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ORIGINAL RESEARCH

EMG OF SHOULDER MUSCLES DURING REACTIVE ISOMETRIC ELASTIC RESISTANCE EXERCISES

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ABSTRACT

Background: Traditionally, shoulder isometrics are introduced in the early stages of shoulder rehabilitation. A patient's isometric torque output is based on a subjective perception of force generation. By utilizing elastic resistance elongation (strain) to standardize force output, clinicians could prescribe shoulder therapeutic isometrics based on % maximum voluntary contraction (%MVC).

Purpose/Hypothesis: The purpose of this study was to measure electromyographic (EMG) activity and determine the %MVC during shoulder flexion, external rotation and abduction isometrics at varying lengths of TheraBand® elastic resistance. It was hypothesized that increased elongation of progressive resistance bands would proportionately increase the %MVC of the shoulder musculature.

Study Design: Laboratory design using healthy subjects.

Methods: Eight healthy subjects (16 shoulders) (5 females, 3 males; avg. age 29.2) were tested. Surface EMG electrodes were placed over the anterior deltoid, middle deltoid, and infraspinatus muscles. A force transducer was anchored to a stable surface with its corresponding end in series with an extremity strap securely holding the elastic band. Subjects were asked to maintain shoulder position for the proper isometric contraction (flexion, abduction and external rotation) while taking incremental steps away from the anchored elastic resistance, to the beat of a metronome to clearly marked distances on the floor (50, 100, 150, 200 and 250% of band elongation). This was repeated with yellow, red, green, and blue TheraBand® resistance levels. Maximum voluntary contractions for both force and EMG were collected for each subject in all three test positions. EMG data were normalized and expressed as a %MVC.

Results: For external rotation and flexion, the infraspinatus and anterior deltoid activity increased with band elongation ($p < 0.01$) and progressive colors ($p < 0.01$). The increases in EMG activity with elongation plateaued with the yellow and red bands but continued to increase with the green and blue bands ($p < 0.01$). The increase in infraspinatus and anterior deltoid EMG activity with progressive band color was more apparent for green and blue bands compared with yellow and red band ($p < 0.01$). For the abduction exercise, middle deltoid activity increased with band elongation ($p < 0.01$) and progressive color ($p < 0.01$). In all three exercises, there was an increase in force exerted by the band with increasing length and band color ($p < 0.001$). However, while there were clear increases in force from red to green to blue, there was no difference in force between yellow and red regardless of elongation ($p < 0.01$).

Conclusion: Isometric flexion, external rotation and abduction muscle activity can be accurately prescribed clinically by adjusting the elongation and resistance associated with progressive colors of resistance bands.

Level of Evidence: 3

Key words: Elastic resistance, isometric exercise, electromyography

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