Patient-specific unicompartmental knee arthroplasty during sit-to-stand: Midterm follow-up

Haithem M'barki[1,2], Etienne L. Belzile[3], Katia Turcot[1,2]
[1] Department of Kinesiology, Faculty of medicine, Laval University, Québec City, Canada
[2] Centre interdisciplinaire de recherche en réadaptation et intégration sociale (Cirris), Québec City, Canada
[3] Division of Orthopedic Surgery, Department of Surgery, CHU de Québec-Université Laval, Quebec City, Canada
Email: Haithem.mbarki.1@ulaval.ca

Summary

Patient-specific unicompartmental knee arthroplasty has increasingly been used as a treatment for medial knee osteoarthritis. In this study, patients who underwent surgery with either patient-specific or off-the-shelf prostheses were evaluated during a sit-to-stand task. The results demonstrated that personalization of the prosthesis did not lead to superior knee function compared to off-the-shelf prosthesis, and compensatory mechanics in adjacent joints persisted even five years post-surgery.

Introduction

Personalizing unicompartmental knee arthroplasty (UKA) to the patient's anatomy have shown better implant positioning and clinical outcomes compared to off-the-shelf prosthesis [1]. However, no biomechanical study has yet compared their differences during a challenging functional task such as sit-to-stand. The aim of this study was to determine whether the personalized unicompartmental prosthesis (Bodycad UKS) leads to superior improvement in terms of knee joint biomechanics compared to an off-the-shelf prosthesis (Oxford UKA) during sit-to-stand task.

Methods

A total of 22 patients and 22 healthy individuals (CG), matched for age and height, were recruited to participate in this study. Eight patients were operated with Bodycad UKS (BUKS) prosthesis, and 14 patients with Oxford UKA (OUKA) prosthesis. All patients were evaluated at a minimum follow-up of 3-years post-surgery. Participants were instructed to stand up from a chair without using their arms at self-selected speed. Five valid sit-to-stand (STS) trails were retained for analysis. To quantify 3D kinematics and kinetics, a 10-camera motion analysis system (100 Hz) and an instrumented chair with 4 force plates (1000 Hz) were used. Thirty-two reflective markers and 8 clusters were placed on lower limbs, pelvis and trunk, creating a 6 DoF model for lower limb and pelvis [2]. Muscles activations were quantified for lower limbs using electromyography sensors (2000 Hz). Spatiotemporal parameters, lower limb angles and moments were estimated in the sagittal, frontal and transverse plans, and the total support moment (TSM) was calculated [3]. Dependent variables were compared between the three groups using Statistical Parametric Mapping.

Results and Discussion

The results showed no significant difference for sit-to-stand total duration ($p>0.05$). OUKA demonstrated a significant decrease in the knee abduction angle between 0-41% STS cycle ($p=0.002$) and a decrease of the hip flexor moment between 41-46%STS cycle ($p=0.005$) compared to CG. BUKS showed a significant decrease of knee internal rotation angle between 53-66% STS cycle ($p=0.008$) and increase of the hip abduction moment between 42-57% STS cycle ($p=0.003$) compared to CG. OUKA demonstrated a significant decrease of peak TSM compared to CG ($p<0.001$). No significant differences for muscles activation during STS cycle compared to CG ($p>0.05$).

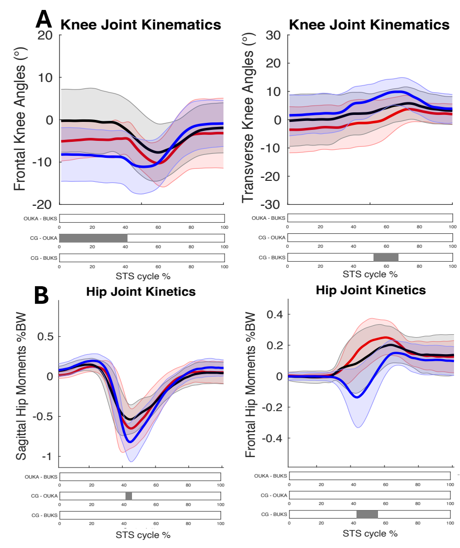

Figure 1: A: Knee joint kinematics in frontal and transverse plans; B: Hip joint kinetics in sagittal and frontal plans

Conclusions

The personalization of the implant did not lead to superior knee function compared to off-the-shelf UKA. In addition, neither BUKS nor OUKA restored normal knee function comparable to a native knee, as compensatory mechanics in adjacent joints persisted even five years post-surgery.

Acknowledgments

HM received financial support from Fondation pour l'Avancement et la Recherche en Orthopédie du Québec.

References

[1] Freigang et al., (2020) *BMC Musculoskelet Disord*, **21:** 773
[2] Wu et al., (2002) *J Biomechanics*, **35:** 543-548
[3] Winter D., (1980) *J biomechanics*, **13:** 923-927