

Evaluating Knee Joint Loads Across Exercises and Activities of Daily Living to Personalize TKA Rehabilitation

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Summary

This study assessed knee joint loading during various physiotherapy exercises and activities of daily living in 30 healthy subjects. Results showed that lunges and squats caused the highest joint forces, while gait and stair activities also imposed substantial loads. These findings support data-driven exercise selection for personalized rehabilitation after total knee arthroplasty.

Introduction

Total knee arthroplasty (TKA) is one of the most prevalent surgical interventions [1]. Yet in some patients, dissatisfaction with outcomes is persistent [2]. Physiotherapy rehabilitation could be a way to improve outcomes. Still there is a lack of evidence regarding the adequate rehabilitation practice following TKA [3]. To recommend appropriate exercises, the knee joint loading during these exercises and during activities of daily living (ADLs) must be known. Therefore, the aim of this study was to assess knee joint loading during various physiotherapy exercises and ADLs.

Methods

30 healthy subjects (age: 22.8 ± 2.1 y, height: 172 ± 8 cm, weight: 67.9 ± 10.5 kg) were recruited. Motion data was recorded at 60 Hz using a marker-less motion capture system (CapturyLive v255, TheCaptury, Germany). Ground reaction forces were recorded at 600 Hz. An instrumented chair and staircase were built, to record forces during sit-to-stand movements and stair walking. Recorded kinematic and kinetic data were used as input for musculoskeletal simulations (AMS, v7.4.4, AnyBody Technology, Denmark).

Results and Discussion

Differences in peak joint loading normalized to body weight (BW) can be seen (Figure 1). Posterior forces are highest during gait and are consistently positive except for stair ascent. Anterior forces are consistently negative and more pronounced during stair ascent, lunges and squats. Medial forces remain close to zero but slightly positive across all tasks and are again highest during gait. Lateral forces are comparatively higher especially during lunges. Distal forces are the highest among all directions, peaking during lunges and remaining substantial during squats and stair ambulation. Proximal forces stay close to zero and positive across all tasks indicating continuous axial compression in the joint. Patients undergoing TKA typically receive physiotherapy as part of

their rehabilitation, which positively impacts outcomes [4]. Still, it is not fully known which activity delivers the most favorable outcomes [4]. This study enables data-driven exercise selection by assessing the knee joint loading of various tasks. Differences were observed between tasks, with comparatively high requirements for lunges and squats and low requirements for sit-to-stand movements and one-legged stand. ADLs like gait and stair ambulation show surprisingly high requirements compared to many exercises.

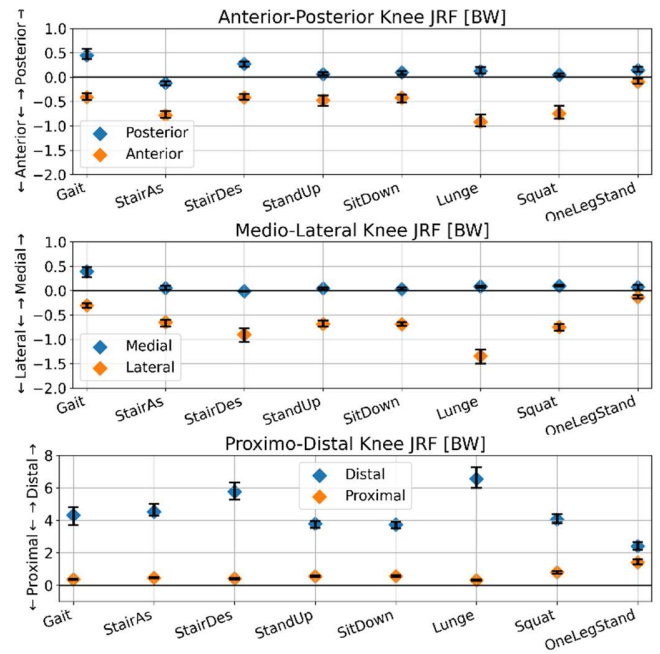


Figure 1: Median and interquartile range of peak knee joint force.

Conclusions

Differences in joint loading were found between tasks which is a first step towards data-driven exercise selection and personalized rehabilitation programs following TKA, by progressively increasing experienced joint loading.

Acknowledgments

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References

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