MORPHOLOGY AND MECHANICS OF HIP DYSPLASIA PRE- AND POST-OPERATIVELY

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Hip dysplasia is the misalignment of the bones of the hip joint and is common in thousands of children and adults. When a person has hip dysplasia, the femoral head and acetabulum will rub against each other in an abnormal way, causing early cartilage deterioration. The commonly accepted surgical treatment for hip dysplasia, before significant cartilage damage, is periacetabular osteotomy (PAO). During PAO, the surgeon fractures the pelvic bone in three places carving the acetabulum free of the pelvis. The acetabulum is then rotated into a better position so that it increases coverage of the femoral head. The rationale of PAO is that by increasing the load-bearing surface of the joint, pressures on the cartilage decrease. However, no experimental studies have validated this claim, due to the fact that it is not possible to measure the cartilage pressure in the native hip joint during daily activities.

Our research is designed to better understand the effects of hip dysplasia and the resulting surgery through the assessment of hip joint mechanics. From computed tomography (CT) images we generate 3D surfaces of a patient's bones and cartilage. Once we have a 3D depiction of the joint, we can construct a computer generated biomechanically active joint. This entails generating patient-specific meshes from cartilage and bone surfaces that can be input to finite element simulations. This simulates the interaction of the bones and cartilage during daily activities such as walking up and down stairs and standing up from a chair. The output from finite element models describes the mechanics of the joint through measures including cartilage pressures and contact area.