

# Is subjective assessment of upper limb associated reactions during walking accurate in people with acquired brain injury?

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## Introduction

Associated reactions (ARs) cause involuntary and abnormal upper limb movement. This frequently occurs when individuals with acquired brain injury (ABI) exert effort during functional tasks, like walking. Clinical observation of leg movements has been shown to be inaccurate compared to criterion-reference three-dimensional motion analysis (3DMA). Robust, criterion-reference AR outcome measures have been devised. However, due to the time and cost of these assessments, evaluation of the accuracy of clinical observations of the upper limb is warranted.

## Aims

To determine the accuracy of clinical observations of abnormal upper limb movements due to ARs during walking, compared to criterion-reference 3DMA.

## Methodology

Forty-two adults with ABI and ARs performed walking trials at their self-selected walking speed. They were assessed concurrently with OptiTrack 3DMA and video recordings. Criterion-reference 3DMA kinematic deviation scores (KDS) and the kinematic deviation score worst axis (KDSw) quantified the AR abnormality at each upper limb joint axis and whole upper limb, respectively. The videos were viewed by three experienced neurological physiotherapists who rated the global and individual upper limb joint severity (0-4) using the International Classification of Functioning, Disability and Health Framework (ICF) Qualifiers Scale (Table 1) as a comparative clinical observation assessment. The relationship (Fisher's exact test), percentage agreement, sensitivity, and specificity were calculated.

Table 1. International, Classification of Functioning, Disability and Health Framework Qualifiers Scale

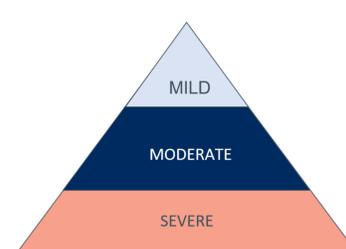
RATING	CATEGORY	CLASSIFICATION TERMS
0	NO problem	none, absent, negligible
1	MILD problem	slight, low
2	MODERATE problem	medium, fair
3	SEVERE problem	high, extreme
4	COMPLETE problem	total

## Results

The clinical observations using the ICF Qualifiers Scale had limited accuracy compared to criterion-reference 3DMA AR assessment (Table 2). The wrist severity score was the only outcome that demonstrated a significant relationship to the corresponding 3DMA KDS ( $p < 0.05$ ). Four out of seven outcomes had  $\leq 58\%$  agreement in abnormality classification. None of the outcomes had high sensitivity and specificity. The sensitivity was relatively low for all outcomes (0.32 - 0.73) and the specificity relatively high ( $> 0.80$ ) for four of the seven outcomes.

Table 2. The accuracy of the ICF Qualifiers Scale compared with criterion-reference 3DMA outcome measures for AR assessment

ICF Qualifiers Scale Score	3DMA KDS Outcomes	Fisher's exact test (p value)	Agreement n (%)	Sensitivity	Specificity
Global severity score	KDSw	0.44	24 (58%)	0.58	1.00
Shoulder severity score	Shoulder flexion	1.00	23 (56%)	0.29	0.75
Shoulder severity score	Shoulder abduction	0.13	21 (51%)	0.32	0.92
Shoulder severity score	Shoulder rotation	0.12	29 (71%)	0.42	0.83
Elbow severity score	Elbow flexion	0.09	30 (73%)	0.73	0.75
Forearm severity score	Forearm Pronation	0.74	21 (51%)	0.58	0.48
Wrist severity score	Wrist flexion	0.01*	34 (83%)	0.40	0.97



Subjective rating



OptiTrack 3DMA cameras



3DMA replicated skeleton

## Conclusions

Clinical observational assessment of ARs during walking using the ICF Qualifiers Scale has low accuracy compared to criterion-reference 3DMA assessment and cannot be confidently implemented in clinical practice. The ICF Qualifiers Scale tended to under classify AR Abnormality with false negatives likely. Future research investigating low-cost objective motion analysis systems is warranted.

