The Modified Ashworth Scale

Instrument for the Evaluation of Spasticity

Test Protocol

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Foreword

This project was carried out as part of a professional assignment in order to complete a Bachelor's degree in physiotherapy, at the European School of Physiotherapy at the Hogeschool van Amsterdam.

There are many people who assisted us to accomplish our goals by providing us with their help and expertise in different aspects of this project. We would like to use this opportunity to thank them all.

Ruud Wong Chung, our client, for his friendly attitude, for sharing his knowledge and for his guidance throughout the whole project.

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Olaf Verschuren, rehabilitation center “De Hoogstraat” in Utrecht, who shared his experience with us.

To all the physiotherapists, who invited us to practice in their clinics and shared their knowledge and practical skills with us:
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- The physiotherapy team at the rehabilitation center "Heliomare": Els Tempelaars, Petra Buiting, Inge Schoolderman, Liesbeth Bosma and Marie-Louise Kamp
- The physiotherapy team at the rehabilitation center Amsterdam (RCA)
- The physiotherapy team at the rehabilitation center "De Trappenberg"

To the children who participated in the instruction video and their parents:
- Cindy, Steven, Frank and Dali

To all the friends who helped in creating the instruction video:
- Nati, Ronim, Maya and Hila

To all the people, who helped with the Dutch translations:
- Dineke Hardebol, Sander Steenuizen and Amets Sanchez Munain

To Sander Steenuizen and Mark Nugent who gave us their voice.
INTRODUCTION

The original Ashworth Scale (Ashworth 1964 cited Pandyan et al 1987) was first developed by Ashworth as a 5-point scale for evaluating and grading spasticity, with the purpose of creating a simple clinical tool to test the efficiency of an anti-spastic drug in patients with multiple sclerosis. The scale was later modified to a 6-point scale by Bohannon and Smith (1987) with the aim of increasing its sensitivity of grades at the lower end of the scale (table 1).

Table 1: The Modified Ashworth Scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No increase in muscle tone</td>
</tr>
<tr>
<td>1</td>
<td>Slight increase in muscle tone, manifested by a catch and release OR by minimal resistance at the end of the ROM when the affected part(s) is moved in flexion or in extension</td>
</tr>
<tr>
<td>1+</td>
<td>Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the reminder (less than half) of the ROM</td>
</tr>
<tr>
<td>2</td>
<td>More marked increase in muscle tone throughout most of the ROM, but affected part(s) easily moved</td>
</tr>
<tr>
<td>3</td>
<td>Considerable increase in muscle tone, passive movement is difficult</td>
</tr>
<tr>
<td>4</td>
<td>Affected part(s) rigid in flexion or extension</td>
</tr>
</tbody>
</table>

The authors of the following protocol carried out a review of 17 scientific articles, which are concerned with the validity and reliability of the Modified Ashworth Scale (MAS) and its applicability to children with Cerebral Palsy (Bauch and Steinberg, 2005). The results of the review show that both aspects, validity and reliability, are questionable. In relation to validity, the scale may not be an exclusive measure of spasticity as it does not distinguish between different aspects of muscle tone; Grades 1 and 1+ include a catch which is a typical component of spasticity, whereas grades 2 and 3 use descriptions of the extent of muscle tone that gradually increases until grade 4 is characterized as rigid. These grades (2, 3, 4) do not define spasticity alone, but could also include other mechanisms that result in hypertonia such as viscous-elastic components.

The reliability of the MAS is controversially discussed throughout literature with results ranking from “little if any” to “very high”.

The authors believe that the reliability of the MAS is partly affected by the lack of standardization of the test. A standardized test will increase the reliability simply for the fact that the practical use will become comparable and uniform and the results could be comparable. It would also provide the first step in testing its validity in order to convey a united message of being or not being a valid measurement tool. For this reason the following test protocol was created and is accompanied by an instruction video.

In order to create the protocol the authors scanned through relevant literature (amongst others: Nuyens et al 1994, Pandyan et al 1999, Verschuren et al 2003), carried out
the review, met with several Pediatric physiotherapists who specialized in working with children with Cerebral Palsy. One of the Physiotherapists was Mr.O. Verschuren (O.Verschuren, personal communication, November 16, 2004) who recently conducted a research related to this topic with the intention of standardising the test procedure (Verschuren et al 2003).

The main conclusions drawn from the investigations are:

- All tests should be performed in the supine position except the Rectus femoris muscle that should be tested in the prone position, as children can become easily distracted and active moving might increase the muscle tone.
- The head of the child should be placed in the mid-position to avoid the affects of the ATNR and the STNR.
- The passive movement should be performed within one second given the fact that spasticity is characterized by a velocity dependent increase in muscle tone.
- Repeated movements must be kept to a minimum, since spasticity will decrease with repeated cycles of stretching.
- If the angle of the starting position cannot be reached, it has to be measured and recorded in the assessment form (appendix 2).
- Pain during passive movement should be recorded, since pain as well as other emotions could increase spasticity, and in order to distinguish between spasticity and protective resistance.

The original Modified Ashworth Scale, which is presented above, differs from the scale used in this test protocol due to the following reasons:

In the description of grades 1 and 4, Bohannon and Smith (1987) state that the affected part is moved in flexion or extension. This excludes other relevant movements such as abduction. Consequently, the authors decided to remove this part off the scale.

Grade 2 implies that although the movement is characterized with marked increase in muscle tone, the limb moves easily. The last part was removed from the scale in order to eliminate any space for subjective interpretations of the term “easily”.

In addition, the authors found throughout the interviews with physiotherapists, that the description of grade 4 is interpreted differently among people. Some therapists consider the word “rigid” as equal to the medical term “rigidity” while others consider rigid as “not bending”, “inflexible” or “unchanged into a different shape or position”. The authors suggest using the second interpretation due to the fact that “rigidity” would completely exclude the spastic component from this grade.

To conclude, this protocol aims to provide the examiner with firm guidelines for the use of the MAS. However, the authors strongly advise not to use the MAS exclusively when evaluating spasticity, due to the fact that it may not be an acceptable tool to quantify spasticity, but a tool to measure the resistance to passive movement. It is recommended that the MAS will be combined in every examination with the Tardieu scale (Tardieu et al 1954 cited Boyd and Graham 1999), which assess the dynamic component of the muscle length. For further reading regarding the MAS, the authors refer to the review (Bauch and Steinberg, 2005).
The Modified Ashworth Scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No increase in muscle tone</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Slight increase in muscle tone, manifested by a catch and release OR by minimal resistance at the end of the ROM</td>
<td><img src="image1.png" alt="Catch and release" /> <img src="image2.png" alt="Min resistance" /></td>
</tr>
<tr>
<td>1+</td>
<td>Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the reminder (less than half) of the ROM</td>
<td><img src="image3.png" alt="Catch" /> <img src="image4.png" alt="Mid ROM" /></td>
</tr>
<tr>
<td>2</td>
<td>More marked increase in muscle tone throughout most of the ROM</td>
<td><img src="image5.png" alt="Mid ROM" /> <img src="image6.png" alt="R" /></td>
</tr>
<tr>
<td>3</td>
<td>Considerable increase in muscle tone, passive movement is difficult</td>
<td><img src="image7.png" alt="R" /></td>
</tr>
<tr>
<td>4</td>
<td>Affected part(s) rigid</td>
<td><img src="image8.png" alt="No Movement" /></td>
</tr>
</tbody>
</table>

1 The illustration is an example of grade interpretation presented on the elbow flexors.
2 The catch may appear at any angle of the ROM.
GENERAL INSTRUCTIONS

1. During the examination of a newborn or an infant make sure that the child is in a normal state of alertness, according to Prechtl state 4 (appendix I).

2. If the supine position brings the child to a position of increased lordosis, place a pillow under the head.

3. Make sure that the limb you are about to move is relaxed as much as possible.

4. It is preferred to perform all movements in lying (supine/prone) position.
   
   Remark:
   If the child’s situation is not enabling you to perform the movements in supine or prone, try side lying or sitting.

5. Make sure the head is in mid-position.

6. Perform the movement quickly over a period of one second.

7. Perform the movement once.
   
   Remark:
   With younger children it might be difficult to have the limb totally relaxed and as a consequence, more than one movement might be needed to determine a grade. In these cases try not to perform the movement too many times and keep in mind that repeated movements are decreasing the initial amount of spasticity.

8. Determine a grade using the MAS – scale.
   
   Remark:
   Regarding grade 1+, remember that “half of the ROM” refers to the actual range that is available for the specific patient and not to a normal ROM.

9. Indicate the following in the assessment form (appendix II):
   - Grades of each muscle (right and left).
   - Starting angle of the joint, if different from the stated in the protocol.
   - Pain if exists.
   - Remarks:
     In this section state any deviation from the instructions listed above, such as:
     - Positioning of the child.
     - Position of the head.
     - Any emotions that could increase spasticity.
TEST PROTOCOL

Hip Flexors

Starting position of the child:
 Lying supine at the edge of the treatment table.
 Both legs are brought in flexion to the chest.

Examiner’s handling:
 Place both hands on the child’s knees.
 Move the tested leg passively into maximum extension within 1 second.
 Determine the grade by detecting if any increase in the muscle tone took place.

Hamstrings

Starting position of the child:
 Lying supine on the treatment table.
 The tested leg is in 90° hip flexion and the knee is in maximum flexion.

Examiner’s handling:
 Place the stabilizing hand proximal to the knee joint.
 Place the moving hand proximal to the ankle joint around the dorsal aspect.
 Move the leg passively into maximum knee extension within 1 second.
 Determine the grade by detecting if any increase in the muscle tone took place.
**Hip Adductors**

Starting position of the child:
- Lying supine on the treatment table.
- Both legs are lying straight.

Examiner's handling:
- Place both hands proximal to the ankle joint.
- Move one or both legs passively into maximum abduction within 1 second.
- Determine the grade by detecting if any increase in the muscle tone took place.

**M. Gastrocnemius**

Starting position of the child:
- Lying supine on the treatment table with the ankles over the edge.

Examiner’s handling:
- Stabilize the knee in maximum extension.
  - It is recommended to place the stabilizing hand distally to the knee joint.
- Place the moving hand on the plantar aspect of the foot cupping the calcaneus.
- Move the foot passively into maximum dorsal flexion within 1 second.
- Determine the grade by detecting if any increase in the muscle tone took place.

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1 The examiner should determine by himself whether he prefers to move one or both legs at the same time.
M. Biceps Brachii

Starting position of the child:
- Lying supine on the treatment table.
- The elbow is in maximum flexion.
- The wrist is in midway position between supination and pronation.

Examiner’s handling:
- Place the stabilizing hand proximal to the elbow joint around the dorsal aspect of the upper arm.
- Move the arm passively into maximum elbow extension within 1 second.
- Determine the grade by detecting if any increase in the muscle tone took place.

Wrist Flexors

Starting position of the child:
- Lying supine on the treatment table.
- The tested arm is lying by the side of the body with the elbow flexed 90° and the wrist is in maximum palmar flexion.

Examiner’s handling:
- Place the stabilizing hand proximal to the wrist joint.
- Place the moving hand on the palmar aspect of the hand proximal to the MCP joint.
- Move the hand passively from maximum palmar flexion to maximum possible dorsal flexion, within 1 second.
- Determine the grade by detecting if any increase of the muscle tone took place.
**M. Rectus Femoris**

Starting position of the child:
- Lying prone on the treatment table.
- Both legs are in maximum knee extension.

Examiner’s handling:
- Place the stabilizing hand on the homolateral ilium.
- Place the moving hand proximal to the ankle joint of the tested leg.
- Move the leg passively into maximum knee flexion within 1 second.
- Determine the grade by detecting if any increase in the muscle tone took place.
REFERENCES


The Modified Ashworth Scale: instrument for the evaluation of spasticity, Instruction video for paediatric physiotherapy, 2005. Video. Netherlands: European School of Physiotherapy\Hogeschool van Amsterdam.

**PRECHTL SCALE (1974)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
</table>
| 1 | Deep sleep  
    No movement  
    Regular breathing |
| 2 | Light sleep  
    Some movement  
    Eyes closed |
| 3 | Dozing  
    Eyes open and shut |
| 4 | Awake  
    Eyes open  
    Minimal movement |
| 5 | Very awake  
    Strong movements |
| 6 | Crying |
# ASSESSMENT FORM

Name of patient: __________________________

Date of examination: ________________________

Date of birth: __________________________

Name of examiner: __________________________

Diagnosis: __________________________

<table>
<thead>
<tr>
<th></th>
<th>Right</th>
<th>Left</th>
<th>Starting angle of the joint</th>
<th>Pain</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Flexors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hamstrings</td>
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<tr>
<td>M. Biceps Brachii</td>
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</tr>
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<td>M. Rectus Femoris</td>
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