HUMAN BILATERAL DEFICIT DURING DYNAMIC, MULTI-JOINT LEG PRESS MOVEMENT

Dean Hay, Vinicius Aguiar de Souza, Senshi Fukashiro
Department of Life Sciences, University of Tokyo, Japan
email: w_dean_c_hay@hotmail.com

INTRODUCTION

Bilateral Deficit (BLD) is used to describe the decrement of the maximum performance elicited by two limbs working simultaneously when compared to the sum of each limb working independently. Both impaired reaction time and decreased force production have been observed in humans during bilateral movements [1, 2]. However, other studies have demonstrated no bilateral deficit [3], or differences dependent upon the motor task and type of athlete [4].

The purpose of this study was to determine whether or not BLD was present during a dynamic movement **(horizontal leg press)** under conditions where the relative load was equal for single and two-legged jumps.

METHODS

Five healthy male subjects (Age: 27.8 ± 3.5 yrs; Weight: 72.2 ± 4.7 kg; Height: 1.76 ± .03 m; mean ± SD) participated in this study with informed consent. Subjects were positioned in the supine position on a horizontal leg press machine and performed a randomized series of left, right, and double leg maximal jumps. Loads were adjusted for single leg (0.5x and 1x body weight - BW) and double leg (1x and 2x BW) jumps. Each condition was repeated 4 times for a total of 24 trials.

Kinematic (200 Hz) and reaction force (1000 Hz) data were recorded along with EMG (1000 Hz) from 6 muscles of the left leg (Sol, MGas, BFem, VMed, RFem, GMax). Joint torque, power, and work were calculated for the ankle, knee, and hip of the left leg (Armo, G-sport, Japan). EMG root mean square (RMS) was also determined. Single and double leg jumps were normalized then statistically analyzed using a repeated measures general linear model (5 subjects x 6 conditions x 4 trials).

The bilateral deficit index was calculated by the formula:

BI = 100 * (single leg – double leg) / single leg)

A positive value denotes a bilateral deficit.

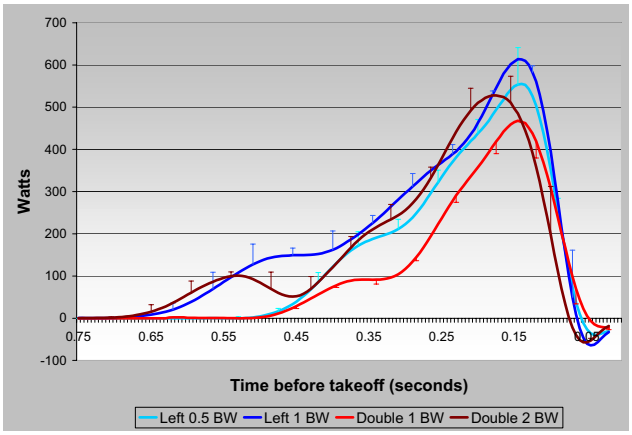

Figure 1: Average knee joint power for 4 conditions with standard deviation bars (one subject).

RESULTS AND DISCUSSION

As there was no significant difference between left and right leg impulse, subsequent analyses were limited to left leg - double leg trials. Left leg jump impulse was significantly greater than double leg impulse (Left 0.5BW vs. Double 1BW; Left 1BW vs. Double 2BW, respectively). Sol, RFem, and VMed showed BLD, while MGas and GMax exhibited bilateral facilitation. Work for each joint exhibited significant BLD (Table 1).

CONCLUSIONS

Bilateral deficit during a multi-joint leg press movement is negatively associated with load. Our data show that BLD is greater during explosive, rapid movement, suggesting general impaired fast-twitch motor unit recruitment. Implications of the results are discussed.

REFERENCES

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Table 1: Bilateral deficit indices for impulse, EMG, and normalized joint work. Statistical significance: * p <0.05; ** p <0.01.

Condition	Impulse	RMS Electromyography						Joint Work		
		Sol	MGas	BFem	VMed	RFem	GMax	Ankle	Knee	Hip
Left 0.5BW vs. Double 1BW	26%**	15.2%**	-2.5%	4.2%	4.8%	14.6%**	-15.1%*	15.1%**	11.1%**	38.35%**
Left 1BW vs. Double 2BW	11.7%**	9.5%**	-7%*	-7.6%	7.1%*	12.1%**	-12.7%*	11.5%**	6.2%**	29.4%**