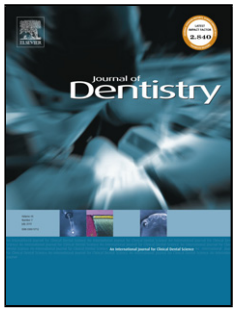

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Author: Nidal W. Elshereksi Mariyam J. Ghazali Andanastuti Muchtar Che H. Azhari

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<AT>Studies on the effects of titanate and silane coupling agents on the performance of poly (methyl methacrylate)/barium titanate denture base nanocomposites

<AU>Nidal W. Elshereksi[a,b], Mariyam J. Ghazali[a], Andanastuti Muchtar[a] , and Che H. Azhari[a,*]
<AU>

<AFF>[a]Department of Mechanical & Materials Engineering, Faculty of Engineering & Built Environment,Universiti Kebangsaan Malaysia (UKM), 43600 Bangi, Selangor, Malaysia
<AFF>[b]Department of Dental Technology, College of Medical Technology, P.O.Box: 1458 Misurata, Libya

<PA>Che H. Azhari, Department of Mechanical & Materials Engineering, Faculty of Engineering & Built Environment, Universiti Kebangsaan Malaysia (UKM), Malaysia. *Email: husna.azhari@gmail.com(Che H. Azhar)*.

<ABS-HEAD>Abstract

<ABS-P><ST>Objectives</ST> This study aimed to fabricate and characterise silanated and titanated nanobarium titanate (NBT) filled poly(methyl methacrylate) (PMMA) denture base composites and to evaluate the behaviour of a titanate coupling agent (TCA) as an alternative coupling agent to silane. The effect of filler surface modification on fracture toughness was also studied.
<ABS-P>

<ABS-P><ST>Methods</ST> Silanated, titanated and pure NBT at 5% were incorporated in PMMA matrix. Neat PMMA matrix served as a control. NBT was sonicated in MMA prior to mixing with the PMMA. Curing was carried out using a water bath at 75 °C for 1.5 h and then at 100 °C for 30 min. NBT was characterised via Fourier transform-infrared spectroscopy (FTIR), Transmission Electron Microscopy (TEM) and Brunauer–Emmett–Teller (BET) analysis before and after surface modification. The porosity and fracture toughness of the PMMA nanocomposites ($n = 6$, for each formulation and test) were also evaluated.
<ABS-P><ST>Results</ST> NBT was successfully functionalised by the coupling agents. The TCA exhibited the lowest percentage of porosity (0.09%), whereas silane revealed 0.53% porosity. Statistically significant differences in fracture toughness were observed among the fracture toughness values of the tested samples ($p < 0.05$). While the fracture toughness of untreated samples was reduced by 8%, an enhancement of 25% was achieved after titanation. In addition, the fracture toughness of the titanated samples was higher than the silanated ones by 10%.
<ABS-P>

<ABS-P><ST>Conclusion</ST> Formation of a monolayer on the surface of TCA enhanced the NBT dispersion, however agglomeration of silanated NBT was observed due to insufficient coverage of NBT surface. Such behaviour led to reducing the porosity level and improving fracture toughness of titanated NBT/PMMA composites. Thus, TCA seemed to be more effective than silane.
<ABS-P>*Clinical significance:* Minimising the porosity level could have the potential to reduce fungus growth on denture base resin to be hygienically acceptable. Such enhancements obtained with Ti-NBT could lead to promotion of the composites' longevity.

<KWD>Keywords: Polymer composite; nanoparticles; coupling agents; dental materials; interphase; porosity; fracture toughness

<H1>1. Introduction

A strong bond between the inorganic filler particles and the organic resin matrix during settling is crucial to obtain dental composites with an excellent clinical performance. This phenomenon is achieved through