Influence of body position on shoulder muscle activity during isokinetic testing with the Humac Norm dynamometer

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Summary

Shoulder muscle activity during isokinetic arm internal/external rotation, flexion/extension and abduction/adduction tasks at 60°/s was compared between two different body positions on the Humac Norm dynamometer in 20 healthy subjects. We found that the body position during the test is relevant to the activity of the shoulder muscles. The effect of gravity and the increased demand for stability of the glenohumeral joint in an upright position are not to be overlooked.

Introduction

The assessment of shoulder muscle activity and strength is an important part of the clinical evaluation of patients with shoulder or neurological disorders, but also in sports to monitor training and progress. Shoulder muscle strength for the same task can be tested in different body positions including supine, sitting, and standing. However, shoulder muscle activity during isokinetic dynamometry has rarely been investigated [1,2], and even less so the influence of body position. We aimed to compare shoulder muscle activity between two different testing positions of isokinetic measurements of arm internal/external rotation, flexion/extension and abduction/adduction in healthy subjects.

Methods

Overall, 20 healthy subjects (10 men and 10 women; mean ± standard deviation; age: 25.4 ± 3.1 years, body mass index: 23.0 ± 2.3 kg/m^2) participated in this study. Muscle activity (Ultium EMG, Noraxon, 2000 Hz) of the anterior, middle and posterior deltoid, infraspinatus, biceps brachii, latissimus dorsi, pectoralis major and upper trapezius muscles was acquired for both shoulders of each subject during two concentric trials with three repetitions each at 60°/s using the Humac Norm dynamometer. The tests consisted of internal/external arm rotation with 15° arm abduction in standing and seated position, and with 90° arm abduction in supine and seated position; arm flexion/extension in supine and seated position; and arm abduction/adduction in seated and lateral recumbent position. Data were processed by bandpass filtering (30-450Hz), rectification, smoothing (100ms moving average window) [3], and normalization to the maximal muscle activity of all movement tasks and testing positions. Mean normalized peak muscle activity was calculated for each task and testing position. Differences in peak shoulder muscle activity between the two positions of each task for the dominant and non-dominant side were examined by paired t-tests or Wilcoxon sign rank tests.

Results and Discussion

Differences in peak muscle activity were observed between the two positions for each task. In the internal/external rotation task with 15° arm abduction (Figure 1), significant differences in normalized peak muscle activity ranging from 8.3 to 21.3 percentage points between the seated and the standing position were found in all deltoid muscle parts ($P \leq 0.040$). In the internal/external rotation task with 90° arm abduction, the infraspinatus, biceps brachii and upper trapezius muscles had higher normalized peak muscle activity in the seated position than in the supine position (range, mean difference 12.2–19.8 percentage points, $P \leq 0.002$). During the flexion/extension task, higher muscle activity of the middle deltoid and biceps brachii and lower muscle activity of the latissimus dorsi were found in the seated position compared to the supine position (9.4–22.2 percentage points, $P \leq 0.049$). During the abduction/adduction task, biceps brachii, pectoralis major, and upper trapezius had higher muscle activity in the seated position compared to the lateral recumbent position (7.7–24.5 percentage points, $P \leq 0.036$ Figure 1).

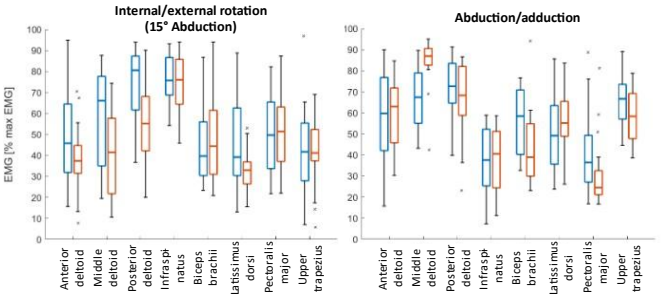

Figure 1: Muscle activity (dominant side) of two tasks in the seated (blue) and standing or lateral recumbent position (orange)

Conclusions

Greater activity was observed in the agonist muscles when the movements were directed against gravity than when they were favored by gravity. Stabilizer muscles (e.g., upper trapezius for the scapula) had a higher activity in the seated position compared to the supine or lateral recumbent positions highlighting the need for increased active stabilization in upright positions. This must be considered when choosing the testing position for clinical evaluation, training or rehabilitation.

References

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