

Abstract SCHK 2014

MyHip: Personalized Planning and Surgical Guidance in Total Hip Arthroplasty

Contexte / Préface

Total Hip Arthroplasty (THA) is a surgery that restores the articulation mobility and stability by implanting a prosthetic hip joint. This surgical act improves the life of the elderly population crippled by arthritis and restores capacities to active patients such as athletes.

But, objectifs

Conventional THA planning mostly exploits anatomical cues from static radiological images like radiographs. Dynamic aspects, such as the patient's mobility, are often neglected despite their impact on implant efficiency and survivorship. The MyHip project targets a personalized planning considering both anatomical and dynamic specificities.

Despite the quality of the planning, surgeons still face difficulties to exactly reproduce the planning as little intra-operative guidance is commonly provided. In this context, the MyHip project also aims to provide cost-effective intra-operative assistance to execute at best the planning.

Méthodes, Résultats

Based on pre-operative radiological images of the patient, we create 3D computer models of the hip anatomy and measure the pelvis tilt in standing position. Using the collected data, the surgeon selects the type, size and orientation of the implant components (e.g., the cup).

A virtual model of the prosthetic hip (resected bones + implant) is first created based on the planning. This model is then animated with a set of hip movements. This simulation computes the hip range of motion (ROM) and detects any articular conflicts (e.g., collisions, excessive luxations) resulting from the planning. With this information, the surgeon adapts and refines the initial planning. Experiments showed that ROM and articular conflicts were both dependent on size and orientation of the cup [1], highlighting the link between hip dynamics and chosen planning.

The set of movements were previously recorded on volunteers with optical motion capture technology. Movements were selected from activities of daily life known to be prone to implant failure (e.g. "lacing a shoe" or "sit-to-stand" actions) [2].

Based on the new planning, an automated process produces personalized guiding blocks. These blocks are positioned intra-operatively on the bony surfaces to assist the surgeon during the resection process. This guiding system has been optimized and validated during cadaveric trials.

Conclusion, Discussion

The MyHip project improves the pre- and intra-operative stages of THA. It relies on rich patient-specific data to deliver a computer-aided planning and a personalized guiding solution.

[1] Christofilopoulos et al. (2013) Hip Range of Motion in Everyday Life. SSOT/SGOT 2013

[2] Charbonnier et al. (2013) Assessment of Congruence and Impingement of Prosthetic Hips during Everyday Tasks. SSOT/SGOT 2013