THE INFLUENCE OF ORIENTATION AND PARTICLE SIZE ON THE INTERFACE FRACUTURE OF A BONE-NANOCOMPOSITE CEMENT

Igor Ilik[1], Morshed Khandaker[1]

[1] Department of Engineering and Physics, University of Central Oklahoma, igorilik@yahoo.com

***Abstract* – Clinical follow-up studies in cemented total hip arthroplasties found that femoral prosthesis loosening is caused by the fracture of the bone-cement interfaces. The research objectives were to determine whether orientation of the bone has any influence on the interface fracture strength, and to determine whether inclusion of micro/nano sizes MgO particles on Cobalt™ HV bone cement has any influence on the interface fracture strength. Flexural tests were conducted on five groups of specimens to find Young Modulus and bending strength: (1) longitudinal bone, (2) transverse bone, (3) pure cement particles, (4) cement with 36 µm and 27 nm MgO particles, and (5) cement with 27nm MgO particles. Also, fracture tests were conducted on six groups of bone-cement specimen to find interface fracture toughness: (1) longitudinal bone-cement without MgO particles, (2) transverse bone-cement without MgO particles, (3) longitudinal bone-cement with 36 µm MgO particles, (4) transverse bone-cement with 36 µm MgO particles, (5) , longitudinal bone-cement with 27 nm MgO particles, and (6) transverse bone-cement with 27 nm MgO particles. Transverse bone specimen was 14% stiffer than longitudinal specimen, while bending strength and fracture toughness of longitudinal specimen was 29% and 2.6 times lower than the transverse specimen, respectively. Reduction of Young's modulus (7.3%), bending strength (27%) and fracture toughness (16%) was observed by the inclusion of microsize MgO particles, and a reduction of the Young's Modulus (19%), bending strength (21%),and fracture toughness (19%) for nanosize MgO particles. The interface toughness of the transverse bone infused with 27nm MgO was about 6 times higher than transverse bone infused with 36 µm particles of MgO. Preliminary studies show that orientation of the bone has significant influence on the interface fracture. MgO particles size have a significant effect on the strength of the bone - cement interface.**