TWELVE WEEKS OF PLANTARFLEXOR STRENGTH TRAINING DO NOT CHANGE GAIT BIOMECHANICS OF HEALTHY OLD ADULTS WALKING AT A SAFE MAXIMUM SPEED

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INTRODUCTION

Locomotion is an important and inherent part of daily life and is integral in maintaining an independent lifestyle, especially in older adults whose functional capacity has declined. This decline is due to changes in many physiological characteristics, particularly a loss of muscle mass, strength and power [1] and it is manifested as a reduced walking velocity in old adults. Kinetically, old adults lose more torque and power at the ankle than at other joints [2,3]. This distal to proximal shift in muscle function could be due to plantarflexor weakness, so strengthening the plantarflexors may help reverse the negative physiological effects of aging and help preserve functional capacity in old adults. The purpose of this study was to determine the effect of a plantarflexor strength training program on gait biomechanics during level walking at a safe maximum speed in healthy old adults.

METHODS

Ten healthy adults, 65 to 85 years old have so far been recruited and randomly assigned to strengthening (n=6) or stretching (control, n=4) groups. Informed consent was obtained for all participants before testing or training. Pre- and post-test measurements of maximal plantarflexor strength were collected for each participant. This included obtaining a 1-repetition maximum (1RM) weight for the left limb ankle plantarflexors and then assessing the plantarflexor torque-velocity relationship using 20, 40, 60, 80, and 100% of the subject’s 1RM. Force and motion data were captured with the subject on a supine leg press machine with a force plate mounted on the foot platform. Visual 3D was used to calculate ankle plantarflexor angular velocity and torque during the ankle press trials. Pre-and post-test gait kinematics and kinetics were collected while walking at a safe maximum speed using an 8-camera Qualisys motion tracking system, AMTI force plate and standard marker placements on the pelvis and left leg. Instructions were to, “walk as fast as you can without feeling like you are going to run or fall.” Visual 3D was used to calculate ankle torque ankle power during the gait trials. Between tests, both groups exercised three 3 per week for 12 weeks. During each exercise session, the strengthening group performed 2 sets of 10 repetitions of a bilateral ankle press for the gastrocnemius and two sets of 10 repetitions on a bilateral seated calf raise for the soleus muscles. Participants in the stretching group performed two 40-second repetitions for each of the static and dynamic gastrocnemius and soleus stretches. All subjects repeated the gait assessments, maximal plantarflexor strength testing and the ankle press trials at the end of the 12 week training period. Due to the small sample sizes, t-tests were used to compare pre versus post-test values within each group to provide a preliminary analysis (p<0.05).

Figure 1: Scan the QR code to view simulation videos of torque-velocity strength testing, strengthening and stretching exercise protocols, and maximum speed walking test.
RESULTS AND DISCUSSION

The strengthening group significantly increased the average peak plantarflexor torque and peak velocity as seen in Figure 2 (p<0.05). The stretching group significantly increased average peak plantarflexor torque (p<0.05) but not peak velocity as seen in Figure 3.

Despite this increase in peak torque, preliminary results showed no effect on the gait characteristics of old adults. As seen in Table 1, there were no changes in stride length, walking velocity, peak plantarflexor torque or peak plantarflexor power from the pre-test to post-test in either group while walking at a safe maximum speed.

CONCLUSIONS

Based on these preliminary results, a 12-week plantarflexor strength training program does not change the gait kinematics or kinetics of healthy old adults walking at a safe maximum speed. A possible explanation for the lack of gait changes could be due to the fact that our subjects were already healthy and mobile before the 12 weeks of exercise. At the pre-test, our subjects walked at 1.88m/s compared to the fastest speed of healthy old adults reported previously (1.66m/s) [4]. Perhaps our old adults do not have the capacity to further increase walking velocity. Additionally, it is possible that 12 weeks of strength training is not long enough to incorporate the increases in strength and joint torque capacity into gait adaptations.

REFERENCES


Table 1: Gait kinematics and ankle kinetics of healthy old adults walking at a safe maximum speed.

<table>
<thead>
<tr>
<th></th>
<th>Strengthening</th>
<th>Stretching</th>
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<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Stride Length (m)</td>
<td>1.68 ± 0.29</td>
<td>1.66 ± 0.23</td>
</tr>
<tr>
<td>Velocity (m/s)</td>
<td>1.88 ± 0.30</td>
<td>1.81 ± 0.25</td>
</tr>
<tr>
<td>Torque (Nm/%BW*H)</td>
<td>9.0 ± 1.3</td>
<td>9.0 ± 0.7</td>
</tr>
<tr>
<td>Power (W/kg)</td>
<td>3.8 ± 1.4</td>
<td>3.9 ± 0.9</td>
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Figure 2: Pre and post torque-velocity relationships. * torque p<0.05; # velocity p<0.05

Figure 3: Pre and post torque-velocity relationships. * torque p<0.05