Statistically significant differences (p<0.05) were found.

In contrast, lateral bounding facilitates earlier quadriceps activation and therefore should be used with caution in the early stages of ACL rehabilitation due to the anterior shear force placed on the ACL from the quadriceps.

Results

• Statistically significant differences (p<0.05) were found between the Q:H ratios of lateral bounding and the scissor jump and between lateral bounding and the squat jump.
• There was a statistically significant difference (p<0.01) in vastus lateralis activation during lateral bounding when compared to the other four exercises.
• There was a statistically significant difference (p<0.05) in peak flexion medial hamstrings activation during bounding when compared to the barrier jump front to back, barrier jump side to side, and the scissor jump.
• There was a statistically significant difference (p<0.05) between the flexion angle of the medial hamstrings compared to the other muscles. The peak EMG flexion angle (58.94˚) for the medial hamstrings was significantly larger than the biceps femoris, vastus lateralis, and vastus medialis.

Conclusion

• The barrier jump front to back, barrier jump side to side, and scissor jump facilitate earlier activation of the hamstrings in relation to the quadriceps suggesting that these exercises provide the most stability to the posterior aspect of the knee, thus protecting the ACL.
• In contrast, lateral bounding facilitates earlier quadriceps activation and therefore should be used with caution in the early stages of ACL rehabilitation due to the anterior shear force placed on the ACL from the quadriceps.
• In conclusion, having knowledge of both the overall Q:H ratios as well as the timing of peak muscle contraction allows for better exercise prescription and progression and could also be used for injury prevention programs.

Clinical Relevance

This study identified exercises that facilitate hamstring activation and stabilization, as well as exercises that should be used with caution during ACL rehabilitation. Clinicians can use the results of this study to guide their exercise prescription with the ACL rehabilitation and prevention population along with a better understanding of return to sport activities.

Method

Collect MVC data of selected muscle groups utilizing Noraxon surface EMG

Qualisys Motion Analysis markers placed on bony prominences of subjects

Subjects performed eight repetitions of five selected exercises

Coactivation ratios calculated from subject’s data

Research Questions

1. What are the Q:H coactivation ratios during closed chain, high velocity exercises including squat jump, barrier jump side to side, barrier jump front to back, scissor jump, and lateral bounding in recreationally active adults?

2. At what angle of knee flexion does the maximum EMG activity occur of the vastus medialis (VM), vastus lateralis (VL), medial hamstrings (MH), and biceps femoris (BF)?

Subjects

Convenience sampling was utilized to recruit 20 healthy recreationally active college students (12 men, 8 women) between the ages of 18-30 years old at Florida Gulf Coast University.

Data Analysis

1. ANOVA was utilized to identify differences in Q:H coactivation ratios among exercises. In addition a multivariate analysis was used to identify the effect of jump between subjects.

2. ANOVA was utilized to identify differences in peak muscle activity for each of the four muscles during all five exercises. In addition, a multivariate analysis to identify the effect of jump on peak EMG flexion angle.

Table 1. Calculated Quadriceps to Hamstrings Coactivation Ratios for Each Plyometric Exercise (Mean ± SE)

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Coactivation Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrier Jump Front to Back</td>
<td>0.81 ± 0.00</td>
</tr>
<tr>
<td>Barrier Jump Side to Side</td>
<td>0.80 ± 0.00</td>
</tr>
<tr>
<td>Lateral Bounding</td>
<td>0.79 ± 0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Coactivation Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scissor Jump</td>
<td>0.78 ± 0.00</td>
</tr>
<tr>
<td>Squat Jump</td>
<td>0.77 ± 0.00</td>
</tr>
</tbody>
</table>

Conclusion

There was a statistically significant difference (p<0.05) in peak flexion medial hamstrings activation during bounding when compared to the barrier jump front to back, barrier jump side to side, and the scissor jump.

Results

• Statistically significant differences (p<0.05) were found between the Q:H ratios of lateral bounding and the scissor jump and between lateral bounding and the squat jump.
• There was a statistically significant difference (p<0.01) in vastus lateralis activation during lateral bounding when compared to the other four exercises.
• There was a statistically significant difference (p<0.05) in peak flexion medial hamstrings activation during bounding when compared to the barrier jump front to back, barrier jump side to side, and the scissor jump.
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