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REVIEW ARTICLE

POSSIBILITIES OF ASSESSING THE FUNCTION OF FINE MOTOR SKILLS IN CHILDREN WITH VARIOUS DISEASES

MOŻLIWOŚCI OCENY FUNKCJI MOTORYKI MAŁEJ U DZIECI W RÓŻNYCH JEDNOSTKACH CHOROBOWYCH

Aleksandra Włodarczyk[1], Ewa Gajewska[2]
[1]Faculty of Health Sciences, Karol Marcinkowski University of Medical Sciences, a student of Physiotherapy, Poznań, Poland
[2]Department of Developmental Neurology, Karol Marcinkowski University of Medical Sciences in Poznań, Poland

ABSTRACT

Introduction
The causes of the disorders of fine motor skills depend on a given disease. Assessment in the case of spinal muscular atrophy, perinatal brachial plexus palsy or cerebral palsy should include the specificity of functional abilities and the disorders, additionally taking into account the age of the child.

Aim of the study
Possibilities of assessing the function of fine motor skills in children with various diseases.

Material and methods
The research was based on the analysis of the available literature on the development scales for the assessment of fine motor skills taking into account various diseases.

Results
In the literature, the mandatory tool for the assessment of fine motor skills in spinal muscular atrophy is theRevised Upper Limb Module. In the case of patients with perinatal brachial plexus, the Assisting Hand Assessment test is increasingly applied and it can also be used in patients with hemiplegia. However, in children under the age of 4 with cerebral palsy the Mini Manual Ability Classification System test should be used, whereas the Manual Ability Classification System should be applied in the case of older children.

Conclusion
The use of fine motor skills development scales taking into account the disease has become indispensable for the assessment of functional changes. The applied scales should be validated, easy to use, adjusted to the specificity of a given disease.

Keywords: fine motor skills, development scales

Author responsible for correspondence:
Ewa Gajewska, Department of Developmental Neurology Karol Marcinkowski, University of Medical Sciences in Poznań, Przybyszewskiego 49, 60-355 Poznań, Poland
e-mail: ewagajewska1011@gmail.com

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STRESZCZENIE

Wstęp

Przyczyny zaburzeń motoryki małej u dzieci uzależnione są od występowania danej jednostki chorobowej. Ocena w rdzeniowym zaniku mięśni, okołoporodowym porażeniu splotu ramiennego czy mózgowym porażeniu dziecięcym powinna zawierać specyfikę możliwości funkcjonalnych i zaburzeń uwzględniając dodatkowo wiek dziecka.

Cel pracy

Analiza możliwości oceny motoryki małej u dzieci w różnych jednostkach chorobowych.

Materiały i metody

Badania zostały oparte o analizę dostępnej literatury dotyczącej skal rozwojowych oceny motoryki małej z uwzględnieniem różnych jednostek chorobowych.

Wyniki

Badania zostały oparte o analizę dostępnej literatury dotyczącej skal rozwojowych oceny motoryki małej z uwzględnieniem różnych jednostek chorobowych.

Wyniki: W literaturze do oceny motoryki małej w rdzeniowym zaniku mięśni jako obowiązujące narzędzie został przedstawiony test Revised Upper Limb Module, dla pacjentów z porażeniem splotu ramiennego coraz częściej używa się testu The Assisting Hand Assessment, który może być również zastosowany u pacjentów z hemiplegią. Natomiast dla dzieci z mózgowym porażeniem dziecięcym przed 4 rokiem życia należy stosować test Mini Manual AbilityClassification System a dla starszych Manual AbilityClassification System.

Wnioski

Zastosowanie skal rozwojowych motoryki małej z uwzględnieniem jednostki chorobowej stało się niezbędne dla oceny zmian funkcjonalnych. Stosowane skale powinny być zwalidowane, proste w użyciu, dostosowane do specyfiki danej jednostki chorobowej.

Słowa kluczowe: motoryka mała, skale rozwojowe

Introduction

There are many reasons for fine motor skills disorders. Some of them may be temporary, e.g. disorders resulting from fractures, where the period of the absence of the limb functioning depends on the time of limb healing. However, there is a large group of diseases in which the disability of the hand is due to a more complex reason (Paczkowska *et al.,* 2015) The occurrence of fine motor skills disorders may be the result of perinatal cerebral plexus palsy, cerebral palsy or spinal muscular atrophy (Skibiński and Synder, 2007). These disorders occur at different stages of life, but each of them can lead to partial or total disability. Its consequences are disorders of motor development, eye-hand coordination, problems with gripping or precise manipulation as well as emotional problems. Early initiation of properly conducted rehabilitation can significantly improve the function of the affected limb. However, there is a need for tools that will reliably assess the progression of changes (Gajewska *et al.,* 2006).

A large group of patients with upper limb disability are children with brachial plexus palsy (Paczkowska *et al.,* 2015). This is usually a mechanical injury sustained during passage through the birth canal. On average, it is found in 0.5–5 children per 1000 live births, and the main reasons are fetal macrosomia or shoulder dystocia (Grodner *et al.,* 2012). Due to the level of injury, it can be classified into three types. Erb-Duchenne-type palsy, which is found most frequently (80% of cases) and affects the upper part of the plexus, i.e. C5-C6, where the abnormalities do not concern the hand itself, but parts of the forearm and the arm. The second type, i.e. Dejerine-Klumpke paralysis, concerns only 2–3% of children and affects the lower parts of the plexus (C7-Th1). The disorders mainly affect the hand and the lower part of the forearm (Mielcarska *et al.,* 2009). The last type of injury, i.e. Erb-Duchenne-Klumpke palsy, is the most severe injury and affects all levels of the plexus, in which case it is usually necessary to have an immediate surgical intervention. The basic tool evaluating the hand function in this ailment is the AHA test (Assisting Hand Assessment) (Paczkowska *et al.,* 2015).

Disorders of the upper limb functions also affect children with cerebral palsy (CP), which is manifested through motor disorders resulting from damage to the central nervous system. These changes occur during the fetal, perinatal or postnatal period and are characterized, for instance, by disorders of muscle tone, dysesthesia, perception and body posture disorders (Gajewska *et al.,* 2006). They are often accompanied by delayed motor development as regards gross and fine motor skills, secondary musculoskeletal problems or epilepsy. In Ingram's classification, there are 5 types of CP: bilateral spastic paralysis (diplegiaspastica), spastic hemiplegia (hemiplegia spastica), bilateral hemiplegia (hemiplegia bilateralis), extrapyramidal form of CP (dyskinesia, athetosis) and its cerebellar form (Mihlewicz, 1998). The MACS (Manual Ability Classification System) and MiniMACS (Mini-Manual Ability Classification System) are used to assess the degree of the impairment of fine motor skills (Eliasson *et al.,* 2005).

Another group of patients suffering from fine motor disorders are children with spinal muscular atrophy (SMA), a genetic disorder characterized by a disorder associated with the degeneration of anterior motor horn cells in the spinal cord. It is manifested by a significant deterioration of muscle strength, mainly intensified within the proximal parts of the limbs. These changes increase dynamically and may occur at various stages of development: from the prenatal period to infancy (type II) and early childhood (type III) (Kroczka *et al.,* 2009). These children manifest areflexia as regards tendon reflexes, rhythmic tremors of fingers and toes, tongue fasciculations, and in the further course of the disease there are disorders of the respiratory or digestive system. Due to the visible deterioration of the upper limb function, the RULM (Revised Upper Limb Module) scale is used to assess the progression of changes (Mazzone *et al.,* 2017).

Aim of the study

An analysis of the possibilities of assessing fine motor skills in children with various diseases.

Table 1. Upper limb function in RULM (i.e., order of difficulty, easiest to most difficult).

Item N.	Function
2	Hands lap to table
5	Pick up tockens
1	Entry item
3	Path
19	Lift 200 g
17	Cup to mouth
6	Token in cup
21	Lift 200 g diagonally
9	Reach to side
20	Lift 500 g
22	Lift weight from lap
13	Tear paper
24	Shoulder abduction
11	Push on light
27	Shoulder flexion
14	Open ziploc
25	Shoulder abduction 500 g
28	Shoulder flexion 500 g
26	Shoulder abduction 1 kg
29	Shoulder flexion 1 kg

Material and methods

The research was based on the analysis of the available literature on the development scales for the assessment of fine motor skills taking into account various diseases.

In order to provide information on the functional status of the limb before the therapy, it is necessary to use reliable diagnostic tools adapted to a given disease during the rehabilitation or after its completion. Their regular use helps to assess the effectiveness of therapeutic work while providing information on the development of change dynamics for specific illnesses (Gajewska *et al.,* 2006).

Over the past few years, more and more attention has been paid to analyzing the results of treatment in patients with spinal muscular atrophy (SMA). The developed scales are designed for patients depending on the type of SMA, (Finkel *et al.,* 2015). The first scale, Hammersmith Functional Motor Scale (HFMS), was developed in 2003 as a clinical and research tool for patients with SMA II and III to assess gross motor skills (Main *et al.,* 2003). Patients with SMA II are children who have never achieved the function of independent walking, who are able to sit independently and who are diagnosed between 6 and 18 months of age, while those with SMA III are individuals who walk or used to walk independently and were diagnosed after the age of 18 months. The next scale used for patients with SMA II and III is Motor Function Measure Training (MFM) also applied in the assessment of gross motor skills (Berard *et al.,* 2005), while the Children's Hospital of the Philadelphia Infant Test of Neuromuscular Disorders – CHOP INTEND is a scale for patients struggling with type I SMA, i.e. children who were diagnosed before the age of 6 months and had never been able to sit independently. It is a scale whose elements assess fine motor skills in the weakest patients with spinal muscular atrophy (Glanzman *et al.,* 2010).

Due to the fact that disorders of fine motor skills are observed in patients with SMA and that there is a need to analyze changes over time on the basis of long-term research and observations, a separate scale has been developed for their

assessment. The assessment with the use of the validated RULM (Revised Upper Limb Module) scale can be performed in "stronger" children, i.e. with SMA II and III (over 3 years of age) and adults. In order to analyze fine motor skills using this scale, you need the right equipment (weights, a pencil, a sheet of paper, a mat, tokens, touch light switch, etc.). Patients can sit on a suitably adjusted chair or a wheelchair without armrests, at an adjustable table top allowing height adjustment to individual needs. All components of the test should be performed in the given order. It is most preferable if the subsequent test is performed by the same person at the same time of the day and under the same conditions. It is important to check whether the patient is right or left-handed; the patient should be properly dressed so as to be able to freely perform all possible movements of the upper limb. In the assessment of individual components three points can be given (0–2), with the exception of the preliminary test (A) where you can receive a maximum of 6 points and the "Open ziploc" test assessed as: not able to open the container-0, able to open the container-1 (Table 1.) (Mazzone *et al.,* 2017).

The Assisting Hand Assessment - AHA is one of the basic tools for assessing the degree of hand disability in a measurable and reliable way, it is intended for children from 18 months to 12 years of age suffering from unilateral upper limb dysfunction. In particular, this includes children with perinatal brachial palsy palsy or hemiparesis in patients with cerebral palsy. The age of the child is irrelevant to the test result (Grodner *et al.,* 2012).

The concept of the AHA test is based on the belief in the diversity of upper limb roles. Each of the limbs has a different function: the dominant hand - manipulative and dexterity functions performed at a fast pace, while the non-dominant hand - supporting and stabilizing functions. In the case when limb disability results in greater limitation of the number of functions (than in the case of the non-dominant hand), but retains the supporting and holding function, it is referred to as the assisting hand according to the concept of AHA. This test thus clearly defines the role of the hand, which has a significant impact on the choice of therapeutic methods and the purpose of the therapy (Paczkowska *et al.,* 2015).

To perform the AHA test, which is carried out in the form of a play, a set of games and toys placed in one suitcase is necessary. This test is called semi-structural, i.e. the material used for the play is imposed in advance, but what the child does with it depends only on the child's will. The subject performs tasks in the form of play requiring ambidexterity for about 10–15 minutes. Making a child feel the sense of failure or frustration is avoided, therefore the words "good" or "bad" are not used. It is important for the patient to feel safe (Kraumlinde-Sundholm *et al.,* 2007).

The test consists of 22 items divided into categories such as: general use, use of arms, gripping and releasing, precise movements, coordination and speed. For each item, the child is awarded from 1 to 4 points, where 4 is the effective task performance, 3 – almost effective, 2 – not effective, 1 – no motion (Kraumlinde-Sundholm *et al.,* 2007). The child performs the tasks spontaneously, having fun which in the end does not lead to fatigue and dissatisfaction. The AHA test provides not only an objective diagnostic test, but also a tool useful in therapeutic treatment focused on the effectiveness of everyday activities (Paczkowska *et al.,* 2007).

The Manual Ability Classification System - MACS is used to determine how a disabled child uses its hands with objects while performing daily activities. This scale is aimed at patients suffering from cerebral palsy and classifies the child's disability range to an appropriate level in a reliable way. It is intended for children from 4 to 18 years of age. MACS is based on independent manual activities, assessing the ability to handle these activities without differentiation with respect to each hand. A child is classified into one of the levels based on the child's daily skills, so it is necessary to work with a parent or a guardian in order to make a proper assessment (Gajewska *et al.,* 2006).

The scale consists of five levels, where level I applies to children who use objects in an easy and effective way, and level V means lack of skills

to handle objects during even simple activities. Levels II, III and IV take into account the speed, quality and the degree of effort in performing additionally defines differences between the levels (Table 2) (Gajewska *et al.,* 2006).

Table 2. Comparison of Manual Ability Classification System (MACS) and Mini-MACS contents.

	MACS	Mini-MACS
I	Handles objects easily and successfully. At most, limitations in the ease of performing manual tasks requiring speed and accuracy. However, any limitations in manual abilities do not restrict independence in daily activities.	Handles objects easily and successfully. The child may have a slight limitation in performing actions that require precision and coordination between the hands, but they can still perform them. The child may need somewhat more adult assistance when handling objects compared with other children of the same age.
II	Handles most objects but with somewhat reduced quality and/or speed of achievement. Certain activities may be avoided or be achieved with some difficulty; alternative ways of performance might be used but manual abilities do not usually restrict independence in daily activities.	Handles most objects, but with somewhat reduced quality and/or speed of achievement. Some actions can only be performed and accomplished with some difficulty and after practice. The child may try an alternative approach, such as using only one hand. The child needs adult assistance to handle objects more frequently compared with children of the same age.
III	Handles objects with difficulty; needs help to prepare and/or modify activities. The performance is slow and achieved with limited success regarding quality and quantity. Activities are performed independently if they have been set up or adapted.	Handles objects with difficulty. Performance is slow and with limited variation and quality. Easily managed objects are handled independently for short periods. The child often needs adult help and support to handle objects.
IV	Handles a limited selection of easily managed objects in adapted situations. Performs parts of activities with effort and with limited success. Requires continuous support and assistance and/or adapted equipment, for even partial achievement of the activity.	Handles a limited selection of easily managed objects in simple actions. The actions are performed slowly, with exertion, and/or with random precision. The child needs constant adult help and support to handle objects.
V	Does not handle objects and has severely limited ability to perform even simple actions. Requires total assistance.	Does not handle objects and has severely limited ability to perform even simple actions. At best, the child can push, touch, press, or hold on to a few items while in constant interaction with an adult.

the activities. They also focus on the use of alternative ways of handling objects. The scale also takes into account the precise differences between the levels in order to facilitate correct qualifications (Eliasson *et al.,* 2005).

For younger children, whose possible diagnosis suggests cerebral palsy, scales adapted to their developmental skills have been created. Mini Manual Ability Classification System (Mini-MACS) is intended for children from 1 to 4 years of age and just like MACS focuses on the use of objects by the child during everyday activities. Its levels are analogous, but due to lower developmental skills, there are some differences, including, for instance, parents' help while performing a given activity or comparing children to their peers. As in the case of MACS, this scale

Discussion

When analyzing the functional development of children with various diseases, an increasing number of authors present a separate assessment of gross and fine motor skills in their research. The proper development of fine motor skills is extremely important in achieving milestones of global motor and social development as regards the grip with the whole hand at first, followed by the forceps or pincers grip. It is important that the assessment scales should be validated as a good but still subjective tool used by doctors, physiotherapists, nurses and other specialists for the assessment of changes. It is important that it should is aimed at a given disease, taking into account the child's age and the specificity of disorders and functional abilities.

Conclusions

1. The use of fine motor skills development scales taking into account a disease has become indispensable for the assessment of functional changes.
2. The applied scales should be validated, easy to use, adjusted to the specificity of a given disease.

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