Coordination variability in movements of the dominant and non-dominant sides of the upper limb in performing activities of daily living

Maryamolsadat Mirhadizadeh [1], Daniel Askew [1], Cassie Wilson [2], Matthew Oldfield [1], Aliah Shaheen [1,3]

[1] Centre for Biomedical Engineering, Department of Mechanical Engineering Sciences, University of Surrey, mm01124@surrey.ac.uk;

[2] Department for Health, University of Bath;[3]Department of Life Sciences, Brunel University London

Introduction

Studies in lower limb movement and sports biomechanics have shown that coordination variability (CV) is an important factor in achieving success in the execution of an action [1].

One of the key challenges in Upper Limb (UL) movement analysis is the **large movement variability between individuals** [2].

Quantitative measures of UL movement and function are often unable to identify the presence, location, direction and degree of abnormalities. Measures of coordination and CV have not been used in kinematic assessments of UL.

Aim

It is hypothesised that the comparison of CV and coordination measures from both sides of the body will reveal trends that can be used to differentiate performance levels.

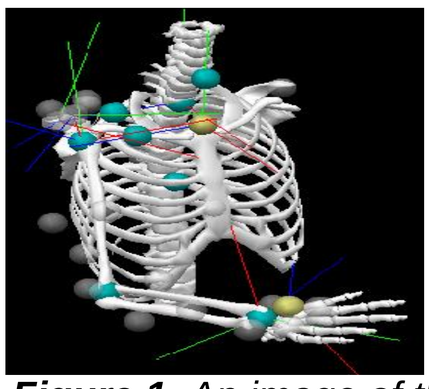
The **aim** of the study was to use CV to distinguish between dominant and two non-dominant (before and after practice) sides movements of the UE when performing activities of daily living (ADLs), thus testing its ability to differentiate between skilled and un-skilled movements.

The **ADLs** performed were Drawing a star, Sipping a drink, Sliding an object, Throwing a ball, and Reaching for an object.

Method

Ten healthy participants aged 18-24 performed five ADLs using their dominant and non-dominant sides. Segmental coordinate frames and joint kinematics were computed using recommendations of the International Society of Biomechanics [3].

Continuous relative phase (CRP) method is an indication of the relationship between phases of two oscillating segments (Fig.1) at each sampled data point throughout the cycle of the movement. Standard deviations of CRP were used as a measure of CV.



CRP method assessed coordination in movements that were likely be coupled in the shoulder, elbow and wrist joints

Figure 1. *An image of the subject model once segments had been applied in Visual3D*

Results

The most significant differences between the dominant and two non-dominant conditions (pre- and post-practice) were in Reach and Throw tasks (Fig.2).

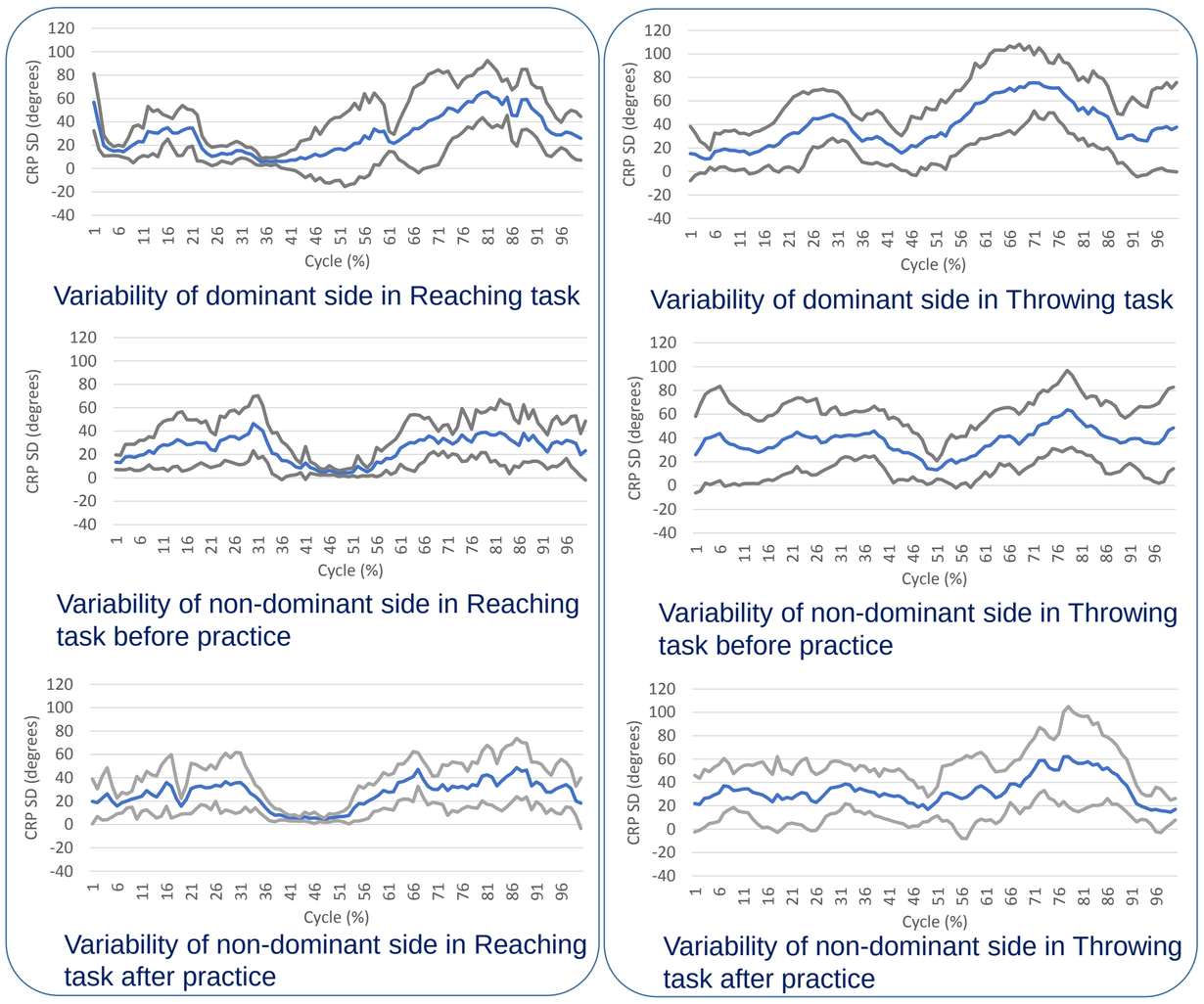


Figure 2. *The blue line indicates the mean SD of the CRP and the grey area is the SD of the mean in Reaching and Throwing tasks.*

The standard deviation (SD) of the mean CRP in the start position for the dominant side during the Reaching task is at 60°, compared to just 15° and 20° for the two non-dominant conditions. In the Throwing task, there is a peak in CRP at 25% on the dominant side that is not present in the non-dominant trials.

Conclusion

Coordination variability can distinguish between dominant and non-dominant movement patterns in the UE. The new technique was able to differentiate between skilled and non-skilled movements, the technique can identify (subtle) differences that cannot be detected using more traditional techniques.

There were no significant differences between dominant and non-dominant movements detected for other tasks and for movements of the upper limb before and after practice. More work must be done to define a threshold for CV in healthy UE movement to enable its use in clinical studies.

References

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