BILATERAL SYMMETRY DURING A POWER CLEAN IN RECREATIONAL VS. COMPETITIVE WEIGHTLIFTERS

Patrick M. Rider, Robert Leonard, Charles Kemble, and Joshua Leonardis

1East Carolina University, Greenville, NC, USA
2National Institute for Occupational Safety and Health, Morgantown, WV, USA

email: riderp@ecu.edu, web: http://www.ecu.edu/cs-hhp/exss/biomechanics-members.cfm

INTRODUCTION

High intensity weightlifting has grown in popularity with recreational exercisers. This style of training often includes performing power cleans. Power cleans are bilateral weightlifting exercises that involve explosive generation of lower extremity joint torques to vertically accelerate a heavy load as rapidly as possible. The goal of this lift is to increase an individual’s ability to generate lower extremity power [1].

There are concerns towards increased risk of musculoskeletal injury by taking part in this type of exercise [2]. Complex, bilateral movements, such as the power clean, typically exhibit symmetry between left and right limbs in elite weightlifters [1,3], however, joint injuries that occur during these movements are typically unilateral. The relationship between lower limb bilateral asymmetries and level of experience during the power clean has not been fully explored.

The purpose of this study was to compare bilateral lower extremity kinetics during the pulling phase of a power clean between recreational and competitive weightlifters. We hypothesized that competitive weightlifters would show more symmetry than the recreational lifters in all lower extremity joint torques and peak ground reaction force (GRFs) values.

METHODS

Four males and three females between the ages of 18-35 years old participated in this study. Each participant was placed in one of two groups, competitive or recreational weightlifters. Groups were determined using the following criteria: Participants that had received at least 6 months of power clean training from a qualified coach were placed in the competitive group (n = 4). Individuals who had regularly performed power cleans within the past 3 months but had not received consistent coaching (n = 3) were placed in the recreational group.

After completing several warm-up trials, each participant completed four single power clean trials at 70% self-reported 1-RM. This percentage was chosen to simulate a typical training load. Full-body, three dimensional biomechanical data were collected using two AMTI force plates (force data captured at 960Hz) and a motion capture system (markers captured at 240Hz). Markers were also placed at each end of the weight bar to track bar movement. Each trial included a 60 second rest period to minimize fatigue. Lower extremity joint torques and peak ground reaction forces were calculated and absolute differences between left and right sides were compared between groups. Percentage differences were calculated by dividing the absolute difference left to right by the average absolute torque produced at each joint.

RESULTS AND DISCUSSION

Peak ground reaction forces showed significantly greater asymmetry in the recreational group (18% vs. 9%). Peak hip joint torque asymmetry was no different between the groups (13.0% Recreational vs. 12.9% Competitive). Peak knee joint torques showed significantly greater asymmetries in the recreational vs. competitive group (30.4% vs. 11.2%). Peak ankle joint torques also showed greater asymmetry in recreational vs. competitive (14.4% vs. 9.5%). Absolute values and associated standard deviations for left and right peak GRFs and torque values are located in Table 1.
CONCLUSIONS

The results partially supported our hypothesis that competitive weightlifters would show less asymmetry in lower extremity joint torques and ground reaction force values. Interestingly, the hip joint showed similar amounts of asymmetry between groups. Individuals may be able to more effectively produce symmetrical motion at the hip joint as each joint is connected through a rigid body (the pelvis). This may provide more proprioceptive feedback for the hip joint.

Although the left to right differences in peak ground reaction forces in competitive weightlifters were small (9%), larger percent differences were observed at the individual joints (11%) within this group. This may indicate kinematic asymmetries these joints. Lower extremity kinematic and kinetic asymmetries might also impact upper extremity symmetry and weight bar movement and play a role in the higher rates of injury in the shoulder and wrist joint in recreational high-intensity weightlifters. Further investigation should examine if any relationships exist between lower extremity kinematic and kinetic asymmetry and upper extremity and bar path kinematics and kinetics.

The most asymmetrical lower extremity joint was the knee in recreational lifters. This might help explain the relatively high injury rates at the knee joint in participants in high intensity training programs. These data might be especially useful for exercise practitioners who prescribe power cleans as a method of training to recreational individuals. Coaching has shown to be effective at improving power clean performance [4] and these individuals may consider reducing the power clean load until lifting technique has been mastered to improve symmetry between left and right limbs.

REFERENCES


ACKNOWLEDGEMENTS

The authors would like to acknowledge the contributions of Tayler Snipes and Jenny Magee in the collection and analysis of these data and their efforts in participant recruitment.

Table 1: Left to right differences in peak ground reaction forces and peak joint torques in recreational vs. competitive weightlifters.

<table>
<thead>
<tr>
<th></th>
<th>Peak GRF</th>
<th>Peak Hip Torque</th>
<th>Peak Knee Torque</th>
<th>Peak Ankle Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recreational</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>1005.3N ± 288.0N</td>
<td>193.3 Nm ± 52.2Nm</td>
<td>95.4 Nm ± 19.2Nm</td>
<td>123.5 Nm ± 52.4Nm</td>
</tr>
<tr>
<td>Right</td>
<td>1109.1N ± 531.4N</td>
<td>212.9 Nm ± 26.5Nm</td>
<td>70.2 Nm ± 10.2Nm</td>
<td>139.5 Nm ± 74.1Nm</td>
</tr>
<tr>
<td><strong>Competitive</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>1175.6N ± 234.1N</td>
<td>221.7 Nm ± 48.3Nm</td>
<td>122.6 Nm ± 15.8Nm</td>
<td>134.4 Nm ± 23.8Nm</td>
</tr>
<tr>
<td>Right</td>
<td>1231.6N ± 194.7N</td>
<td>212.3 Nm ± 28.1Nm</td>
<td>113.9 Nm ± 21.7Nm</td>
<td>145.6 Nm ± 23.5Nm</td>
</tr>
</tbody>
</table>