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Post-operative Kinematics Assessment in Patients after Total Hip Arthroplasty: A Pilot Study

C. Charbonnier¹, S. Chagué¹, C. Chênes², P. Hoffmeyer³, P. Christofilopoulos³, M. Bernardoni⁴, J. Schmid²

¹Medical Research Department, Artanim Foundation, Geneva, Switzerland

²Geneva Health School (HEdS), HES-SO, Geneva, Switzerland

³Orthopedics and Trauma Service, University Hospitals of Geneva, Geneva, Switzerland

⁴Medacta International SA, Lugano, Switzerland

Introduction

Following THA, impingements and dislocations may occur during motion, resulting from different factors (eg, implant positioning, biomechanical aspects). These side effects are usually not evaluated post-operatively and require a dynamic assessment of the prosthesis. The goal of this study was to perform a post-operative kinematics evaluation in patients after THA to evaluate the prevalence of impingements during daily activities. We also compared patient's range of motion (ROM) with data obtained from healthy subjects.

Methods

Three male patients undergoing THA were recruited. The planning parameters were to place the acetabular cup parallel to the transverse ligament and the stem in neutral femoral anteversion. Four months after surgery, CT and motion capture were performed. 3D reconstructions of the bones and implants positioning were obtained from the CT data. Motion from the patients were acquired during routine activities (stand-to-sit, lace the shoes while seated, pick an object on the floor while seated or standing) known to create significant stress in the artificial joint.

Based on the markers trajectories and the patient's 3D models, the hip joint kinematics and ROM were computed using a validated fitting algorithm (accuracy: translational error $\approx 0.5\text{mm}$, rotational error $< 3^\circ$). During motion, impingements were detected using a collision detection algorithm. Femoral head translations were also computed. To evaluate the patients' mobility, additional simulations were performed with motion data obtained from a database of healthy subjects during the same activities.

Results

Post-operative cups positioning was respectively $38^\circ\text{-}22^\circ$, $49^\circ\text{-}30^\circ$ and $48^\circ\text{-}26^\circ$ for the 3 patients. No impingements could be noted for any patient using their own motion. When the motion database was used, impingements occurred for all patients during lace the shoes and pick an object while standing. Patients had lower hip flexion (mean: -13°) and higher abduction (mean: $+14^\circ$) than healthy subjects. One patient could not perform the full ROM of one motion because of hip and back pain.

Conclusion

Patient's motion was free of collisions, but not when testing with ROM of healthy subjects. Simulations revealed interesting motion adaptations in order to execute the different activities. In particular, patients adopted less hip flexion with more abduction to avoid impingement. This kind of study could be useful to assess patient's mobility, stability and kinematic changes after THA.