doi:10.1017/S1431927616000350

Studying the topographic changes in ProTaper Next endodontic rotary file by Scanning Electron Microscopy (SEM)

Ranya Eleman[1], José A. Capelas[1] and Manuel F. Vieira[2]

[1.] Department of Endodontics, Faculty of Dental Medicine, University of Porto, Rua Dr. Manuel Pereira da Silva, 4200-393 Porto, Portugal.
[2.] CEMUC, Department of Metallurgical and Materials Engineering, University of Porto, R. Dr. Roberto Frias, 4200-465 Porto, Portugal.

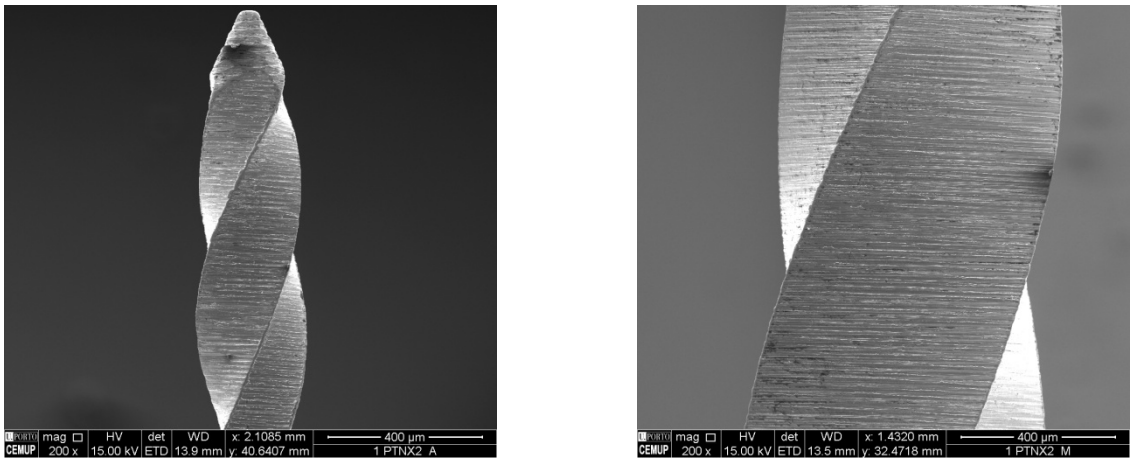
NiTi endodontic files are prone to fracture without any visible defect being noticed. Their fracture occurs frequently by cyclic fatigue or torsional stress while they are being used in root canals [1]. The potential difficulty in removing fractured pieces of the canals, which may compromise the outcome of endodontic treatment, makes imperative the knowledge of the behavior in service of these instruments. Although many researchers have studied different aspects of failure of NiTi materials (for a review see, for instance [2]), the fracture behavior is not yet fully understood. The characterization of topographic changes and microdefects are also essential to identify the fracture mechanisms.

The purpose of this study was to evaluate the morphological alterations of the surface of six ProTaper Next (PTN) endodontic rotary files after being used in simulated root canals in acrylic resin blocks with 60º degrees of canal curvature. PTN instruments are used at a constant rotation speed of 350 rpm and a torque of 2.5 N/cm. The instrumentation of the root canal is carried out using the crown-down technique and 99% alcohol was used for irrigation throughout the procedure. After three root canals preparation, and before the microstructural examination, the instruments were cleaned.

All the PTN files were observed in the same position before and after three canals preparation using high resolution scanning electron microscope (FEI Quanta 400FEG ESEM / EDAX Genesis X4M). Figure 1 shows lateral views of a PTN file before use. In five of the instruments no obvious topographic changes, like instrument's spiral distortion or surface wear, were detected. Figure 2 shows the file of Figure 1 after the preparation of three simulated root canals. However, one PTN file fractured during the third use (Figure 3). The strong plastic deformation of the file near the fracture, indicates the fracture occurred by torsional stresses and not by fatigue. This fracture occurs when the tip or other parts of the file is locked in the root canal during the preparation, but the shaft remains rotating [3]. Although the tested files are small in number, this study show that each file can prepare three canals without fracturing by cyclic fatigue.

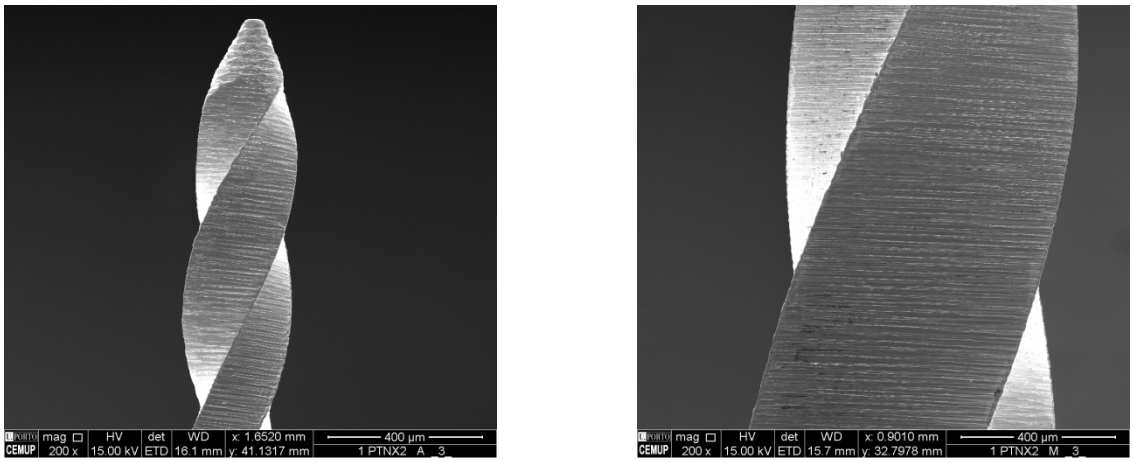
References:

[1] M.C.C. de Melo, M.G. de Azevedo Bahia, V.T.L. Buono, Journal of Endodontics **28**:11 (2002) p. 765.
[2] M.J. Mahtabi, N. Shamsaei, M.R. Mitchell, Journal of the Mechanical Behavior of Biomedical Materials **50** (2015) p. 228.
[3] E. Johnson, A. Lloyd, S. Kuttler, K. Namerow, Journal of Endodontics **34**:11 (2008) p.1406.



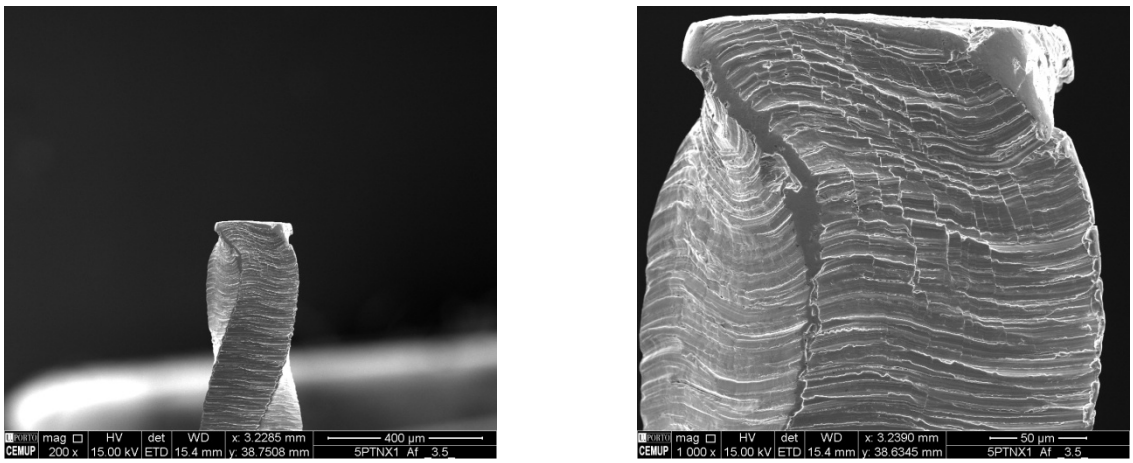
(a) (b)

Figure 1. SEM images of lateral views of a PTN file.



(a) (b)

Figure 2. SEM images of the PTN file shown in Figure 1 after three uses.



(a) (b)

Figure 3. SEM images of the fractured PTN file (a) showing in detail the plastically deformed region (b).

https://doi.org/10.1017/S1431927616000350 Published online by Cambridge University Press