BIODYNAMIC CHANGES ACCOMPAYING AGE AND INACTIVITY IN FEMALES

Lee Cabell[1], David Pienkowski[2, 3] Robert Shapiro[4]
[1] School of Graduate Medical Education, Seton Hall University, South Orange, NJ 07079
[2] Center for Biomedical Engineering, University of Kentucky, Lexington, KY 40507
[3] Department of Orthopaedic Surgery, School of Medicine, University of Kentucky, Lexington, KY 40536
[4] Department of Kinesiology and Health Promotion, University of Kentucky, Lexington, KY 40506

INTRODUCTION

Bone fractures secondary to falls in the elderly continue to be a major healthcare and economic problem [1]. A greater understanding of the processes that contribute to the propensity of elderly females to fall may be obtained by kinematic and kinetic gait studies [2]. The purpose of this study was to examine the 3-D gait parameters in female subjects to determine the effects of aging and activity on selected biomechanical parameters and to determine if any measures might predict a predisposition to musculoskeletal dysfunctions and subsequent remedial intervention.

METHODS

Younger (24 ± 1.6 yrs) and older (67 ± 7.1 yrs) healthy female volunteers (n=17 total) were divided into active and sedentary subgroups in this IRB approved study. Data from three-dimensional video images were collected by 5 high-speed (60 Hz) video cameras (FALCON HR 240, Motion Analysis Corporation, Santa Rose, CA). The basic simplified ("Helen Hays") marker set of 15 retro-reflective external markers were attached to significant anatomical locations of the right lower extremity. Resulting video images were digitized by using the Motion Analysis HiRES analysis package. Ground reaction forces were measured by a Kistler force platform at 1000 Hz. Each subject was asked to walk at a self-selected pace across the force platform in a 20m walkway during which kinematic and kinetic data were collected for three seconds and analyzed during the stance phase of the gait cycle. The data were analyzed by repeated measures ANOVA and each model included the two factors of age and activity level. The Scheffe criteria was used for multiple group corrections. P-values less than 0.05 were considered indicative of significant difference.

RESULTS AND DISCUSSION

As expected, the elderly group had greater functional and mobility limitation in their lower extremity joints compared to the younger group [3], and of these, he largest differences were observed in the ankle (Fig. 1). Knee joint biodynamics were related to both activity and age. The hip was the most effected joint in sedentary population (Fig. 2). These findings led us to postulate that lower limb gait alterations may begin at the ankle, progress up the lower extremity, and eventually act in concert to predispose elderly and sedentary women to gait imbalances and subsequent slip-induced fall or low energy bone fracture. This is important because it means that there may exist specific physical activities involving targeted controlled 3-D muscle movements which help maintain lower limb joint kinematics, kinetics and their accompanying intrinsic postural control strategies that together help prevent gait imbalances and subsequent falls.

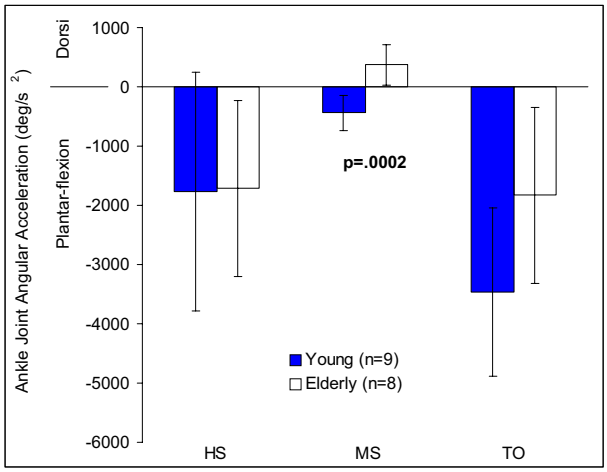

Figure 1: Comparison of ankle joint dorsiflexion / plantar flexion angular acceleration.

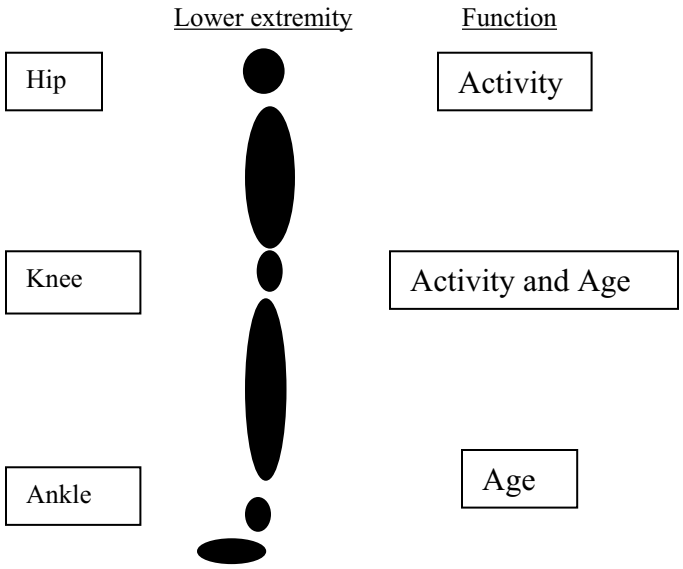

Figure 2: Model of the lower extremity noting the key biodynamic factors most effecting the indicated joints.

Address questions or comments to cabellle@shu.edu

REFERENCES

1. Daubney ME, Culham EG. Lower-extremity muscle force and balance performance in adults aged 65 years and older. Phys Ther **79**, 1177-85 1999.
2. Owings TM, Grabiner MD. Variability of step kinematics in young and older adults. Gait Posture **20**, 26-29, 2004.
3. Finley FR, Cody KA. Locomotive characteristics of urban pedestrians. Arch Phys Med Rehabil **51**, 423-6, 1970.

ACKNOWLEDGEMENTS

Thank you to Dr. Doreen Stiskal for her clinical comments.