

# MUSCLE ACTIVATION LEVELS DURING STANDING HIP JOINT STRENGTHENING EXERCISES USING ELASTIC TUBING RESISTANCE: COMPARISON OF TRADITIONAL CARDINAL PLANE MOVEMENTS VERSUS PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF) SPIRAL-DIAGONAL PATTERNS

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**Disclosure of source of funding for this project (if none, indicate "no funding"):** Project funding came from the Mayo School of Health Sciences Program in Physical Therapy.

**Compliance Statement:** Project approved by the Mayo IRB (#11-006057). All subjects signed an approved consent form.

## **Abstract (Limited to 300 Words):**

**PURPOSE:** Quantify activation levels bilaterally of hip muscles during resisted lower extremity (LE) standing exercises using elastic tubing: (1) front pull; (2) back pull; (3) crossover; (4) reverse crossover; (5) PNF diagonal 1 flexion (D1F); (6) PNF diagonal 1 extension (D1E); (7) PNF diagonal 2 flexion (D2F); and (8) PNF diagonal 2 extension (D2E).

**SUBJECTS:** Thirteen men ( $25 \pm 3$  years), 13 women ( $24 \pm 1$ ) participated.

**METHODS AND MATERIALS:** Electromyographic (EMG) signals for moving and stance side hip muscles were collected using DE-3.1 double differential surface electrodes at a sampling frequency of 1000 Hz. EMG signals were normalized to peak activity in the maximum voluntary isometric contraction (MVIC) trial and expressed as a percentage. Subjects completed 3 - consecutive repetitions of LE exercises in random order.

**ANALYSES:** Descriptive statistics-including means and standard deviations (SDs)- for EMG recruitment (% MVIC) in the gluteus medius, hip adductors, hamstrings, and rectus femoris were calculated for both the stance and moving sides. The magnitudes of the EMG recruitment were analyzed with a 2 x 8 repeated-measures ANOVA for each muscle ( $\alpha = .05$ ).

**RESULTS:** Adductor average EMG activation was greatest during crossover (moving limb  $69 \pm 5\%$  MVIC; stance limb  $52 \pm 4\%$  MVIC). Rectus femoris average EMG activation was greatest bilaterally during reverse crossover (moving limb  $51 \pm 6\%$  MVIC; stance limb  $57 \pm 7\%$  MVIC). Hamstring average EMG activation was greatest for the moving limb during back pull ( $57 \pm 7\%$  MVIC), and for the stance limb during D1F ( $51 \pm 6\%$  MVIC). Gluteus medius average EMG activation was greatest during reverse crossover (moving limb  $72 \pm 5\%$  MVIC; stance limb  $67 \pm 7\%$  MVIC).

**CONCLUSIONS:** Hip muscles were activated above a 50% MVIC threshold necessary for strengthening using one of the eight exercises.

IMPLICATIONS: The stance limb generated muscle activation levels (> 50% MVIC) consistent with LE strengthening during resisted exercises using elastic tubing.