lateral incisor, that became necrotic before the complete formation of the apex.
**Methods:** A 35-year old male patient referred a history of recurring abscesses with a vestibular fistula corresponding to the left maxillary lateral incisor. The intraoral periapical radiograph showed the presence of a periapical radiolucency of the 2.2 which had an open apex, and dentine tissue similar to a tooth within the pulp chamber. Cone Beam Computed Tomography (CBCT) confirmed the diagnosis of "dens invaginatus class II Ohler". The concerned tooth did not respond to both electric and heat test. Provisional diagnosis was concluded as non-vital tooth with periapical lesion in relation to 2.2. After proper isolation with rubber dam an appropriate access cavity was prepared to allow the debridement of the necrotic pulp. A barbed broach was used for debridement. The glide path was performed with a manual K-file n. 10, which crossing the invaginated canal reached the immature apex at a working length of 22 mm measured by Root ZX apex locator. Thanks to the operating microscope it was possible to find access to the "real" endodontic space and to clean it circumferentially to the invaginated hard tissues. Gentle circumferential filing had been performed with minimal dentin removal using #80 H file. The canal was then irrigated with 5.25% NaOCl. Paper point had been introduced inside canal to dry it. Trying to follow and respect the C-shaped, already highlighted by CBCT. At first the whole endodontic space, both the real and the invaginated one, was filled with calcium hydroxide for 3 months. After 3 months the calcium hydroxide was removed by irrigation with 5.25% NaOCl, and the endodontic space was dried . The intraoral radiograph and CBCT showed that the internal hard structure was almost completely detached from the "real" canal walls; so, it was mobilized and removed with ultrasonic tip (StartX #3) through the access cavity, and the wide endodontic space was filled with MTA, condensed for approximately 3 mm by using a Schilder's plugger and an ultrasonic tip for 10 seconds; it was covered with a moist cotton pellet, and the access was sealed with Cavit. One week later, a dual composite sealer (Relyx Unicem 2) was placed over the MTA cement, and the tooth was restored with an universal nano-hybrid composite (Tetric Evoceram).
**Results:** After the first sessions of root canal shaping and medication with calcium hydroxide, the clinical symptoms and the fistula, which to date (two years) have not presented, disappeared. The radiographs, 12 months after the end of endodontic treatment, showed that the periapical lesion was gradually reduced both in size and intensity of gray.
**Conclusion:** The cases of dens invaginatus may differ and consequently different is the treatment approach. In the case described, through the use of CBCT and the operating microscope, it was possible to locate and remove the hard tissue invaginated and then to proceed as a classic endodontic treatment of a tooth with open apex. The patient was included in a follow-up program to check and verify the complete periapical bone healing of the affected tooth.

## Activation of two irrigating solutions with the XP-Endo finisher: canal cleanliness analysis

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**Aim:** To evaluate the formation of smear layer and debris on canal walls of prepared root canals after activating the irrigating solution by using the XP-endo Finisher either with sodium hypochlorite or ethylenediaminetetraacetic adic (EDTA).
**Methods:** The crowns of 24 single-rooted similarly-sized extracted teeth were removed with a cutting disc. After working length determination and glide path creation, root canals were shaped with BT Race files up to size 40/.04. During the enlargement phase, the canals were rinsed with 2 ml of 5% sodium hypochlorite solution after each instrument. The prepared canals were rinsed with 3 ml of distilled water and dried with sterile paper points. At this stage, the roots were randomly allocated to a control and two test groups (n=8). The control group received three minutes-long rinses with 17% EDTA followed by 5% sodium hypochlorite. The canals of the remaining roots were rinsed with the same irrigants, activating for one minute with the XP-endo Finisher (800 rpm, 1 Ncm) the EDTA solution in the first test group and the sodium hypochlorite solution in the second. Two longitudinal grooves were created on the external surface of the roots, which were split, sputter coated with gold and observed at the scanning electron microscope. Five microphotographs per canal third were acquired at 2000 magnifications and scored according to the Hülsmann scale for smear layer and debris formation. The median value of the scores attributed to each third was regarded as statistical unit. Non-parametric statistical analysis was performed to assess the differences among groups and canal thirds ($p<0.05$).
**Results:** The coronal third was found to be satisfactorily cleaned irrespective of the experimental group; on the contrary, all the considered irrigation protocols were unable to avoid smear layer and debris accumulation in the apical third. In the group where the sodium hypochlorite was activated, significantly worse scores were attributed to the middle third in terms of both smear layer and debris, in comparison to the other two

groups ($p<0.05$).
**Conclusion:** Under the conditions of the present study, the use of the XP-endo Finisher at the end of the root canal preparation procedure did not appear to contribute to the cleaning of the canal walls at a microscopic level. More specifically, no visible improvement was detected in the most clinically relevant canal portion, namely the apical third. Other studies are needed to understand which is the ideal role that the XP-endo Finisher can play in an irrigant activation protocol to maximise canal cleanliness.

## Micro-CT evaluation of root filling quality with warm guttapercha vertical technique and guttacore obturation systems

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**Aim:** Successful endodontic therapy depends on effective chemomechanical instrumentation of the root canal system and a successive 3D filling which provides hermetic sealing of the available spaces. Therefore the aim of this study was to evaluate, by microCT analysis, the root filling quality of two different obturation systems: warm gutta-percha vertical technique and GuttaCore. A quantitative and qualitative evaluation of gutta-percha filled areas (GPFA) and voids and their specific location in root canal cross sections was made.
**Methods:** Thirty human extracted mandibular first molar were selected with fully formed apexes and independent mesial canals. The teeth were free of root caries, cracks and artificial alterations. After access cavity and pulp removal, a size- 10 K-file was inserted up to the apical foramen and then withdrawn 1 mm, determining the working length (WL). Mechanical glide path was performed with ProGlider (Dentsply Maillefer Ballaigues, Switzerland). Irrigation was performed with a solution of EDTA 10% and NaOCl 5%. Teeth were shaped with WaveOne Gold (Dentsply Maillefer Ballaigues, Switzerland). Then half of the samples were filled with warm gutta-percha vertical technique and half with GuttaCore. In both cases ThermaSeal Plus sealer was used to achieve an hermetic seal. Specimens were scanned after the canal obturation to perform the matching volumes and for post-treatment analysis (SkyScan, Bruker-microCT, Kontich, Belgium). Every tooth was scanned with the same parameters. The X-Ray tube was operating at 50 kV and 200 µA with 15 µm risolution and 360° rotation. An Al+Cu filter was used to suppress beam-hardening artifacts. Afterward the images were reconstructed and analyzed by NRecon and CTAn softwares (Bruker-microCT) to evaluate the area of GPFA, interfacial gaps at the filling/dentine surface and voids surrounded by filling material. The bidimensional area occupied by voids in sections of the apical 5 mm was obtained with 1 mm of distance from each other.
**Results:** both obturation systems demonstrated the ability to obtain a three-dimensional hermetic seal of the root canal system. However Guttacore system demonstrated a lower amount of cross sectional areas occupied by voids, especially in the apical 5 mm.
**Conclusion:** The reproducibility and accuracy of micro-CT for analysing root canal fillings have been well demonstrated in previous studies. This non-destructive technique provides rapid imaging of the gaps and voids present in the filled canal space and produces impressive 3-D visualisation of the orientation and continuity of these deficiencies within the filled canal. According to the literature, this study confirmed that warm vertical compaction technique is much more operator dependent than GuttaCore technique even if both ensures a good 3D filling. Due to the similar obturation quality between GuttaCore and warm vertical compaction, the GuttaCore core-carrier technique represents a valuable alternative for canal obturation.

## Immediate and residual antimicrobial efficacy of irrigants activated by cordless sonic or ultrasonic devices: an *ex-vivo* study

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**Aim:** The improvement of irrigating protocols is essential to achieve better disinfection and ensure greater residual antimicrobial activity in the root canal system. Aim of this study was to evaluate immediate and residual antimicrobial activity of irrigants activated by two different cordless devices (sonic or ultrasonic) on root canals infected by Enterococcus faecalis.
**Methods:** One hundred and ten single-rooted extracted teeth were infected with biofilm of E. faecalis. After preparation, the roots were randomly divided into six groups (n=15): 3% sodium hypochlorite (NaOCl) with EndoUltra or EndoActivator or conventional syringe irrigation without activation; sterile bi-distilled water