

Wear Analysis of HyFlex Instruments after Clinical Use

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Objectives: Wear may increase the risk for instrument fracture during endodontic treatment. Higher the number of canals instrumented, higher the risk for instrument damage. ESEM/EDX evaluation of the surface and metallographic analysis are techniques for demonstrating surface alterations in NiTi rotary instrument. Aim of this study was to evaluate the surface and the alloy properties of HyFlex CM NiTi files before and after clinical use in teeth presenting complex anatomies.

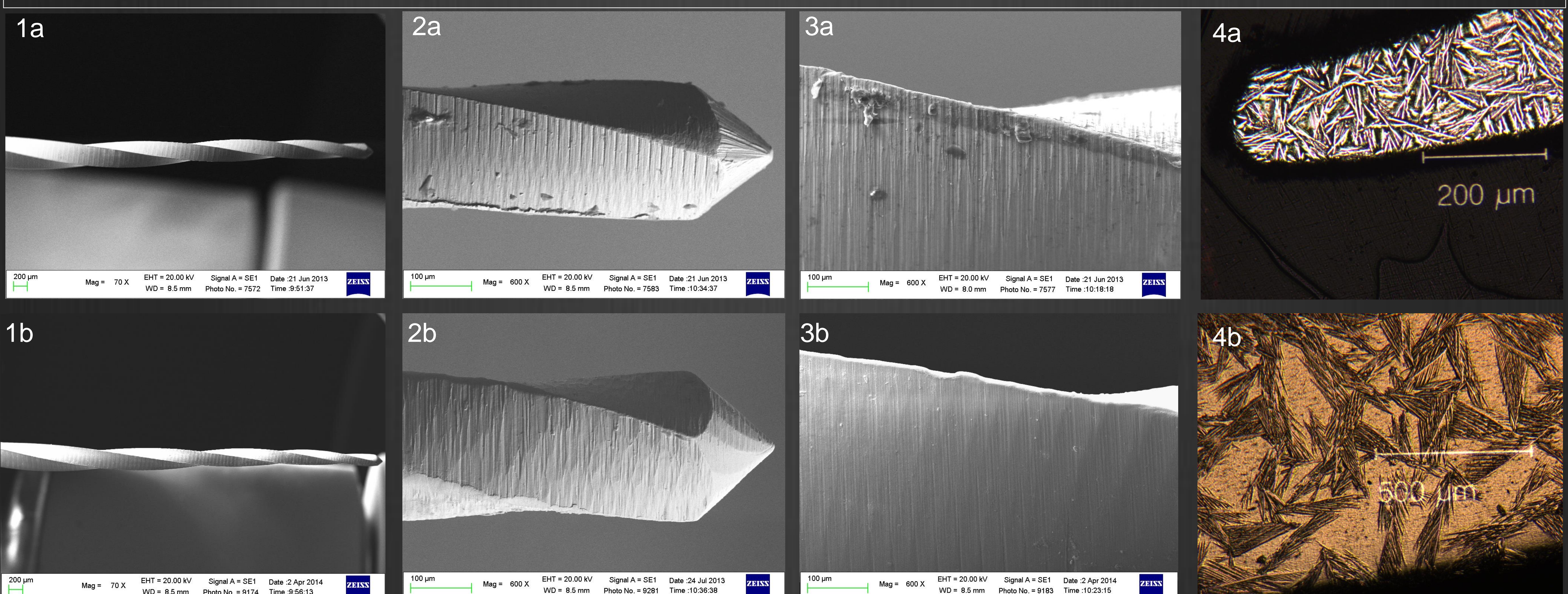
Material and Methods: 16 multirooted-teeth selected on the strength of their anatomy were endodontically treated by a single trained operator. All teeth presented calcified canals and/or severe curvatures. Four sequences of HyFlex CM (Coltène/Whaledent, Switzerland) (n=16) were used to instrument 12 canals *per* sequence. All canals were pre-flared up to #20 apical size with manual K-files. Irrigation was provided with 3ml of 5% NaOCl (Ogna, Muggiò, Italy) and with 3ml of 10% EDTA (Ogna, Muggiò, Italy). The quality of the endodontic procedures was assessed with periapical radiographs. HyFlex were autoclaved after each tooth treatment and discarded after 12 canals.

The ESEM/EDX analysis was conducted pre- and postoperatively at same points and with same angulations to compare surface characteristics and to identify the wear features. Number of fractures, microcracks, blunt/disruption of cutting edge and tip deformations were reported. Metallographic evaluation was performed 4mm from the tip and near the handle with optical microscope on new and used instruments to evaluate matrix morphology.



Results: No instrument fractured. Metal strips were absent and tip profile was well-maintained. Multiple microcracks perpendicular to the longitudinal axis of the file were present in 4 instruments. Cutting edge was worn-out in 6 instruments. Concerning alloy properties of new and used files, the presence of nano-crystalline martensitic grains embedded in austenite matrix was observed only at the handle, whereas in the apical portion only lenticular martensitic grains were found.

Figure Legends: Micrographs of brand new 25.04 instrument (1-3 original magnification 70-600X): the tip of unused instruments (1a-2a) was tapering and with a pointed terminal portion; the same instrument after 12 uses (1-2b). The superimposition of the images showed that after several times of being used, the outline is not altered. (3a-b) Longitudinal examination of the cutting blades in 20.06 instrument. A comparison between pre-instrumentation (3a) and post-instrumentation (3b) shows a well maintained morphology of cutting edges. Optical micrograph of the NiTi alloy matrix (4a: 12-times used tip portion; 4b: 12-times used handle portion) corresponding to the typical martensitic matrix with its twinning elements (4a) and flat austenitic area (4b).



Conclusions: HyFlex CM instruments demonstrated a safe clinical use in curved or calcified root canals. Among the tested instruments, 20.06 file was the instrument that better maintained the original superficial features. A slight loss of cutting ability seemed to be the only limit affecting this endodontic sequence.

References

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