

# Cyclic fatigue resistance and three-dimensional analysis of instruments from two nickel-titanium rotary systems

Grande NM, Plotino G, Pecci R, Bedini R, Malagnino VA, Somma F, *Int Endod J* 2006; 39: 755-763

**Aim:** To determine how instrument design affects the fatigue life of two nickel-titanium rotary systems (M<sub>t</sub>wo<sup>®</sup> and ProTaper<sup>®</sup>) under cyclic fatigue stress in simulated root canals.

**Methodology:** Cyclic fatigue testing of instruments was performed in stainless steel artificial canals with radii of curvature of 2 or 5 mm and an angle of curvature of 60°. A total of 260 instruments were rotated until fracture occurred and the number of cycles to failure were recorded. The morphology of NiTi rotary instruments was investigated by measuring the volume of millimeter slices of each instrument size starting from the tip to the shank by means of  $\mu$ CT analysis. The fracture surface of three representative samples of each size was analysed by scanning electron microscopy (SEM). Data was analysed using one-way ANOVA, Holm t-test, paired t-test and linear regression; the significance was determined at the 95% confidence level.

**Results:** Cycles to failure significantly decreased as the instrument volume increased for both radii of curvature tested ( $P < 0.01$ ). The radius of curvature had a statistically significant influence on the fatigue life of the instruments ( $P < 0.05$ ). Under cyclic stress larger instruments fractured in less time than smaller ones. SEM evaluation showed typical features of fracture through fatigue failure.

**Conclusions:** The metal volume in the point of maximum stress during a cyclic fatigue test could affect the fatigue life of NiTi rotary instruments. The larger the metal volume, the lower the fatigue resistance. The M<sub>t</sub>wo<sup>®</sup> files were considerably more resistant to fracture than ProTaper<sup>®</sup> under the conditions of the study.

Figure 8  
Number of cycles before  
breakage of instruments  
Radius of curvature 5 mm  
Angle of curvature 60°

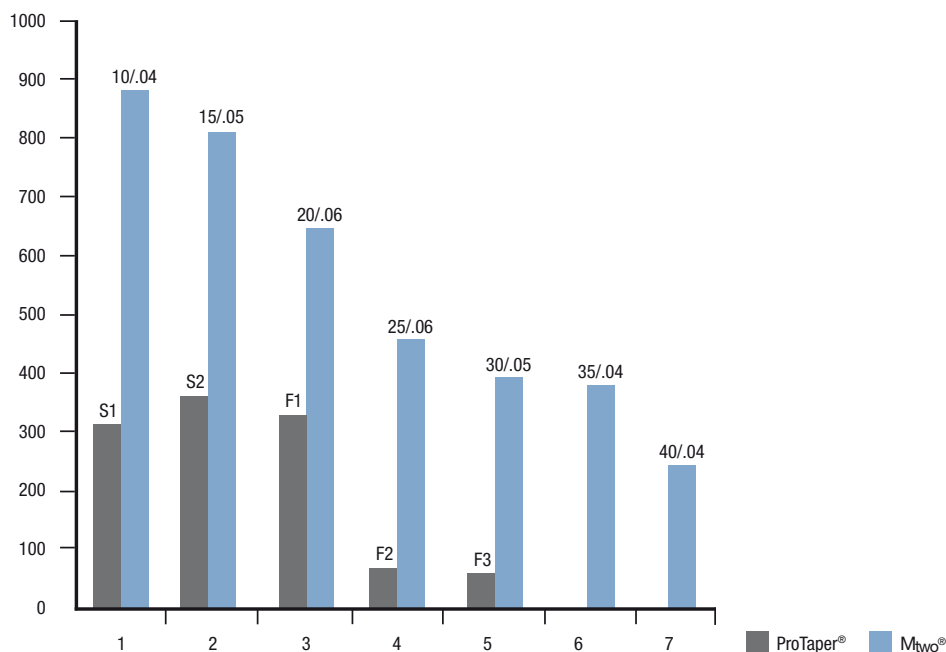


Figure 9  
Number of cycles before  
breakage of instruments  
Radius of curvature 2 mm  
Angle of curvature 60°

