ISOMETRIC TORQUE-ANGLE CURVES FOR ELBOW FLEXION AND EXTENSION IN THE TRANSVERSE PLANE

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INTRODUCTION

Neuromusculoskeletal models have shown to be a usefull instrument in studying motor control. For investigating motor control of the arm most experimental set-ups and model simulations are restricted to the transverse plane [1,2]. No study has been published that experimentally obtained isometric torque-angle curves for elbow extension in the transverse plane. These data are essential for estimating the parameters describing the force-length relationship of the elbow extension muscles to be modelled.

Furthermore, we expect an influence of shoulder configuration on isometric torque-angle curve for both elbow flexion and extension since biarticular elbow flexors and extensors cross both the elbow and the glenohumeral joint. This influence has never been investigated.

The purpose of this study is to provide data on isometric torque-angle curves for elbow extension. Additionally we will determine how isometric torque-angle curves for elbow flexion and extension depend on the glenohumeral angle in the transverse plane.

METHODS

Maximal voluntary isometric elbow torque for both flexion and extension was measured over a range of elbow angles (θ_{ELB}): 10°, 20°, 30°, 45°, 60°, 75°, 90°, 105°, 115° and 125° (with 0° corresponding to full extension). This was done for two different thoracohumeral angles in the transverse plane: 20° (TH20) and 45° (TH45). Joint torque was measured with a dynamometer. Eleven subjects participated. They were seated with their humerus elevated 90° to shoulder height. They were instructed to build up maximal torque and hold this torque for about 0.5 seconds all within a 3-second period. For each contraction, a peak torque value was obtained by finding the highest average over a 0.5-s interval.

To measure possible changes in elbow angle and shoulder configuration when going from inactive state to maximal voluntary contraction a photograph was taken from above during the contraction. From this photograph, the actual elbow angles were determined (φ_{ELB}) as well as the glenohumeral and thoracoscapular angles in the transverse plane.

RESULTS AND DISCUSSION

The isometric torque-angle curve for elbow extensors showed a maximum of 54 Nm at an elbow angle of 50-60°.

A two(TH)-by-ten(θ_{ELB}) ANOVA showed no significant difference in thoracohumeral angle in the transverse plane for both flexion and extension torque. This means that changing this angle by 25° did not influence the torque-angle relationship in the elbow. This can partly be explained by the observation that the change in glenohumeral joint was smaller (mean: 10°±9°) than the 25° change observed in thoracohumeral angle. Thus, the length change in the biarticular elbow muscles remained small.

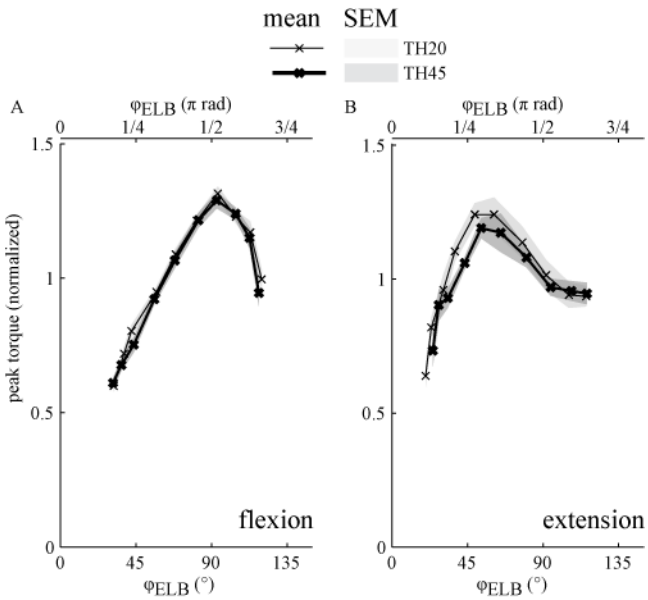

Figure 1: Mean isometric torque-angle curves for elbow flexion and extension and for two different thoracohumeral angles in the transverse plane (TH20 and TH45). Mean normalization factor was 50 Nm for flexion and 41 Nm for extension.

CONCLUSIONS

Firstly, an isometric torque-angle curve is available to determine parameters for the force-length relationship of the elbow extensors. Secondly, isometric torque-angle curves for both elbow flexion and extension are not influenced by moderate changes in glenohumeral angle in the transverse plane.

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REFERENCES

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