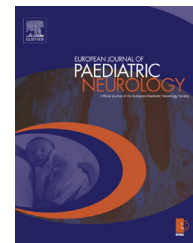




ELSEVIER

Official Journal of the European Paediatric Neurology Society



Original article

Relation between unimanual capacities and bimanual performance in hemiplegic cerebral-palsied children: Impact of synkinesis



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ARTICLE INFO

Article history:

Received 4 June 2014

Received in revised form

8 December 2014

Accepted 9 December 2014

Keywords:

Hemiplegia

Upper limb

Synkinesis

Capacity

Performance

ABSTRACT

Objective: Analyze the link between unimanual capacities and bimanual performance in cerebral-palsied (CP) hemiplegic children, aged between 5 and 18 years old, studying specifically the impact of synkinesis.

Material and methods: 71 CP hemiplegic children (35 boys and 36 girls – with average age of 8 years and 6 months; MACS levels from I to III; GMFCS from I to IV) took part in a transversal study, assessed – Melbourne Test (MUUL) for unimanual capacities, and Assisting Hand Assessment (AHA) for bimanual performance – with a specific scale to analyze synkinesis during Box and Block test for affected and healthy hands, collecting synkinesis type, duration and intensity.

Results: There is a strong correlation between unimanual capacities (MUUL) and bimanual performance (AHA) ($r = 0.871$). Neither age nor gender contribute to bimanual performance (AHA). Multiple linear regression shows that MUUL contributes to bimanual performance variance (AHA) by 70%. Synkinesis is partly correlated to capacities (MUUL) and accounts for 10% of the variance of the gap between capacities and bimanual performance.

Conclusion: A high relationship between unimanual capacities and bimanual performance is confirmed by this study; some authors demonstrated impact of sensory troubles, we demonstrate that synkinesis influences the use of unimanual capacities in bimanual performance.

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<http://dx.doi.org/10.1016/j.ejpn.2014.12.002>

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1. Introduction

If lower limbs have been the first concern of parents and teams for cerebral-palsied (CP) children during these last decades, in order to acquire or improve walking, there is today increasing interest for upper limb and functional problems caused by affected upper limbs.

Consequently, many assessment tools have been developed these last years, especially for hemiplegic children.¹ Tools to assess unimanual capacities are commonly usable in all contexts (unilateral or bilateral involvement). Few tools, however, are reliable and usable to assess bimanual capacities, and hardly any of them focus on bimanual performance. Yet the aim of any therapeutic action is not only to improve analytic or test situations, that is to say functional “capacities”, or what the child can do ... but therapeutic action tends to improve real life situations, that is to say “performance”, or what the child really does, trying to have an effect on participation.^{2,3}

Recent studies have focused on the relation between global motor capacity and global motor performance in CP children by using GMFM^{4,5}; others have searched for a link between lesion aspects and unilateral motor capacity in the upper limb⁶; but few studies have focused specifically on the link between unimanual capacity and bimanual performance in the upper limb.⁷

In hemiplegic children, the gap regularly observed between unimanual capacity and bimanual performance often raises questions ... The impact of sensory troubles is nowadays better known⁸ but explains only partially the discordance between motor capacities tests and bimanual performance.

In this study, we focused on the relation between unimanual capacity, assessed by the Melbourne test (Melbourne Unilateral Upper Limb Assessment),^{9,10} and bimanual performance in hemiplegic CP children, assessed by AHA (Assisting Hand Assessment).^{11,12} We first explored how important the link was between unimanual capacity and bimanual performance; then we looked for the impact of synkinesis in the healthy hand or in the affected hand on this relation.

2. Method

This study was conducted at the Centre Médico-Chirurgical de Réadaptation des Massues - Croix Rouge Française, Lyon (France).

2.1. Participants

Included in the study:

- All hemiplegic CP children evaluated and/or treated at the Centre des Massues who benefited at the same time from functional evaluations assessing unimanual capacities and bimanual performance
- These children had to be at least 5 years old, and up to maximum 18 years old, should not present severe sensory associated deficit (correct or partial exteroception and proprioception on simple perception tests of touch and

movement), and should cooperate enough to allow evaluations.

Excluded from the study:

- Hemiplegic children with etiology other than CP
- Cases of evaluations being refused.

The severity of impairments found in the participants was classified using the Manual Ability Classification System (MACS),¹³ which rates the ability to handle objects in daily activities on five levels; and using the Gross Motor Function Classification System (GMFCS),¹⁴ which classifies on five levels a child's ability to perform self-initiated movements related to sitting and walking. Age, gender and hemiplegia side were reported.

2.2. Instruments

The main evaluation criteria were specific tools developed for this population, based on standardized video evaluation, validated in French:

- The analysis of unimanual capacity in the affected upper limb was realized with the 1st version of the Melbourne test (MUUL). MUUL is a video evaluation test, valid for children with central neurologic impairments between 5 and 15 years old, testing the child's best capacities in answering verbal instructions or precise demonstrations. The final score is a percentage, ranging from 0 to 100, where the highest score reflects the best capacities. Initially developed by Melinda Randall and her colleagues,⁹ this tool was then translated and validated in French, with the Melbourne Royal Children Hospital authorization.¹⁵ The Melbourne test was found reliable (inter-rater reliability CIC 0.95 and intra-rater reliability CIC 0.97).
- The analysis of bimanual performance was realized with the Assisting Hand Assessment (AHA). The AHA was developed by Lena Krumlinde-Sundholm et al.,^{11,12} using the Rasch model, and also has its own official translation into French.¹⁶ The AHA measures and describes how effectively children with unilateral disability use their affected hand in bimanual activity performance. This tool is valid for children between 18 months and 12 years with brachial plexus palsy or CP hemiplegia. Its reliability is high for the total score, according to both intra-rater (CIC 0.99) and inter-rater (CIC 0.98) evaluations. The final score is reported as a percentage score, with high scores reflecting the best levels of performance. This score, of ordinal level, is then converted into an interval score, and expressed on a logits-based scale, from 0 to 100 AHA-units.¹⁷ For children over 12 years old, an AHA research version was used, based on observation of functional activities with the same scoring criteria.

Children were assessed by an AHA-certified (course and certification procedure obligatory) occupational therapist, experienced in using MUUL.

- Evaluation of synkinesis in the affected hand and in the healthy hand was performed during the Box and Block test

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