OPTIMIZATION OF SNATCH LIFT BY USING GENETIC ALGORITHM

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KEY WORDS: weightlifting, optimization, genetic algorithm.

INTRODUCTION: Barbell trajectory during weightlifting has been investigated by many researchers like Garhammer (2001). Some motion patterns was categorized as optimized one because of the percentage of their owners' success. We believe that in optimizing the barbell trajectory we should consider the mechanical principles. We formulate a 5-link (shin, thigh, trunk, upper arm and forearm) dynamic model, according to anthropometric data, to predict the optimum (minimum torque) barbell trajectory by using genetic algorithm (GA).

METHOD: A GA operates on a population of randomly generated solutions, chromosomes, represented by a vector of real numbers. We represent each individual chromosome as a sequence of five angles (ankle, knee, hip, shoulder and elbow) of weightlifter's model during the snatch lift. Starting the first random population (i.e. several random trajectories); we score them by solving the equations of motion via inverse dynamics. Then we select the best trajectories and reproduce the next generation of solutions by genetic operators. This procedure continues until the stop criterion, minimizing the actuating torques, fulfilled.

RESULTS: We solved a problem for a weightlifter with 70 kg mass and 1.7 m height who lifts a 90 kg barbell between "lift-off" and start of "catch phase". Figure 1 shows the barbell trajectory. At the start of catch phase the barbell moves as a "projectile".

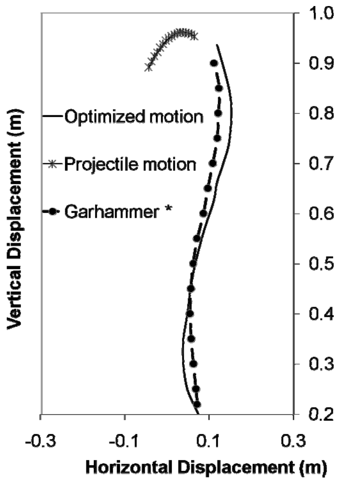

Figure 1: Experimental Barbell Trajectory Reported by Garhammer vs. Optimized Trajectory

DISCUSSION: The barbell trajectory described by Garhammer (2001) shows the typical toward-away-toward form. One can see the good agreement between optimized trajectory of our model and experimental results shown in Figure 1.

CONCLUSION: This dynamic approach can helps coaches to train weightlifters on a more systematic manner. This model can help them, not only to increase the success of weightlifters but to reduce their injury risks also.

REFERENCES:

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ELECTROMYOGRAPHY IN PECTORALIS MAJOR, TRICEPS BRACHIALIS AND ANTERIOR DELTOID DURING THE BENCH PRESS EXERCISE

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KEY WORDS: pectoralis major, bench press, electromyography.

INTRODUCTION: The bench press exercise is often used by athletes and the incidence of pectoralis major ruptures during this exercise have increased in weightlifters (Potter *et al.,* 2006). However, the activities of each muscle during this exercise remain controversial. The aim of this study was to compare the electromyographic (EMG) activity of Pectoralis Major - Clavicular Portion (PM-C), Pectoralis Major - Sternal Portion (PM-S), Long Head of Triceps Brachialis (TB) and Anterior Deltoid (AD) during the horizontal bench press exercise.

METHOD: 10 individuals without upper arm lesions participated (Mean ± SD: age = 26 ±2.0 years-old; weight = 81 ±7.4 Kg; height = 183.0 ±7.5 cm). They performed one maximal resistance horizontal bench press exercise, while surface EMG of PM-C, PM-S, TB and AD were collected. An eight channel surface electromyography system was used to record the EMG signals. All raw EMG signals were bandpass filtered between 10 and 500 Hz, amplified (common mode rejection ratio >100 dB, overall gain 1000) and analogue-to-digital converted (12-bit) at a sampling rate of 2000 Hz. The EMG signal was quantified by the root mean square and normalized by the peak value during maximal resistance dynamic contraction. A video recorder camera was synchronized with the electromyography system and movement was divided into eccentric, transitioning and concentric phases. Statistical analysis was conducted using the Friedman method and Wilcoxon tests. Significant statistical values were accepted at $p<0.05$.

RESULTS AND DISCUSSION: When comparing different muscles, in each of the phases only one significant difference in %max was found. Specifically, the PM-S was significantly different from the AD in the bench press eccentric phase (P=0.035). No other significant differences were found in any other phase. When comparing the same muscle in different bench press phases, significant differences were found for AD between the eccentric and transitional phases (P=0.005) and transitional and concentric phases (P=0.037*).* Regarding PM-C, significant differences were found between the eccentric and transitional phases (P=0.005) and transitional and concentric phases (P=0.047). For the PM-S, a significant difference was found between the eccentric and transitional phases (P=0.009), however no difference was found in the transitional to concentric phase. For the TB, no significant difference between the eccentric and transitional phases occurred, however, a significant difference was found between the transitional and concentric phases (P=0.017). Given this, it seems that uniform activity occurs among the muscles during the bench press and that imbalance in this activity could cause ruptures due to muscle superactivation.

CONCLUSION: During the horizontal bench press exercise activity of AD and PM-C seem to increase between eccentric, transitional and concentric phases. In the TB, the EMG activity in the eccentric and transitional phases is the same and in the PM-S, the EMG activity in the transitional and concentric phases is the same. However, between phases no difference in muscle activity was found, with exception of the AD and PM-S in the eccentric phase.

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