The Associations Between Changes in Physical Activity and Gait Characteristics in Patients Awaiting Knee Arthroplasty

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Summary

Knee osteoarthritis (OA) limits physical activity (PA) and worsens joint function [1]. This study examined associations between objectively-measured PA outcomes with gait kinematics, pain, anthropometrics, and demographics in patients with end-stage knee OA before knee arthroplasty surgery (KAS), and the associations with longitudinal change in PA outcomes during the wait period for surgery. Worse PA outcomes at baseline were associated with lower self-selected walking speed, BMI and female sex, but no other gait outcomes. Change in PA outcomes during the wait period was only associated with baseline PA levels, such that PA declined more rapidly in more active patients during the wait period.

Introduction

Knee OA clinical symptoms and poor joint function reduce patients' engagement in PA. The management of PA in the pre-KAS period can help reduce OA symptom progression and maintain knee function which contribute to improved KA outcomes [2]. Following KAS, PA levels often remain unchanged or decline [1], despite its known contribution to improving strength and function [2]. This study examined the associations between objectively measured PA and longitudinal PA changes with gait kinematics, demographics and anthropometrics to further understand the heterogeneity among patients with end-stage knee OA and if objectively measured PA is an important clinical consideration.

Methods

Patients with end-stage knee OA on the KAS waitlist were recruited, with a subset repeating testing at least 3 months later. An inertial measurement unit sensor (AX6, Axivity) was affixed to the tibia of the OA-affected limb for one week to monitor in vivo activity. Mean amplitude deviation quantified daily step counts (DSC) and the percentage of time spent sedentary (Sed), in light (LPA), and moderate-to-vigorous (MVPA) PA through custom processing. A 10-camera (Sony RX0II) markerless motion capture system (Theia) was used to capture 3D limb segment poses and model 3D knee angles during walking of patients in the clinic hallway (Visual3D; HAS-motion). Principal Component Analysis defined clinically relevant features in knee flexion and adduction angles during gait. The numeric pain rating scale (NPRS) assessed self-reported pain. Longitudinal changes in PA were examined using paired t-tests and associations between baseline PA outcomes and longitudinal changes in PA with baseline gait outcomes, pain, sex, and BMI were examined.

Results and Discussion

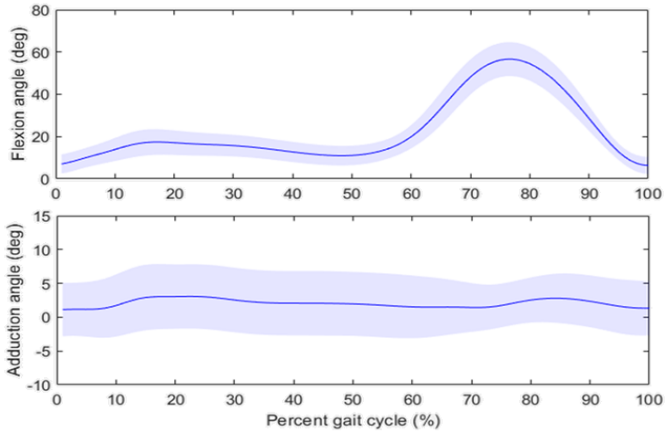

Figure 1: Mean (SD- shaded) knee flexion (top, full gait cycle) and adduction (bottom, stance phase) angles for baseline data.

There were no significant changes in PA outcomes from time 1 to time 2, and change in PA outcomes were only correlated with baseline PA levels. Decreases in DSC were negatively correlated with higher DSC at baseline (r=-0.54), suggesting that more physically active patients had more rapid decrease in PA while awaiting KAS. Worse PA at baseline (lower DSC and % MVPA, and higher % sedentary) were associated with higher BMI (r=-0.36, r=0.36, r=-0.41), lower gait speeds (r=0.49, r=-0.51, r=0.54) and female sex. These differences are consistent with previous findings [3], highlighting patient profiles at risk of larger decline in PA and function during the pre-operative wait period for KAS.

Conclusions

Pre-operative objectively-measured PA levels in knee OA patients are highly variable, with more active individuals at baseline experiencing greater declines while awaiting arthroplasty, independent of pain or gait changes.

References

[1] Paxton RJ et al. (2015). *Baishideng Pub. Group Co.*
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[3] Bindawas SM et al. (2015). *Int J Environ Res Public Health*

Table 1: Demographics, pain, and PA outcomes. ([1] = baseline; Δ= change time 1 to time 2; NPRS: 0=no pain, 30=severe pain).

N total: 66 (41F/25M)	Age = 66.8 (33.5) years	DSC[1] = 5079 (2549)	ΔDSC = -565 (3798)
N follow-up: 28 (17F/11M)	BMI[1] = 33.5 (6.9) kg/m^2	Sed[1] (%) = 10.6 (3.4)	ΔSed (%) = 1.8 (5.1)
	Pain[1] (NPRS) = 19.5 (5.6)	LPA[1] (%) = 8.0 (3.4)	ΔMVPA (%) = -0.9 (3.5)
		MPA[1] (%) = 1.0 (0.2)	ΔMVPA (%) = -0.9 (2.2)