3-DIMENSIONAL KINETIC ANALYSIS OF OLYMPIC SNATCH LIFT

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INTRODUCTION

Olympic Weightlifting (OL) is a sport requiring tremendous muscular effort in addition to excellent coordination and timing [1]. The components of Olympic Weightlifting, the snatch and the clean & jerk, involve all large muscle groups and are performed with emphasis on speed of movement and technical mastery [1]. Limited 3-dimensional kinetic research has been conducted on OL movements [2]. This study will examine selected kinetic and kinematic differences in lift mechanics as barbell load varied between 80-90% of maximal.

METHODS

The selection method was opportunistic to ensure competent lifting performances. The five male participants (4 adult, 1 junior) were National or International caliber weightlifters. A 14-segment rigid-link model represented the musculoskeletal system. Participants executed 3 snatch lifts at predetermined relative capacities. Trial order was balanced to limit order effects. A five-camera Vicon MX system, sampling at 200 Hz, captured lift kinematics. Trajectories were low-pass filtered using Butterworth filters with 6 Hz cut-offs. Ground reaction forces of both feet were recorded from two Kistler force platforms and digitally filtered (10 Hz cut-offs). Net moments and powers were computed using Visual3D.

RESULTS

Figure 1 shows the results of one subject's successful and unsuccessful attempt at a 95% capacity lift. Peak moments of force and powers about the joints of the lower extremity in the sagittal plane across both trials are presented in Table 1 below.

DISCUSSION AND CONCLUSIONS

Inspection of Figure 1 shows sagittal plane angular velocities, moment of force and power about the joints of the lower extremity are similar. Ankle net moment of force was plantiflexor from lift-off through to explosion its power production was punctuated with two distinct periods of positive work occurring during barbell lift-off (A1) and explosion (A2) with a small burst of negative between.

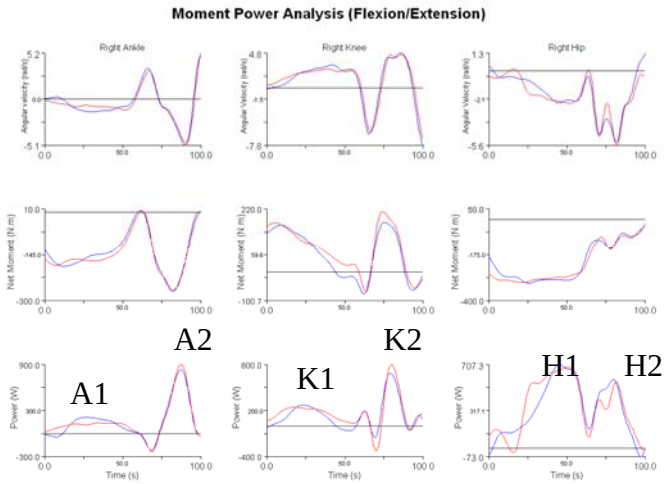

Figure 1: The angular velocities (rad/s), moments of force (N.m) and powers (W) about the ankle (left), knee (middle) and hip (right) about the flexion/extension axis. Successful trial variables are blue, and missed lift is red.

The knee moment of force produced two bursts of extensor positive work (K1 and K2) separated by short bursts of positive work by the flexors and of negative work by the extensors. These correspond to the initial knee extension during liftoff, rapid flexion during transition (due to double knee bend technique), and a prestretch before the final extension during the explosion phase (K2). The hip moment was extensor throughout the lift producing two peaks of positive work, first during liftoff (H1) and a second during the explosion (H2). These patterns of activity are similar to those of vertical jumping where all three joints also produce extensor moments nearly simultaneously.

REFERENCES

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Table 1: Summary of peak moments of force and powers across successful and an unsuccessful 95% snatch lift

	Ankle Moment (N.m)	Ankle Power (W)	Knee Moment (N.m)	Knee Power (W)	Hip Moment (N.m)	Hip Power (W)
Successful	-268.52	832.76	174.4	685.96	-315.28	707.26
Unsuccessful	-265.13	909.5	211.7	802.14	-311.73	802.14