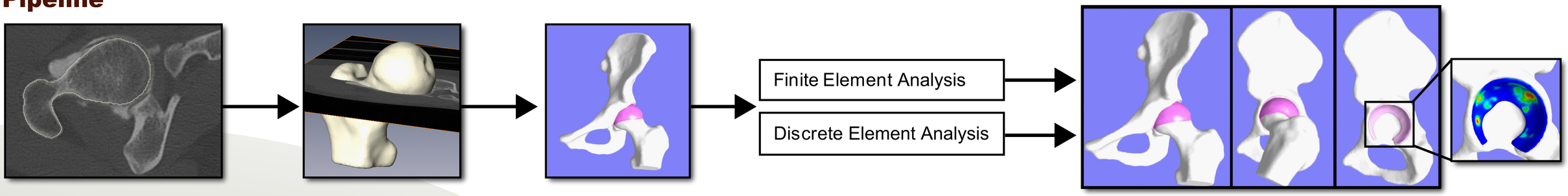
Subject-specific Computational Modeling of Normal and Dysplastic Hips

Michael Harris, Corinne Henak, Christine Abraham, Benjamin Ellis, Andrew Anderson, Jeffrey Weiss

Pipeline



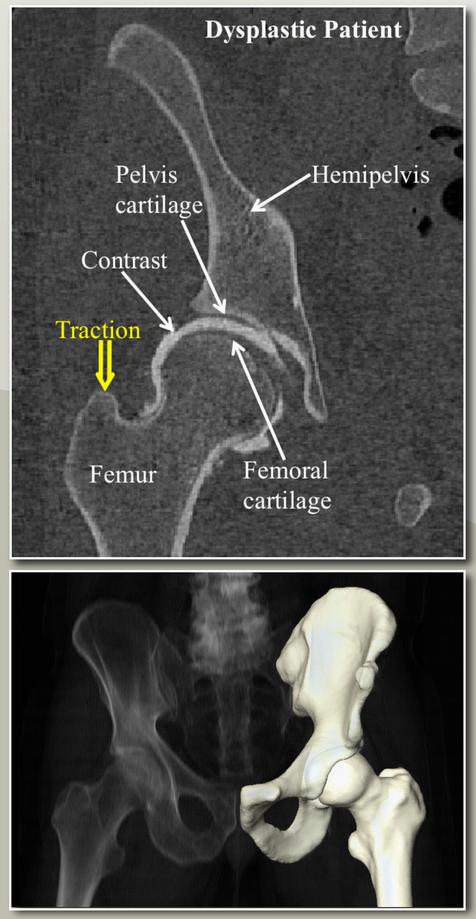
Hip Dysplasia

Acetabular dysplasia may be the leading cause of premature osteoarthritis (OA) of the hip, a degenerative joint disease. Hip OA affects ~9% of the US population.

While it is thought that mechanical factors are the link between dysplasia and OA, clinical studies cannot determine the mechanics of the dysplastic hip.

CT arthrogram captures three-dimensional hip geometry. Image data are segmented using a combination of automatic and manual methods.

Subject-specific 3D reconstruction of bony geometry, overlaid on volumetric CT data. Incorporating subject-specific geometry into models produces more accurate predictions of cartilage contact stresses [Anderson et al., 2008 *J Biomech Eng*].

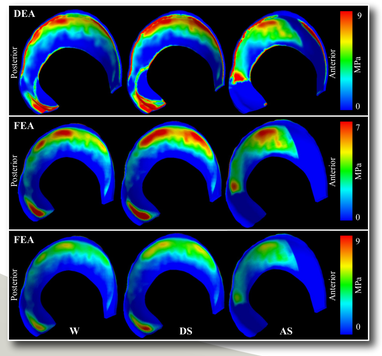


Patient-specific hip joint computational models

Patient-specific finite element or discrete element analysis is used to determine contact stresses in the hip joint during simulated activities of daily living. These methods improve the understanding of the biomechanics of normal and dysplastic hips.

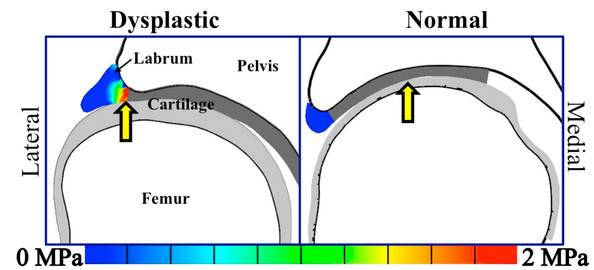
Patient-specific hip joint computational models also have a number of potential longer-term uses and benefits, including patient-specific approaches to treatment and prediction of the long-term success rate of corrective surgeries based on pre- and post-operative mechanics.

Discrete Element Analysis (DEA) Method for Predicting Hip Contact Stresses



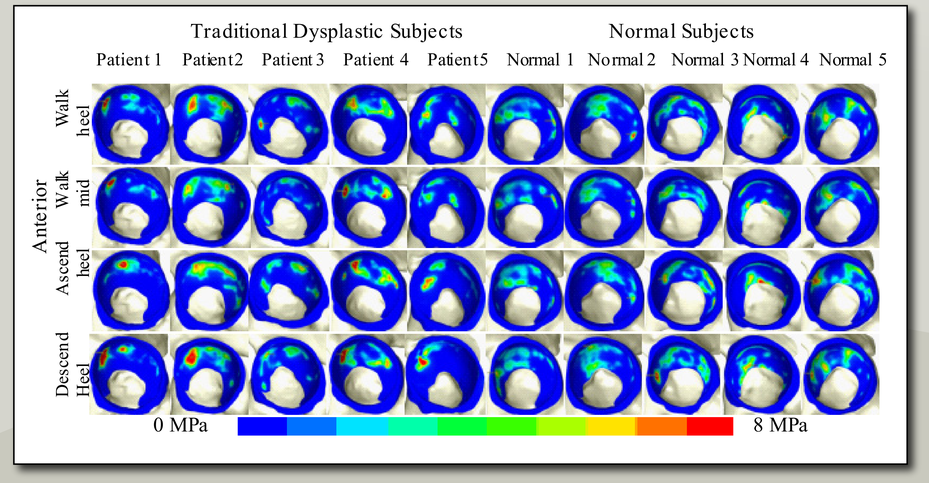
Contact stress patterns correspond well between DEA and FE models.

Finite Element (FE) Predictions of Labrum and Cartilage Mechanics in Dysplastic Human Hips



The location of contact was centered more laterally in dysplastic subjects than in normal subjects during some activities of daily living.

Initial results indicate altered contact mechanics in dysplastic hips when compared to normal hips. The labrum in dysplastic hips had significantly larger contact areas in all simulated activities, and supported significantly more load in most activities. Peak pressures in the superolateral region were larger in dysplastic hips for half of the activities and average pressures in the anteromedial region were larger in the normal hips for most activities.



SCI INSTITUTE • EXHIBIT • EXPLORE • EXCITE • EXPERIENCE • EXCHANGE • SCIX

THE UNIVERSITY OF UTAH

SCI www.sci.utah.edu

MRL