

Charalambos P. Charalambous

105.1 Author

Bohannon RW, Smith MB.

105.2 Reference

Phys Ther. 1987;67:206–207

105.3 Institution

Department of Physical Therapy, Southeastern Regional Rehabilitation Center, Cape Fear Valley Medical Center, Fayetteville, NC

105.4 Abstract

The authors undertook this investigation to determine the inter-rater reliability of manual tests of elbow flexor muscle spasticity graded on a modified Ashworth scale. They each independently graded the elbow flexor muscle spasticity of 30 patients with intracranial lesions.

The authors agreed on 86.7 % of their ratings. The Kendall's tau correlation between their grades was .847 ($p < .001$).

Thus, the relationship between the raters' judgments was significant and the reliability was good. Although the results were limited to the elbow flexor muscle group, the authors considered them to be positive enough to encourage further trials of the modified Ashworth scale for grading spasticity.

C.P. Charalambous, BSc, MBChB, MSc, MD, FRCS (Tr&Orth)
Department of Trauma and Orthopaedics,
Victoria Hospital, Blackpool, UK
e-mail: bcharalambos@hotmail.com

105.5 Summary

Abnormal muscle tone is a common motor disorder following neurological injury that may require rehabilitation. The modified Ashworth scale is a 6-point rating scale that is used to measure muscle tone. The inter-rater and intra-rater reliability of measurements obtained with the scale remain equivocal.

Both Ashworth and the modified Ashworth scale ask the examiner to move a limb through its full range of movement and rate the amount of resistance felt according to descriptions (Table 105.1).

Bohannon and Smith observed that many of their patients with hemiplegia demonstrated levels of spasticity defined by the grades at the lower end of the Ashworth scale and that the Ashworth grade of "1" was indiscrete.

To render the scale more discrete, they added the grade "1+" and slightly modified the definitions (Table 105.2).

It was believed that these modifications would result in a scale that conforms even more precisely than the Ashworth scale to the guidelines of Mackenzie and Charlson.

The purpose of this study was to determine the inter-rater reliability of a manual test of elbow flexor muscle group spasticity using the modified Ashworth scale. The author's expectations were that two clinicians, who regularly use the test, could measure spasticity reliably using the modified scale.

Thirty patients were involved in the study. All patients had lesions involving the central nervous system. Each patient was tested first by one of the authors and then by the other author.

Table 105.1 Original Ashworth scale for grading spasticity

Grade	Description
0	No increase in muscle tone
1	Slight increase in muscle tone giving a catch when the limb is moved
2	More marked increase in muscle tone, but limb easily moved
3	Considerable increase in tone, passive movement difficult
4	Limb rigid in flexion or extension (abduction/adduction)

Table 105.2 Modified Ashworth scale for grading spasticity

Grade	Description
0	No increase in muscle tone
1	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension
1+	Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM
2	More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
3	Considerable increase in muscle tone, passive movement difficult
4	Affected part(s) rigid in flexion or extension

The patient's elbow is extended from a position of maximal possible flexion to maximal possible extension over a duration of about 1 s while the forearm is grasped distally (just proximal to the wrist). While the elbow was extended, the arm also is stabilized proximal to the elbow. The forearm should be in neutral supination. Each author independently performed five to eight such sequential extensions. A period of several minutes separated each rater's "blind" rating. Each rater graded each patient's spasticity using the modified Ashworth scale

105.6 Citation Count

1,542

105.7 Related References

1. Pandyan AD, Johnson GR, Price CI, Curless RH, Barnes MP, Rodgers H. A review of the properties and limitations of the Ashworth and modified Ashworth scales as measures of spasticity. *Clin Rehabil.* 1999; 13(5):373–83
2. Blackburn M, van Vliet P, Mockett SP. Reliability of measurements obtained with the modified Ashworth scale in the lower extremities of people with stroke. *Phys Ther.* 2002;82(1):25–34
3. Haas A, Bergström E, Jamous A, Bennie A. The inter rater reliability of the original and of the modified Ashworth scale for the assessment of spasticity in patients with spinal cord injury. *Spinal Cord.* 1996;1–5. Nature Publishing Group.

105.8 Key Message

Measurement of spasticity is a difficult problem partly due to its complexity and the fact that there are many factors involved. The modified Ashworth scale measures spasticity and is applied manually to determine the resistance of muscles to passive stretching.

Bohannon and Smith modified the Ashworth scale by adding an additional grading and slightly changing the definitions. They reported high inter-rater reliability between two experienced examiners using it to measure spasticity in the elbow flexor muscle group.

105.9 Why It Is Important

Reliable and valid spasticity assessment is essential for clinical and research purposes, and clinicians believe the measurement of spasticity to be important.

Clinical assessment of muscle spasticity is important in order to accurately evaluate the effectiveness of the therapeutic interventions used in the management of muscle spasticity, to guide treatment decisions, and to measure progress in patients with spasticity [1].

Also therapist use muscle tone to categorize patients and plan treatment programmes and goals.

Of the clinical rating scales available the most frequently cited in the literature is the Modified Ashworth scale (MAS), contributing to the high index score.

This article emphasises the importance of evaluating inter-rater reliability of clinical tests. It also stresses the importance of evaluating modifications to originally described assessment systems.

105.10 Strengths

The modified Ashworth scale is easily and commonly used for assessing spasticity in a clinical setting. No equipment is needed

In this study Bohannon and Smith established the inter-rater reliability when using the MAS to assess spasticity in elbow flexors

105.11 Weaknesses

Although the Ashworth scale measures resistance to passive movement this does not necessarily equate with spasticity.

The modified Ashworth scale has proved less reliable in the muscle groups of the legs

In the study conducted by Bohannon and Smith the modified Ashworth scale lacked well defined exclusion criteria and excluded patients with known cognitive impairment and known spasticity.

Blackburn et al. found poor inter-rater reliability in the lower limbs of patients with strokes. This poor agreement especially on grade 1, 1+ and 2 has been found in a number of other studies. For this reason Hass warned that the scales should only be used with extreme caution [2].

In a review by Pandyan et al. [3], it was noted that much of the reduction of reliability of measurements obtained with the MAS appears to center on the disagreements at the lower end of the scale (i.e. between the grades of 1 and 1+). Pandyan et al. suggested that the lower reliability observed when using the MAS, compared with using the Ashcroft scale, could be attributed to the extra level of classification, which increased the probability of error.

Several studies report low reliability of the MAS in children with cerebral palsy [4–7]. Poor inter-rater reliability of the MAS raises the question as to whether this tool should be used by different raters to measure the same participants.

The MAS is an ordinal scale and such may lack precision and sensitivity for measuring and detecting smaller degrees of, or changes in spasticity.

105.12 Relevance

Lance defined spasticity as “a velocity-dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, resulting from the hyper-excitability of the stretch reflex, as one component of the UMN syndrome [8]”. It occurs in disorders of the central nervous system such as stroke, spinal cord injury, multiple sclerosis and traumatic head injury. Impaired function may be a combination of spasticity and weakness in the same or antagonist muscle groups [1].

The Ashworth Scale is a 5 point rating scale for measuring muscle tone with ratings from 0 (no increase in tone) to 4 (limb rigid in flexion and extension) [9]. It was suggested that the Ashworth scale grade 0 could cover patients with “low tone” as well as “normal” muscle tone [2]

This scale had initially developed as a simple clinical tool to test the efficacy of an anti-spastic drug in patients with multiple sclerosis. Bohannon and Smith in earlier investigations of the reliability of measurements obtained using the

Ashworth scale, found a clustering of scores at its lower end. In order to increase the sensitivity of the scale, they added an extra item to the lower end (grade 1+)

Later Bohannon and Smith modified the original scale by adding an additional category, a 1+ falling between 1 and 2, with the aim of increasing its sensitivity.

When Bohannon and Smith tested the MAS for reliability on elbow flexion muscle tone on 30 patients with intracranial lesions they found that 2 raters agreed on 86.7 % of the ratings

Although biochemical and electrophysiological methods are available to quantify the level of spasticity these are difficult to perform in routine clinical practice [10].

References

1. Naghdi S, Nakhostin Ansari N, Azarnia S, Kazemnejad A. Interrater reliability of the Modified Modified Ashworth Scale (MMAS) for patients with wrist flexor muscle spasticity. *Physiother Theory Pract.* 2008;24(5):372–9.
2. Haas A, Bergström E, Jamous A, Bennie A. The inter rater reliability of the original and of the modified Ashworth scale for the assessment of spasticity in patients with spinal cord injury. *Spinal Cord.* 1996;1:1–5. Nature Publishing Group.
3. Pandyan AD, Johnson GR, Price CI, Curless RH, Barnes MP, Rodgers H. A review of the properties and limitations of the Ashworth and modified Ashworth scales as measures of spasticity. *Clin Rehabil.* 1999;13(5):373–83.
4. Fosang AL, Galea MP, McCoy AT, Reddihough DS, Story I. Measures of muscle and joint performance in the lower limb of children with cerebral palsy. *Dev Med Child Neurol.* 2003;45(10):664–70.
5. Clopton N, Dutton J, Featherston T, Grigsby A, Mobley J, Melvin J. Interrater and intrarater reliability of the modified Ashworth scale in children with hypertononia. *Pediatr Phys Ther.* 2005;17(4):268–74.
6. Mutlu A, Livanelioglu A, Gunel M. Reliability of Ashworth and modified Ashworth scales in children with spastic cerebral palsy. *BMC Musculoskelet Disord.* 2008;9(1):44.
7. Damiano DL, Quinlivan JM, Owen BF, Payne P, Nelson KC, Abel MF. What does the Ashworth scale really measure and are instrumented measures more valid and precise? *Dev Med Child Neurol.* 2002;44(2):112–8.
8. Lance JW. The control of muscle tone, reflexes, and movement Robert Wartenbeg Lecture. *Neurology.* 1980;30(12):1303–13.
9. Blackburn M, van Vliet P, Mockett SP. Reliability of measurements obtained with the modified Ashworth scale in the lower extremities of people with stroke. *Phys Ther.* 2002;82(1):25–34.
10. Sloan RL, Sinclair E, Thompson J, Taylor S, Pentland B. Inter-rater reliability of the modified Ashworth scale for spasticity in hemiplegic patients. *Int J Rehabil Res.* 1992;15(2):158–61.