KNEE JOINT PIVOT MOTION PATTERN DURING WALKING BEFORE AND AFTER UNICOMPARTMENTAL ARTHROPLASTY

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Introduction

Knee osteoarthritis (OA) is a very common and disabling pathology. Symptoms are mostly pain, reduced joint function, and kinematic impairments [1,2]. One of the last treatments for advanced OA is total or unicompartmental knee arthroplasty (UKA). An UKA is preferred in young patients, because it needs less bone resection and allows for potential revision surgery at an older age [3]. While studies showed that UKA may preserve native knee kinematics (i.e., primarily guided by soft tissues) in cadaver knees [4], this has not been assessed in vivo yet. This study aims at assessing if the motion pattern of the knee center of rotation (i.e., joint pivot) is altered with UKA. The hypothesis was that the joint pivot motion remains unchanged after UKA.

Materials and Methods

Fifty-six (56) participants were included in this study. All patients received UKA at the orthopedic service of the Croix Rousse hospital (Lyon, France). Knee landmarks and kinematics were captured during gait using the KneeKG® system (Emovi Inc., Canada) before and 6 months after surgery. Joint pivot motion was determined during swing phase (from 60 to 100% of the gait cycle) by projecting consecutive transepicondylar axis positions in the transverse plane (i.e., tibial plateau) during motion [5]. Joint pivot motion patterns were then divided into four categories, whether they displayed a shift of the transepicondylar axis with I) no rotation (pure antero-posterior (AP) translation) or a rotation around II) a lateral pivot point, III) a medial pivot point or IV) a central pivot point (see Figure 1). Patients were classified based on their predominant pattern. All calculations were performed using MatLab (Mathworks, MA). Joint pivot motion patterns pre- and post-UKA were compared within each participant.

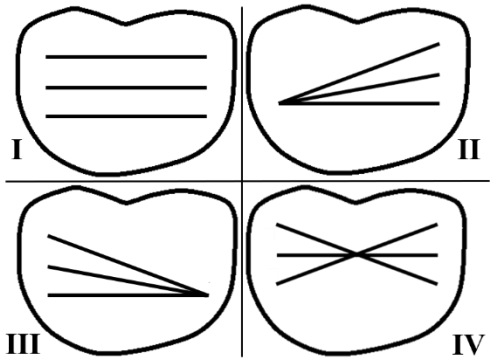

Figure 1 – Joint pivot motion patterns - Superior view of the transverse plane.

Results

Pre-operatively, 41 out of 56 (73%) patients presented a pure AP translation pattern during swing phase. Six months post-UKA, almost two thirds (60%) of the patients kept a similar pivot motion pattern (see "Non-changers" in Table 1). Interestingly, 97% of the patients who did not change their pivot motion pattern presented a pure AP translation pattern pre-operatively.

Table 1 - Distribution of joint pivot motion patterns pre- and post-UKA and proportion of non-changers for each pattern.

	Pre-UKA N (%)	Post-UKA N (%)	Non-changers
I) Pure translation	41 (73)	45 (80)	80 %
II) Lateral pivot	5 (9)	2 (4)	20 %
III) Medial Pivot	4 (7)	5 (9)	0 %
IV) Central pivot	6 (11)	4 (7)	0 %

Discussion

The presented method extends the work done by Banks et al. [5] who determined the pivot point from fluoroscopic images. The proposed method which defines four different pivot motion patterns using gait analysis with the KneeKG system can be performed in a clinical setting [6]. Results show that after UKA, most patients kept the same joint pivot motion pattern they had before surgery. Interestingly, this was especially the case in patients who displayed pure AP translation pre-operatively. This suggests that while UKA can preserve native knee kinematics in terms of joint pivot motion, this may differ based on the pivot motion pattern pre-surgery. This innovative approach gives new insight on prosthetic knee motion in terms of rotation while walking and how to measure it. Further research is needed to explore associations between joint pivot motion and patients' satisfaction in order to verify if preserving native kinematics could prevent residual pain post-surgery.

References

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