University of Mosul
College of Dentistry

Evaluation of Iron Oxide Nanoparticles as a Root Canal Irrigating Solution (An in vitro Study)

A Thesis

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ABSTRACT

Objectives: This investigation aimed to evaluate the cytotoxicity and antibacterial effect of different concentrations of iron oxide nanoparticles (IONPs) in combination with hydrogen peroxide (H_2O_2) in *vitro* as a new antimicrobial endodontic treatment. **Materials and Methods**: For evaluating cytotoxicity, human dermal fibroblast (HDFn) cell line was exposed to different concentrations (٨, ٤, ٢, ١, ٠,٥, and ٠,٢٥ mg/ml) of IONPs with ٣٪ H_2O_2. Cytotoxicity was assessed after ١٠ minutes of exposure using the Mosmann's Tetrazolium Toxicity (MTT) assay. For Minimum inhibitory concentration (MIC) and Minimum bactericidal concentration (MBC) technique, the tested irrigants (IONPs+H_2O_2, IONPs, ٣٪ H_2O_2, ٥,٢٥٪, NaOCl) were serially diluted in brain heart infusion (BHI) broth and ١٠٠ µl of standard microbial suspensions of *Enterococcus faecalis* (*E. faecalis*) were added. The obtained results were based on the turbidity and growth on agar plates. For the antibacterial effect, sixty human extracted single-rooted teeth samples were prepared using the protaper NiTi rotary system. The apical foramen of each sample was sealed by composite resin restorative material on the outer apical ٣mm. Each root was embedded in the silicon impression material block and autoclaved. ١٠ µl (١,٥*١٠^{٨}) of *E.faecalis* suspension was injected inside the canals of all the tested groups and incubated for ٧٢ hrs. The teeth were then randomly divided into five experimental groups (n=١٢). In Group I: IONPs (٠,٥ mg/ml) + ٣٪ H_2O_2, Group II: IONPs (٠,٥ mg/ml), Group III: (٣٪ H_2O_2), Group IV: (positive control, ٥,٢٥٪ NaOCl), Group V: (negative control, distilled water). Canal disinfection was followed by taking the intracanal bacterial samples for counting the colony-forming units. **Results:** For cytotoxicity, Tukey's test indicated that no significant difference was seen in the cell viability at lower concentrations (٠,٢, ٠,٥, ١, and ٢ mg/ml). While at the concentration of ٤ and ٨ mg/ml, the cell viability was not significantly

different from each other but, they were significantly different from previous concentrations. MIC and MBC tests revealed that IONPs+H_2O_2 showed to be more effective against *E. faecalis* than IONPs, ٣٪ H_2O_2, ٥,٢٥٪ NaOCl. NaOCl exhibited an antibacterial effect equivalent to that of H_2O_2, while IONPs alone exhibited a stimulatory growth at the high tested concentration. For the antibacterial test, the data of Bonferroni test for the tested groups revealed that no statistically significant difference was found between IONPs+ H_2O_2 and NaOCl, also, the tabulated data indicated that there was no significant difference between IONPs+ H_2O_2 and IONPs alone. Contrarily, IONPs+ H_2O_2 was significantly different from H_2O_2 alone and distilled water ($P< ٠,٠٠١$) for both. **Conclusions**: Within the limitation of this study, the use of IONPs+ H_2O_2 as an irrigating solution had a promissing effect on the reduction of microbial colonies of *E. faecalis* both in planktonic and biofilm in comparison to other experimental groups. Also, IONPs+H_2O_2 proved to be non-cytotoxic to HDFn at the same concentration shown by root canal irrigant for antibacterial action.