BIOMECHANICAL ANALYSIS OF THE WALKING PATTERN IN HEALTHY SUBJECTS WITH AND WITHOUT ROLLATOR

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INTRODUCTION

The rollator is a commonly used walking-aid in elderly and in disabled subjects. The purpose of using the rollator is to improve the walking performance and minimize the risk of falling. Studies have shown that the walking performance in elderly subjects measured as distance, cadence and velocity is improved when they walk with a rollator [1]. However, knowledge about the specific changes in the joint moment patterns of the ankle, knee and hip joint are limited. Thus, the purpose of the present study was to investigate the biomechanical effects of walking with a rollator on the walking pattern in healthy subjects.

METHODS

Seven healthy women (age: 34.7 (range: 25-57) years, height: 1.70 (range: 1.64-1.78) m, weight: 64.7 (range: 55-75) kg) participated in the study, which was approved by the local ethics committee. The subjects were asked to walk across two force platforms (AMTI, OR6–5-1) both with and without a rollator (Dolmite Maxi 650, Dolomite AB, Anderstorp, Sweden) at a speed of 4.5 km/h. Fifteen small, reflecting spherical markers were placed on the subjects according to the marker set-up described by Vaughan et al. [2]. In addition, 14 markers were placed on the upper extremities and on the rollator.

Five video cameras (Panasonic WV-GL350) operating at 50 Hz were used to record the movements. The video signals and the force plate signals were synchronized electronically with a custom-built device. The device put a visual marker on one video field from all cameras and at the same time triggered the analogue-to-digital converter, which sampled the force plate signals at 1000 Hz. The subjects triggered the data sampling and synchronization when they passed the first pair of photocells. Three-dimensional coordinates were then reconstructed by direct linear transformation using the Ariel Performance Analysis System (APAS). Prior to the calculations, the position data were digitally lowpass filtered by a fourth-order Butterworth filter with a cut-off frequency of 6 Hz, and the 1000 Hz force plate signals were down sampled to 50 Hz to fit the video signals.

An inverse dynamics approach was used to calculate the kinematics and kinetics for flexion and extension. Six gait cycles were normalized and averaged for each subject and situation (with and without rollator, resp.). Normalization was performed by interpolating data points to form 500 samples for each gait cycle. Only the stance phase of the left leg was analyzed. A Students t-test for paired data was used to identify statistically significant differences between walking with and without rollator in selected kinematic and kinetic variables of the walking patterns. The level of significance was set at 5%.

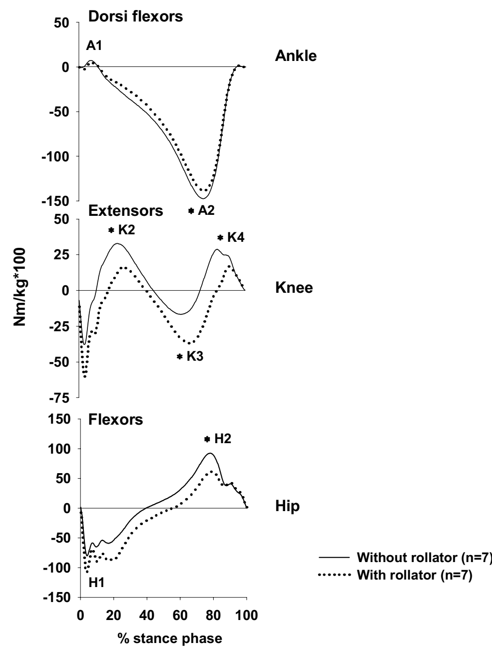

Figure 1: Average joint moments (Nm/kg*100) of the left ankle, knee and hip. 0% indicates heel strike and 100% indicates toe off on the x-axis. * indicates significant difference between walking with and without rollator.

RESULTS AND DISCUSSION

The hip was significantly more flexed during the stance phase when walking with the rollator (p=0.007). The peak ankle plantar flexor moment (A2, p=0.02) and knee extensor moments (K2 + K4, p=0.01) were significantly smaller during walking with rollator, while the peak knee flexor moment (K3, p=0.000) was larger than without rollator (Figure 1). The peak hip flexor moment (H2) was smaller during walking with rollator than without (p= 0.000) (Figure 1).

CONCLUSIONS

The results showed that walking with a rollator unloaded the plantar flexors and knee extensors. The hip was more flexed when walking with rollator because the trunk was leaned forward. This resulted in a smaller hip flexor moment during walking with rollator. However, the more flexed hip position should result in better conditions for the hip extensors to produce moment. Further investigation is needed to answer this question.

REFERENCES

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