BIOMECHANICAL EVALUATION OF PROVOCATIVE TESTS FOR SUPERIOR GLENOID LABRUM LESIONS

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INTRODUCTION

Arthroscopic surgery is considered the gold standard for diagnosis of lesions of the superior glenoid labrum (Parentis, 2005). However, arthroscopy is an expensive and invasive diagnostic tool. Consequently, at least 17 different provocative tests have been developed to try to detect superior labral pathology during routine physical examination. Most of the tests aim to elicit labral symptoms by producing tension in the long head of the biceps brachii (LHBB) muscle, which pulls on its proximal labral attachment during contraction, reproducing pain or discomfort (Morgan, 1998).

Clinical evaluations of provocative tests have varied widely, with many showing poor specificity and sensitivity at detecting labral lesions (McFarland, 2002). However, the ability of each of the provocative tests to specifically and effectively activate the LHBB has not been determined. The purpose of this study is to quantify the amount of LHBB muscle activation and the selectivity of muscle recruitment in five clinical tests for superior labral pathology that were designed to activate the LHBB.

METHODS

Performance of each provocative test was evaluated using electromyography (EMG). Ten male subjects without history of shoulder pathology were recruited to participate. Six Ag-AgCl surface electrodes were placed over the muscle belly of the LHBB, short head of biceps brachii, anterior deltoid, pectoralis major, latissimus dorsi, and infraspinatus muscles. An intramuscular fine-wire electrode was placed in the supraspinatus due to its deep location.

Subjects performed three repetitions of a maximum voluntary isometric contraction (MVIC) for each muscle. The peak activation level in any of the processed MVIC trials was considered 100% effort and used to normalize the provocative test data.

A physician performed three repetitions of each of the following five provocative tests on one arm of each subject in random order (Figure 1): Active Compression Test (2 positions) (O’Brien, 1998), Biceps Load Test (Speed’s Test), Pronated Load Test (Postlethwaite, 1999), and RSER Test (Postlethwaite, 1999).

Figure 1: Provocative tests for superior glenoid lesions: 1. Active Compression Test 2. Speed’s Test 3. Pronated Load Test 4. Biceps Load Test II 5. RSER Test.
Test II (Kim, 2001), Pronated Load Test (Wilk, 2005), Resisted Supination External Rotation (RSER) Test (Myers, 2005), and Speed’s Test (Bennett, 1995).

One way repeated measures ANOVA and Tukey HSD post-hoc tests ($\alpha=0.05$) were used to compare peak muscle activation across the five tests. Selectivity, defined as the proportion of EMG signal received from all muscles monitored that is attributable to the LHBB, was compared using the same statistical methods.

RESULTS

Maximal activation of the LHBB was significantly different between the five tests ($p=0.004$). Post-hoc analysis revealed that the Biceps Load Test II produced a significantly greater activation of the LHBB than the Active Compression Test (palm down) and the Pronated Load Test. Activation in the Biceps Load Test II was not significantly greater than in Speed’s Test, RSER Test, or the Active Compression Test (palm up). LHBB activation in the two positions of the Active Compression Test was different. With the palm up, activation was only 48.5±17.4%; while in the palm down position it was significantly greater (80.0±12.4%, $p<0.05$, Table 1).

Selectivity was also significantly different between the five tests ($p=0.000$). Post-hoc analysis revealed that the RSER Test, Pronated Load Test, and Biceps Load Test II elicited the highest selectivity with no statistical difference between them.

Table 1: LHBB activation (%MVIC) and selectivity ratio for each provocative test.

<table>
<thead>
<tr>
<th>Tests</th>
<th>LHBB Musc Activation ±SD</th>
<th>Selectivity ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Compression Test (palm down)</td>
<td>48.5±17.44</td>
<td>.19±.02</td>
</tr>
<tr>
<td>Active Compression Test (palm up)</td>
<td>80.0±12.42</td>
<td>.13±.01</td>
</tr>
<tr>
<td>Biceps Load Test II</td>
<td>93.0±11.51</td>
<td>.17±.07</td>
</tr>
<tr>
<td>Pronated Load Test</td>
<td>65.7±23.42</td>
<td>.26±.06</td>
</tr>
<tr>
<td>RSER Test</td>
<td>74.7±21.34</td>
<td>.22±.07</td>
</tr>
<tr>
<td>Speed's Test</td>
<td>85.9±8.21</td>
<td>.22±.01</td>
</tr>
</tbody>
</table>

DISCUSSION

The primary objective of the provocative tests is to elicit symptoms by either passively or actively tensioning the tendon of the LHBB, which, in turn, pulls at its proximal attachment to the superior glenoid labrum. To avoid confounding the test results due to pathologies of the surrounding shoulder muscles, the tests should ideally minimize activity of other muscles.

Analysis revealed that, of the six test positions studied, the Biceps Load Test II, Speed’s Test, RSER Test, and Active Compression Test (palm up) maximally activated the LHBB. The RSER Test, Biceps Load Test II and Pronated Load Test displayed the highest selectivity. With their high LHBB activation and selectivity, the Biceps Load Test II and RSER Test should be the most suitable for diagnosing superior labrum lesions. However, a kinematic analysis to study the passive stretching of the LHBB tendon should be conducted to determine whether the tests effectively strain the superior labrum through other means.

REFERENCES


