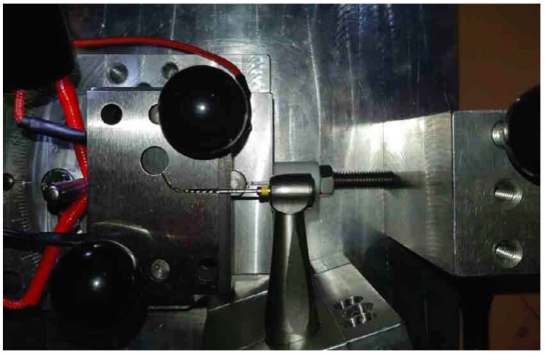
Cyclic Fatigue evaluation



Aim of this preliminary study was to evaluate cyclic fatigue resistance of Plex V (Orodeka, China) nickel titanium rotary instruments.

60 new Plex V files of 25-mm length were used and divided into 4 groups (n = 15): Plex V1 15.03 (group 1), Plex V2 20.04 (group 2), Plex V3 25.06 (group 3) and Plex V5 35.04 (group 4).

All instruments were previously inspected using an optical stereomicroscope with 20 magnification for any signs of visible deformation. No instrument was discarded.

For this purpose, a customized cyclic fatigue testing device was used (Figure 1). This consisted of a platform composed containing the electric handpiece and a mobile support on rails for the insertion/withdrawal of the file.

This mobile platform contained the artificial canal and produced the different inclinations of insertion of the tested file. Consequently, it was possible to evaluate the cyclic fatigue of the tested instruments with different inclinations of insertion of the files with respect to the standard position (0°).

Group 3 (25.06)

Moreover, the testing device allowed the use of artificial canals with different angles and radii of curvature as well as to different temperatures. In this preliminary study, a simulated 16-mm-long stainless steel artificial canal (60° angle and a 5-mm radius) with an inclination of 0° at environmental temperature was used.

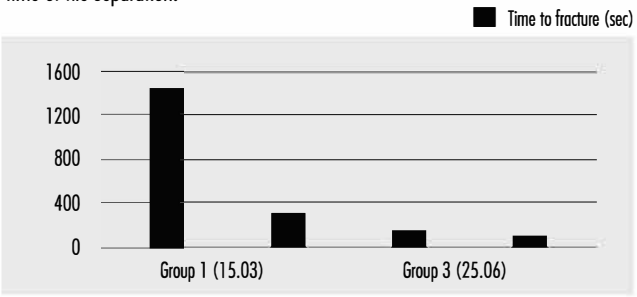
15 instruments of each type were activated using a 6:1 reduction handpiece (Sirona Dental Systems GmbH, Bensheim, Germany) powered by a torque-controlled motor (Silver Reciproc, VDW) at 400 rpm in continuous rotation as recommended by the manufacturer. Torque was set at the maximum value. Each instrument was positioned in the contra-angle handpiece and introduced into the canal at the same position (16 mm). To reduce the friction of the file as it touched the artificial canal walls, a special high-flow synthetic oil designed for lubrication of mechanical parts (Super Oil; Singer Co Ltd, Elizabethport, NJ) was applied.

For each instrument, the time to fracture in seconds from the start of the test until the moment breakage was detected visually and/or audibly was recorded with a chronometer to an accuracy of 0.1 second. To obviate human error, video recording was performed simultaneously and the recordings were observed to cross-check the time of file separation.

Instrument	Cyclic fatigue (TtF)	Fractured fragment length (mm)
Group 1 Plex V1 15.03	1473 ± (48)	5.1 ± (0.5)
Group 2 Plex V2 20.04	307 ± (32)	5.3 ± (0.4)
Group 3 Plex V3 25.06	137 ± (21)	5.0 ± (0.5)
Group 4 Plex V5 35.04	98 + (18)	4.9 + (0.3)

The length of the fractured file tip was measured by using a digital microcaliper (Mitutoyo Italiana srl, Lainate, Italy).

The mean time to fracture for the cyclic fatigue test and the length of the fractured fragments are presented in Table 1 and summarized in Figure 2.



Conclusions:

The Orodeka Plex V instruments tested had a good cyclic fatigue resistance compatible with a safe use during root canal shaping procedure.

Cutting efficiency evaluation

Aim of these tests was to evaluate cutting efficiency of Plex V (Orodeka, China) nickel titanium rotary instruments. For this purpose, we employed a new customized testing machine (Figure 1). This new device allows to test cutting ability at different file inclinations and different millimeters from the tip. Standardized gypsum samples were used as substrates to evaluate cutting efficiency because their similar properties to dentine.

0 new Plex V files of 25-mm length were used: Plex V1 15.03, Plex V2 20.04, Plex V3 25.06 and Plex V5 35.04.

All instruments were previously inspected using an optical stereomicroscope with 20 magnification for any signs of visible deformation. No instrument was discarded. All files were tested at 90° and at 10 ± 0,75 mm from the tip and activated following manufacturer's instructions.

Cutting efficiency of the instruments (n=10) was evaluated by the weight loss of gypsum plates using an analytical balance (sensitivity of ± 10-1 mg) (Balance E42-B, Gibertini, Italy). The samples were measured at the beginning and at the end of the experiment.

Moreover, maximum cutting depth of the instruments was also registered. The length of the gypsum block cut was measured using a digital caliper (sensitivity of ± 10-1 mm).

The mean values for the weight loss and cutting depth were calculated for all tested files and are represented in Figures 2-3.

Conclusions

The Orodeka tested instruments had a good cutting efficiency compatible with a safe and efficient use during root canal shaping procedures. Moreover, Orodeka Plex V instruments achived cutting efficiency results similar or better of other NiTi files made by conventional or heat-treated NiTi.

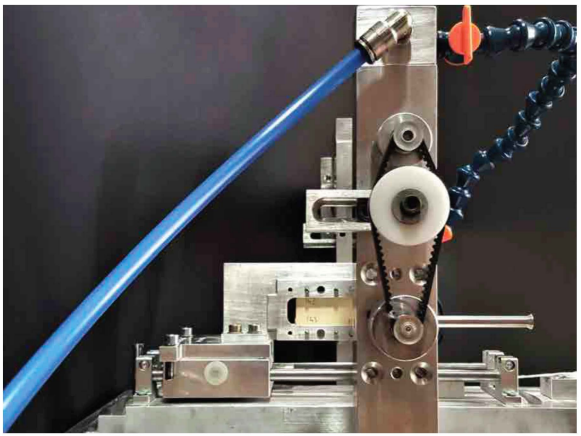
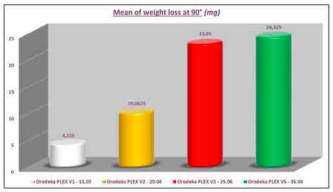
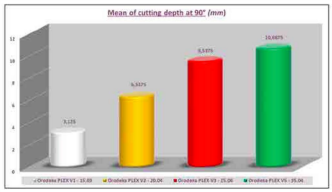


Figure 1. Customized testing machine employed for cutting efficiency tests.



Figures 2. Histogram and line graph of mean weight loss at 90° of PLEX V instruments.



Figures 3. Histogram and line graph of mean cutting depth at 90° of PLEX V instruments.

	Weight loss (mg)	Cutting depth (mm)
Conventional Ni–Ti 15.03 file	4	2
Plex V1 15.03	4.22	3.12

Table 1. Mean weight loss and cutting depth of a conventional Ni-Ti 15.03 file and Plex V1 15.03. mg: milligrams, mm: millimeters

	Weight loss (mg)	Cutting depth (mm)
Conventional Ni–Ti 25.06 file	13.6	9.7
M–wire Ni–Ti 25.08 file	19	7.4
Blue–heat treated Ni–Ti 25.08 file	20	7.8
Plex V3 25.06	23	9.5

Table 2. Mean weight loss and cutting depth of a conventional Ni-Ti 25.06, M-wire Ni-Ti 25.08, blue-heat treated Ni-Ti 25.08 files and Plex V3 25.06. mg: milligrams, mm: millimeters

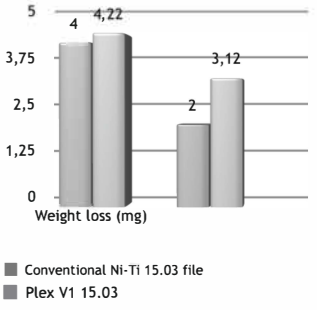


Figure 4. Histogram of mean weight loss and cutting depth of a conventional Ni-Ti 15.03 file and Plex V1 15.03. MG: milligrams, MM: millimeters

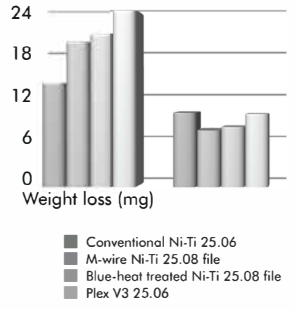


Figure 5. Histogram of mean weight loss and cutting depth of a conventional Ni-Ti 25.06, M-wire Ni-Ti 25.08, blue-heat treated Ni-Ti 25.08 files and Plex V3 25.06. mg: milligrams, mm: millimeters