RELATIONSHIP OF LEG STRENGTH, H-REFLEXES AND BALANCE IN YOUNG AND ELDERLY ADULTS - A PRELIMINARY STUDY.

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INTRODUCTION

The control of human balance involves the integration of the visual, the vestibular, and the proprioceptive or reflex systems. With aging, all three systems deteriorate. Changes in these systems in turn affect balance in standing, walking, and stair climbing. Injuries due to falling are a primary health concern for the elderly. Eighty percent of injury to elderly in local retirement homes have been attributed to falls.

The purpose of this investigation was to determine how the aging process affects the muscular system with regard to balance. Also, we sought to examine how the reflex system affects balance in the elderly. We selected elderly subjects for testing who ranged in age from 60 - *80* years. The results of their performances were then compared to young subjects.

METHODS

The experiment was carried out on 28 neurologically normal individuals. Individuals were categorized by age into the following age groups: young 20-30 yrs; elderly *60-70* yrs; 70-80 yrs; and over *80* yrs. There were *10* young subjects and 6 elderly subjects (3 men and 3 women) in each age group. All subjects were volunteers who read and signed informed consent forms approved by the University's Committee for the Protection of Human Subjects.

Soleus H-wave and M-wave recruitment curves were determined for each subject.

Each subject was tested on one day under two randomly administered conditions: 1) standing; and 2) prone. Surface electrodes (Therapeutics Unlimited) were placed over the soleus muscle of the right leg, approximately two centimeters below the point where the two heads of the gastrocnemius join the Achilles tendon. Electrodes were placed longitudinally on the skin, with a two centimeter intraelectrode distance. The ground electrode was positioned over the lateral malleolus. Once in place, the recording and stimulating electrodes were not removed until the completion of the study, to ensure that exact placement was maintained.

A percutaneous electrical stimulus (1 ms duration pulse) was delivered to the posterior tibial nerve in the popliteal fossa to elicit the M-response and H-reflex. The current was increased by two milliamp incrememts from zero until a maximal M-wave was obtained and a plateau observed. Briefly, the M-wave represents all muscle fibers in the muscle contracting at the same time; the H-reflex represents that part of the muscle that is activated by the reflex. The H/M ratio, therefore, represents this as a percent. On each trial, the current delivered was monitored with a current probe. The dependent variable was the peak-to-peak amplitude of the EMG waves of both the H-reflex and the M-response.

After the H-reflex recruitment curves were determined, each subject was also tested for postural stability. For this test, each subject stood motionless on a Kistler force platform. A customized QuickBasic computer program (sample rate = *50* Hz) was developed to measure the area of sway for three fifteen second trials. Each subject performed six trials - three with their eyes open and three with their eyes closed. The sway area (in cm^2) was calculated for each condition.

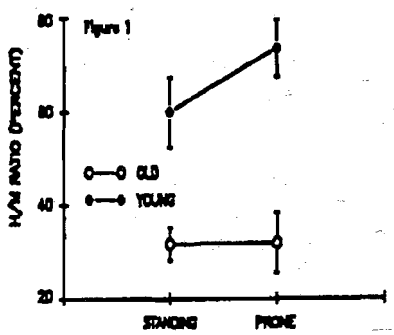
Each subject was also tested for hamstring and quadriceps leg strength of the right leg on a Cybex II isokinetic dynamometer. Each subject performed three maximal voluntary

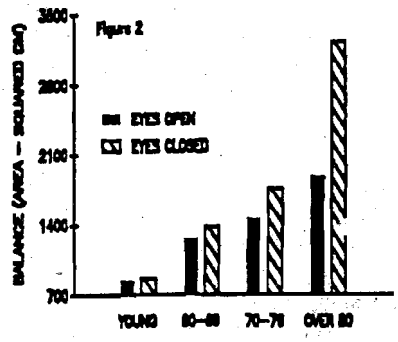
contractions of leg extension (quadriceps) and leg flexion (hamstrings) at 60 degrees per second.

For both the prone and the standing condition, each subject's H-max/M ratio was calculated. A 2 X 2 (Group x Condition) ANOVA was used to determine differences between groups and across each condition. The H-reflex and leg strength were correlated with the calculated sway area.

RESULTS

There were significant differences in the H-reflexes between the two groups. This is shown in Figure 1. Also, the young subjects increased their reflex when they laid down, whereas the the elderly subjects did not (Figure 1). The elderly subjects also swayed more (Figure 2) and vision was much more important in the over 80 age group. as shown in Figure 2. Finally, although the elderly subjects demonstrated less strength of the quadriceps and hamstrings, there was no relationship between leg strength and balance ability in any group. However, the subjects in the present study were quite active and very strong, and therefore may not have representative of the elderly population in general. Also, it should be noted that in this study, quadriceps and hamstring strength were investigated whereas in the future, soleus/gastrocnemius strength will be examined. Soleus/gastrocnemius strength may be more instrumental in balance control. Finally, although not analyzed, the frequency of sway was recorded in this study and this variable may in fact correlate with leg strength.





It is concluded that the H-reflex may be instrumental in maintaining balance control in the elderly. Also, it is concluded that leg strength is unrelated to balance control in the elderly.

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