

Force and Torque Behavior of 0.04 Taper Rotating Endodontic Files Derek Peek

Objectives: To determine the relationship between force and torque values of 0.04 taper helical and non-helical endodontic files at selected insertion-rates and rotational-velocities.

Methods: Acrylic microscope slides with ten uniform pilot channels ($d=0.35\text{mm}$, $h=1.60\text{mm}$) were mounted on a torque transducer (model MRT2P, Interface Force, Inc.) supported by a 1kN load cell. Endodontic files (Miltex, Inc.; size 45, taper 0.04) were axially aligned in a dental handpiece affixed to the cross-head of an Instron testing instrument. This arrangement enabled measurement of both force and torque generated during insertion of the rotating files. The classification variables were: file-type (Pow-R/helical, Liberator/non-helical), insertion-rate (7.5/15.0 mm/min) and rotational-velocity (250/500 rpm); resulting in eight test groups of 20 files each. Coding was by file-type, insertion-rate, and rotational-velocity, e.g., PR75500 indicates Pow-R, insertion-rate 7.5 mm/min, rotational-velocity 500 rpm. Data were acquired along the cutting length of the file, beyond its tip, from 2-10 mm. The relationship between force and torque for each test group was ascertained by SAS software.

Results: Correlation coefficients for force vs. torque ranged from 0.6937 to 0.8064 for LB and from -0.9309 to -0.7707 for PR. Linear regression analyses produced mean slope values (mm^{-1}) for each group. GLM analysis found significant differences among the slopes and a *post hoc* Duncan's multiple range test ($p<0.05$) separated the test groups as shown below.

Code	Mean±SD slope (mm^{-1})	Code	Mean±SD slope (mm^{-1})
PR75500	-0.1471±0.0616 ^B	LB75250	0.1226±0.0430 ^A
PR15250	-0.2136±0.0955 ^C	LB75500	0.1139±0.0509 ^A
PR15500	-0.2452±0.0422 ^{CD}	LB15500	0.1121±0.0492 ^A
PR75250	-0.2697±0.0279 ^D	LB15250	0.1036±0.0371 ^A

Conclusions: (1) Force and torque were inversely correlated for the PR group, *i.e.*, the force generated decreased as torque increased. (2) Force and torque were directly correlated for the LB group. (3) LB files were more affected by insertion-rate, whereas no trend was observed for the PR files.