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Novel Electrospun Polymeric Nanofibers Loaded Different Medicaments as Drug Delivery Systems for Regenerative Endodontics

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Abstract : Background: A combination of antibiotics, including metronidazole (MET), ciprofloxacin (CIP), and minocycline (MINO), has been demonstrated to disinfect bacteria in necrotic teeth before regenerative processes. It has been presented clinically that antibiotic pastes may drive to possible stem cell death and difficulties in removing from the canal system, which can limit the regenerative procedure. This study was designed to (1) synthesize nanofibrous webs containing various concentrations of different medicaments (triple, double, and calcium hydroxide,Ca(OH)2), and (2) coat thiselectrospun fibrous gutta-percha (GP) cones. Methods: Poly(vinylpyrrolidone) (PVP)-based electrospun fibrous webs were processed with low medicaments concentrations. Scanning Electron Microscopy (SEM), Energy Dispersive X-Ray Spectroscopy (EDX), and X-Ray Photoelectron Spectroscopy (XPS) were carried out to investigate fiber morphology, antibiotic incorporation, and characterized GP-coated fibrous webs, respectively. The chemical and physical properties of dentine were carried out via Fourier Transform Infrared Spectroscopy (FTIR) and Nano-SEM, respectively. The antimicrobial properties of the different fibrous webs were assessed against various bacteria by direct nanofiber/bacteria contact. Cytocompatibility was measured by applying the MTT method. Results: The mean fiber diameter of the experiment groups of medicament-containing fibers ranged in the nm scale and was significantly smaller than PVP fibers. EDX analysis confirmed the presence of medicaments in the nanofibers. XPS analysis presented a complete coating of the fibers with GPs; FTIR and Nano-SEM showed no chemical and physical configuration of intracanal medicaments on the dentine surface. Meanwhile, nanofibrous webs led to a significant reduction in the percentage of viable bacteria compared with the negative control and PVP. Conclusion: Our findings suggest that TA-NFs, DA-NFs, and $C_a(OH)_2$)-NFs coated GP cones have significant potential in eliminating intracanal bacteria, cell-friendly behavior, and clinical usage features.

Keywords : drug delivery, drug carrier, electrospinning, nano/microfibers, regenerative endodontic, morphology
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