Cold Atmospheric Pressure Plasma Treatment to Assist Bacterial Inactivation and Tooth Restoration in Endodontic Procedures

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In recent years, cold atmospheric plasma (CAP) - an ionized gas where the electronic temperature is much higher than the macroscopic plasma temperature - have raised great interest for the treatment of living tissue. A potential application of CAP is in the field of dentistry, where preliminary studies have demonstrated its potential use to improve osteointegration, dental instrument cleaning, adhesive polymerization, tooth bleaching, root canal disinfection and other purposes. The present study aims to investigate the use of an innovative and handheld DBD-jet plasma source, properly designed to be translated to the clinical environmentand in a realistic endodontic procedure for the disinfection and restoration of root canals.

Root canal disinfection experiments have been performed on tooth models and were designed to also address: i) the influence of the humidity of the root canal on the treatment efficacy ii) the possibility of employing plasma activated liquids with antibacterial properties as irrigants.

On the side of endodontic restoration in the coronal region, the adhesive-dentin interface has been well recognized as the weaker area for dental composite resin restoration; the improvement, through the development of new materials and techniques, of its characteristic is essential to extend the longevity of dental restorations. To evaluate the enhancement of adhesive properties induced by CAP treatment of dentin, a push-out analysis is carried out on extracted teeth, where the shape of the root-canal has been standardized, using EDTA and phytic acid as etching reagents.

Finally, the restoration of the apical region of root canal aims at avoiding a new bacterial colonization in the tooth apex. Filling materials such as guttapercha, are generally used to completely seal the root apex, but they are characterized by low adhesive performances; thus, endodontic cements, known as sealers, are generally applied despite their cytotoxicity to improve the adhesion with dentine. The present study investigates the enhancement of adhesion between these materials and apical dentine of ex-vivo teeth treated by a DBD-jet plasma sourceby means of pushout tests and confocal microscopy analysis.

Although investigations on long-term stability of adherent monoblock to dentine surface and clinical studies are required, the present study supports the exploitability of cold plasma devices in real-life endodontic clinics.

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