Evaluation of Antibacterial and Cytotoxicity Properties Of Bulk fill Composite Resins Containing Nanoparticles Of (Ag/ZnO/ 4A zeolite و TiO_2/ZnO/ 4A zeolite)

Abstract

Introduction: Nowadays, many efforts are made to create antibacterial properties in composites in order to prevent secondary decay and as a result, the failure of composite restorations. Studies show that nanoparticles allow more reaction with microorganisms and increase antibacterial activity. For example, silver, zinc, titanium oxide and ZnO have antibacterial properties. In addition,by adding materials to the composition of composites, efforts are made to reduce their cytotoxicity effects. According to studies, the use of metal oxide in combination with zeolite increases the antibacterial property and reduces the cytotoxicity of nanocomposites.Therefore, this study was conducted with the aim of investigating the antibacterial properties and cytotoxicity of bulk-fill composite resins containing nanoparticles (Ag/ZnO/4A zeolite and TiO2/ZnO/4A zeolite).

Materials and Methods: In this study, after combining nanoparticles with bulk-fill flow composite using a high-speed mixer, the synthesized nanocomposites were divided into 5 groups (bulkfill composite without nanoparticles, bulkfill nanocomposites (Ag/ZnO/4A zeolite) with 3% and 6% by weight and (TiO2/ZnO/4A zeolite) 3 and 6% by weight) were divided. Composite resins prepared in the form of discs were exposed to Streptococcus mutans bacteria. Then the antibacterial activity of the components was checked using the agar disk diffusion method. Then, the cytotoxicity property was also determined using the MTT test in 13 groups (bulkfill composite without nanoparticles, bulkfill nanocomposites (Ag/ZnO/4A zeolite) and (TiO2/ZnO/4A zeolite), each 3% and 6% weight and concentrations of 60, 40 and 80 micrograms) were investigated. SPSS version 25 software was used to analyze the data. Data analysis was done with descriptive statistical tests and analytical statistics (independent t-tests, one-way analysis of variance and Pearson's correlation) ($P<0.05$).

Results: Bulkfill composite containing (Ag/ZnO/4A zeolite) and (TiO2/ZnO/4A zeolite) with 6% and 3% by weight, has led to a decrease in bacterial colonies compared to the control group. Also, the reduction of bacterial colonies in (TiO2/ZnO/4A zeolite) bulk-fill nanocomposites was higher than (Ag/ZnO/4A zeolite) bulk-fill nanocomposites. In addition, the antibacterial properties of nanocomposites increased with the increase in the weight percentage of nanoparticles. According to the results of cytotoxicity, the toxicity increases with increasing the percentage of nanoparticles, but still the cell death is less than 30%. which shows the non-toxicity of nanoparticles in all percentages and concentrations. Tests were performed at concentrations of 40

micrograms, 60 micrograms and 80 micrograms for all percentages. Even at the concentration of 80 micrograms, about 75% of the cells survive, which indicates the high survival of the cells.

Conclusion: According to the results obtained from the current study, adding zinc oxide, titanium oxide, and silver nanoparticles into the 4A zeolite network to the composite composition gives it antimicrobial properties. The results of the MTT test showed that the toxicity of the synthesized nanoparticles increases with increasing concentration, however, even at high concentrations, the survival rate remained above 70%, which indicates that the nanoparticles are non-toxic in the all percentages investigated in this study.

Keywords: antibacterial, cytotoxicity, bulk fill composite resin, nanoparticle