An EMG-driven Musculoskeletal Model to Predict Muscle Forces During Performing a Weight Training Exercise with a Dumbbell

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Musculoskeletal system of human body is a redundant system and as a result, employing only inverse dynamics techniques to obtain muscle forces would lead to a dead end. Using EMG signals in order to obtain muscle forces, has been used extensively. In this study, in order to predict muscle forces of elbow flexors (Biceps brachii, brachioradialis, and brachialis) and extensors (Triceps brachii) during flexion/extension weight training with a dumbbell, a hybrid EMG-driven method has been implemented. 6 subjects (4 women and 2 men) were volunteered for the experiments. During performing the action, using a high speed camera and a muscle tester device, kinematic information and EMG signals were obtained, respectively. Besides, exploiting manual muscle testing method, maximum voluntary contraction of all of the mentioned muscles for each subject has been measured. The EMG-driven method, incorporated a forward and an inverse dynamics approach, and by comparing the joint moments obtained from these two routines, the unknown variables of the model (electromechanical delay, shape factor, excitation filter coefficients) were obtained. Finally, in order to compare the virtue of the muscle forces, these results were compared with the same results obtained from a static optimization method (objective function: sum of squared muscle forces). Conducting a two-way ANOVA for comparing the results, a significant difference between the two results, has been observed ($P < 0.005$).