Introduction

Strong abdominal muscles are thought to be important in maintaining a healthy spine. However, exercises geared toward abdominal strengthening also facilitate contraction of the hip flexor muscles secondary to their origin on the spine.

Given the variety of ways to train the abdominals and the potential hip flexor contribution, the purpose of the study was to examine the effect of lower extremity (LE) stabilization on abdominal force production and activation.

Purpose #1: determine the effect of hip position (i.e. hips in neutral with knees extended vs. flexed) and LE stabilization (i.e. no strap versus strap) on activation of the abdominal and hip flexor muscles.

Purpose #2: determine the effect of hip position and LE stabilization on peak trunk flexion force.

Methods

• Preliminary Date:
  • 20 healthy subjects (10 male, 10 female)
  • All participants signed informed consent and the protocol was approved by the Institutional Review Board of Ohio University.
  • Hip flexor flexibility. An inclinometer was used to measure hip flexion angle.
  • Modified Thomas Test (hip and knee flexed)
  • Thomas Test and Modified Thomas Test
  • External oblique Passive abdominal resistance
  • Internal oblique Passive abdominal resistance
  • Rectus abdominus Passive abdominal resistance

• Procedure:
  • Subjects were positioned supine on a customized table, with the thorax strapped in a free-floating board to counterweight to the subject's trunk mass. The pelvis and lower extremities rested on the table.
  • Two maximal voluntary contractions were performed in two different test positions with and without LE stabilization.
  • Test position 1: knees extended, strap, followed by knees flexed and knees flexed, no strap.
  • Test position 2: hips and knees flexed, no strap, followed by hips extended, strap.
  • The inclinometer was zeroed on mid thigh before performing measurement.

• Data Analysis:
  • Real-time visual feedback of max force was displayed on a flat-panel monitor using software developed in LABVIEW (National Instruments, Austin, Texas, USA).
  • Data were displayed as percentage of maximum voluntary contraction (MVC).

Results

Analysis of interactions revealed:

• Main effects:
  • Peak trunk flexion force was not significantly higher contingent on test position (p > .05).
  • Knees extended, no strap, mean = 35.338, versus knees flexed, no strap, mean = 35.338.
  • Peak trunk flexion force was significantly higher with distal fixation versus no distal fixation (F(1,18) = 130.618, p < .05).
  • Knees extended, strap, mean = 81.156, versus strap, mean = 50.552.
  • Peak trunk flexion force was significantly higher in males versus females (F(1,10) = 6.092, p < .05).
  • Males, knees extended, strap, mean = 102.922, versus females, knees extended, strap, mean = 59.314.

• There was no significant interaction of position by strap (p > .05).

• General testing positions:
  • There was no significant interaction of strap by gender on peak trunk flexion force (F(1,18) = 11.415, p > .05).
  • There was no significant interaction of position by strap (p > .13).
  • There was no significant interaction of position by gender (p > .73).
  • There was no significant correlation between hip flexor muscle length (assessed via Thomas Test and Modified Thomas Test) and peak trunk flexion force for any of the test positions (p > .25).

Conclusion

• Previous studies have failed to look at the effect of distal fixation and hip position on the production of peak trunk flexion force, and activation of the abdominal and hip flexor muscles.

• This study revealed that hip position has no significant effect on peak force.

• Additionally, there was no effect of test position on peak EMG activation of any of the abdominal muscles.

• For all subjects, regardless of hip position, the ability to generate peak trunk flexion force and the greatest activation of the hip flexors occurred with lower extremity stabilization.

• Gender had a significant effect on the ability to produce peak force (males greater than females), and there was no significant interaction of position by gender of peak force.

• Additionally, preliminary Thomas Test measurements and peak trunk flexion force were assessed during Thomas and Modified Thomas Test, which indicated that all testing positions there was no significant correlation between hip flexor muscle length and the ability to generate force (p > .05).

• Core strengthening is a key component in the treatment of low back pain. Our findings suggest that in a healthy population, the abdominal muscles can be maximally activated without lower extremity stabilization. Our data also reveals that hip flexor muscle length does not effect force production. Therefore emphasis should not be placed on lower extremity stabilization or hip flexor flexibility when strengthening the abdominal muscles.