SHOULDER-POSITION DEPENDANT ELBOW TORQUE COUPLING DURING ADDUCTION AFTER STROKE

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INTRODUCTION

Previous work [1] has identified abnormal elbow torque coupling during isometric shoulder abduction and adduction of the impaired upper extremity after stroke. Changes in heteronymous (proprioceptive) reflex pathways, that link shoulder and elbow joint muscles [2], may underlie the expression of this coupling due a stroke-induced loss in descending corticospinal input to the spinal cord. In an effort to test this hypothesis, elbow/shoulder torque coupling was measured isometrically in two shoulder positions.

METHODS

Eleven individuals ranging from 14 to 289 months after stroke participated in the study. All subjects were able to support the upper limb against gravity and demonstrate the ability to generate some concurrent active elbow extension. In each of the two positions studied, the elbow angle was 90º while the shoulder angle (abduction) was either 75º or 20º.

Single-Task Protocol: Maximum voluntary torques [1] were measured isometrically at the shoulder and elbow for each shoulder position. Joint torque data was collected concurrently for both the shoulder and elbow while the subject attempted to maximize torque in a primary direction.

Dual-Task Protocol: Subjects maintained various percentages of isometric maximum shoulder adduction (25%, 50%, and 75%) while attempting to maximize either elbow flexion or extension.

RESULTS AND DISCUSSION

A significant effect of shoulder position was found on elbow/shoulder torque coupling (fig. 1). Specifically, a profound torque direction reversal occurred in the adducted or

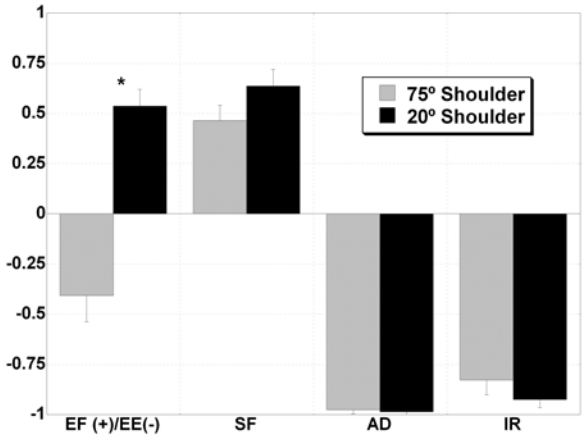

Figure 1: Normalized maximum shoulder adduction (AD) and coupled elbow flexion (EF)/extension (EE), shoulder flexion (SF), and internal rotation (IR) torques during the single-task protocol for the 75º-and 20º-shoulder positions.

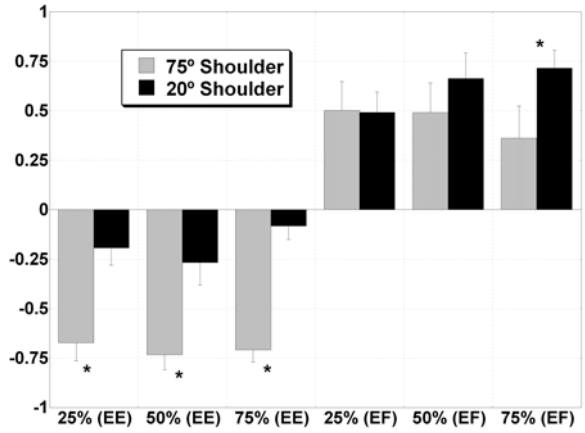

Figure 2: Normalized maximum elbow flexion (EF) (+) or extension (EE) (-) torque during various percentages of maximum adduction torque (25%, 50%, and 75%) for the 75º- and 20º-shoulder positions.

20º-shoulder position. This reversal suggests an alteration in the "stereotypical" extension pattern previously described [1] as coupling of shoulder adduction with elbow extension. This phenomena was further examined during a dual-task protocol. Consistent with previous results, [1] subjects generated considerable elbow extension and progressively less elbow flexion during higher levels of adduction in the 75º-shoulder position (fig. 2). However, in the 20º-shoulder position, subjects generated less elbow extension and greater elbow flexion during higher levels of adduction. The effect of shoulder position on joint torque coupling may be explained by position-dependant differences in proprioceptive feedback from shoulder abductor and adductor muscles and/or reorganization at the level of the spinal cord affecting the integration of ascending proprioceptive input.

CONCLUSIONS

Abnormal torque coupling of shoulder adductors with elbow extensors appears to be dependant upon shoulder position.

REFERENCES

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