**Original Article**

# Evaluation of spasticity using the Ashworth Scale with Intermediate Scores (ASIS)

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**Aim:** The main purpose of this research was to study and contribute to an accurate test of spastic limb. The intra, inter rater reliability of the test was examined.

**Method:** The present study was carried out in two parts; In the first part of the study, the modified Ashworth Scale with Intermediate Scores (ASIS) was studied. During the second part of the study the intra, inter rater reliability of the ASIS were evaluated. Twenty cerebral palsy individuals who had spasticity on their knee flexors , eleven males and nine females, recruited in the study, their mean age was 25.4 (range from 18 to 35 years of age). The limbs were tested according to the ASIS. The same subjects were measured twice during a week period by each tester.

**Results:** According to the first part of the study intermediate scores were added to the modified Ashworth scale. In the second part of the study inter operators and intra operators' reliability of the ASIS were analyzed. Pearson's correlations coefficient were 0.78 and 0.89 for intra rater reliability and 0.46 and 0.53 for inter rater reliability.

**Conclusion:** It appears that the Modified Ashworth Scale would be more sensitive if an intermediate score was added to each score (2-4). It was concluded that the intra rater reliability of ASIS measurements was high and the inter rater reliability of ASIS measurements was low.

**Key words:** evaluation of spasticity, spastic limb, Ashworth scale, outcome measures.

**Introduction**

Many investigators have studied and developed different methods of assessment of spasticity and spastic limbs (1, 2, and 3).

Ashworth (4) employed a scale for the grading of spasticity in the evaluation of MS patients. The grading was from 0 (no increase in tone) to 4 (limb rigid in flexion and extension).

Bohannon and Smith added an additional grading to the Ashworth scale and evaluated inter-rater reliability of the spasticity scores on the elbow flexors and reported high reliability between two testers (5).

The reliability of Ashworth scale was evaluated by a number of investigators and they reported a variety results:

A number of investigators found it is a reliable scale, specially on the elbow(5,6). Nuyens and colleages studied the Ashworth scale and reported that interrater reliability is varies in different muscle

groups, but intra rater reliability is good for all of the muscle groups (7). In a study Benz and co-workers compared the Ashworth scale with an other method of assessment of spasticity (SCATS) on spinal cord subjects and reported the SCATS scores corrolated significantly with some of the Ashworth scores (8) . Zajicek and co-workers suggested that while Ashworth scale is the best available measure of spasticity, it may not be sensitive enough to identify small but clinically significant changes (9). Allison and colleages found the scale is less reliable (10).

Johnson proposed that the scale needed to be more accurate (1) and Pandyan and co-workers and Fleuren suggested that the modified Ashworth scale does not provide a valid measure of spasticity (11, 12). However, investigators widely used the scale for evaluation of spasticity, because it is an available and simple clinical measure of tone, (13, 14, 15).

Deglado and co-workers proposed a number of tools for assessment of spasticity including Tardieu scale

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and recommended that Tardieu scale is a proper tools for evaluation of spasticity (16). However, there is a shortage of literature investigating validity and reliability of the scale (17).

Some of investigators employed elctrodiagnosis technique for measurement of spasticity, but this technique can be used only for individual muscle or local measurements (18). Also an assessment method has been suggested for disabled people with spastic limbs (2). This method is used for sport and functional classification. The majority of the spasticity scales are based on assessment of resistance during passive movement, Rekand (19). But still there is a gap and a need for an accurate and reliable method.

The Ashworth scale with intermediate scores (ASIS) described in our study requires to be examined further in different movements for its sensibility and reliability for the measurement of spasticity.

The study was designed to contribute to an accurate and simple test of spastic limb. The intra, inter rater reliability of the test was examined.

## Method

The present study was carried out in two parts.

In the first part of the study, forty six cerebral palsy candidates with spastic limbs 26 males and 20 females participated in the study.

The spastic lower limbs were tested according to the modified Ashworth scale. In total 5 tests were used on each subject during a five-week period (one test each week). During the five weeks the subjects were under a rehabilitation programme.

The tests were carried out by the two experienced therapists. Each test was carried out once.

As far as possible all tests on each patients were carried out at the same time of the day and in the same place. It was asked the patients to empty their bladder befor each test and the same positions were used during all tests.

For testing, the patient was positioned comfortably in the supine position on a padded mat table while the leg was grasped distally and the thigh was stabilised proximal to the knee. The knee was extended passively and for measurement of spasticity the patient's knee was extended from a position of flexion to full extension over a duration of about one second.

During a treatment programme tests using tone scores (0-4), in some cases there was a gap between two grades during clinical testing (e.g. between 3 and 4). During the repeated tests in some patients it appeared that although an alteration of spasticity was felt during assessment using the modified Ashworth scale, this alteration was not actually equal to one score, in this case an intermediate score was used for analysis. For example when spasticity during pretest (week 1) was 4 and during post test (week 5) it appeared less than 4 but not exactly 3, the score was recorded as 3+.

At the end of the programme each (+) was recorded as 0.5 and in case of the above example the score for analysis would be 3.5.

The description of each score has been shown in Table 1. Attention was paid on deformity during tasks on each score.

**Table 1.** ASIS scores, based on Modified Ashworth Scale for grading spasticity (Wade DT, (1992), In: Measurement in Neurological Rehabilitation)

| Grade | Discription |
|---|---|
| 2.5 | affected part (s) easily moved, with minor deformity in the limb during task |
| 3+ | Considerable increase in muscle tone, passive movement difficult, with sever deformity in the limb during task |

### The second part of the study

During the second main part of the study the intra, inter rater reliability of the tests were examined.

Twenty cerebral palsy individuals who had spasticity on their knee flexors, eleven males and nine females were participated in the study. Their mean age was 25.4 (range from 18 to 35 years of age).

### The assessment tools

Each subject was examined by the two independent therapists. Both therapists had five years clinical experience. Each measurement was carried out once. The two therapists were blind to the results of each other's tests and also blind to their own first and second tests and there was no decision of results by therapists until the full list of all measurements were completed.

Each subject was individually assessed by the therapists. Therapists measured the subjects in random order at each session. Each test was recorded on a separate sheet of papers.

Each of the therapists collected two sets of measurements from the involved subjects. The measurements were carried out for the second time within a week of the first measurements in all persons. The therapists followed specific directions that defined according to the following procedures;

The tests' procedure was based on the first part of the study.

Following data collection, descriptive statistics were completed for the subjects and the two measurements. The inter-raters and intra-rater reliability were investigated. Correlation between the two measurements were calculated.

Analysis was used to determine differences of the ASIS scores carried out by the two therapists. Furthermore, Statistic calculations were performed using SPSS.

**Results**

The description of each score during the first part of the study has been shown in Table 2.

The total numbers of tests carried out during 5 weeks on 46 subjects were 230 tests and the number of intermediate scores recorded for subjects were 99. The intermediate scores were 43.04 % as a percent of the total tests, Table 2.

**Table 2.** This table shows the total tests number using ASIS during each week, the number of intermediate scores recorded for subjects, percent of intermediate scores respectively when compared with the total tests number during each week.

|  | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 |
|---|---|---|---|---|---|
| The number of tests | 46 | 46 | 46 | 46 | 46 |
| Intermediate | 16 (34.8%) | 18 (39.1%) | 26 (56.5%) | 25 (54.3%) | 14 Scores (30.4%) |

Using the analysis of data, estimates of inter-operators and intra-operator reliability were obtained

**Table 3.** The results of the two sets of measurements by the two operators

| No | Opa1 | Opa2 | Opb1 | Opb2 |
|---|---|---|---|---|
| 1 | 2.00 | 2.00 | 3.00 | 3.00 |
| 2 | 2.50 | 2.00 | 2.50 | 3.00 |
| 3 | 3.00 | 2.50 | 3.00 | 2.00 |
| 4 | 3.00 | 3.00 | 2.50 | 2.50 |
| 5 | 3.50 | 3.50 | 2.50 | 2.50 |
| 6 | 3.50 | 4.00 | 3.50 | 3.00 |
| 7 | 4.00 | 4.00 | 3.00 | 3.00 |
| 8 | 4.00 | 4.00 | 3.50 | 3.50 |
| 9 | 2.50 | 2.50 | 3.50 | 3.50 |
| 10 | 2.00 | 2.00 | 2.50 | 2.50 |
| 11 | 2.00 | 2.00 | 2.50 | 2.50 |
| 12 | 2.50 | 2.50 | 3.00 | 3.00 |
| 13 | 3.00 | 3.00 | 3.00 | 3.00 |
| 14 | 4.00 | 3.50 | 3.50 | 3.50 |
| 15 | 2.00 | 2.00 | 2.00 | 2.00 |
| 16 | 2.00 | 2.00 | 2.50 | 2.50 |
| 17 | 3.50 | 3.50 | 3.00 | 3.00 |
| 18 | 3.00 | 4.00 | 3.50 | 3.50 |
| 19 | 2.00 | 2.50 | 3.00 | 2.50 |
| 20 | 2.50 | 2.50 | 3.00 | 3.00 |

The Pearson's correlation coefficient of intra operators was high for the raters and Pearson's correlation coefficient of inter operators was moderate Table 4. The paired t-test of the two operators showed no significant differences over the two measurement repetitions (P<0.05) and the t-test of the two operators showed no significant differences between the operators as well (P<0.05).

**Table 4.** The Pearson's correlation coefficient of intra and inter operators

**Correlations**

|  |  | OPA1 | OPA2 | OPB1 | OPB2 |
|---|---|---|---|---|---|
| OPA1 | Pearson Correlation | 1.000 | .899** | .533* | .464* |
|  | Sig. (2-tailed) | . | .000 | .015 | .039 |
|  | N | 20 | 20 | 20 | 20 |
| OPA2 | Pearson Correlation | .899** | 1.000 | .621** | .519* |
|  | Sig. (2-tailed) | .000 | . | .003 | .019 |
|  | N | 20 | 20 | 20 | 20 |
| OPB1 | Pearson Correlation | .533* | .621** | 1.000 | .788** |
|  | Sig. (2-tailed) | .015 | .003 | . | .000 |
|  | N | 20 | 20 | 20 | 20 |
| OPB2 | Pearson Correlation | .464* | .519* | .788** | 1.000 |
|  | Sig. (2-tailed) | .039 | .019 | .000 | . |
|  | N | 20 | 20 | 20 | 20 |

**·** Correlation is significant at the 0.01 level (2-tailed).

*· Correlation is significant at the 0.05 level (2-tailed).

## Discussion

The intra rater reliability of ASIS measurements was found to be high with no significant differences between different test of each operator (P<0.05). The Pearson's correlation coefficient of inter raters was low.

The first part of the study provided the greater understanding of grading spasticity.

The classification is considered as follow and the immediate goals of this classification are accurate distinction of spasticity categorization.

It is noted that spasticity may affects muscle elasticity and muscle mechanical properties (20). It is important to observe how much of the deformity is appeared during the activity of the patient. In addition; the level of spasticity was effective in the level of deformity (2) and therefore severity of deformity was added to the classification.

The results of our study indicated that the Modified Ashworth Scale would be more sensitive if an intermediate score was added to each score (2-4). The present study included patients with a range of mobility and spasticity. It seems that this is a

potential strength for the study. The present study suggested that ASIS is more accurate if performed by a single tester. The scale could apply on fixed muscle shortening (contracture) with a caution because there is a loss of sarcomeres and increasing passive resistance on the involved muscles (1). Finally it is concluded that the ASIS is sufficient for practical work in patients with spasticity.

## Conclusion

It appears that the Modified Ashworth Scale would be more sensitive if an intermediate score was added to each score (2-4). It is concluded that the intra rater reliability of ASIS measurements was found to be high and the inter rater reliability of ASIS measurements was found to be moderate .

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