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Altered Biomechanics of a Perthes' Hip Investigated by Contact Modeling

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Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):
Salmingo, R. A., Skytte, T. L., Traberg, M. S., Mikkelsen, L. P., Henneberg, K-Å., & Wong, C. (2014). Altered Biomechanics of a Perthes' Hip Investigated by Contact Modeling. Abstract from 7th World Congress of Biomechanics, Boston, MA, United States.

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M303 A Method for Validation of Finite Element Models in Scoliosis Bracing Simulation

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M304 Do Biomechanical Exam Variables Predict Response to Conservative Treatment of Non-Chronic Plantar Fasciitis?

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M305 A Bandwidth Limitation in Joint Motion Simulator Control

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M306 Effects of ligature pretension in interspinous process spacer on stability and spinous process fracture risk

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M307 Application of computational lower extremity model to investigate muscle activities and joint force patterns in knee osteoarthritis patients during walking

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Kyung Hee University, Yongin, REPUBLIC OF KOREA.

M308 Altered Biomechanics of a Perthes' Hip Investigated by Contact Modeling

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M309 Caliper Method vs Digital Photogrammetry for Assessing Arch Height Index in Pregnant Women

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M310 The Effect of Different Thumb Orthoses on Thumb Stabilization and Hand Function in Individuals with Carpometacarpal Osteoarthritis

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M311 Loading rate during gait and stair descent for individuals with focal cartilage defects in the knee

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M312 Altered Landing Mechanics in Professional Athletes with Patellofemoral Pain

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M313 Understanding Knee Functionality: Simultaneous Assessment of Whole Body Kinematics, Videofluoroscopic Tibiofemoral Implant Kinematics, EMG and Ground Reaction Forces during Daily Activities

P. Schütz, H. Gerber, M. Hitz, S. Ferguson, W. R. Taylor, R. List;
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M314 The Effect of Bone Preparation on Cementless Femoral Component Micromotion in Total Knee Arthroplasty

A. Gopalakrishnan, E. Hamp; Stryker Corporation, Parsippany, NJ.

M315 A Comparison of Upper Extremity Joint Demands during Pediatric Lofstrand Crutch and Walker-Assisted Gait

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M316 A Method for Assessing Accuracy in Tracking Foot Bones with Biplanar Videoradiography

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M317 A Preliminary Evaluation of Shoulder Mechanics Using a Novel Wheelchair: The Influence of Pain

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University of Florida, Gainesville, FL.



Presentation Abstract

Session: Monday General Poster Session

Presentation: **Altered Biomechanics of a Perthes' Hip Investigated by Contact Modeling**

Presentation Time: **Monday, Jul 07, 2014, 11:00 AM - 9:30 PM**

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Abstract: Introduction

Perthes' disease is one of the most common hip disorders in young children characterized by malformation of the femoral head. Several studies have investigated the biomechanical alterations of Perthes' disease using Finite Element Analysis (FEA), however, most of them were 2D models and lack patient-specific details of the cartilage and necrotic bone. Thus, the objective of this study was to investigate the altered biomechanics of a Perthes' hip joint by finite element contact modeling using MRI to develop the patient-specific model of the cartilages and bones.

Methods

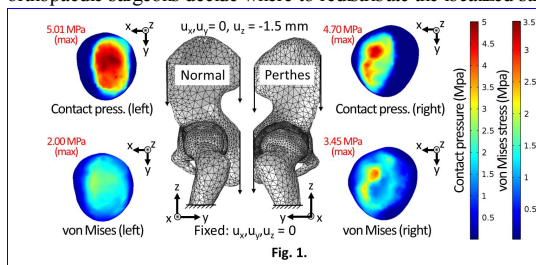
The MRI data of both hips of a unilateral Perthes' case was obtained to segment the bones and cartilages using Simpleware. A 3D point cloud data of the segmented parts were exported to SolidWorks to build the 3D models. FEA was performed using Comsol 4.3b. The same Poisson's ratio 0.30 was set for the femoral, pelvic and necrotic bones. The Poisson's ratio 0.35 was set for the femoral and acetabular cartilages. The elastic modulus for the pelvis, femur, cartilages and necrotic bone were, 5 GPa, 500 MPa, 50 MPa and 20 MPa, respectively. For the loading conditions, the distal part of the femur was fixed while the pelvis was displaced 1.5 mm downwards in the axial direction (Fig. 1).

Results

The results show that the contact pressure in the femoral cartilage of normal hip (left) is more distributed than the Perthes' hip (right) (Fig. 1). Since the elastic modulus of the femur is higher than the necrotic bone in the affected hip, the maximum contact pressure 5.01 MPa was found in the normal hip (4.70 MPa for Perthes' hip). The von Mises stress distribution of the femoral cartilage was more localized in the Perthes' hip (3.45 MPa max.), i.e. where the junction of the necrotic and normal bone is located below the femoral cartilage.

Conclusion

In this study, we have found out that the increase and localization of stress significantly altered the biomechanics of the hip joint. This knowledge will help orthopaedic surgeons decide where to redistribute the localized stresses and thus important in the treatment planning of Perthes' disease .



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