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**Aim:** To evaluate the mechanical properties and thermal behaviour of Reciproc Blue compared to Reciproc M-wire files and to analyse the usage degradation of the files after ex-vivo test in extracted human teeth. The instruments underwent Scanning Electron Microscope (SEM) imaging, Energy Dispersion Spectroscopy (EDS), Raman Spectroscopy, metallographic analysis, DSC, XRD and nano-hardness test.
**Methods**: Reciproc and Reciproc Blue 25 .08 variable taper files were used in the study. Ten brand new instruments and ten used in four severely curved root canals were observed by SEM with EDS to study the new file's morphology and chemical composition and to verify the degradation of the files. The surface of both new and used files was analyse with micro-raman spectroscopy at room temperature with a Nd:YAG laser at 532.05 nm.The microstructure of both new and used files was studied with a light microscope on etched cross-sections and the samples were also observed with SEM for better analyse the morphology of the alloys' grains. DSC was used to analysed the transition temperatures of both new and used files by using segments of the files (10-15 mg of overall weight). XRD was used for investigate the phase composition of three new and used Reciproc and Reciproc Blue files at room temperature using a Cu-Kα monochromatic radiation (40 kV and 40 mA). The hardness and elastic modulus of two new and used Reciproc and Reciproc Blue files were evaluated using nano-indentation test using a Berkovich diamond tip according to ISO 14577. Statistical analyses were performed using STATA version 11 (STATA Corp., Texas, USA).
**Result:** Reciproc and Reciproc Blue files have a slightly different tip geometry and on both instruments are visible milling grooves perpendicular to the long axis. They are both composed of almost the same equiatomic NiTi alloy. The SEM analysis of used files reveals the presence of microcracks along the surface of four instruments per type. The micro-raman spectroscopy confirms the presence, on Reciproc Blue, of a superficial oxide layer of TiO2 arranged in Brookite and Rutile while no signal of a detectable titanium oxide was showed on Reciproc surface. The etched surface of both new and used files appeared characterized by several precipitates dispersed in a matrix composed by acicular martensitic grains and austenitic plain areas. The area of Reciproc Blue grains was statistically lesser than Reciproc one. A two-stage reverse phase transition curve was found for Reciproc Blue. M-Wire Reciproc files do not complete their reverse phase transformation at 37°C, while Reciproc Blue Austenite finish temperature is equal or less than body temperature. XRD confirms that both files have a mixed phase composition, including austenite, martensite and R-phase. Reciproc Blue have a lower nano-hardness and elastic modulus compared to Reciproc files in used conditions.
**Conclusion:** Reciproc and Reciproc Blue files are composed of the same NiTi alloy but they undergo different thermal treatment. The Reciproc Blue show a titanium oxide superficial layer as confirmed by Raman spectroscopy and are more flexible than Reciproc M-Wire due to their different thermal treatment. The smaller and denser grains of Reciproc Blue files are responsible for the different transition temperatures of the two instruments.

## A micro-computed tomographic analysis of retreatability of two bioceramic sealers using rotary instrumentation with supplementary irrigant agitation techniques

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**Aim:** Hydraulic tricalcium silicate-based bioceramic materials have been recently introduced as root repair cements. The retreatability of Guttaflow Bioseal (Coltene Whaledent, Langenau, Germany) and BioRoot RCS (Septodont, Saint Maur des Fossés, France) has not been investigated thus far. Aim of this study was to evaluate the retreatability of two tricalcium silicate-based materials (BioRoot RCS and Guttaflow Bioseal,) using a combination of rotary instrumentation and supplementary irrigant agitation techniques (syringe irrigation, Tornado Brush and ultrasonically activated irrigation) by high-resolution micro-computed tomography.
**Methods:** Single-rooted mandibular premolars were prepared to size 40/0.04 (Hyflex EDM rotary nickel-titanium instruments, Coltene, Coltene/Whaledent AG, Altstatten, Switzerland) and randomly divided into 2 experimental groups (n=24) depending on the root filling material. Root canals were filled with Guttaflow Bioseal (Group 1) or BioRoot RCS (Group 2), scanned using a microCT scanner (Skyscan1172, Brunker microCT, Antwerp, Belgium) at 80 kV and 100 µA with an isotropic resolution of 11 µm and stored in phosphate buffered saline for 4 months. In all the groups, the root filling was removed using the R-Endo nickel-titanium rotary instruments (MicroMega) according to the manufacturer

recommended protocol. Then, the specimens were randomly allocated to one of the subgroups for supplementary irrigant agitation: subgroup A (syringe irrigation), subgroup B (Tornado Brush, M.I.B, France) and subgroup C (ultrasonically activated irrigation). Specimens were re-scanned with micro-CT to calculate the root canal volume and volume of remnant root filling material. The volume of root canal filling material between the groups prior to retreatment procedures was compared using one-way ANOVA. To determine the effect of material and irrigant agitation method on the volume of remnant root filling, two-way analysis of variance (ANOVA) was used with post hoc Tukey test (Prism 8.0; GraphPad Software, Inc, La Jolla, CA). The significance level was set at P=0.05.

**Results:** The preliminary analysis of root canal volume for teeth filled with Guttaflow Bioseal and BioRoot RCS showed no statistically significant difference (P>0.05). Specimens filled with Guttaflow Bioseal showed significantly less remnants compared to BioRoot RCS (P<0.05). There was no significant difference between the supplementary irrigant agitation groups in the removal of Guttaflow Bioseal (P>0.05). In group 2 (BioRoot RCS), subgroups B (Tornado Brush) and C (ultrasonically activated irrigation) showed significantly less remnant compared to syringe irrigation (P<0.05), with no significant difference between the two (P>0.05).

**Conclusion:** Guttaflow Bioseal demonstrated superior retreatability than BioRoot RCS, 4 months after root filling. Supplementary irrigant agitation techniques did not influence the removal of Guttaflow Bioseal.

## Rotary glide path influence on mean torque and instrumentation time: an in vitro study

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**Aim:** The aim of the present poster is to evaluate the influence of rotary glide path on torque developed by Nickel Titanium Rotary in a single instrument technique and if instrumentation time can be reduced despite the increasing of files used.

**Methods:** 40 S-one rotary instruments for shaping and 20 AF blue S4 18.05 for glide path (Fanta Dental, Shangai, China) were randomly divided in two groups: A, S4 18.05 and S-One 25.06 and B, S-One 25.06 only. Each instrument was previously evaluated using a 20x stereomicroscope for macroscopical defects. Each rotary file was used once and discarded. 40 resin blocks were randomly assigned at group A or B. Each block had standardised length, taper, angle and radius of curvature, to avoid influence due to different dental hardness and canal characteristics. Both groups were instrumented with the same setting 350 rpm and 2 Ncm, with the same motor (Kavo, Biberach, Germany) ,the same 1:1 handpiece and by the same operator. Torque was recorded by the motor dedicated software and compared. Instrumentation time was recorded using a digital chronometer (1/100 s). Data were recorded and statistically analysed. The comparison of both mean torque and instrumentation time was made with T-test with significance level at 95%. Instruments were used with two different techniques: Operative technique for group A (Rotary glide path and shaping), Rotary Glide Path with Af Blue S4 18.05, S-one 25.06 until resin block shaping was completed; Operative technique for group B (Single instrument shaping) 1) S-one 25.06 until resin block shaping was completed.

**Results:** Mean torque values were 0,52 Ncm (0.08) for Group A and 0,63 Ncm (0.04) for Group B. Mean instrumentation time values were 63,66s for Group A and 95,34s for Group B. Both techniques allowed instruments to complete resin block shaping with no deformation or fracture in all cases. Mean torque for both groups was below the torque limits, 2 Ncm, with a significant differences found between the two techniques. The use of glide path significantly reduced instrumentation mean torque values and instrumentation time.

**Conclusion:** Instrument separation is a problem increased with the spread of Nickel Titanium rotary instruments. According to the literature, separation can be related to two different factors: flexural and torsional stress. In order to avoid this event, several techniques has been proposed. The use of a low torque instrumentation has been proposed for reducing the torsional stress applied to the instrument, however it is not well known and quantified the amount of torque reduced by glide path techniques. The result of the present study shows that the use of rotary glide path files helps in reducing torsional stress. These instruments enlarge the canals dimension allowing a continuous progression from the orifice to the end of the root canal of the following instrument. However both the techniques allowed a safe instrumentation due to a mean torque much below the torque limit proposed by the manufacturer. Moreover the increase of instrument used did not results in an increase of time consumed for shaping procedure, this can be related to the different approach. A single file technique requires an instrumentation in accordance with the crown down principles, that seems to be more time consuming. The use of glide path files and low torque seems a promising technique to improve safety and efficiency of single file rotary techniques.

## Influence of flat side design on flexural resistance

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