SSOT 2013 Paper Submission

Hip Range of Motion in Everyday Life

P. Christofilopoulos[1], S. Chagué[2], J. Schmid[3], P. Hoffmeyer[1], C. Charbonnier[2]

[1]Orthopedics and Trauma Service, University Hospitals of Geneva, [2]Medical Research Department, Artanim Foundation, [3]Geneva Health School (HEdS), HES-SO, Geneva, Switzerland

Introduction

To date, there is no clear consensus as to the amplitude of movement of the "normal hip". Knowing the necessary joint mobility for everyday life is also important to understand different pathologies and to better plan their treatments (correct implant positioning in total hip arthroplasty, define amount of bone resection in the treatment of femoroacetabular impingement, planning of reorientation osteotomies, etc.). To address these questions, we performed a preliminary study that aims at defining in a precise way the necessary hip joint mobility for everyday tasks based on the coupling of MR imaging and optical motion capture.

Methods

Motion capture and MRI was carried out on 4 healthy volunteers (mean age, 28 years). A morphological analysis (alpha angle, acetabular depth and version, etc.) was performed to assess any bony abnormalities. Motion from the subjects were acquired during routine activities (stand-to-sit, lie down, lace the shoes while seated, pick an object on the floor while seated or standing) known to be painful or prone to implant failure (dislocation, impingements). The hip joint kinematics was computed from the recorded markers trajectories using a validated optimized fitting algorithm which accounted for skin motion artifacts (accuracy: translational error ≈ 0.5mm, rotational error < 3°). The resulting computed motions were applied to patient-specific hip joint 3D models reconstructed from their MRI data.

The hip range of motion was quantified for each subject and for all motions, thanks to two bone coordinate systems (1 for the femur and 1 for the pelvis). Given the computed bone poses from motion capture data, hip angles were determined at each point of the motion, independently of the major anatomical planes.

Results

According to the morphological analysis, all subject's hips were normal. For all movements, a minimum of 95° hip flexion was required (mean range 95° – 107°), lacing the shoes and lying down being the more demanding. Abduction/adduction and IR/ER remained low (± 20°) and variable across subjects.

Conclusion

As shown in this study, daily activities of a "normal hip" involve intensive hip flexion, which could explain why such motion can yield hip pain or possible implant failure. This information should be

considered by orthopedists and implant manufacturers in the surgical planning and prosthesis design when restoring patient mobility and stability.