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Can we improve shear stability of intramedullary nail for the fixation of distal tibial fractures?

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Potential for malalignment is the main disadvantage of IM nailing, which can occur mainly as a result of reduced bone-implant contact at the distal quarter and high shear interfragmentary movements (IFM). The goal of this study was to evaluate the performance of a new designed IM nailing system in which an extra screw could be inserted right above the fracture gap. For this purpose, a three-dimensional finite element model of tibia-nail system was constructed by considering a 3mm transverse gap at the distal quarter. Physiological boundary conditions were applied, and three different materials, i.e. stainless steel, titanium, and carbon/epoxy, were assumed for the IM nail. The von Mises stress, interfragmentary movements, and the specific production of different tissue phenotypes were obtained to make a comparison among different bone-nail constructs. Results of this study showed that inserting an extra screw above the fracture gap can cause a dramatic reduction in the shear IFM. However, since axial IFM mainly occurred as a result of bony fragments' tilting, insertion of extra screw also restricted axial movements. Thus, in order to preserve stimulatory axial micromotion, the proposed design is recommended when an IM nail with a low young modulus, such carbon/epoxy, is used. The finite element model was validated with the results of in vitro tests on cadaver.

Biography

Gholamreza Rouhi received his BSc and MSc degrees from Sharif University of Technology, and his PhD from the University of Calgary for his investigations on bone remodelling and resorption theories. After earning his PhD degree, he joined University of Ottawa, Canada, as Assistant Professor. He then moved back to Iran and was recruited by Amirkabir University of Technology (AUT). He is involved in various projects including: Bone fracture healing; bone remodelling theories; bone-implants interaction; orthopaedic implants and prostheses; and biomechanics of articularcartilage. He is now the Director and Principal Investigator of Orthopaedic & Dental Biomechanics Lab at AUT.

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