

# Endodontics

## Influence of Photon-Induced Photoacoustic Streaming (PIPS) on root canal disinfection and post-operative pain: a preliminary randomized clinical trial

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**Aim:** Quality of endodontic treatment is the most important factor to achieve high success rate. PIPS device was introduced as a method to improve efficiency of cleaning. It implies the use of Er:YAG laser and irrigating solutions. Potential risk of apical extrusion of infected debris during endodontic treatment, correlated with use of laser, can produce an acute inflammatory response, with postoperative pain. This clinical study evaluates the ability of PIPS Er:YAG laser to reduce the root canal bacterial count in vivo compared to traditional technique by collecting intracanal bacterial samples. Moreover, the study evaluated patients post-operative quality of life after therapy through a questionnaire filled by patients.

**Methods:** Forty eight anterior and posterior teeth with pulp necrosis and apical periodontitis were selected for endodontic treatment and randomly assigned to group A (n=24) with traditional irrigation and group B (n=24) with PIPS method applied according to protocol. Irrigation was carried out with NaOCl 5% and EDTA 10% solutions. Intracanal samples were taken before and after endodontic treatment with sterile paper points and were subjected to culture test. Values of microbial analysis were evaluated with Kolmogorov-Smirnov normality test and Mann-Whitney test ( $p < 0,05$ ). Self-

assessment questionnaire was presented to patients to evaluate postoperative pain during 7 days after therapy. Variation of quality of life's indicators were assessed with a form of analysis of variance for repeated measurements and the Student's T-test.

**Results:** The results obtained from the microbial analysis show a significant reduction of the CFU counts for both techniques in vivo, but there is no statistically significant difference between traditional method and PIPS method. In the seven days following the treatment, however, there were statistically significant differences for:  
- maximum perceived pain ( $p = 0.02$ ),  
- difficulty eating ( $p = 0.03$ ),  
- difficulty in performing usual functions ( $p = 0.02$ ),  
lower, on Day 1, for patients who underwent endodontic treatment with PIPS irrigation method. As for the other variables analyzed, such as average perceived pain, difficulty in speaking, difficulty in relationships, quality of life in general, number of pain killers taken, PIPS method seems to cause less discomfort, but the data are not statistically significant.

**Conclusion:** PIPS method and traditional method seem to be equally effective in reducing the bacterial load in vivo, but PIPS method in general seems to cause less discomfort for the patient. Therefore PIPS could represent a promising aid to root canals disinfection, especially in case of simplified operative protocols and reduced times of instrumentation.

## Metallurgical characterization of Reciproc and Reciproc Blue Ni-Ti instruments

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### Effectiveness of the phytic acid in the preparation of the post space: a confocal laser scanning microscope analysis

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**Aim:** Validate the efficacy of phytic acid (IP6) in the cleansing of the dentinal tubules during the preparation of the post space.

**Methods:** Eighty teeth were selected, single-rooted, forty with circular-shaped root canal (group A) and forty with oval-shaped root canal (group B), avulsed for orthodontic or periodontal reasons. Each group has been divided into two subgroups (A1, A2, B1, B2) each consisting of 20 elements. The elements whose roots were fractured or affected by carious lesions, reconstructions, intracanal material, resorption, calcification, lateral canals and a curvature of more than 5° evaluated with the Schneider technique were excluded. The elements were decoronated, and their length was standardized; afterwards they were shaped, cleaned and obtured. The total volume of 5.25% NaOCl used for each tooth during the root canal shaping was 12.5 ml. The subgroups A1 and B1 received, as final wash, 5 ml of a phytic acid solution (IP6); similarly the A2 and B2 subgroups were treated with a solution of 5 ml of 18% EDTA. They followed, for both, three minutes of cleansing with physiological water. After seven days, post space was prepared with Largo burs # 1-2-3 and standardized to a length of 10 mm. Subsequently, a cleansing with 5 ml IP6 of 1% was carried out for subgroups A1 and B1. For subgroups A2 and B2, a cleansing was maintained with 5 ml EDTA 18%. For both groups, the perfect cleaning and permeability of the dentinal tubules was guaranteed with a wash of 5 ml of physiological solution. The composite used for adhesive cementation was the New Techcem (Isasan, Rovello Porro - Como - Italy), to which was added, during mixing, rhodamine-B powder to be able to appreciate the distribution of cement under confocal microscope. In the first group (A), Tech 2000 full fiber post, Isasan (1.2 mm diameter) was cemented; in the second group (B) Techole, Isasan hollow fiber-reinforced post (1.2 mm external diameter, 0.5 mm inner hole diameter) was used. Three cross sections, with a thickness of 1 mm, were obtained respectively from the coronal, middle and apical third of each element, for observation under confocal microscopy. The parameters examined are the percentage of circumference (PC) showing the penetration by the cement and the maximum penetration point (MP) for each section. Using the Mann-Whitney non-parametric statistical test U, the two groups were compared, using

a significance level of 0.05.

**Results:** Comparing the elements treated with EDTA and those with phytic acid, a statistically significant difference emerges. For group A, the results were significantly higher in the elements treated with IP6 (mean PC = 83,69%; mean MP = 2061 μm) compared to those treated with EDTA (mean PC = 53,03%; mean MP = 1002 μm). Also in group B, the results are significantly higher when the cleansing occurred with IP6 (mean PC = 54,65%; mean MP = 1530 μm) rather than with EDTA (mean PC = 54,65%; mean MP = 844 μm)

**Conclusion:** Phytic acid in 1% aqueous solution guarantees a better conditioning of the root dentin compared to the traditional 18% EDTA for the purpose of adhesion. Therefore, the use of the new irrigant is preferable to EDTA in the preparation of the post-space, regardless of post used or root canal morphology.

### Evaluation of full fiber post and hollow fiber-reinforced post in two different root canal morphologies: a confocal laser scanning microscope analysis

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**Aim:** Post-endodontic restoration can be obtained with adhesively cemented fiber post. Currently, hollow and full fiber posts are used without considering a protocol adapted to root canal morphology. The aim of the study is to investigate the most appropriate type of fiber post to be cemented into root canals with circular or oval anatomy.

**Methods:** Forty teeth were used, single-rooted, twenty with circular-shaped root canal and twenty with oval-shaped root canal, avulsed for orthodontic or periodontal reasons. The elements whose roots were fractured or affected by carious lesions, reconstructions, intracanal material, resorption, calcification, lateral canals and a curvature of more than 5° evaluated with the Schneider technique were excluded. The teeth received the decoronation procedure, and their length was standardized; afterwards they were shaped, cleaned and obtured. The total volume of 5.25% NaOCl used for each tooth during the root canal shaping was 12.5 ml. The final wash was carried out with a solution of Phytic Acid (IP6) 5 ml, followed by three minutes of cleansing with physiological water. After seven days, post space was prepared with Largo burs # 1-2-3 and standardized to a length of 10 mm. Once the preparation was completed, a cleansing was performed with 5 ml of 1% phytic acid followed by 5 ml of



physiological solution, in order to guarantee the perfect cleansing and permeability of the dentinal tubules. The composite used for adhesive cementation was the New Techcem (Isasan, Rovello Porro - Como - Italy), to which was added, during mixing, rhodamine-B powder to be able to appreciate the distribution of cement under confocal microscope (LSM510 - Carl Zeiss). Both the elements with circular and oval section root canal were divided into two groups, consisting of ten elements each. In the first group, Tech 2000 full fiber post, Isasan (1.2 mm diameter) was cemented; in the second group Techole, Isasan hollow fiber-reinforced post (1.2 mm external diameter, 0.5 mm inner hole diameter). Three cross sections, with a thickness of 1 mm, were obtained respectively from the coronal, middle and apical third of each element, for observation under confocal microscopy. The parameters examined are the percentage of circumference (PC) showing the penetration by the cement and the maximum penetration point (MP) for each section. Using the Mann-Whitney non-parametric statistical test U, the two groups were compared, using a significance level of 0.05.

**Results:** For circular-shaped root canals, full fiber post proved to be significantly more effective (mean PC = 83.69%; mean MP = 2060.53  $\mu\text{m}$ ) than hollow fiber-reinforced post (mean PC = 74.52%; mean MP = 1597.80  $\mu\text{m}$ ). For oval-shaped root canals, on the other hand, the parameters analyzed were significantly better for hollow fiber-reinforced post (mean PC = 75.60%; mean MP = 1530.00  $\mu\text{m}$ ) compared to full fiber post (mean PC = 43.75%; mean MP = 1278.06  $\mu\text{m}$ ).

**Conclusions:** The data obtained from the study show how the shape of the canal influences the distribution of cement in the dentinal tubules of the root canal, in the two different cementation techniques, both as regards the percentage of penetrated circumference and the maximum penetration recorded. The hollow fiber-reinforced post showed better efficacy in the oval root canals; in round canals, the cementation protocol of the full fiber post is even more effective.

### A dynamic navigation system to prepare pulp chamber space. A new device to teach endo

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**Aim:** Design of endodontic cavities for different tooth types have remained unchanged for decades with only

negligible modifications. Access cavity preparation is one of the most important factor that influences the quantity of the residual dental substance and, consequently, the fracture strength of treated teeth. The trend of the last years in dentistry is to perform minimally invasive procedures. This is true in surgery as well as in Endodontics to minimize tooth structure removal. Dynamic navigation is an innovative technology that could be used to achieve this aim. The present study describes a new method to identify with a minimally invasive procedure the root orifices via the use of a dynamic navigation system.

**Methods:** Three human teeth extracted for orthodontic reasons were selected, cleaned and stored in distilled water at 4° C for 10 days. Samples were fixed with a light curing resin composite into a prefabricated mouth plastic model in place of the correspondent resin teeth. Two teeth were lower premolars and one was a lower molar; one of them was endodontically treated, filled with resin sealer and gutta-percha and reconstructed with resin cement and a carbon fiber- post. A markers plate for the navigation system was placed in situ by the use of Putty impression material (Ramitec, 3M ESPE, USA), according to the protocol of the navigation system manufacturer (ImplaNav, BresMedical, Sydney, Australia). The ImplaNav Navigation System was used for this step. ImplaNav consists of a software interface running in Microsoft Windows (Microsoft), which processes positional data obtained from a stereoscopic camera. The cone beam computed tomography (CBCT) scan of the model was then imported on the ImplaNav software and a 3D reconstruction model was then obtained. A registration procedure of the model for the calibration of the system was done by touching three points with the tip mounted on the handpiece. After that, the preparation of the pulp chamber cavity was performed with a diamond bur in a dynamical way by real-time navigation. The bur position was virtually followed on the navigation system screen up to reach the root entrance. Then without any other type of preparation, the access to the root canal was verified via the insertion of an endodontic manual stainless-steel instrument. Finally, a postoperative CBCT was undertaken to prove radiographically the presence of a unique hole for each root from the enamel to the root canal.

**Result:** The minimal access cavity allowed to preserve the structure integrity and allowed to localize the root canal orifices with a simplified technique. No root canal perforations, canals aberrations or instrument fractured were observed.

**Conclusion:** From this preliminary results, the dynamic navigation appears as an useful device to aid the Endodontist to identify the root canal orifices through an image fast moving guided procedure and could be employed for teaching endodontics. Further studies are necessary to validate these method.