IFSSH Scientific Committee on Cerebral Palsy

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Evaluation and Outcome Tools for Assessment of

Upper Extremity Function in Cerebral Palsy

Cerebral Palsy is a group of disorders of development of movement and posture that cause activity limitations attributed to non-progressive disturbances of the developing fetal or infant brain (Ref 1). The primary problem in cerebral palsy is a central nervous system (CNS) insult which leads to secondary muscle imbalance, resulting injoint mal-positioning and functional impairment of the upper limb. This can lead to tertiary problems of muscle contracture, joint contractures and skeletal deformity.

This report examines the evaluation and outcome tools for assessment of upper extremity function in cerebral palsy. Evaluation of upper extremity function includes defining the degree of disability in use and function of the upper limb. The World Health Organization (Ref 2) defines disability as causing bodily impairment, activity limitations, and participation restrictions. Impairment is a problem in body function or structure. An activity limitation is a difficulty encountered by an individual in executing a task or an action. A participation restriction is a problem experienced by an individual in involvement in life situations. Thus, disability is a complex phenomenon interaction between features of a person's body and the features of the society in which he or she lives. Disabilities encountered in children with cerebral palsy encompass impairments of bodily function, activity limitation and participation restrictions. Assessment of upper extremity function ideally would measure disability in all 3 realms, in addition to the dimension of quality of life. Traditionally, assessment has primarily focused on bodily function, but more recently assessment has also included activity limitations and to some extent, participation restriction.

Assessment of the upper extremity in cerebral palsy always includes measures which are used for standard upper extremity function assessment including active and passive range of motion as well as grip and pinch strength testing. Hand function tests that are not specific to cerebral palsycan be used for assessment of hand function, such as the Jebsen-Taylor hand function test, the 9-hole peg test, and the box and blocks test. For the higher functioning child, each of these can be useful for assessment of unilateral hand function. This report would like to outline those assessment tools which are specifically designed for cerebral palsy and provide references for the practitioner desiring more in depth testing information.

The House upper extremity assessment (Ref 3) is a 9-point scale that describes the use of the affected arm during activities (Table 1). This classification was designed specifically for cerebral palsy and describes use of the limb ranging from "does not use" (level 0), to full spontaneous use (level 8). More recently, the Manual Abilities

Classification System (MACS) has been designed as a classification of manual ability (Ref 4) in children with cerebral palsy age 4 – 18 years. MACS assesses the child's ability to handle objects in important daily activities such as play, leisure, eating and dressing. As shown in Table 2, MACS scores a child as level 1 (handles objects easily and successfully), to level 5 (does not handle objects and has severe limited ability to perform even simple actions). The MACS gives an overall picture of the child´s ability to use the hands in daily life, including the influence of cognitive problems. The classification supplements the Gross Motor Function Classification (Ref 5) in giving a general description of motor function in the child with cerebral palsy. Similar to the House scale, the MACS classification system provides a general description of upper extremity use during activities of daily living.

The Shriners Hospital Upper Extremity Evaluation (SHUEE) (Ref 6) has been used specifically for assessment of the upper extremity in cerebral palsy. This test has 5 sections, including: active and passive range of motion, activities of daily living, spontaneous use functional analysis, grasp and release, and dynamic positional analysis. The range of motion measurements include shoulder, elbow, forearm, wrist, hand, finger and thumb as well as an assessment of modified Ashworth scale (0 – 4) for tone analysis during range. The activities of daily living section analyses 7 activities and grades the patient as independent, dependent or assist. The spontaneous functional analysis is an examination of 9 different activities, assessing spontaneous use of the affected arm using a modified House scale (6-point scale, from "does not use" to "spontaneous use"). The dynamic positional analysis analyzes 5 different segments (thumb, finger, wrist, forearm and elbow) and describes the position of the segment during 16 different activities. For example, the thumb segment is described as either across the palm, closed, next to the index finger, or open. The finger segment is assessed as in flexion, neutral or extension and similarly the wrist segment in flexion, neutral or extension, and the elbow segment in extreme flexion or extension, while the forearm section is extreme pronation, pronation neutral or supination. The grasp and release analysis looks at the ability to grasp and release the object when the wrist is in three different positions: flexion, neutral and extension.

Other methods of functional assessment specific to cerebral palsy include use of video analysis. First validated by Waters (Ref 7), observation of daily activities have been shown to have both intra- and inter- observer reliability. Additionally, Carlson (Ref 8) has shown that changes were made to initial pre-surgical plans on over 70% of patients after video tape evaluation. This was most common for surgical procedures addressing the wrist, digit and thumb, pointing to the fact that these can be dynamically assessed using video analysis and that this video analysis leads to different conclusions than that which may be seen in an office setting.

The Melbourne Assessment of Unilateral Upper Limb Function (Ref 9) is a validated, standardized test for measuring affected limb function in children aged 5-15 years with unilateral cerebral palsy. Children are videotaped performing 16 test activities of grasp, release, reach, and manipulation. The videotapes are scored for qualities of movement range, accuracy, fluency, and dexterity. More recently, a modified Melbourne assessment for ages 2-4 has been developed.(Ref 10)

Further elaboration of use of the video has been described by Van Heest (Ref 11). Using motion lab facilities with the use of split screen videos, biplanar assessment of dynamic deformity can be assessed. Additionally, dynamic electromyographic assessment of muscle function can be simultaneously collected to further evaluate deforming forces of spastic or flaccid or dystonic muscle patterns. The patterns of muscle firing can be used for assessment for tendon transfer surgery.

Many of the functional analyses examine the affected hand in cerebral palsy with forced unilateral function in a controlled test situation. The Assisting Hand Assessment (AHA) is a major advancement in upper limb assessment in CP because it allows grading of the ability of the affected hand to serve as an assist for bimanual tasks in spontaneous activities (Ref 12). The AHA was designed for unilateral conditions such as brachial plexus birth palsy and unilateral cerebral palsy . The AHA evaluates how effectively the affected hand and arm is used in bimanual performance and the assessment is made by observing the child's spontaneous handling of toys in a relaxed and playful session.

In summary, recent advances in cerebral palsy have included development of disease specific validated evaluation and outcomes tools. These assessment tools are specifically designed for upper limb involvement due to cerebral palsy, and provide the hand surgeons the means to evaluate extent of disease for specific individuals, as well as outcomes of treatment interventions.

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TABLE 1: House Upper Extremity Functional Use Classification

Class	Designation	Activity Level
0	Does not use	Does not use
1	Poor passive assist	Uses as stabilizing weight only
2	Fair passive assist	Can hold onto object placed in hand
3	Good passive assist	Can hold onto object and stabilize it for use by other hand
4	Poor active assist	Can actively grasp object and hold it weakly
5	Fair active assist	Can actively grasp object and stabilize it well
6	Good active assist	Can actively grasp object and then manipulate it against other hand
7	Spontaneous use, partial	Can perform bimanual activities easily and occasionally uses the hand spontaneously
8	Spontaneous use, complete	Uses hand completely independently without reference to the other hand

Table 2. Manual Ability Classification System (MACS)

MACS **Level of Ability**	**Description**
Level I	Handles objects easily and successfully. At most, limitations in the ease of performing manual tasks requiring speed and accuracy.
Level II	Handles most objects but with somewhat reduced quality and/or speed of achievement. May avoid some tasks or use alternative ways of performance.
Level III	Handles objects with difficulty; needs help to prepare and/or modify activities.
Level IV	Handles a limited selection of easily managed objects in adapted situations. Requires continuous support.
Level V	Does not handle objects and has severely limited ability to perform even simple actions. Requires total assistance.