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Shoulder Muscle Activation Among Indian Women Following Breast Cancer Treatment: A Cross-Sectional Analysis.

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Abstract

This study was performed to compare the shoulder muscle activity in women presenting with and without pain following breast cancer treatment and also to compare the same with normal.

A total of 90 women were included and allocated to three groups: (i) 12 women with persistent peripheral pain after breast cancer treatment, (ii) 10 women without pain after breast cancer treatment, and (iii) 10 healthy women. Surface electromyography was employed to measure the onset and amplitude of the muscle activity of three shoulder movements. Statistically significant differences were found in the neuromuscular activity for all the muscles and shoulder movements among women with persistent pain versus healthy women (i.e., amplitude muscle activity variable $p < 0.001$). Statistically significant differences were also observed in the neuromuscular activity for certain muscles in shoulder movements among women with persistent pain versus women without pain, as well as between women without pain versus healthy women. Therefore, following breast cancer treatment, women showed alterations in their shoulder neuromuscular activity, which were more significant if persistent pain existed. These findings may contribute to developing a selective therapeutic exercise program that optimizes the shoulder neuromuscular activity in women after breast cancer treatment.

1. Introduction

The life expectancy and survival rate have increased to between 78% and 88% at 5 years after breast cancer therapy due to the significant improvement in breast cancer management quality (Yuste Sánchez et al., 2015). However, due to the disease's progression as well as the medicine and treatment, many women still have a number of side effects after undergoing treatment for breast cancer, including prolonged pain and residual impairment, tightness in the soft tissues, and more.This may lead to have a reduced quality of life in an individuals.

There will be a Altered shoulder biomechanics in an individuals, which is caused by anterior chest wall or axillary tissue changes, myofascial pain syndrome, increased mechanosensitivity of neural tissue, and other shoulder complaints.(Torres Lacomba et al., 2010) Usually all the movements are affected in every direction, especially during elevation it requires proper coordination between scapula ,clavicle and the humerus (Adriaenssens et al., 2012; Fong et al., 2013; Shamley et al., 2012). This could have an impact on the others, raising the likelihood of shoulder dysfunction due to the modification of neuromuscular activation (Borstad & Szucs, 2012)

It is important to have a research question on how chronic pain affects the motor changes. There will be abnormal neuromuscular activity after breast cancer treatment which is mainly caused by the changes in the central nervous system's neuroplasticity. Therefore, this neuroplasticity alterations were linked to a poor prognosis brought on by traditional therapies. On behalf of this, whether any changes in the shoulder's neuromuscular activity takes place is crucial for deciding whether to use a more modern form of physiotherapy that is consequently more effective, as well as for providing the potential of a preventive approach. To determine the variations of shoulder neuromuscular activity in women with peripheral chronic pain following breast cancer therapy, women without such pain following treatment, and healthy women, as well as to determine whether such variations could occur among women's.

A cross-sectional descriptive study was conducted from January 2015 to May 2019 in Amreli, Gujarat, India. A subject- woman was assigned to one of her three groups: Group 1, Group 2, or Group 3.

Group 1 (G1):Women with persistent pain after breast cancer treatment (surgery and/or radiotherapy and/or chemotherapy).

Inclusive criteria: age group between 45 and 65 years, with at least 6 months of pain on the dominant side. Women who received hormone therapy during the study were also included.

Exclusion criteria: Predominant sided shoulder pain episode before breast cancer treatment, bilateral breast cancer, major central sensitizing pain identified using the central sensitization inventory (>40 points).

Group 2 (G2):

Eligibility criteria: Same as for G1, but only eligible women with no persistent pain after breast cancer treatment were included in G2.

Group 3 (G3): A healthy woman from 45 to 65. Surface electromyography (sEMG) was used to examine the five different shoulder muscles that perform her three movements (abduction, forward flexion, and external rotation) that are more affected in post-breast cancer women. We measured the onset and amplitude of muscle activity. Upper trapezius, lower trapezius and especially serratus anterior were identified as representatives of the upward rotator of the scapula in all movements evaluated. The infraspinatus was chosen to represent the rotator cuff muscle group. The middle deltoid was chosen to represent shoulder abduction as it is a key move in this movement. Onset of muscle activity in -each woman's were performed those movements three times with her 5-seconds pause between attempts to restore baseline signal.shoulder abduction, shoulder forward flexion, and shoulder external rotation were noted .

2. Results

Shoulder abduction - A statistically significant difference was found at the onset of lower trapezius muscle activity between G1 and G2 ($p=0.001$), G1 and G3 ($p< 0.001$) and G2 and G3 ($p< 0.001$) $p<0.001$). We also noticed early muscle activation on G1 and G2 versus G3 as well as G1 versus G2. Likewise, statistically significant differences were found for all groups in the middle deltoid muscle (G1 vs. $p< 0.001$; G1 vs G3: $p< 0.001$; G2 vs G3: $p = 0.004$), showing slow activation in G1 vs G3 and G1 vs G2. The upper trapezius muscle was activated earlier in G1 than in G2 ($p=0.004$) and G3 ($p=0.005$). Delayed activation was observed in the anterior aliasing of G1 compared with G2 and G3 ($p < 0.001$). Finally, a statistically significant difference was found in the initiation of infraspinatus muscle activity compared with G1 versus G3 ($p=0.002$) and G2 versus G3 ($p=0.006$), indicating a delay in activation delay at the onset of muscle activity relative to G3 (G1: 1.01 (1.81); G2: 0.90 (0.27); G3: −0,10 (1,13)).

Shoulder jerking motion - A statistically significant difference was found in mean delta muscle % RMS between G1 and G2 ($p=0.001$), G1 and G3 ($p<0.001$), and G2 and G3 (p). = 0.043), finding increased muscle amplitude in both G1 and G2 relative to G3, as well as G1 versus G2. Similarly, a statistically significant difference was found between all groups in the anterior serosa ($p < 0.001$), with muscle amplitude reduced at G1 and G2 compared with G3 and G1 compared with with G2. An increase in amplitude was observed in the upper trapezius muscle at G1 compared with G2 and G3 ($p < 0.001$). The subscapular region showed % RMS reduction in G1 vs G2 and G1 vs G3 ($p < 0.001$). Finally, we observed a lower amplitude reduction in trapezius muscle activity on G1 vs G3 ($p < 0.001$) and G2 vs G3 ($p = 0.007$).

Forward shoulder flexion - A statistically significant difference was found in the % RMS of the lower trapezius muscle between G1 and G2 ($p=0.020$), G1 and G3 ($p< 0.001$) and G2 and G3 ($p<0.001$). We found a decrease in muscle amplitude in G1 and G2 relative to G3, as well as in G1 versus G2. Statistically significant differences were found between all groups in the subspinous and anterior molar muscles ($p < 0.001$), observing a decrease in muscle activity amplitude in G1 vs G2, G1 vs. with G3 and G2 against G3. We observed an increase in the amplitude of anterior deltoid muscle activity on G1 versus G2 and in G1 versus G3 ($p < 0.001$). Finally, in the upper trapezius muscle, an increased muscle amplitude was observed on G1 vs G2 and G1 vs G3 ($p < 0.001$).

Forward shoulder flexion - Statistically significant difference was found at the onset of anterior serosarcoma activity between G1 and G2 ($p < 0.001$), G1 vs G3 ($p < 0.001$)) and G2 vs G3 ($p = 0.026$), detecting a delay in the initiation of muscle activity of G1 and G2 vs G3 as well as G1 vs G2. The upper trapezius muscle was activated earlier in G1 than in G2 and G3 (−0.1 (0.14)) ($p < 0.001$). Similarly, earlier activation of the lower trapezius upper G1 was observed compared with G2 and G3 ($p < 0.001$). Statistically significant differences were found at the onset of subspinous muscle activity between G1 vs G2 ($p = 0.028$) and G1 vs G3 ($p < 0.001$), indicating earlier activation. compared to G3. Finally, we observed a delay in G1 anterior deltoid activation compared with G2 and G3 ($p < 0.001$).

External Rotation of the Shoulder - A statistically significant difference was found at the onset of upper trapezius muscle activity between G1 and G3 ($p=0.003$), indicating early activation. A delay in the initiation of muscle activity of the posterior deltoid was observed in G1 versus G3 ($p = 0.002$) as well as that of the subspinous muscle when comparing G1 with G3 ($p = 0.002$). Statistically significant differences were found in the lower trapezius muscle for G1 vs G2 ($p=0.006$) and G1 vs G3 ($p=0.001$), indicating a delay in muscle activation above G1. compared to G2 and G3. Finally, we observed a delay in the initiation of muscle activity of the anterior serosa of G1 compared with G2 ($p = 0.006$) and G3 ($p < 0.001$).

External rotation of the shoulder - A statistically significant difference was found in % RMS of the lower trapezius and posterior deltoid between G1 vs G2 and G1 vs G3 ($p < 0.001$), indicating that reduced muscle range. Statistically significant differences were found in all groups ($p < 0.001$) in the infraspinatus and in the anterior serrated muscle, indicating a reduced muscle amplitude. Finally, the upper trapezius muscle increases the amplitude of action of the upper G1 vs G2 and G1 vs G3 muscles.

3. Discussion

In this study, shoulder neuromuscular activity values quantified by sEMG reveals a changes in muscle activity amplitude and respective onset of selected shoulder movements in women (G1 and G2) after breast cancer treatment. Since changes were greater when pain persisted. Regarding the onset of muscle activity, the upper trapezius was activated early with all movements in women's who is treated for breast cancer. This prediction may be a compensatory attempt made by the upper trapezius to compensate for the delayed muscle activation associated with the rotator cuff. Delayed onset of muscle activity could results in unstable between the humeral head and glenoid fossa which reduces the subacromial space. Therefore, the upper trapezius muscle lifts the clavicle to create more space when performing the movement. (Escamilla et al., 2014; Naef et al., 2015)

The onset of trapezius muscle activity was expected during shoulder abduction and forward bending exercises in women treated for breast cancer. This may be due to compensatory mechanisms associated with delayed activation of the serratus anterior muscle (Struyf et al., 2015). In addition, the inferior trapezius and serratus anterior delayed participation in shoulder external rotation in women after breast cancer treatment. The position of the shoulder during external rotation (i.e. shoulder abduction at 90 degrees) can put more stress on the neuromusculoskeletal system. The onset of anterior deltoid, mid deltoid, and posterior deltoid muscle activity was delayed for each assessed shoulder movement. The reason may be related to the ineffective stabilization of the humeral head in the glenoid by the rotator cuff.

The amplitude of upper trapezius muscle activity was markedly increased in women treated for breast cancer (G1 and G2) for all movements assessed. This mechanism has also been observed in various shoulder dysfunctions, including subchondral collision syndrome. These changes may be mediated by the central nervous system as an adaptation to weakness of the rotator cuff muscles. (Pelletier et al., 2015). The anterior serrated muscle is reduced in activity with every movement in women being treated for breast cancer. This muscle has a high percentage of phase fibers that can promote muscle inhibition (Tintignac et al., 2015). Medical treatment for women with breast cancer that directly affects the anterior serosa. In this sense, its alteration is often associated with nerve tissue damage of the long thoracic nerve during surgery, the change in mechanical sensitivity can be amplified and maintained by the action of radiation and chemotherapy, the presence of fibrosis and scarring, as well as the existence of myalgia syndrome. However, different studies in women undergoing breast cancer treatment have shown that the amplitude of action of the superior trapezius and anterior serosa is different according to the surgical side, type of surgery, and adjuvant therapy. (Shamley et al., 2012; Torres Lacomba et al., 2010).

The lower trapezius muscle showed decreased activity in women treated for breast cancer, which coincides with other studies involving pain variability in the shoulder. In the present study, the lower trapezius muscle was activated earlier; however, this does not imply an increase in neuromuscular activity. For this phenomenon, a possible explanation may be related to the high proportion of phasic fibers in this muscle, the presence of which seems to be related to muscle inhibition (Ludewig & Braman, 2011; Naef et al., 2015).

The anterior deltoid and medial deltoid muscle amplitudes were significantly increased during all range of motion assessed in women undergoing breast cancer treatment, possibly to counteract the weakness in the rotator cuff muscles. However, the posterior deltoid reduces the amplitude of its action. The most likely cause is that the rotation of the shoulder was performed with an anterior abduction that inhibits the deltoid muscle activity.

4. Discussion

Women after breast cancer treatment show significant changes in shoulder neuromuscular activity. These changes are magnified when there is persistent peripheral pain. Therefore, conservative treatment is performed such as selective therapeutic exercise program to optimize shoulder neuromuscular activity in women after breast cancer treatment.

5. References

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