Upper Body Kinematic Range-of-Motion and Variability of Transradial Prosthesis Users Performing Goal-Oriented Tasks

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Introduction

➢ Inherent redundancy of degrees-of-freedom (DoFs) of the upper body musculoskeletal architecture allows the central nervous system to select various task-equivalent motor strategies [1].
➢ Redundancy allows adaption to account for lost DoFs due to pathology [2], e.g. trunk/shoulder motion to compensate for reduced active distal DoFs in transradial prosthesis users [3].
➢ Training is aimed at refining movement quality of upper limb prosthesis users [4, 5], but little is known of the compensatory motions and associated movement variability of experienced users.

Purpose: Compare upper body movements and variability between able-bodied and transradial prosthesis users during execution of goal-oriented tasks.

Methods

➢ Design: Group comparison between 6 able-bodied (35±11 yrs) and 7 myoelectric prosthesis users (49±18 yrs, prosthesis experience of 20±18 yrs) performing activities of daily living.

Procedure

Five goal-oriented tasks performed with non-dominant (able-bodied) or prosthetic limb as instructed by the Southampton Hand Assessment Procedure [6]:
- Food cutting
- Page turning
- Carton pouring
- Lifting and transferring a weighted object
- Lifting and transferring a tray

Data Collection

➢ Kinematics: Custom, upper-body marker set
➢ Equipment: 12-camera digital motion capture system (Motion Analysis Corp, Santa Rosa, CA)

Data Analysis

➢ DoF range-of-motion (RoM), average standard deviation (SD), and adjusted coefficient of multiple determination (CMD) estimated across five trials

Results

Carton Pouring

Weighted Object Transfer

Tray Transfer

RoM (Degrees)

SD (Degrees)

CMD

Able-Bodied

Prosthesis Users

Conclusions

➢ Prosthesis users consistently demonstrated greater shoulder abduction and trunk RoM across tasks to manipulate endpoint position, but this was associated with greater variability.
➢ Increased variability may be reflective of healthy motor adaptation, but this may be perceived as unreliable device response and contribute to diminished perceived utility of the prosthesis.

References


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