ADL CAPABILITY AND COMPENSATORY MOTIONS FOR LIMITED ELBOW ANGLES

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INTRODUCTION

In rehabilitation treatment of patients with constrained joint motions in the upper extremity we appeal on available compensating mechanisms though we know little about the kinematic demands on the joints involved¹. We wish to be able to define the minimal demands for typical daily activities in terms of joint angles, to predict functional outcome based on observed joint angles and identify activity limiting joints.

The goal of this study is to determine the limiting elbow rotations on five standardized activities of daily life (ADL) and concurrent compensating joint rotations in both patients (haemophilia) and matched healthy controls with artificially limited elbow rotations.

METHODS

Shoulder and arm kinematics of 10 patients with restricted range of motion (RoM) of the elbow and 10 matched controls with splinted elbows at variable angles were recorded while performing 5 ADL tasks under laboratory conditions (A: combing hair, B: perineal care, C: drinking, D: washing axilla, E: tying shoe laces). Electromagnetic tracking and application of an internationally standardized protocol² resulted in the orientations of the thorax, clavicle, scapula, arm and hand and their connecting joint rotations. The orientations and joint rotations of healthy subjects and patients were subsequently compared for similar elbow angles.

RESULTS AND DISCUSSION

Two domains of elbow angles were identified, an extension domain with a maximum elbow flexion of 85° and a flexion domain with a minimum elbow angle of 120° (Figure 1), about similar to Vasen et al.³,⁴. On average, the controls needed a ‘transitional’ RoM of about 40° to successfully perform the flexion tasks. Perineal care required a specific flexion limited flexion range of 65° – 95°.

One patient with an elbow arthrodesis of about 90° did not meet the above mentioned requirements and was not able to perform flexion tasks A and C, but surprisingly did perform task D. The presented ‘general’ model is thus descriptive but not yet fully predictive.

Arm-shoulder kinematics did not significantly differ for comparable elbow RoM in patients and controls. Each task required significant different compensating motions. Significant linear (regression) relations with elbow flexion were dominantly found for thorax axial rotation (B,C,E), elbow pronation (A,D,E) and wrist palmar flexion (A,B,C,E).

CONCLUSIONS

With sufficient range of motion, a mid-range flexion angle of 90° allowed the subjects to perform tasks in both extension and flexion domain. In case of an elbow arthrodesis, 90° flexion will make both domains unapproachable and leads to significant disability⁴,⁵ and one of the domains should be chosen, as illustrated here.

Individual prediction is not yet possible based on this ‘general’ model and depends on the compensating motions in the kinematic chain. Trial fixation by means of an adjustable splint may be helpful for the patients’ choice of preferred fixation angle, especially in cases of multi-joint pathologies.

REFERENCES


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