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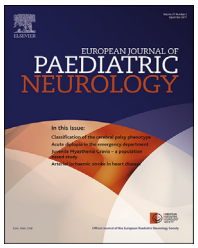

Original article

Upper limb and hand patterns in cerebral palsy: Reliability of two new classifications

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ABSTRACT

Aim: To evaluate the inter- and intra-rater reliability of two previously developed classifications of upper limb and hand patterns.
Method: Two hundred and twelve films of patients with CP (118 of UL postures and 94 of hand tasks; median age 14, 3–46 years) were viewed by 18 examiners from 2 different rehabilitation centers, and one expert who had participated in the design of the classifications. They classed upper limb (3 patterns with sub-types) and hand patterns (2 patterns with subtypes) twice, at 2 months' interval. Inter- and intra-rater reliability were analysed.
Results: Intra-rater and inter-rater reliability were very high for upper limb and hand patterns ($0.87 < k < 0.92$), and high for the subtypes ($0.58 < k < 0.68$). Examiners stated that both classifications were useful and feasible in clinical practice.
Interpretation: Despite the single, short training session on use of the classifications, agreement between the examiners and the expert examiner was good to high, confirming that these classifications are easy to use and reliable. The classifications proposed here provide homogenous terminology for use in both clinical practice and research, to describe, evaluate and follow-up changes in upper limb and hand patterns in patients with cerebral palsy, particularly those with dyskinesia.

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Cerebral palsy (CP) has been defined as "a group of permanent disorders of the development of movement and posture causing activity limitation(s) that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain".[3]

Hypertonia of the upper limb is common in CP. It interferes with both active and passive arm function, leading to disability. It may also cause pain. The identification and treatment of hypertonia is a key aspect of rehabilitation. Local intramuscular injections of botulinum toxin type A (BoNT-A) are an established and well-tolerated treatment for local hypertonia in patients with CP.[17] BoNT-A can be used in both lower and upper limb muscles, and is often combined with splinting and physical and occupational therapy.

Guidelines for BoNT-A therapy state that the specific pattern of hypertonia should be considered when determining the muscles to inject, and that the choice must relate to the goal of treatment.[18,19] However, the muscles that should be injected to improve a particular spastic or dyskinetic pattern are not simple to determine. A classification system that states the most likely muscles involved in a particular spastic pattern would be useful. Equally, such a classification could be used to evaluate changes over time and following treatment. Existing classifications for subtypes of CP are based on location of lesion, part of the body involved, degree of impairment,[4] gait patterns in spastic hemiplegia and spastic diplegia,[5] or function such as the Gross Motor Function Classification System (GMFCS[6]) that evaluates function in sitting and walking. More recently, the Manual Ability Classification System (MACS[7]) was developed to evaluate how children use their hands to handling objects during daily activities. Several classifications have attempted to describe different grips or to classify hand-postures in patients with cerebral palsy,[8–10] however they do not include all the patterns observed in patients. McConnell[11] and Wagner[12] recently highlighted several useful classifications that were first developed for surgical purposes, but are commonly used in clinical practice; for instance the Zancolli[13] classification for the wrist, and the Matev,[14] House[15] and Corry[16] classifications for the thumb.

Hefter et al.[20] proposed a classification of upper limb and hand postures in adults with acquired cerebral lesions that indicates the muscles involved. However, there are no similar classifications for use in patients with CP.

The final goal of any treatment is to improve participation, as defined in the International Classification of Functioning, Disability and Health (ICF – World Health Organization 2001), however many treatments are aimed at the body function and structure levels. Treatment of upper limb and hand deformities in children is important to help normal growth and prevent neuro-orthopedic complications that can lead to pain in adulthood, and potentially impact participation and quality of adult life.[21] A classification of upper limb and hand deformities would be very useful to evaluate the relationship between improvements in body function and structure, activity and participation, as well as the role of changes in muscle function on improvements or losses of function, through longitudinal studies. A classification system would also be useful in clinical practice to identify predominant patterns of deformity for example in patients with dyskinesia, to facilitate communication between clinicians and for patient follow-up. From a research point of view, such a classification could help to identify homogenous subgroups of patients with CP for investigations as well as to evaluate the effects of treatments such as botulinum toxin injection or surgery.

We previously developed two classification systems, one for the upper limb and one for the hand, based on 100 films of patients with cerebral palsy.[22] Separate classifications were developed following an initial study in which we found no correlations between upper limb and hand patterns, meaning that specific upper limb patterns are not always associated with specific hand patterns. Thumb patterns were not included in these classifications since robust classifications already exist,[14–16] moreover thumb patterns are independent from hand patterns.

The aim of the present study was to evaluate the inter- and intra-rater reliability of classifications of upper limb patterns and hand patterns in patients with CP. The second aim was to evaluate the usefulness and feasibility of such a questionnaire in clinical practice and research, according to clinicians.

1. Methods

1.1. *Participants*

Patients with CP in our center are systematically filmed during assessments. We selected 212 films of patients to test the reliability of the classifications. The films were selected to cover a wide range of ages and what we assumed would be a wide range of upper limb and hand postures, that is to say that all films were included as far as they were exploitable regarding technical aspects (standardized shots, adequate definition of the image). Upper limb patterns were classified at rest (n = 40), during ambulation (walking or wheelchair) (n = 38) and during activity of the contralateral limb (n = 40). Regarding ambulation, there is some difference between the situations of walking or propelling an electric wheelchair, but there is also some likeness, as both situations allow the observation of tonic syncinesia while mowing. Patients are often complaining about the position of their upper limb while moving – because they sometimes hardly control it, and it can lead to uncomfortable situations, as the hand hitting other people or doorframe for example. This occurs during walking or while propelling an electric wheelchair. We thus chose to define ambulation as a situation of observation, as it was closely connected with patients' complains.

Hand patterns were classified at rest (n = 39) and during grasping activities (n = 55). The examiners were clinicians of different professions from two rehabilitation centers.

1.2. *Refining of the classification*

The first versions of the classifications[22] were presented at national and international conferences (Toxine et MembreSupérieur – Colloque Lyon 2010, SPHERE – Brest 2013) to