INTRODUCTION

Locomotion is one of the most important motions for us to live actively. Unfortunately, the ability to walk seems to deteriorate for the elderly with aging. However, we can find the biomechanical causes for the deterioration of locomotion and the way to maintain the locomotion ability for the elderly from the results of kinetic analyses in their motion. The purpose of this study was to investigate the changes in walking kinetics with aging for elderly males.

METHODS

Twenty-two healthy Japanese elderly males from 61 to 86 years old (73.7±6.8 yr.) were instructed to walk as usual. Their locomotion was videotaped with a high speed VTR camera in order to get the image of them in the sagittal plane, and the ground reaction force on the right foot was measured with a force platform. Two-dimensional coordinates of the 13 body landmarks (right hand, right wrist, right elbow, right shoulder, right toe, right fifth metatarsal, right ankle, right knee, right hip, vertex, tragion, upper end of thorax) were obtained by using the video digitizing system (Frame-DIAS, DKH Inc.). These coordinates were smoothed by the fourth order zero-phase shift Butterworth digital filter at the optimal cut-off frequencies that were derived from the residual analysis (Winter, 1990). After synchronization between the smoothed coordinate data and the ground reaction forces, joint torques at the ankle, knee, hip, wrist, elbow, shoulder and neck were calculated using a link-segment model based on the inverse dynamics method. Joint torque powers were next calculated by multiplying the joint torque by the joint angular velocity. Finally, joint mechanical work was calculated by integrating the joint torque power over time.

RESULTS AND DISCUSSION

Figure 1 shows the changes in joint positive work of lower limb joints during one walking cycle with age. Positive work of ankle joint gradually decreased with age. The decline of the work per year was 0.0052 J/kg. On the other hand, no significant relationship was shown for the knee and the hip. These results indicate that although the elderly older than eighty years old can exert the similar positive work of sixty years old at the knee and hip joint in spite of decline of walking speed, they can’t maintain the mechanical output at the ankle after sixty years old. Because the positive work of the ankle is mainly caused by the concentric contraction of plantar flexors during the late stance phase of walking, the function of plantar flexors seem to be remarkably effected by aging. Judge et al (1996), Winter et al (1990) and Okada and Ae (1999) studied the joint kinetics during walking for the elderly and pointed out the functional decline of ankle plantar flexors for the elderly comparing with the young. The results of this study shows that the decline of ankle plantar flexors during walking represents the characteristics of walking kinetics for the elderly and it was indicated not only from the comparison with the young but also from the changes with aging after sixty years old that the decline of ankle function may gratefully restrict their walking ability.

REFERENCES