 times larger on the middle section and 92.9 times larger on the apical section, compared to the areas before canal instrumentation. Considering the data in their study, it was proved that BioRace files caused more mistakes in the apical part, which did not favor the preparation of root canals in dentists' daily clinical practices (24).

In conclusion, from our scientific perspective, since the coronal area is the area which has the largest diameter, it is acceptable that the increasing of diameters should be smaller for the two rotary instruments.

The process of preparing the root canal diameters becomes more difficult by going deeper into the root canal that is why it is very important to use a safe rotary Ni-Ti instrument.

Standard deviations of (Ai) varied from .008 in S1 to .019 in S4 for Mtwo instruments and from .013 in S1 to .035 in S4 for BioRace instruments.

By comparing standard deviation values, the current study proved that Mtwo instruments preserved the anatomy of the root canal diameters better than the BioRace files. Similar results were obtained by de Menezes et al., who proved that the Mtwo system was not only advantageous, but also user-friendly and preserver of the anatomy of the root canal (25).

The BioRace instruments have extremely sharp cut ends and a cross-sectional design. These characteristics may create dentinal defects. Statistical analysis in the present study indicated that enlargement of the root canal diameters has equally resulted in the coronal section of the root canal prepared with Mtwo instruments and BioRace files, as the values were (P=.000) in S1 (D1) and S1 (Dpi).

Mtwo rotary instruments have a higher success rate and superior quality in the preparation of root canals by better preserving the tooth structure. Canga *et al.* compared the performance of Race and Mtwo rotary instruments and showed a lower frequency of canal transportation with Mtwo rotary system (26).

According to the current study analysis, the Ni-Ti endodontic instruments must prepare all diameters at the working length of root canals neither more nor less, so to be effective.

In our view, respecting all diameters at the working length of the root canals is crucial for patients who need an endodontic treatment. Clearly, if instruments do not respect all diameters at the working length of the root canals, there will be more organic detritus in the root canals. It is not acceptable to treat the root canals either 4-5 times or two times.

Based on the results of the current study, it was proved that Mtwo rotary endodontic instruments provide more excellent preparation of root canal diameters in comparison with BioRace instruments, that showed more deviations in the middle and apical section, and their usage can have negative effects for endodontic treatment by putting at risk the clinical success. ❑

CONCLUSION

In conclusion, according to the findings of the present study, enlargement of root canal diameters resulted to be better in the middle and apical section of the canal prepared with Mtwo instruments in comparison with BioRace instruments, and as a result, Mtwo instruments can increase the rate of success of endodontic therapy. ❑

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