INTRODUCTION

Isokinetic exercise and testing is commonly used in clinical settings for muscle strengthening. Its application in rehabilitation and muscle conditioning has been extensively investigated.

The reliability of moment measurement is a very important issue in isokinetics. Poor measurements reliability may lead to erroneous conclusions about the parameter examined (Baltzopoulos, 1998). The reliability of isokinetic moment measurements is influenced by several mechanical-physiological factors that may affect the conclusions muscular performance. One of the most important problems in isokinetic testing is the misalignment of the examined joint centre to the axis of rotation of the rotating arm. The glenohumeral joint has an extensive range of motion and its axis moves approximately 8 cm in flexion/extension movements (Walmsley, 1993a). This results from the contribution of the scapula in elevation of shoulder joint, especially after 90 degrees of flexion (Doody SG, 1970). Therefore the single assessment of positioning of the shoulder for the full range of flexion / extension movement is problematic (figure1).

Most studies on isokinetic assessment of the shoulder addressed test-retest reliability of the measurements (Plotnikof, 2002) and reproducibility of isokinetic peak moment (Mayer, 1994). Some studies addressed both intra- and inter-day variability of isokinetic shoulder measurement (Meeteren, 2002; Magnuson, 1990). However, no studies have been found observing the differences between peak moments produced in different seating positions.

The purpose of this study was to examine the effect of two positions on the peak flexion and extension moment of the shoulder joint.

METHODS

Fifteen female subjects (mean age 19.8 y, mean mass 53 Kgr, Mean height 1.65m) without any history of shoulder pathology volunteered to participate. All the subjects were right hand dominant. All the subjects were participating in leisure activities.

The Cybex NORM isokinetic dynamometer was used to measure the isokinetic moment of shoulder during flexion/extension. Gravity correction procedures were followed as per standardized set-up for the Cybex Norm Isokinetic dynamometry.

Each subject performed a warming up program at the beginning of each measuring session. Instructions about the procedure were given to the subjects prior to the test. A familiarisation of five trials was given before the measurements and 2 minutes pause was allowed before starting the actual tests. Subjects were stabilized in supine position with two separate straps, one across the pelvis and the other across the chest.

The subjects were seated in two shoulder positions. In the first position the axis of rotation of the moment arm of the isokinetic dynamometer was estimated to pass through the shoulder joint center when the shoulder was at 0 degrees flexion (Figure 2). In the second position (Figure 3) the moment arm passed through the shoulder joint center when the shoulder was at 135 degrees flexion (position 2). The alignment of the shoulder joint axis was made with respect to a point located to the lateral border of the acromion.

The isokinetic test involved three continuous maximum effort concentric flexions/extensions of the shoulder at 90 deg/sec at each position. The subjects were measured at three different days. The sequence of measurements was randomised. The highest moment produced during flexion and extension of the three sessions at each of the two seated positions was used as the criterion.

Two (flexion and extension) paired t-tests were used to investigate significant differences between the maximum moments produced in the two placement positions. The level of significant was set to p=0.05. The symmetry index (SI) (Giakas and Baltzopoulos, 1997) was also calculated as:

\[
SI = 200 \times \frac{Position1 - Position2}{Position1 + Position2} \%
\]
The differences between the two positions are of considerable amount but they are less than the test-retest differences found by Mayer et al., (1994).

**Table 1:** The mean moment values

<table>
<thead>
<tr>
<th></th>
<th>Position 1</th>
<th>Position 2</th>
<th>SI mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension</td>
<td>36.4, 3.9</td>
<td>41.5, 5.2</td>
<td>11.9%</td>
</tr>
<tr>
<td>Flexion</td>
<td>40.8, 5.3</td>
<td>35.8, 5.3</td>
<td>-13.3%</td>
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</tbody>
</table>

**SUMMARY**

The positioning of the subject changes the moment outcomes by approximately 13%. It is recommended that different positioning is used depending on the range of movement examined.

**REFERENCES**
