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Biomaterials Research Report
Matt Cowen, B.S., John M. Powers, Ph.D.
DENTAL ADVISOR Biomaterials Research Center
Ann Arbor, MI 48104
matt@dentaladvisor.com
Number 166 – August 2023

Laboratory Evaluation of FQ Rotary Files

M. Cowen, J.M. Powers

Introduction:

This study evaluated the cyclic fatigue resistance and cutting efficiency of 2 types of rotary files, the new ***FQ Endodontic System*** from Komet® and ***ProTaper Ultimate*** from Dentsply Sirona. The heat-treated FQ Files features a variable tapered core for increased flexibility toward the shank while the cutting edges are uniformly tapered for smooth canal excavation. The cutting edges feature a double S curve for improved evacuation of debris while cutting.

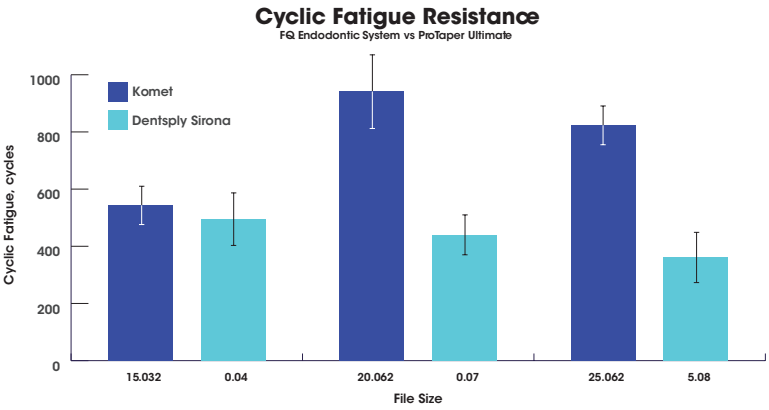
A ***Promark Endo Motor*** (Densply Sirona) was used at 400 RPM and torque settings listed in the IFU for tested file sizes #15.03, 20.06, 25.06 for the FQ Files and 20.04, 20.07, 25.08 with 25 mm length. The cyclic fatigue test using the DENTAL ADVISOR Cyclic Fatigue Platform featuring an 80˚ and 5-mm radius was conducted until file failure. Cutting efficiency and durability was assessed using plastic blocs with canals instrumented in sequence with 3 canals per file, until unwinding or file damage occurred, with the time to instrument each canal measured. Additionally, the amount of cutting debris that is removed with the files was also measured to compare claims of increased debris removal of the FQ files.

Conclusion:

The ***FQ File System*** had between 110% and 228% of the cyclic fatigue resistance of the ***ProTaper Ultimate*** system in the cyclic fatigue test. The ***FQ files*** also instrumented the training blocs about 24% faster overall with no file damage detected, and with more debris removed after use.

Methods:

Cyclic Fatigue Resistance (n=10): 10 files of 3 different sizes were tested as received. Canals precision milled into hardened stainless steel with 5 mm radius and 80° angle in the DENTAL ADVISOR Cyclic Fatigue Platform was used at 400 RPM. Time until fracture was recorded, and means with standard deviations reported in the results. Representative images of files that failed after cyclic fatigue testing were imaged under SEM.



Cyclic Fatigue Resistance Summary: ***FQ File System*** had between 110% and 228% of the cyclic fatigue resistance of the ***ProTaper Ultimate*** system or between a 10% and 128% increase, with the largest differences in the larger file sizes. The combination of the heat treatment, lack of surface defects and variably tapered core likely contributes to higher cyclic fatigue resistance for ***FQ File System***.

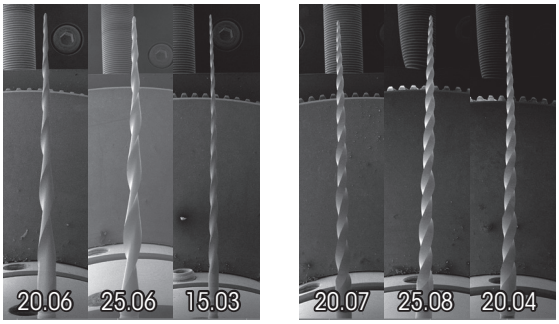


Fig 1. Full Length views of ***FQ Rotary Files*** and ***ProTaper Ultimate*** files.

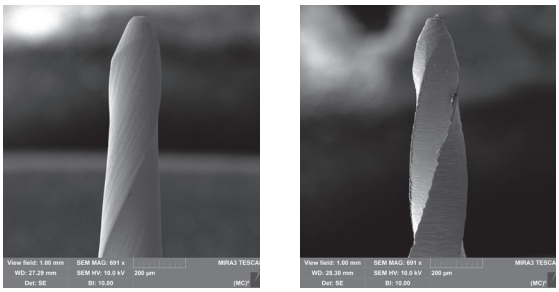


Fig 2. Magnified views of tip design, ***FQ Rotary File*** 20.06 and ***ProTaper Ultimate*** 20.07.

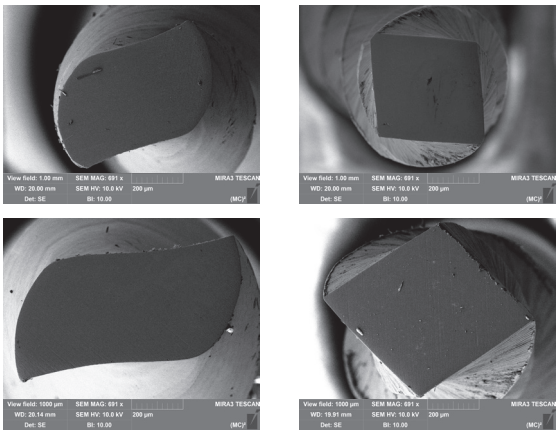
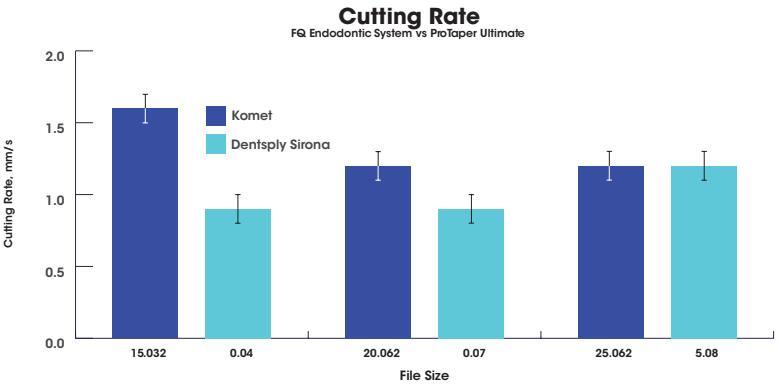


Fig 3. Cross-sectional views of 20.06 ***FQ*** and 20.07 ***ProTaper Ultimate*** rotary files sectioned at 8 mm and 13 mm from the tip. ***ProTaper Ultimate*** files feature a parallelogram design with a variable ~85-105° cutting edge. ***FQ*** rotary files feature a more acute cutting angle with a ~110-130° cutting edges with 2 smooth lands in an S-Shape which function to reduce transportation, screw-in effect and aid in debris removal. ***FQ Files*** (shown above) have a 0.23 and 0.35 mm² cross-sectional area and 0.7 mm and 1.0 mm diameter at 8 mm and 13 mm distance from the tip compared to 0.17 and 0.28 mm² area and 0.6 and 0.8 mm diameter for the ***ProTaper Ultimate***.

Cutting Efficiency and Durability (n=5): After practice and familiarization with the materials, canals were instrumented root canals of Endo-Training-Bloc (Ref: A0177, Dentsply Sirona) with light water irrigation to remove excess debris using a light pecking motion when resistance was felt. The working time to reach the apex was measured for each instrument in sequence and the sum of the working times for each file used was calculated for files listed in the materials section. Canals were first prepared using the 16.02 file for ***ProTaper Ultimate***, and 20.08 Opener for Komet ***FQ***. Three canals were instrumented in sequence by each set of files at 400 RPM, and with torque limits set suggested by each manufacturer's instructions. Microscopic evaluation under 40x magnification next to new files were conducted before continuing to detect the presence of unwinding. Files were weighed before and after their first use to measure the mass of debris which was removed attached to the files with 5 replications each of the first cutting test.



Cutting Efficiency and Durability Summary: Overall cutting rate for ***FQ Endo Files*** was 24% faster than ***ProTaper Ultimate***. All Files survived past 3 canals instrumented. The canal opening file 20.08 allowed less resistance for the initial 15.03 file for FQ which may have contributed to the subsequent values. There was little resistance found with the 15.03 glidepath file until the apex as it is primarily used to clean the apex after use of the coronal canal opener file.

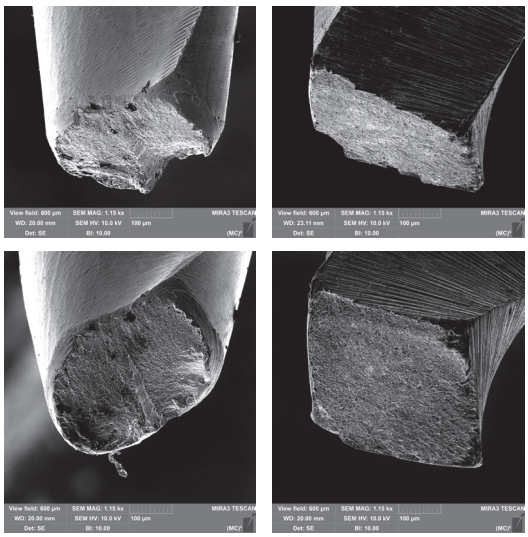
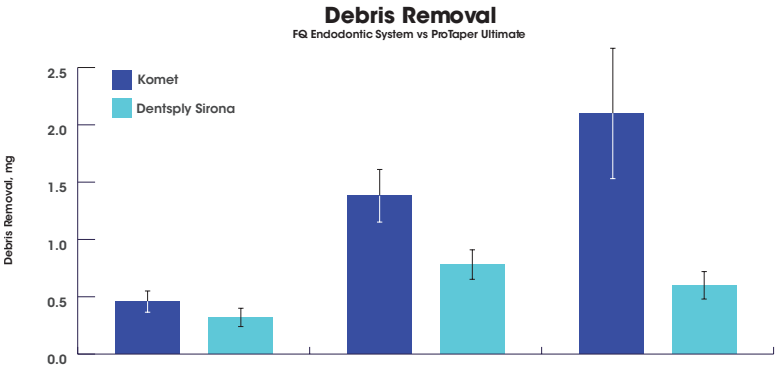


Fig 4. Size 25.06 and 25.08 files after cyclic failure. Note the smoother surface and difference in core texture of the ***FQ Endodontic Files*** (left). Failure tended to initiate at the corners of the ***ProTaper Ultimate*** files.



Debris Removal: ***FQ Rotary*** files removed significantly more debris attached to the files. Longer strips of debris were generally created due to the grooves of the S-shaped canal design compared to ***ProTaper Ultimate*** which tended to shred the canal into more fragments. The larger outside surface area of the ***FQ Rotary Files*** and larger lands and deeper grooves may contribute to the higher measured debris removal.

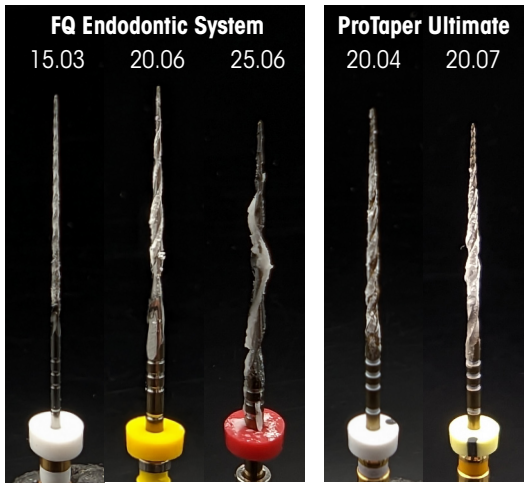


Fig 5. Images of debris removal after cutting evaluation. The mass of debris left on the file varies with how much debris is removed from water irrigation in the simulated canal.