

Femoroacetabular Impingement Patients Show a Post-Operative Reduction of External Joint Moments during Running

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Summary

Femoroacetabular impingement syndrome patients have an increased risk of hip osteoarthritis development which is reduced by surgery and influenced by joint loading. The effect of surgery on joint loading is however still unknown. We therefore estimated lower-limb joint loading by external joint moments during various tasks and compared them pre to one year post-op. A decrease in hip external rotation moment was observed only during running. For a more precise loading estimation, musculoskeletal modelling could be applied.

Introduction

Patients with femoroacetabular impingement syndrome (FAIS) suffer from groin pain, functional limitations and an increased risk for early development of hip osteoarthritis (OA) [1]. Surgical treatment of FAIS reduces pain, improves function and has a preventive effect on hip OA development and progression [2]. OA development is potentially induced by cartilage defects, whose severity was correlated with hip flexion moment impulses [3]. Its progression might be influenced by hip joint loading, which can be estimated with external joint moments. The impact of surgery on joint loading is however still debated. We therefore compared pre- to post-surgery external joint moments of FAIS patients during various functional tasks.

Methods

25 FAIS patients performed various tasks pre- and one year post-surgery (19 arthroscopy, 6 open dislocation). The tasks included walking, running, stepping up a two-step stair, stand up/sit down, drop jump, lateral hop and pivot turn. Three-dimensional kinematic data was captured by 13 infrared cameras (Vicon, Oxford Metrics Ltd, UK) using a full-body marker set. Ground reaction force (GRF) was recorded with four decoupled force plates (Kistler Instruments, Switzerland). Hip joint angles were calculated according to ISB recommendations. External hip, knee and ankle joint moments were computed using an inverse quasi-static approach, integrating GRF, hip joint position and sex-specific segment masses [4]. Time-series of moments were compared between pre- and post-op using vector-field statistical parametric mapping (SPM) with Hotelling's T^2 statistic ($\alpha=0.05$), followed by post hoc scalar-field SPM t-tests ($\alpha=0.05/3$) in case of significance. Peak moments were compared using paired samples t-tests ($\alpha=0.05/6$).

Results and Discussion

When comparing time-series data of external hip and knee moments between pre- and post-op, significant changes were observed only for running. From 57 to 67% of the running

stance phase, FAIS patients showed a decreased hip external rotation moment after surgery (Figure 1). This result is in contrast with Freemyer et al., who found no difference between pre- and post-op joint moments during running [5].

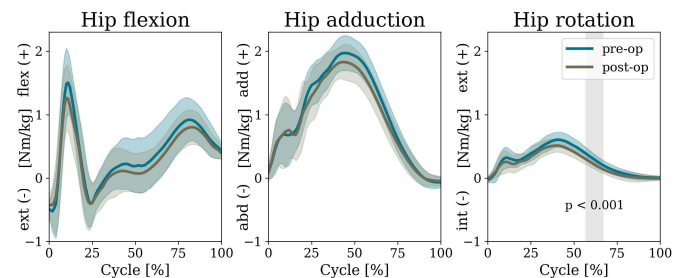


Figure 1: Pre- and post-op external hip joint moments (mean and SD, normalized to body mass) of FAIS patients during running.

If movement patterns change, the timepoint of peak external moments might shift. For comparison of the maximal joint loading, we therefore calculated peak moments. Similar to time-series data, only running peak values differed from pre- to post-op. We observed a decrease in hip external rotation moment (from 0.65 ± 0.12 to 0.56 ± 0.11 Nm/kg, $p < 0.002$), which was not described previously. During gait, the peak moments did not change, which is in line with previous literature [6, 7] but contrary to the meta-analysis by Marshall et al. who reported an increase in peak hip flexion moment post-operatively [8]. The contradictory findings between the present and previous studies could be due to the heterogeneity of FAIS patients. Larger sample sizes or stratification of the study population (i.e. by treatment, morphology or sex) could give further insights.

Conclusions

A decrease in hip external rotation moment during running was the only adaptation observed one year post-op in FAIS patients. It seems therefore that surgery has a negligible impact on external joint moments. A more specific estimate of hip joint reaction force i.e. by musculoskeletal modelling, might however be needed. This would additionally consider muscle forces which might be relevant since FAIS patients typically show neuromuscular impairments [9].

References

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