The influence of strength, activation and laxity on functional hop test symmetry in ACL deficient patients.

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Background
Non-operative management of ACL deficiency initially experienced low success rates when the patients self-selected surgical or conservative management[1]. When a screening process consisting of functional hop scores[2], reports of episodes of giving way and self-report scores was used to select patients for non-operative management, success rates increased to 79%. [3]. These hop tests have been shown to be good predictors of dynamic knee stability[4]. This classification scheme to determine the plan of care of ACL deficient subjects has been performed for more than 12 years at the University of Delaware. These criteria have been refined through reassessment of a growing database which includes measures of knee joint laxity, maximum isometric quadriceps contractions with and without electrical augmentation, quadriceps activation ratios, self report questionnaires and functional measures of symmetry on hop tests. The effect of quadriceps strength, activation and knee joint laxity on hop test performance has not been established. The purpose of this study was to examine the effect of quadriceps strength, activation deficits and laxity on functional performance.

Methods
332 consecutive patients referred from a single orthopedic surgeon proceeded from initial evaluation through pre-screening rehabilitation until they met the criteria to hop. The ACL deficient patient is allowed to perform hop testing when they have met standard rehabilitation criteria including minimal knee joint effusion, symmetrical range of motion and the patient is able to hop on their involved knee without pain. A minimal symmetry in quadriceps strength of 70% is also required for hop testing.

Results
R² values for the entire sample, potential copers and non-copers are presented in Table 1 for the linear regression using QI, CAR-I, MVC and laxity. When taking all four factors into consideration, there was a statistically significant effect on the hop symmetry of the group as a whole and non-copers individually, but only on the single hop for potential copers. The R² values for these tests were small, ranging from .046 to .074 in the entire population, and .084 to .131 in the non-copers. The only significant value for the potential copers was in the single hop at .074.

Table 1 – R² Values

<table>
<thead>
<tr>
<th>Group</th>
<th>Single Hop</th>
<th>Crossover Hop</th>
<th>Triple Hop</th>
<th>Timed Hop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire Sample</td>
<td>.062***</td>
<td>.046***</td>
<td>.074*</td>
<td>.05**</td>
</tr>
<tr>
<td>Potential Copers</td>
<td>.074*</td>
<td>.023</td>
<td>.059</td>
<td>.011</td>
</tr>
<tr>
<td>Non-copers</td>
<td>.084**</td>
<td>.131***</td>
<td>.094*</td>
<td>.098**</td>
</tr>
</tbody>
</table>

*denotes p≤.05; ** denotes p≤.01; *** denotes p≤.001

Discussion
The value of a screening tool lies in its ability to determine the presence of the problem or diagnosis of interest, in this case poor dynamic knee stability that predicts failure of non-operative management in highly active individuals. The screening tool used to classify ACL deficient patients at the University of Delaware uses a hop test to help determine those patients who may successfully return to high level sports without undergoing surgical management. The factors that are measured before hopping: strength and activation ratios, normalized strength values and knee joint laxity, account for a small, but statistically significant amount of the variance in performance on hop tests. Accounting for a range of 8% to 15% in the non-coper group, who are most likely to fail at return to sports, suggests that these measures are independent and contribute uniquely to the determination of knee stability status. The measured variables cannot be used to predict successful hop test performance. An estimated 200,000 people will tear an ACL each year. With accurate classification of ACL deficient patients, conservative management can be confidently offered to those potential copers who do not wish to pursue surgical management, thus decreasing the number and cost of surgeries and limiting the number of competition hours missed by athletes.


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