INTRODUCTION

Breast cancer is the most common form of cancer in women [1]. It is estimated that up to one third of breast cancer survivors will be diagnosed with lymphedema [2]. Lymphedema may lead to difficulty performing activities of daily living above 90° elevation, discomfort, and sensation of heaviness [1,3].

There is little research on the effects of lymphedema on scapular kinematics. Crosbie et al compared the shoulder and spinal kinematics of women post unilateral mastectomy for breast cancer to a control group. They found increased scapular upward rotation (UR) of the involved limb. Lymphedema was an exclusion criterion in their study [4].

Three research hypotheses were investigated: 1) Involved limb volume would be significantly greater than the noninvolved. 2) Affected scapular kinematics at peak humerus to trunk elevation in the plane of choice would be significantly less than the unaffected. 3) Both involved limb volume and scapular kinematics would be significantly correlated to the Penn Shoulder Score (PSS).

METHODS

This study included 12 participants with unilateral lymphedema in their dominant limb post-mastectomy. Eleven were right arm dominant. One was left arm dominant. Arm volume was measured with a volumeter. Scapular UR, internal rotation (IR), and posterior tipping (PT) during humerus to trunk elevation in the plane of choice (POC) were assessed using a 3-dimensional electromagnetic motion capture system. Humerus, scapula, and trunk segment locations and rotation sequences were performed as recommended by the International Society of Biomechanics [5]. Participants performed each motion three times. The peak value across the trials was utilized for data analysis. Shoulder function was assessed using the PSS.

Data analyses included paired tests comparing limb volume and scapular kinematics and correlations between the factors of interest and PSS. Significance level was p≤0.05.

RESULTS AND DISCUSSION

All of the variables were normally distributed except for limb volume. Participants’ age, PSS, and affected limb volume are outlined in table 1.

Limb volume was found to be statistically significantly more in the involved than the noninvolved limb (z = -3.059, p = .002). The volume differences are outlined in Figure 1. Scapular UR at peak elevation in POC was statistically significantly less in the involved than the non-involved limb (t = -2.749, p = .019). The comparative scapula to trunk kinematics are outlined in Figure 2.

The PSS correlation and scapular PT was statistically significant. The Pearson correlation for involved scapular posterior tipping at peak humerus to trunk elevation in the POC and the PSS was (r = .871, p = .000). Correlation results are outlined in table 2.

The first hypothesis was supported. The involved limbs had significantly more volume than the noninvolved. The second hypothesis was partially supported as scapular UR was found to be significantly different between extremities. The
third hypothesis was also partially supported as a significant correlation of kinematics of scapular PT was found to correlate with the PSS but girth was not found to be correlated.

Our results do not support Crosbie et al’s overall results. However, they are similar to one of Crosbie et al’s secondary findings. They found significantly less scapular UR in participants who had had a mastectomy on their dominant extremity than those that had had a mastectomy on their non-dominant extremity [4].

Ludwig et al studied the alterations of shoulder kinematics in participants with symptoms of shoulder impingement and found, in relation to the group without impingement, the group with impingement showed decreased scapular UR and decreased scapular PT during humerus to trunk elevation [6]. Our results showed decreased scapular UR which may predispose the participants to shoulder impingement. The increased scapular PT at may be a compensation to avoid this. Increased PT may lessen the likelihood of the developing shoulder impingement.

While the finding of a correlation of scapular PT to the PSS was significant, the other scapular motions were not. An alternative shoulder functional scale may be more appropriate. Since the time of the initial investigation, a lymphedema specific ICF tool has been identified and may be more appropriate for use in further studies.

CONCLUSIONS

Limb volume is greater and scapular UR is less in participants with lymphedema post-breast cancer surgery. Scapular PT is correlated to function. Further study is recommended to more fully determine the effect of lymphedema on the upper extremity in this population.

REFERENCES


Table 1: Participant demographics

<table>
<thead>
<tr>
<th>Volume (ml)</th>
<th>Median 2960</th>
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<tr>
<td>Mean</td>
<td>S.D.</td>
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| Age (years) | 56.3 | 12.3 |
| PSS         | 72.6 | 17.0 |

Table 2: Correlations Between PSS and Factors of Interest

<table>
<thead>
<tr>
<th>Volume</th>
<th>UR</th>
<th>IR</th>
<th>PT</th>
</tr>
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<tbody>
<tr>
<td>PSS r</td>
<td>-.263</td>
<td>.049</td>
<td>.571</td>
</tr>
<tr>
<td>p</td>
<td>.419</td>
<td>.879</td>
<td>.053</td>
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Median Volume

Figure 1: Comparative Limb Volume

Scapula Motion

Figure 2: Comparative Scapula to Trunk Motion