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Modelling of patient-specific femur with osteogenesis imperfecta to determine the fracture risk under various loads (Article)

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Abstract

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Osteogenesis imperfecta (OI) is a fragile bone disease characterized by easy fractures. The femur consists of cortical and cancellous bone, each with different mechanical properties. Bone fractures often occur throughout patients' lifetime. However, doctors still have no quantitative method to predict fractures. Therefore, this project's purpose is to investigate the OI femoral fracture risk to help prevent fractures. The project consists of three sections; cortical and cancellous segmentation, reconstruction of 3D OI femoral model and finite element analysis (FEA) of the OI femur to obtain fracture risk. The fracture risk in daily activities and the fracture load were examined. All the stress values were judged by the fracture criteria, assumed as 115 MPa. The exercises that exerted force more than 6 times of body weight can cause fractures. In addition, the optimal compressive force and tensile force were 919.7 N and 912.1 N, respectively, while medial and lateral impact were 230.8 N. Cancellous bone was not affected even a fracture happen. Based on these findings, we can conclude that when the OI femur is subjected to lateral or medial forces, the femur breaks easily. The bone can be reconstructed into a solid body without having to separate bone into cortical and cancellous.

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SciVal Topic Prominence ⓘ

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Prominence percentile: 94.659 ⓘ

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