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FINITE ELEMENT ANALYSIS OF STRESS DISTRIBUTION AND DISPLACEMENT IN THE HUMAN KNEE JOINT: ENHANCING OSTEOARTHROSIS DIAGNOSIS

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Abstract

In the context of sustainable healthcare systems and the growing need to reduce the environmental and economic burden associated with chronic degenerative diseases, this study addresses the development of non-invasive and resource-efficient diagnostic approaches for knee osteoarthrosis. The knee joints of humans undergo continuous degradation with aging, often resulting in the onset of osteoarthrosis (OA) accompanied by significant functional impairments. The non-invasive early diagnosis of this disorder through vibroarthrography (VAG) necessitates the acquisition and signal processing of vibroacoustic signals obtained from the knee joint during repeated flexion and extension movements of the leg. Establishing the optimal diagnostic procedure for the knee joint requires determining the requisite movements to derive significant diagnostic parameters from VAG signals, with a particular focus on the maximum contact pressure in the knee joint for various positions between the tibia and femoral bones. This paper presents a finite element analysis (FEM) of a human knee joint, emphasizing the critical movements that must be incorporated into the optimal non-invasive diagnostic procedure for OA, with a specific emphasis on the assessment of maximum contact pressure. Overall, the findings support the advancement of sustainability-oriented healthcare by enabling early diagnosis, reducing reliance on invasive procedures, and contributing to more efficient use of medical resources

Key words: bioengineering, diagnosis, FEM analysis, knee joint, osteoarthrosis

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