Factors affecting the change in knee adduction moment of contralateral knee joint after high tibial osteotomy

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INTRODUCTION: The knee adduction moment (KAM) indicates the medial compartment loading of the knee joint [1]. Valgus high tibial osteotomy (HTO) for medial osteoarthritis (OA) corrects the coronal alignment of the knee joint. Valgus high tibial osteotomy (HTO) for medial osteoarthritis (OA) corrects the coronal alignment of the knee joint, resulting in the center of gravity (COG) shifting toward the operated side and the decreasing in KAM lever arm. Consequently, KAM decreases after HTO [2]. Regarding contralateral (non-operated) knee, patients sometimes complain the contralateral knee pain after initiated HTO, suggesting that the medial compartment loading of the contralateral knee joint increased after initiated HTO. We hypothesized that the change in the kinetics of contralateral knee joint after initiated HTO was caused by the COG shifting toward the operated side and the increase in KAM of the contralateral side. However, it has been unclear how the kinetics of contralateral knee joint changed after HTO. The purpose of this study was to reveal factors affecting the change in the kinetics of contralateral knee joint after initiated HTO.

METHODS: Fourty-seven patients (47 knees) who underwent medial open-wedge HTO and gait analysis before and 1 year after surgery between 2016 to 2020 were enrolled in this study. There were 22 men and 25 women with a mean age of 55.8 years at the time of surgery. This study was conducted with a prior approval from the institutional ethical review board, and all subjects were provided detailed explanation before undergoing any measurement. All patients were assessed while walking at a self-selected speed using an optical motion capture system; subsequently, six degrees of freedom knee joint kinematics were calculated using the Point Cluster Technique [3]. The external moment of contralateral side was calculated by using inverse dynamics and amplitude-normalized to body mass (Nm/kg). In addition, the top 25% of KAM impulse change rates were classified as the KAM increase group, while the bottom 25% were classified as the KAM decrease group. We compared the pre- and post-operative values in the whole group. In addition, we performed an analysis of the characteristics that affect the increase and decrease of KAM impulse using Student’s t test and Fisher’s exact test. P-values less than 0.05 were considered statistically significant.

RESULTS: In the whole group, the hip-knee-ankle (HKA) angle of operated side significantly changed from −4.0 ± 2.3° to 3.6 ± 1.4° (P < 0.001). HKA angle contralateral side does not change significantly (P = 0.99). Walking speed was significantly faster after surgery (1.3 ± 0.1 m/sec) than before surgery (1.2 ± 0.1 m/sec) (p<0.01). There was no significant difference in height, weight, BMI, thigh circumference, or postoperative lower limb alignment. However, the KAM increase group had a significantly higher proportion of female (p=0.01) and a smaller thigh circumference-to-weight ratio (p=0.03).

DISCUSSION: This study analyzed the kinetics of the contralateral side after initiated HTO and showed no significant change in KAM after HTO. However, there were significantly different in being female and having a smaller thigh circumference-to-weight ratio in the KAM increase group compared to the decrease group. These results indicated that female and low quad muscle strength relative to body weight are associated with a higher risk of increased KAM on the contralateral side after HTO, which may consequently lead to the possibility of undergoing HTO on the contralateral side.

SIGNIFICANCE: Female and low quad muscle strength relative to body weight may lead to undergo HTO on the contralateral side.


IMAGES AND TABLES

Figure 1

![Figure 1](https://example.com/figure1.png)

Figure 1. Scatter plot of pre- and post-operative KAM AUC