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: According 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.
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 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, Mu-
 nich, Germany). The following Mtwo instru-
ments sequences were used: 10/0.04, 15/0.05, 20/0.06
and 25/0.06. The Mtwo rotary instruments en-
tered 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 ap-
plied in a 16: 1 handpiece (Anthogy, Sallanches,
France), simultaneously with a high torque en-
dodontic electric motor (E-Go; Sweden & Marti-
na, 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 di-
vided into two subgroups (n=40). In the first sub-
group, root canals were prepared by BioRace ro-
tary 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. Sub-
group 2 served as a control group (n=40) with its
simulated root canals. The examiners took images
of the instrumented sample using an optical mi-
croscope at a magnification power of 50 xs with
the help of a Mitutoyo Profile Projector. After-
wards, images were compared using the AutoCAD
program, in order to evaluate the differences be-
fore 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 per-
pendicular 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 diam-
eters were evaluated after instrumentation with
Mtwo rotary instruments and BioRace files. Mean-
while, unprepared canals served as the control
group.

In the present research, the standardized sam-
ple took into consideration 80 canal blocks simu-
lated, which were not instrumented.

The standardized sample compared the ef-
effects of instrumentation on the root canal diam-
ters 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 rota-
ry 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 diam-
eters were evaluated at the four heights in order
to determine the greatest change.

**Statistical analysis**

Data were recorded using SPSS version 23 soft-
ware (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 instru-
ments 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 unpre-
pared canal showed that the amplitude of the de-
viations obtained during treatment with Mtwo
rotary instruments was lower than that obtained
during treatment with BioRace instruments. Bio-
Race 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 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 (A) and (P=.006) in S4 (A).

**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 et 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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