

the cutting efficiency of two single file systems Reciproc R25 (REC) (VDW, Munich, Germany) and Reciproc blue R25 (REB), at different inclinations.

Methods: 60 new REC and REB files were divided into 6 groups (n=10): groups 1, 2, 3 included REC tested at 90°, 70° and 45° of inclination in relation to the sample, respectively; groups 4, 5 and 6 formed by REB tested at 90°, 70° and 45°, respectively. Cutting test was performed using a customized machine in which all instruments were activated in reciprocating motion against standardized gypsum blocks for 120 seconds. Unlike the previously employed testing machines, this device displays some new elements. In particular, an adjustable platform allows to set different predetermined angles of incidence between the instrument and the sample. The cutting efficiency was investigated at 10±0.75 mm from the tip of each instrument. The reciprocating motion was performed via a computing platform (Arduino; Smart Project Srl, Strambino, Italy) connected to a step by step motor, which allows to set up all movement parameters such as revolutions per minute (rpm), angle and direction of movement. Once the setup was accomplished, the motor of the testing device was activated and the instrument took out material passing through the sample actively. The efficiency to cut was determined by measuring the weight loss of the block using an analytical balance ($\pm 1 \times 10^{-4}$ g, Balance E42-B, Gibertini, Italy) and by measuring the length of the surface cut in the block using a digital caliper (10–4 m). The results were expressed as means and standard deviations (SD) for each group and data were statistically analyzed by two-way ANOVA and Bonferroni t-test, with the level of significance set at $P < 0.05$.

Results: No difference was observed for REC among 90°, 70° and 45° ($P > 0.05$). REB had no statistical difference between 90° and 70° ($P > 0.05$), however, its cutting efficiency significantly increased at 45° ($P < 0.05$). A significant difference was observed between REC and REB at 45° only ($P < 0.05$).

Conclusion: Within the limits of the present study, increased file inclination to 45° and blue heat-treatment improved cutting efficiency of reciprocating files. In particular, Reciproc with blue heat-treatment had equal or greater cutting efficiency than the ones made from M-wire.

Influence of different angles of file access on cyclic fatigue resistance of 2Shape rotary instruments in different artificial canals

Giusy R.M. La Rosa¹, Pietro La Paglia¹, Gianluca Conte¹, Karalambos Lazaridis¹, Gaetano Isola¹, Eugenio Pedullà¹, Sebastiano Ferlito¹, Luigi Generali², Placido Verzi¹

¹Department of General Surgery and Surgical-Medical Specialties,

University of Catania, Catania, Italy

²Department of Surgery, Medicine, Dentistry and Morphological Sciences with Transplant Surgery, Oncology and Regenerative Medicine Relevance, University of Modena and Reggio Emilia, Modena, Italy.

Aim: Several parameters including extent of the curvature and angulated insertion of file into the canal could influence cyclic fatigue of nickel-titanium files. The purpose of this study was to compare the influence of different access angles associated to different curvature radii on cyclic fatigue resistance of 2Shape (TS; Micro-Mega, Besancon, France) rotary instruments.

Methods: 60 instruments were tested in two 16mm-stainless steel artificial canals with angle of curvature of 60° and 5mm or 3mm radius of curvature respectively. 2Shape TS2 #25.06 and 2Shape TS1 #25.04 were evaluated at 0°, 10° and 20° insertion angles (n=10 for each angle of access). Cyclic fatigue resistance was determined by Number of Cycles to Failure (NCF) using a new testing device machine. This device consists of a platform composed of a block containing the electric handpiece and a mobile support on rails for insertion/disconnection of the file. Moreover, a metal mobile platform is connected to the mobile support. This second platform with the artificial canal produces the different inclination of insertion of tested file maintaining the entrance of instrument perpendicular to the canal. Each instrument was tested in continuous rotation (300 rpm) following the manufacturer's instructions. Fracture surface was examined with a scanning electron microscope. Data were statistically analyzed using 2-way analysis of variance and the Bonferroni multiple comparison post-hoc test (Prism 7.0; GraphPad Software, Inc, La Jolla, CA) with a significance level of $P < 0.05$.

Results: TS1 (#25.04) exhibited higher cyclic fatigue resistance than TS2 (#25.06) for each angle and radius tested ($P < 0.05$). When files were tested inside 3mm-radius canal, independently from taper, they recorded lower cyclic fatigue resistance than in 5mm-radius one ($P < 0.05$). Considering canal with 5mm-radius of curvature, no significant cyclic fatigue resistance reduction was observed for .06 taper-instruments for each angle tested ($P > 0.05$), while files with .04 taper exhibited significant lower NCF when tested at 20° ($P < 0.05$). In canals with 3mm radius of curvature, TS2 (#25.06) showed no significant differences for each angle tested ($P > 0.05$). TS1 (#25.04) exhibited significant resistance reduction between 0° and 10° as well as between 0° and 20° ($P < 0.05$), with no difference between 10° and 20° ($P > 0.05$).

Conclusion: Inclined angle of file access into the canals decreased cyclic fatigue resistance of #25.04 files especially when the radius of curvature is reduced. Cyclic fatigue resistance of #25.04 instruments was



higher than #25.06 files made with the same thermal treatment. Independently from taper, each file tested in 3mm-radius canal showed lower cyclic fatigue resistance than instruments tested in 5mm-radius canal.

3D micro-CT analysis of the interface voids associated with BioRoot RCS and Guttaflow Bioseal

Karalambos Lazaridis¹, Gianluca Conte¹, Pietro La Paglia¹, Giusy RM La Rosa¹, Prasanna Neelakantan², Ernesto Rapisarda¹, Sebastiano Ferlito¹

¹Department of General Surgery and Surgical-Medical Specialties, University of Catania, Catania, Italy;

²Discipline of Endodontology, Faculty of Dentistry, University of Hong Kong, Hong Kong, Korea.

Aim: The material used for root canal obturation is one of the critical determinants for the success or failure of endodontic treatment. Lately, a number of new endodontic materials have been introduced. The Aim of this study was to investigate the percentage of 3D voids within root fillings produced by BioRoot RCS (Septodont, Saint Maur des Fossés, France) and Guttaflow Bioseal (Coltene Whaledent, Langenau, Germany) using micro-computed tomography.

Methods: Forty-eight single-rooted mandibular premolars were collected and decoronated. The root canals were instrumented using Hyflex EDM nickel-titanium rotary instruments (Coltene, Coltene/Whaledent AG, Altstätten, Switzerland) up to size 40/0.04. The roots were randomly allocated into 2 groups (n=24), and each group was obturated by using single cone technique with a different material: BioRoot RCS (Group 1) and Guttaflow Bioseal (Group 2). Specimens were numbered and scanned with a micro-CT (Skyscan1172, Brunker microCT, Antwerp, Belgium) at 80 kV and 100 µA with an isotropic resolution of 11 µm. Volume rendering and multiplanar volume reconstruction were performed to calculate the volume of root filling material using the software Amira 5.3 (Mercury Computer System Chelmsford, MA, USA) which permitted the subdivision of the root canal into thirds (coronal, middle, apical and last 1mm). The volume of voids was calculated by subtracting the filling material volume from the post-obturation root canal volume. All data sets were tested for normality of the data by the Shapiro-Wilk test and the data showed a normal distribution. Data obtained were statistically elaborated using a t test (P < 0.05) (Prism 8.0; GraphPad Software, Inc, La Jolla, CA).

Results: Root canals obturated with GuttaFlow Bioseal showed a significantly lower percentage of volume of voids than the ones obturated with BioRoot RCS (P<0.05), while no statistically difference was observed between them in the last 1 mm (P>0.05). Within each group, the percentage volume of voids in the

coronal third was significantly higher than in the other anatomical parts examined for BioRoot RCS (P<0.05), with no significant difference among the last 1mm, apical and middle thirds (P>0.05). No statistically significant difference was observed among all examined parts for Guttaflow Bioseal (P>0.05).

Conclusion: Within the limits of the present in vitro study, the results of micro-CT study showed that Guttaflow Bioseal, used as endodontic root canal sealer, had significant less percentage of voids in comparison with BioRoot RCS in all anatomical part examined except for sections at 1 mm.

Root-end resection after filling with single cone technique and bioceramic sealer: an effective way to simplify endodontic surgery?

D. Angerame¹, M. De Biasi¹, M. Lenhardt¹, D. Porrelli¹, E. Pedullà²

¹Clinical Department of Medical Science, Surgery and Health, University of Trieste, Trieste, Italy

²Department of General Surgery and Surgical-Medical Specialties, University of Catania, Italy

Aim: State of the art endodontic surgery with controlled retrograde procedures may not be feasible in all teeth due to poor access and other technical difficulties. In selected cases, the possibility to perform the sole apical resection without further retrograde manoeuvres might constitute a substantial clinical advantage. The present study compared the filling quality obtained with standard retrograde procedures with that of an alternative technique without retrograde preparation and filling.

Methods: Previously published data served for sample size calculation ($\alpha=0.05$; $\beta=0.20$; $\delta=3.0$; $\sigma=1.5$). Twelve single-rooted teeth were selected from a pool of freshly extracted teeth, discarding those with aberrant anatomy. Selected teeth of comparable size were decoronated to obtain 12 mm long roots. The canals were scouted with manual files and the working length acquired. After mechanical glide path establishment, canal shaping was performed with HyFlex rotary files up to size 40, .04 taper (500 rpm; 2.5 Ncm). The roots were analysed with a computed microtomography scanner to identify the possible presence of dentine microcracks. Afterwards, all the canals were filled with the single cone technique with dedicated cones and BioRoot RCS bioceramic sealer. After 24 h, the roots were apically resected with a carbide bur 3 mm from the apex. At this point, the roots were randomly assigned to two groups: no retrograde procedures (n=6); standard retrograde ultrasonic preparation and Biodentine filling (n=6). Lastly, the formation of internal and external voids was quantified by means of a second computed microtomographic analysis. The normality