ABSTRACT
INJURY RISK ASSESSMENT OF THE FEMUR IN CHILDREN WITH OSTEOGENESIS IMPERFECTA

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Osteogenesis imperfecta (OI) is a genetic disorder characterized by increased bone fragility and decreased bone mass, which leads to high rates of bone fracture. OI has a prevalence of 1/5,000 to 1/10,000 in the United States. About 90% of persons with OI have a genetic mutation in the coding for collagen type I, which is the major protein of connective tissues, including bone. While its prevalence classifies it as a rare disease, it is the most common disorder of bone etiology. Until recently, little was known about the mechanics and materials of OI bone or their impact on fracture risk. Fracture risk is typically characterized by clinical type and radiographs. Finite element (FE) models have recently been developed to examine fracture risk during ambulation and various daily activities of the femur and tibia in children and adolescents with OI.

This research aims to provide further information about the impact of OI in children and adolescents during loading conditions. FE models of the femur with normal bone, OI type I (mild) bone and OI type III (severe) bone material properties were developed and analyzed. The goal of these models was to determine the effects of lateral bowing versus increased gluteus medius and gluteus maximus force production on bone injury risk. Along with FE models, quantitative gait analyses were performed on 10 children with mild OI and ten age- and gender-matched controls to analyze the firing patterns of the gluteus medius and gluteus maximus muscles during normal ambulation. Additional FE models examined the impact of creating the model directly from a CT scan of a child with severe OI versus scaling a standard model to match the size and shape of and OI femur based on x-ray images alone.