

عنوان مقاله:

Comparative Evaluation of Carbon Reinforced Polyetherketone Acetabular Cup using Finite Element Analysis

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خلاصه مقاله:

Background: Patients suffering from osteoarthritis undergo surgery to replace hip joints with hip prosthesis implants. Today most acetabular cups of hip prostheses are made of Ultra-High-Molecular-Weight-Polyethylene. However, these materials acting as acetabular cups of the implant have been recalled since patients have been feeling uncomfortable and abstained from physical activities. A newly introduced material, ۳۰% Carbon Reinforced Polyetherketone, possess better isotropic mechanical properties and lower wear rates. Objective: The research aims to compare the von-Mises stresses and deformation in static and dynamic loading of Ultra-High Molecular-Weight-Polyethylene to ۳۰% Reinforced Carbon Fiber Polyetherketone using Finite Element Analysis. Material and Methods: An analytical study was performed to evaluate material selection and their contact performances of acetabular cups. Four pairs have been analyzed under loading conditions following ASTM F۲۹۹۶-۱۳ and ISO ۷۲۰۶-۴ standards. The acetabular cups options are made of ۳۰% Carbon Reinforced Fiber Polyetherketone or Ultra-High-Molecular-Weight-Polyethylene. Besides, the femoral head and steam options are either Alumina Ceramic or Cobalt Chrome Molybdenum. Results: The yield strength of Ultra-High-Molecular-Weight-Polyethylene is considerably small, resulting in the acetabular cup to fail when applied to high loading conditions. Carbon Reinforced Polyetherketone with Alumina Ceramic yielded ۶۵% lower deformation at stumbling phase. Conclusion: Since the study focuses on linear isotropic material properties, Alumina Ceramic dominates a higher elastic modulus than Cobalt Chrome Molybdenum, nominating it the best fit combination for lower von-Mises stresses, acting on the Carbon Reinforced Polyetherketone acetabular cup.

کلمات کلیدی:

Hip Prosthesis, Carbon Fiber, Acetabular Cup, Dynamic and Static Contact, Finite Element Analysis, Acetabulum

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