

# Torsional and cyclic fatigue resistance of the new Hyflex EDM instruments and their comparison with Reciproc and WaveOne

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## Aim

To investigate the torsional strength, angular rotation and cyclic fatigue resistance of the new Hyflex EDM OneFile, manufactured by CM-wire and a process novel to nickel-titanium (NiTi) file production called electrical discharge machining (EDM), and compare these findings with Reciproc R25 and WaveOne Primary (both made with M-wire).

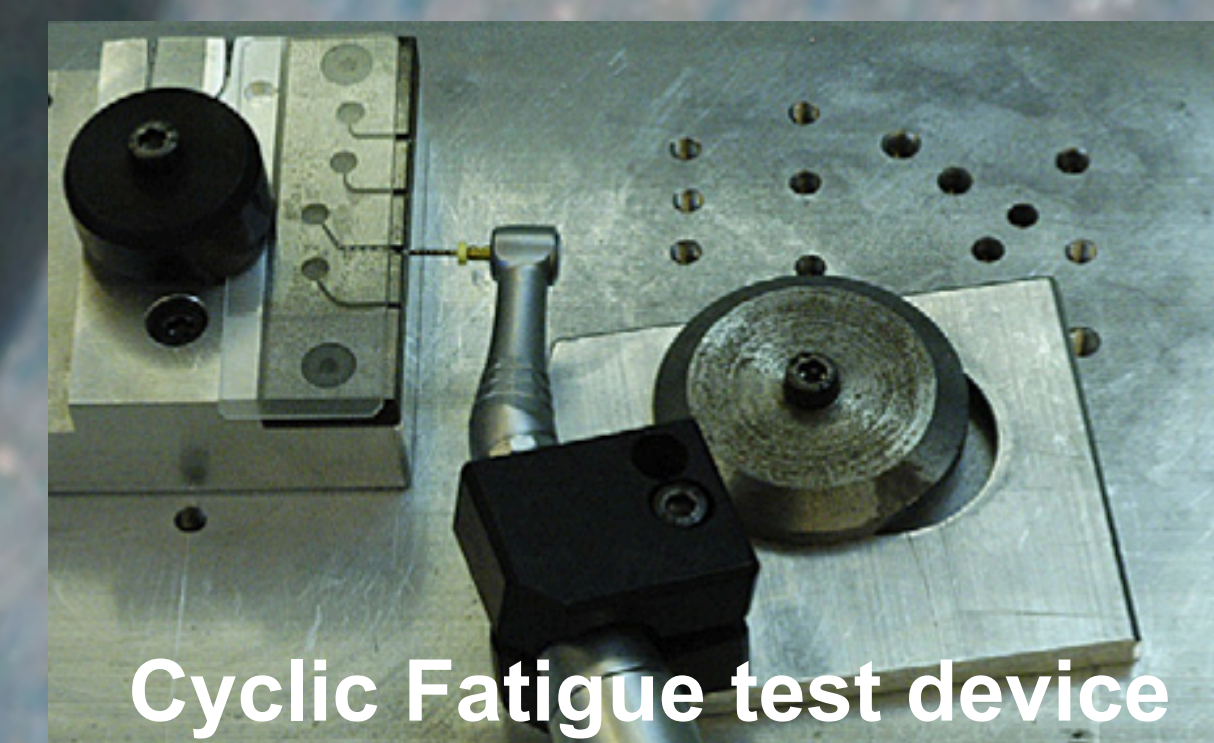
## Methodology

Thirty new Hyflex EDM OneFile, Reciproc R25 and WaveOne Primary files were tested for torsional and cyclic fatigue resistance. Cyclic fatigue testing was performed with the instruments (n =15 each) operating until fracture inside an artificial canal with 60° angle of curvature and 5 mm radius of curvature in continuous rotation at 500 RPM for Hyflex EDM and in the reciprocating motion for the Reciproc R25 and WaveOne Primary files as recommended by each manufacturer. The number of cycles to fracture (NCF) was determined by measuring the time to fracture.

Instruments (n=15 each) were tested to torsional strength and angular rotation to fracture following the ISO 3630-1 guidelines by using a torsionmeter. Kruskal-Wallis and Dunn's multiple comparison post-hoc tests at 0.05 were used to evaluate all data. The fracture surface of each fragment was examined with a scanning electron microscope (SEM).

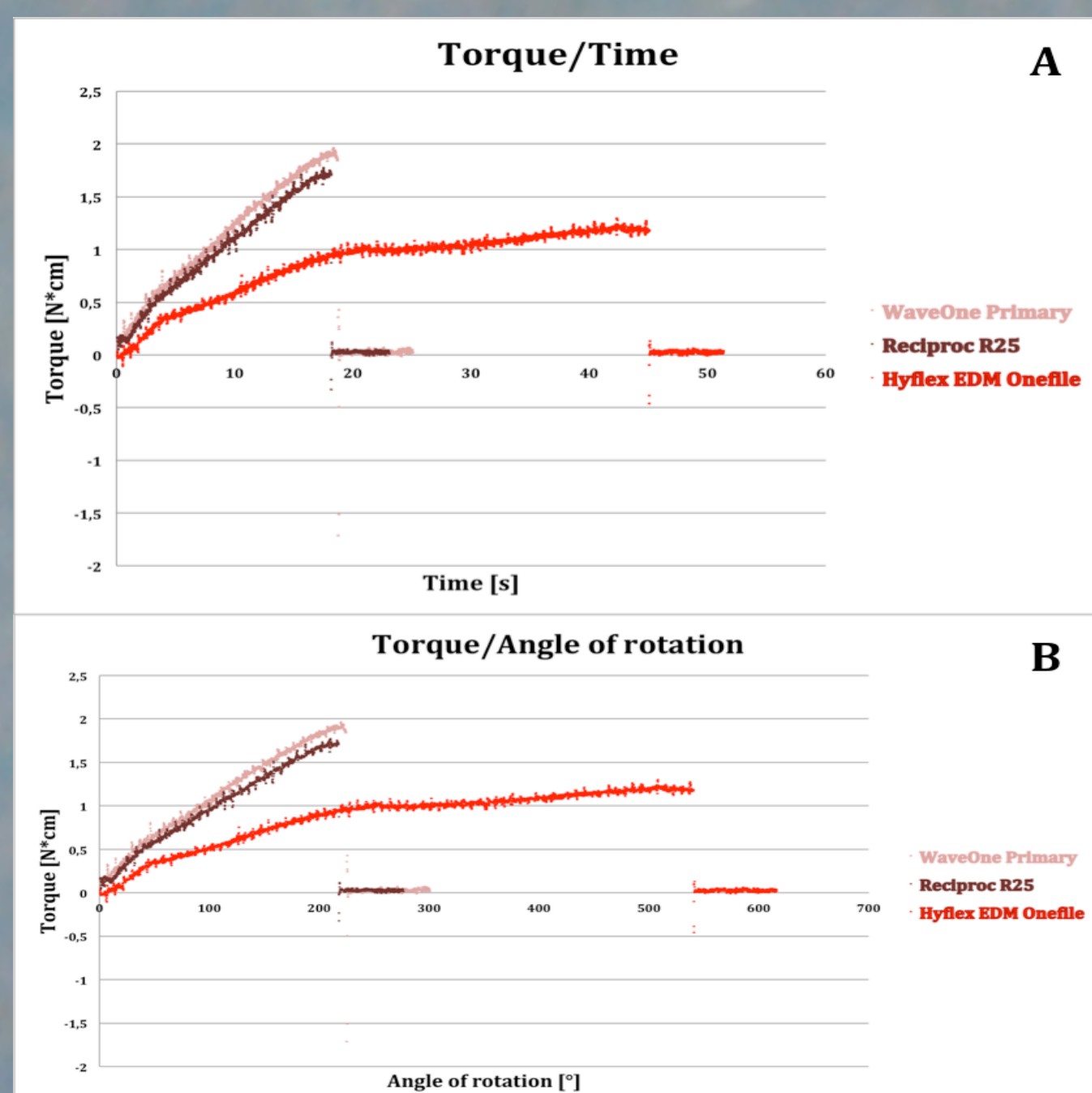


ISO 3630-1

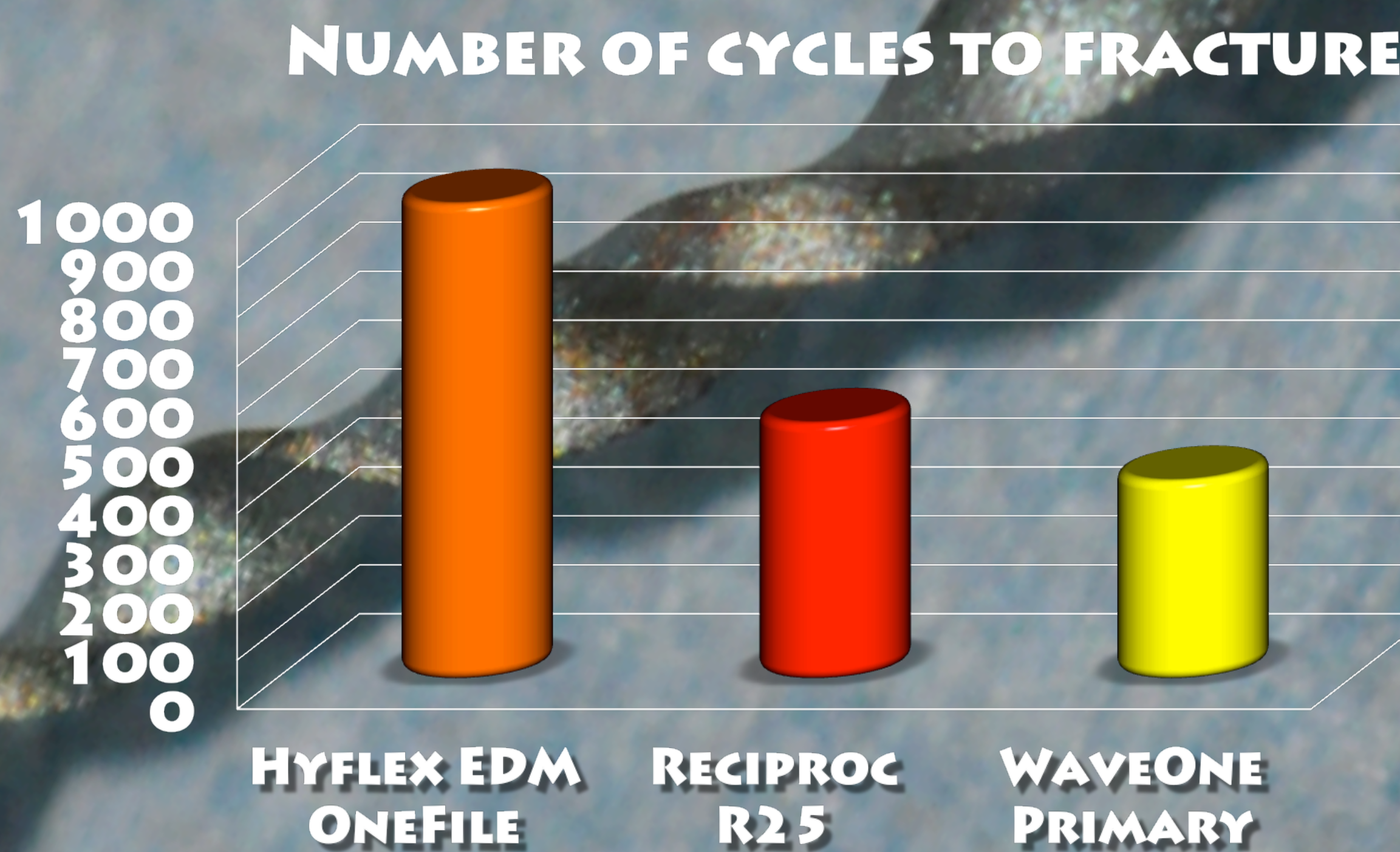


## Results

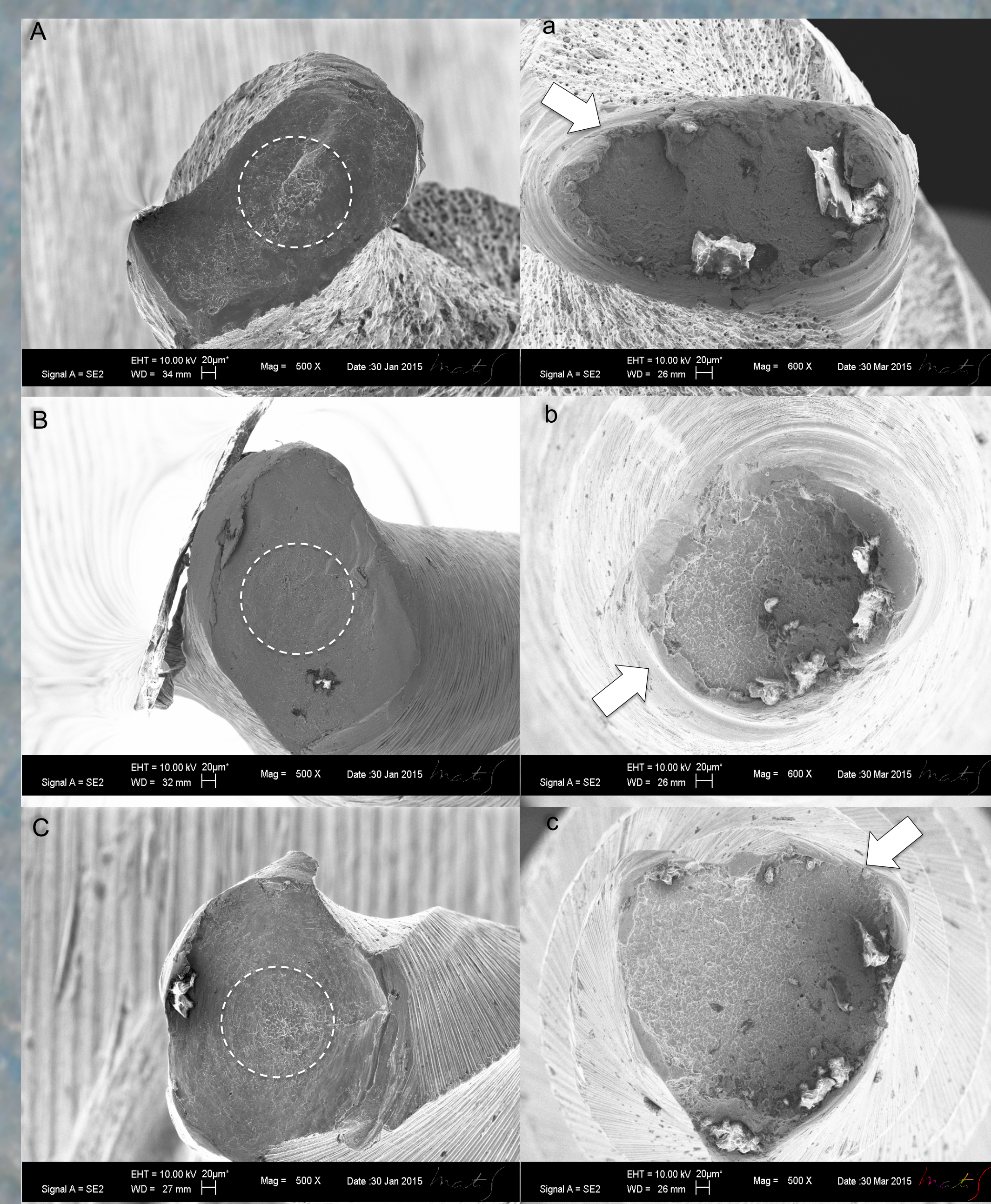
- ✓ Cyclic fatigue resistance of Hyflex EDM was significantly higher than that of Reciproc R25 ( $P < .001$ ).
- ✓ Reciproc R25 cyclic fatigue resistance was higher than WaveOne ( $P < .01$ ).
- ✓ Hyflex EDM OneFile had a significantly higher angular rotation to fracture and lower maximum torsional strength than Reciproc R25 and WaveOne Primary ( $P < .05$  and  $P < .001$  respectively).
- ✓ No significant difference was found in the torque and angular rotation to fracture of the reciprocating instruments tested.



Representative torque versus Time (A) or Angle of rotation (B) curves of each instruments tested.



Instrument	Cyclic Fatigue (NCF)		Torque (Ncm)		Angle of Rotation (°)	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Hyflex EDM OneFile	973 <sup>a</sup>	152	1.33 <sup>a</sup>	0.05	536.20 <sup>c</sup>	96.70
Reciproc R25	525 <sup>b</sup>	58	1.57 <sup>b</sup>	0.15	215.20 <sup>d</sup>	35.89
WaveOne Primary	407 <sup>b</sup>	51	1.74 <sup>b</sup>	0.11	211.70 <sup>d</sup>	31.37



Scanning electron micrographs of fracture surface of separated fragments (first row: A, a = Hyflex EDM OneFile; second row: B, b = Reciproc R25; bottom row: C, c = WaveOne Primary). Left column (A-C) shows the images after torsional test, with the circular box indicating the concentric abrasion mark and the skewed dimples near the center of rotation are typical features of torsional failure. Right column (a-c) shows images after cyclic fatigue test, with arrows indicating the crack initiation origin and surface pattern shows dimples and cones are observed in the same fracture plane.

## Conclusions

Hyflex EDM OneFile had higher cyclic fatigue and angular rotation, but lower maximum torque to fracture than Reciproc R25 and WaveOne Primary, due to their alloy and production processes.

## References

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