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**Title : Maximal amplitude postures of the scapula : simulations with the Anybody software**

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**Abstract** – Word Count = 420 (<450 words)

### **Context**

Scapular dyskinesis is often associated to shoulder joint injuries. However, as stated by Kibler (2003), “no specific pattern of dyskinesis is associated with a specific shoulder diagnosis”. To better understand the pathomechanisms associated to scapular dyskinesis, the effect of scapular position and orientation still need to be investigated.

### **Methods**

The scapulohumeral rhythm of one male participant with no shoulder pain history was measured (ethics 14-110-CERES-D, Université de Montréal, Canada). The participant was equipped with reflective markers attached to the thorax and upper limb skin and was asked to perform 25 poses (Michaud et al., 2017). These 25 poses resulted from the combination of 5 scapula poses (centered, elevated, lowered, protracted and retracted) and 5 arm elevations (0°, 45°, 90°, 135° and 180°). A scapula palpator was used to measure the reference scapular kinematics (angulus inferior, trigonum spinae and angulus acromialis). The trajectories of the reflective markers (on the skin and on the scapula palpator) trajectories were collected using an 18-camera Vicon™ optoelectronic motion analysis system (Oxford Metrics Ltd. Oxford, UK).

The registered kinematics was then transferred to the Anybody software (Anybody Technology, Aalborg, Danemark). A shoulder model from the Anybody repository was modified to include our marker set. Through optimisation (minimisation of the distances between the experimental and numerical markers), the model was first scaled and its kinematics was predicted. Secondly, inverse dynamics calculation provided the net glenohumeral forces. Finally, shoulder muscle forces were assessed through optimization. The magnitude and components of the glenohumeral forces generated for the five different scapula poses, and the shoulder predicted muscle forces were compared for each arm elevation through Wilcoxon signed rank tests.

### **Results**

The statistical tests did not show any significant differences on the glenohumeral net forces ( $p < 0.05$ ) but discrepancies appeared for the forces of the scapula elevator muscles.

### **Conclusion**

The scapular position did not influence the glenohumeral net forces. This may signify that the glenohumeral reaction was actually not altered or that the Anybody calculations from motion capture data were not able to reproduce any alterations. The muscles attached to the scapula showed different activations depending on the scapular positions. These conclusions will need to be investigated by applying this methodology to a larger sample of participants and to a pathological population.

## **References**

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