Intra-operative Analysis Of The Kinematic Behavior Of A Total Knee Replacement By A Navigation System. Initial Experience And Further Development.

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Introduction: INTRODUCTION: Modern total knee replacements aim to reconstruct a physiological kinematic behavior, and specifically femoral roll-back and automatic tibial rotation. The most frequent studies are cadaver studies, which cannot reproduce easily the real clinical situation. Most clinical studies only analyze the post-operative kinematic with fluoroscopic evaluation, but there are few possibilities to compare pre- and post-operative kinematics and to assess the modification due to prosthesis implantation. An intra-operative analysis may allow improving the reconstruction by choosing the most appropriate component adaptation and ligament tension. We developed a specific software derived from a clinically used navigation system to allow in vivo registration of the knee kinematics before and after total knee replacement. We wanted to test for the feasibility of the intra-operative registration of the knee kinematics during standard, navigated total knee replacement.

Methods: METHODS: We are using on a routine basis a non image based navigation system for total knee replacement. The standard software has been modified in order to allow the intra-operative registration of the knee kinematic before and after implantation. The software measures the respective movement of the femur and the tibia, and specially antero-posterior translation and tibial rotation during passive knee flexion. Kinematic registration was performed twice during an usual procedure of navigated total knee replacement: 1) Before any bone resection or ligamentous balancing; 2) After fixation of the final implants. 200 cases of total knee replacement have been analyzed. Post-operative kinematic was classified as following: 1) Occurrence of a normal femoral roll-back during knee flexion, no roll-back or paradoxical femoral roll-forward. 2) Occurrence of a normal tibial internal rotation during knee flexion, no tibial rotation or paradoxical tibial external rotation.

Results: RESULTS: Recording the kinematic was possible in all cases. The results of both pre-operative and post-operative registrations were analyzed on a qualitative manner. The results were close to those already published in both experimental and clinical studies. About femoral roll-back (fig.1), 54% had a normal femoral roll-back during knee flexion after total knee replacement, 13% had no significant roll-back and 33% had a paradoxical femoral roll-forward. About tibial rotation (fig.2) : 65% had a normal tibial internal rotation during knee flexion, 16% had no significant tibial rotation and 19 had a paradoxical tibial external rotation.

Discussion: DISCUSSION: It is possible to record the kinematic behavior of a knee intra-operatively during total knee replacement. This might help choosing the most appropriate type of reconstruction to get a closer to a normal kinematic. The surgeon might for example test different posterior tibial slopes, different heights of polyethylene inlays, different rotational position of the tibial component⋯ However, only passive kinematic may be analyzed, and it might be significantly different from the active kinematic after the procedure. Furthermore, this software allows a kinematic registration of the antero-posterior stability, which is not commonly displayed by usual navigation system. This may help choosing between preservation or substitution of the posterior cruciate ligament.

Significance: SIGNIFICANCE: Intra-operative analysis of the kinematic of the knee during total knee replacement may offer the chance to modify the kinematic behavior of the implant and to choose the best fitted constraint to the patient’s native knee.

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References: Levinger P, Menz HB, Morrow AD, Perrott MA, Bartlett JR, Feller JA, Bergman NB. Knee biomechanics early after...

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