MECHANICAL ENERGY CONTRIBUTIONS OF THE LOWER EXTREMITY JOINTS IN DIFFERENT LEG EXPLOSIVE MOVEMENTS

Lee, C. W.¹, Huang, C. F.²
¹National Taipei University, Taipei
²National Taiwan Normal University, Taipei
email: carollee@mail.ntpu.edu.tw

KEY WORDS: inverse dynamics, grab start, mechanical energy

INTRODUCTION: Countermovement jump (CMJ), standing long jump (SLJ) and swimming grab start (GS) have some similar characteristics in the lower extremity. Athletes have to flex and then extend their legs when executing these movements. Besides, the moving directions were jumping forward in standing long jump and grab start. The purpose of this study was to compare the mechanical energy contributions of the ankle, knee and hip joints in three movements.

METHOD: Eight male swimmers performed countermovement jump, standing long jump and swimming grab start in this study. One Readlake high-speed video camera operating at 250 Hz and one Kistler force plate (500Hz) were synchronized to collect data. An inverse dynamic method was used to calculate net muscle joint moment and power of the lower extremities. Mechanical energy was determined by numerical integration of the joint power curve. The differences of parameters among three movements were analyzed with repeated one-way ANOVA.

RESULTS: The results were shown in Table 1.

Table 1: The Contributions of the Lower Extremity Joints in Three Movements (Mean ± S.D.)

<table>
<thead>
<tr>
<th></th>
<th>GS</th>
<th>CMJ</th>
<th>SLJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankle (%)</td>
<td>7.50 ± 3.00</td>
<td>26.41 ± 3.89</td>
<td>24.84 ± 3.28</td>
</tr>
<tr>
<td>Knee (%)</td>
<td>53.36 ± 5.44</td>
<td>31.69 ± 5.57</td>
<td>26.55 ± 5.97</td>
</tr>
<tr>
<td>Hip (%)</td>
<td>39.14 ± 4.09</td>
<td>41.90 ± 7.54</td>
<td>48.61 ± 5.40</td>
</tr>
</tbody>
</table>

n=8, p < .05

DISCUSSION: Table 1. showed the contributions of three joints of the lower extremity in three jumps. The contribution of ankle was less in grab start than in other jumps. In contrast, Knee had more contribution in grab start than in other jumps. Hip had less contribution in grab start than in standing long jump, but had no difference with countermovement jump. Otherwise, the primary energy generator was knee muscles, and the primary energy absorber was hip muscles in swimming grab start. It means that the grab start was a high skilled technique because of the specific of hip joint. Athletes should pay more attention in hip muscles when training grab start.

CONCLUSION: Swimming grab start, countermovement jump and standing long jump were movements involving extension of the lower extremity. The patterns of motion and relative energy contributions in countermovement jump and standing long jump were similar, but were different from grab start. It has been suggested that coaches should rely on the specific of grab start in instructing and training.

REFERENCES