

RELIABILITY OF A HAND-HELD INSTRUMENT FOR MEASURING MOMENT ABOUT THE ANKLE IN CHILDREN WITH CEREBRAL PALSY

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INTRODUCTION

In children with a spastic paresis, the range of motion of the ankle joint is often limited. Assessment of the efficacy of treatment requires measurements of the net (passive) moments about the ankle in these children. For this purpose we constructed a hand-held instrument which is designed to measure normally developing children (NDC) as well as children with cerebral palsy (CPC) who are impaired by a deviation of the foot towards equines combined with valgus or varus. The aims of this study were: 1) to validate the instrument and to test the reproducibility, 2) to determine the least number of repetitions for reliable measurements.

METHODS

The hand-held dynamometer consists of an adjustable foot-fixation, a torque wrench and a goniometer. The adjustable foot-fixation (Figure 1) consists of forefoot part and a hindfoot part. The two parts can be adjusted in distance and in longitudinal rotation with respect to each other. The torque wrench and goniometer are positioned in the sagittal plane, measuring dorsal and plantar flexion moment and angle.

Ten NDC (aged 8.7 ± 2.1 yrs) and ten CPC (aged 8.9 ± 2.1 yrs) participated in the reliability study. The dynamometer measurements were performed with children in a prone position with their feet overhanging the edge the bench. Three ankle angles (yielding passive moments of A. -4Nm plantar, B. 0Nm neutral and C. +4Nm dorsal) and two moments (at half of angle range AB and at half of angle range BC) were measured. All measurements were repeated ten times and each measurement the joint angle was held for five seconds. EMG signals of mm. tibialis anterior and lateral gastrocnemius were recorded to check for activity of the muscles during the measurements.

A Generalizability-study [1] was used to determine the reliability of the instrument. The intraclass correlation coefficient (ICC), the standard error of measurement (SEM; calculated as the square root of the error variance) and the smallest detectable difference (SDD; calculated as $SEM \cdot \sqrt{2 \cdot 1.96}$) were determined. SEM and SDD have the same dimension as the object of measurement (i.e. ° and Nm) and are therefore clinically relevant. Reliability values were calculated at repetitions considered from 10 to 2.

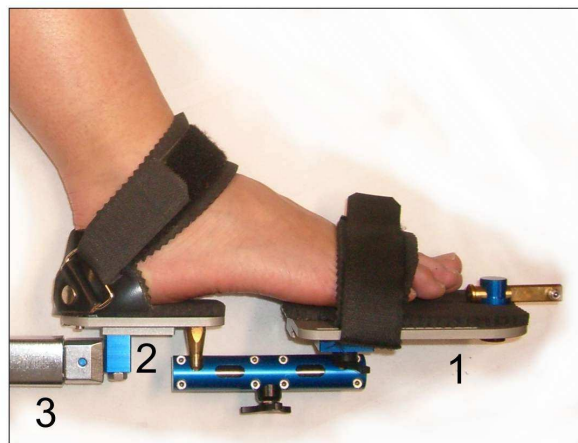


Figure 1: The adjustable foot-fixation with the forefoot part (1), hindfoot part (2) and attached torque wrench (3).

RESULTS AND DISCUSSION

Table 1 shows results for ICC, SEM and SDD for the CPC. At 10 repetitions, the plantar angle measurement has the largest SDD (i.e. 5.95°). With fewer repetitions, the SEM and SDD gradually increase. Under 6 repetitions the SDD of rest angle measurement increases to up to 7.36° . The SDD for moment measurement is lower than 0.4Nm and does not increase significantly with a decrease in repetitions. Qualitatively similar results were found for the NDC. At +4Nm, CPC have 25° less dorsal flexion angle than NDC. This is in accordance with results found in other studies [2].

CONCLUSIONS

The hand-held instrument provides reliable measurements of passive moment and angle when 6 repetitions are performed.

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Table 1: Reliability at decreasing repetitions (Rep) for the measurements of the three angles and two moments.

Rep	Angle									Moment					
	plantar			neutral			dorsal			half plantar			half dorsal		
	ICC	SEM	SDD	ICC	SEM	SDD	ICC	SEM	SDD	ICC	SEM	SDD	ICC	SEM	SDD
10	0.93	2.15	5.95	0.98	1.74	4.81	0.94	1.26	3.50	0.96	0.11	0.30	0.94	0.12	0.34
6	0.93	2.16	6.00	0.98	1.91	5.30	0.95	1.25	3.46	0.95	0.12	0.33	0.93	0.13	0.35
2	0.91	2.44	6.77	0.96	2.66	7.36	0.92	1.42	3.95	0.94	0.13	0.35	0.93	0.13	0.36