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New parameters of computerized motion analysis represent upper limb function in children with CP.

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Objectives

There are various tools that measure upper limb function in children with cerebral palsy (CP) clinically, but this measurement method depends on the subjective judgment of the examiner and the upper limb function is not measured as a continuous variable, which makes it difficult to quantitatively evaluate. The purpose of this study is to evaluate the correlation between Melbourne Assessment 2 (MA2) and computerized motion analysis in children with CP and to see if the new parameters derived from kinematics reflect the upper limb function in the clinical upper limb function evaluation result.

Subjects and Method

A total of 27 children with CP (age, 3 to 15 years) participated in this study. MA2 and Computerized upper limb motion analysis test were conducted. MA2 is a validated evaluation tool that measures the range of motion (ROM), Accuracy, Dexterity, and Fluency of the unilateral upper extremity function during 14 tasks. Computerized motion analysis test was conducted during the Reach & Grasp Cycle. The computer recognizes the movement of the markers attached to the upper limb of children during this task. The task is composed of four parts; reach out to the cup and grab the cup (T1), lift the cup to the mouth (T2), put the cup back in its original position (T3), and put the hand back in place (T4). New parameters (movement time, number of movement unit, index of curvature, movement speed) were derived from kinematic data. Movement time is time spent in each part of task. Number of movement unit is the number of acceleration-decelerations in the velocity profile of the wrist marker. Index of curvature is the path length of the wrist during each part of task divided by the linear distance between the initial and final positions. Movement speed is the distance travelled per unit time. For correlations between MA2 and kinematic parameters, the Spearman rank coefficient was used.

Results

Most of MA2 scores showed moderate negative correlation with movement times during T2 ($r_s = -0.464, -0.500, -0.441$; ROM, accuracy, fluency, respectively; $p < 0.05$), T3 ($r_s = -0.431, -0.395, -0.412$; accuracy, dexterity, fluency, respectively; $p < 0.05$), and T4 ($r_s = -0.456, -0.527, -0.446, -0.474$; ROM, accuracy, dexterity, fluency, respectively; $p < 0.05$). All dimensions of MA2 (ROM, accuracy, dexterity, fluency) showed negative correlation with

index of curvature during T2 ($r_s=-0.559, -0.523, -0.388, -0.424$, respectively; $p<0.05$) and T3 ($r_s=-0.737, -0.716, -0.590, -0.708$, respectively; $p<0.01$)

Conclusion

We calculated quantitative parameters to measure unilateral upper limb function using computerized motion analysis during each part of the task. Most dimensions of MA2 correlated with more straight movement during lifting the cup to the mouth and put the cup back. In addition, all dimensions of MA2 correlated with the faster time to lift the cup to the mouth, put the cup back and put the hand back in place.

Table 1. Correlation between Melbourne assessment-2 and Movement time during each task

	Movement time(s)			
	T1	T2	T3	T4
MA2 ROM(%)	-0.216	-0.464*	-0.337	-0.456*
MA2 Accuracy(%)	-0.246	-0.500**	-0.431*	-0.527**
MA2 Dexterity(%)	-0.168	-0.369	-0.395*	-0.446*
MA2 Fluency(%)	-0.228	-0.441*	-0.412*	-0.474*

* $P<0.05$ by Spearman's rank correlation test

** $P<0.01$ by Spearman's rank correlation test

MA2, Melbourne assessment-2; ROM, range of motion; T1, reach out to the cup and grab the cup; T2, lift the cup to the mouth; T3, put the cup back in its original position; T4, put the hand back in place

Table 2. Correlation between Melbourne assessment-2 and Curvature index of kinematic data

	Index of curvature			
	T1	T2	T3	T4
MA2 ROM(%)	-0.205	-0.559**	-0.737**	-0.006
MA2 Accuracy(%)	-0.215	-0.523**	-0.716**	-0.114
MA2 Dexterity(%)	-0.263	-0.388*	-0.590**	-0.043
MA2 Fluency(%)	-0.191	-0.424*	-0.708**	-0.021

* $P<0.05$ by Spearman's rank correlation test

** $P<0.01$ by Spearman's rank correlation test

MA2, Melbourne assessment-2; ROM, range of motion; T1, reach out to the cup and grab the cup; T2, lift the cup to the mouth; T3, put the cup back in its original position; T4, put the hand back in place