Precision Analysis of Patient-Specific Bone Mechanics: Orthopedic Care through 3D Image-Based Modeling

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Abstract

Accurate assessment of the mechanical status of patient bones is crucial for selecting surgical strategies and ensuring postoperative recovery in orthopedic disease treatment. Due to the complexity of bone structures and significant interindividual variability, coupled with limitations in current in vivo bone characterization techniques, effectively analyzing the stress state of patient bones has become a pressing issue in the field of medical engineering integration. The utilization of finite element methods based on medical CT imaging offers a novel perspective by simplifying bone models, thus facilitating individualized biomechanical analysis of bones. This approach not only enhances the precision of analysis but also provides scientific recommendations for postoperative patient recovery, aiding clinicians in more accurately assessing surgical outcomes. In this presentation, I will elaborate on the complete technical process of reconstructing simplified bone models from medical CT images and demonstrate through specific cases how mechanical analysis can be effectively integrated into medical procedures. Through this discussion, the aim is to underscore the crucial role of mechanical analysis in orthopedic disease treatment and provide insights for further research and clinical applications in related fields.

Keywords: 3D CT, Bone mechanics, Orthopedic care