# EVALUATION OF A MEDIAL THRUST GAIT PATTERN TO REDUCE THE PEAK KNEE ADDUCTION TORQUE

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## INTRODUCTION

Gait modification may be an effective strategy for reducing medial compartment contact force in patients with knee osteoarthritis (OA). Since internal contact force cannot be measured in patients, researchers have identified the knee adduction torque as a surrogate external measure. Previous studies have shown that toe out gait significantly reduces the second but not the first peak of the knee adduction torque curve [1]. However, only the first peak during early stance has been shown to be higher in patients with knee OA compared to healthy controls [2]. Recently, a medial thrust gait motion that reduces both adduction torque peaks has been reported in the literature [3]. This gait motion was designed by a patient-specific gait optimization and proved successful on the patient for whom it was developed.

This study seeks to determine whether the medial thrust gait pattern a) can be taught quickly and easily to a different subject using only verbal feedback, and b) is an effective general strategy for reducing both knee adduction torque peaks simultaneously.

## METHODS

A single subject was recruited to evaluate the achievability and effectiveness of the medial thrust gait pattern. Institutional review board approval was obtained for the experiments. The subject performed three types of gait motions – normal, toe out, and medial thrust – with simultaneous collection of video motion and ground reaction data. In additional, the subject performed isolated joint motion trials to identify patient-specific functional axes.

The subject was given verbal coaching for how to achieve the medial thrust gait motion. First, the researchers explained the two key principles behind the gait pattern – slight knee flexion and forward rotation of the stance leg hip, both of which bring the stance leg knee under the center of mass of the body. Second, the researchers explained that the ultimate goal was medialization of the stance leg knee and that the subject should focus on rubbing the insides of the knees together rather than on achieving the component motion changes. Third, the researchers demonstrated a highly-flexed exaggerated version of the medial-thrust gait pattern and asked the subject to perform the exaggerated pattern as practice. Fourth, the researchers demonstrated how knee flexion could be decreased while still rubbing the insides of the knees together, and the subject was instructed to do likewise. Once the subject was able to walk with the knees flexed as little as possible while still being able to rub the insides of the knees together, gait data were collected from the subject. For each gait pattern, five trials were collected with resulted presented for one representative trial. Results from the other trials were similar.

To calculate the adduction torque, a dynamic, patient-specific gait model was developed using previously published methods [3]. Functional axes of the ankles, knees, and hips and the mass properties of the body segments were determined via a sequential optimization procedure. The resulting patient-specific model was aligned to the experimentally measured marker positions from each time frame using a method based on the singular value decomposition [4]. Finally, a bottom-up inverse dynamics approach was used to calculate the external knee adduction torque for each gait pattern.

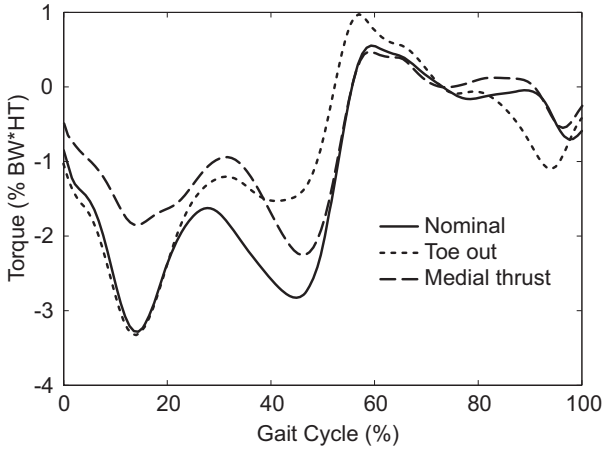


**Figure 1**: Normalized external knee adduction torque curves for nominal, toe out, and medial thrust gait.

## RESULTS AND DISCUSSION

The subject was able to achieve a medial-thrust gait pattern that successfully reduced both peaks of the knee adduction torque curve (Fig. 1). For this subject, medial thrust gait was highly effective at reducing the first peak (43% decrease) but less effective at reducing the second one (19% decrease), whereas toe out gait was highly effective at reducing the second peak (46% decrease) but produced little change in the first one (2% increase).

These results support recently published findings that the medial thrust gait pattern is achievable and highly effective at reducing the first peak of the external knee adduction torque curve [3]. However, the long term clinical significance of these findings remains unknown. Whether or not these reductions alter medial compartment contact forces will require future data collected from instrumented knee replacements. Furthermore, we do not know whether larger adduction torque reductions could have been achieved by the current subject if real-time visual feedback with a knee medialization "target" based on patient-specific gait optimizations had been provided to the subject.

## REFERENCES

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