

A method to investigate the biomechanical alterations in Perthes' disease by hip joint contact modeling - DTU Orbit (09/11/2017)

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Perthes' disease is a destructive hip joint disorder characterized by malformation of the femoral head in young children. While the morphological changes have been widely studied, the biomechanical effects of these changes still need to be further elucidated. The objective of this study was to develop a method to investigate the biomechanical alterations in Perthes' disease by finite element (FE) contact modeling using MRI. The MRI data of a unilateral Perthes' case was obtained to develop the three-dimensional FE model of the hip joint. The stress and contact pressure patterns in the unaffected hip were well distributed. Elevated concentrations of stress and contact pressure were found in the Perthes' hip. The highest femoral cartilage on Mises stress 3.9 MPa and contact pressure 5.3 MPa were found in the Perthes' hip, whereas 2.4 MPa and 4.9 MPa in the healthy hip, respectively. The healthy bone in the femoral head of the Perthes' hip carries additional loads as indicated by the increase of stress levels around the necrotic-healthy bone interface. Identifying the biomechanical changes, such as the location of stress and contact pressure concentrations, is a prerequisite for the preoperative planning to obtain stress relief for the highly stressed areas in the malformed hip. This single-patient study demonstrated that the biomechanical alterations in Perthes' disease can be evaluated individually by patient-specific finite element contact modeling using MRI. A multi-patient study is required to test the strength of the proposed method as a pre-surgery planning tool.

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