Effect of Hand Dominance on Active Range of Motion During Reach-to-Grasp and Transport Tasks

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INTRODUCTION: Active range of motion (AROM), the range of motion (ROM) to perform various tasks, is a measure used to quantify the mobility of joints for diagnostic and therapeutic purposes. Previous studies have identified minimum AROM required for activities of daily living (ADL), but little is understood about biomechanical differences in dominant and non-dominant limbs. This study investigates the impact that hand dominance has on AROM.

METHODS: All procedures complied with state and federal guidelines, was approved by the local institutional review board, and informed consents were collected. A *Vicon Vero* motion capture system was used to record 25 healthy subjects' movements during ADLs. 21 markers were placed on the subjects' upper extremities and torso to capture 3-dimensional movements of the shoulder, elbow, and wrist joints. Subjects performed two variations of a reach-to-grasp and transport task. First, subjects stacked 6 blocks on top of each other. Second, subjects transferred a large ring from one hand to the other, then placed it on a cone contralateral to the receiving hand. All subjects' full ROM (flexion, extension, abduction, adduction) of the shoulder and wrist joints, and flexion and extension of the elbow joints were measured to ensure there were no baseline ROM differences or impairments. Each task was performed 3 times with each arm.

Data was processed to remove noise, then the AROM for each trial was calculated as the difference between the maximum and minimum joint angle in each trial. We used MATLAB to find the mean AROM in each limb and calculated the mean difference by subtracting the non-dominant AROM from the dominant AROM for each joint. A paired t-test was used to identify differences between the dominant and non-dominant limb.

RESULTS SECTION: Table 1 shows the differences in the AROM during the blocks task of the dominant and non-dominant limbs, along with the paired t-test results between the AROM of the limbs. Table 2 shows the differences in AROM during the rings task, along with the paired t-test results between the AROM of the dominant and non-dominant limb.

DISCUSSION: The results of our study suggest that hand dominance does not affect the AROM during reach-to-grasp and transport tasks. Previous studies have identified significant differences between the full ROM of dominant and non-dominant limbs, but this study suggests the difference does not impact AROM.

SIGNIFICANCE/CLINICAL RELEVANCE: The goal of the study is to understand normative values in healthy patients to be used in future comparisons with the motion of patients with UE dysfunction. Our study demonstrates that there are minimal AROM differences between the dominant and non-dominant limbs during ADLs involving reach-to-grasp and transport movements.

IMAGES AND TABLES:

Table 1: Blocks task differences in dominant and nondominant AROM

Joint (Dimension)	Mean Difference (°)	Confidence Interval (°)	p-value
Wrist (Flexion)	-0.613	[-7.31, 6.08]	0.084
Wrist (Abduction)	-1.458	[-6.18, 3.27]	0.517
Wrist (Internal Rotation)	-1.763	[-10.67, 7.15]	0.678
Elbow (Flexion)	-4.504	[-9.26, 0.25]	0.060
Shoulder (Flexion)	1.634	[-2.75, 6.02]	0.463
Shoulder (Abduction)	-0.321	[-5.19, 4.54]	0.876
Shoulder (Internal Rotation)	-0.090	[-5.20, 5.02]	0.955

Table 2: Rings task differences in dominant and nondominant AROM

Joint (Dimension)	Mean Difference (°)	Confidence Interval (°)	p-value
Wrist (Flexion)	1.985	[-3.27, 7.24]	0.454
Wrist (Abduction)	0.361	[-3.70, 4.42]	0.875
Wrist (Internal Rotation)	3.401	[-4.25, 11.05]	0.375
Elbow (Flexion)	3.466	[-0.46, 7.39]	0.085
Shoulder (Flexion)	-3.734	[-8.21, 0.74]	0.093
Shoulder (Abduction)	-1.552	[-12.42, 9.32]	0.763
Shoulder (Internal Rotation)	-2.373	[-9.32, 4.58]	0.478