Comparison of Muscle Activation Levels during Arm Abduction in the Plane of the Scapula versus Proprioceptive Neuromuscular Facilitation (PNF) Upper Extremity Patterns

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ABSTRACT

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PURPOSE: This study quantified the activation of 8 muscles of the shoulder-trunk-and back during standing performance of (1) arm abduction in the plane of the scapula (scaption), PNF diagonal 1 flexion (D1F), and (3) PNF diagonal 2 flexion (D2F) while lifting dumbbell with dominant hand.

SUBJECTS: Twelve men (26.1± 4.4 years) and 13 women (24.5± 1.9 years) volunteered to participate.

METHODS AND MATERIALS: Electromyographic (EMG) signals were collected with DE-3.1 double-differential surface electrodes at a sampling frequency of 1.000Hz. EMG signals were normalized to peak activity in the maximum voluntary isometric contraction (MVIC) trial and expressed as a percentage.

ANALYSES: One-way repeated measures ANOVA with Bonferroni corrections ($\alpha = .05$) examined the muscle activation patterns across the 3-conditions.

RESULTS: Average activation was greater for scaption (125 ± 28% MVIC; p=.006) and D2 (114 ± 33% MVIC; p=.001) than D1 (98 ± 28% MVIC). For the middle trapezius average activation was greater (p=.001) for D2 (113 ± 37% MVIC) than D1 (81 ± 33% MVIC). The lower trapezius average activation was greater (p = .047) for D2 (67 ± 22% MVIC) than D1 (55 ± 22% MVIC). The erector spinae showed greater activation for D2 (43 ± 19% MVIC; p< .001) and D1 (53 ± 20% MVIC; p<.001) than scaption (21 ± MVIC). Lastly, external oblique demonstrated greater average activation (p = .021) for D1 (47 ± 23% MVIC) than scaption (33 ± 24% MVIC).

CONCLUSIONS: During D1F, all 6 muscles of the shoulder complex demonstrated very high activation levels (> 60% MVIC) during arm elevation except the lower trapezius (55% MVIC). In contrast the erector spinae and external oblique muscles showed moderate activation (21% to 40% MVIC) during arm elevation.

IMPLICATIONS: The 6 muscles of the shoulder complex displayed high to very high muscle activation at a level appropriate for strength training.