EFFECT OF IMPACT VELOCITY ON THE LOWER LIMB STRETCH-SHORTENING CYCLE MUSCLE FUNTION

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Introduction

Stretch-shortening cycle muscle function (SSC) can be effectively trained using free drop jumps (DJ) and jumps on sledge jump systems (SLJ) [Bubeck & Gollhofer, 2004]. The use of jumps using pendulum devices (PDJ) was shown to be also effective regarding SSC [Trzaskoma, 1994; Trzaskoma *et al*, 2010] since the total body mechanical power output is enhanced. Despite the fact that SSC modifications caused by different impact velocity magnitude (V_{IMP}) were reported in DJ and SLJ studies [Bubeck & Gollhofer, 2001], impact parameters were not controlled in previous PDJ studies [Fowler & Lees, 1998]. The purpose of the present study was to examine the biomechanical differences of PDJ executed with 75%, 100% and 125% of the nominal V_{IMP} during a DJ from 40cm.

Methods

27 healthy Physical Education Students (23.0yrs ± 3.8, 1.85m ± 0.06, 82.8kg ± 7.8) participated in the study. An instrumented bifilar pendulum swing device with a fixed seat [Panoutsakopoulos, 2011] was used for the PDJ. The desired V_{IMP} was achieved by releasing the device after lifting it to the proper position. A digital video camera (100fps) recorded the tests and EMG activity from eight lower limb muscles was collected (S_f = 1kHz). PDJ kinematic data were simultaneously acquired (S_f = 500Hz) from a force-platform on the wall and from the attached to the pendulum goniometer, accelerometer and force transducer (Figure 1). Differences among V_{IMP} conditions were examined with repeated measures ANOVA using the SPSS 10.0.1 (SPSS, Chicago, Il) software.

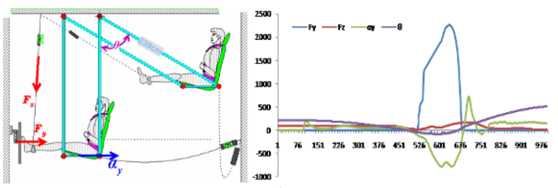

Figure 1: Illustration of the experimental set-up (left) and representational acquired data (right).

Results

PDJ performance was significantly ($p < .05$) enhanced as V_{IMP} increased ($V_{IMP75\%}$: 0.40m ± 0.09, $V_{IMP100\%}$: 0.43m ± 0.07, $V_{IMP125\%}$: 0.45m ± 0.08). Table 1 presents the observed values for contact time (t_C), maximum reaction force (F), maximum total body mechanical power output (P), knee angle at its maximum flexion (ϑ_K) and maximum knee extension angular velocity (ω_K) during the contact phase. EMG activity was greater in $V_{IMP100\%}$ compared to the two other experimental conditions.

Parameter	$V_{IMP75\%}$	$V_{IMP100\%}$	$V_{IMP125\%}$
t_C (msec)	428 (89)	443 (65)	473 (57)*#
F (kN)	2.0 (0.3)	2.2 (0.3)*	2.4 (0.3)*#
P (kW)	4.7 (0.9)	5.0 (0.9)	4.4 (1.0)#
ϑ_K (rad)	1.6 (0.3)	1.3 (0.2)*	1.2 (0.2)*#
ω_K (rad/sec)	12.6 (2.0)	13.4 (1.9)*	12.8 (2.3)

Table 1: Mean (Standard Deviation) values of the PJD biomechanical parameters examined (: $p < 0.05$ vs. $V_{IMP75\%}$; #: $p < 0.05$ vs. $V_{IMP100\%}$).*

Discussion

Modifications in SSC of PDJ were observed confirming similar observations concerning DJ and SLJ [Bubeck & Gollhofer, 2001], where an increased V_{IMP} results in differences concerning t_C, F, ϑ_K and EMG activity. Further research is necessary in order to identify the optimum stretch load needed to improve SSC during PDJ training.

References

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