Hypertonia Assessment Tool (HAT)

USER MANUAL

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Authors: Fehlings, D., Switzer, L., Jethwa, A., Mink, J., Macarthur, C., Knights, S., & Fehlings, T.

We value your feedback!
Please address all correspondence &
commentary about the HAT to:
Dr. Darcy Fehlings
Bloorview Kids Rehab
150 Kilgour Road
Toronto, ON, Canada M4G1R8
dfehlings@bloorview.ca

TABLE OF CONTENTS

HYPERTONIA ASSESSMENT TOOL OVERVIEW

Hypertonia is defined as "abnormally increased resistance to externally imposed movement about a joint" [1]. Spasticity, dystonia, and rigidity are three subtypes of neurologically mediated hypertonia. Spasticity occurs when "resistance to externally imposed movement increases with increasing speed of stretch and varies with the direction of joint movement, and/or resistance to externally imposed movement rises rapidly above a threshold speed or joint angle" [1]. Dystonia is "a movement disorder in which involuntary sustained or intermittent muscle contractions cause twisting and repetitive movements, abnormal postures or both" [1]. Rigidity is velocity-independent bidirectional resistance to externally imposed movement [1].

While several scales existed to grade the severity of hypertonia in the paediatric population, there was no available measure that differentiated the different forms of hypertonia. This was the main objective for the development of the Hypertonia Assessment Tool (HAT). The HAT can be used in research to classify the hypertonia of the study participants, thereby improving the ability of researchers and clinicians to interpret the results of the study. Clinically, a discriminative measure will help clinicians to better manage the specific type(s) of hypertonia present to improve treatment outcomes. For example, spasticity responds to tizanidine, whereas dystonia improves with trihexyphenidyl.

The HAT is a seven item tool that has been developed for children/youth between the ages of 4 to 19 years, whereby an evaluator moves a child's arm or leg in a series of purposeful stretches and movements in order to observe movement, increased tone and/or resistance. The presence of at least one HAT item per hypertonia subgroup (spasticity, dystonia, rigidity) confirms the presence of the subtype and the presence of items from more than one subgroup identifies the presence of mixed tone. The HAT is capable of discriminating hypertonia subtypes for both the upper and lower extremities and takes approximately 5 minutes to conduct per limb assessed.

The following sections provide additional detail pertaining to the development of the HAT, the administration of items, and the scoring of the HAT [2].

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[1] Sanger TD, Delgado MR, Gaebler-Spira D et al. Classification and definition of disorders causing hypertonia in childhood. *Pediatrics*.2003;111(1):89-97.

[2] Jethwa A, Mink J, Macarthur C, Knights S, Fehlings T, Fehlings D. Development of the Hypertonia Assessment Tool (HAT): a discriminative tool for hypertonia in children. *Dev Med & Child Neurol* 2010;52(5) : e83-e87.

DEVELOPMENT OF THE HAT

The framework for the development of the HAT included the following components: item generation, item reduction, and reliability and validity assessment. These components will be briefly described below, with additional detail provided in the original reference[2].

1. Item Generation
   The purpose of item generation was to build a comprehensive list of items that discriminated between the three subgroups (spasticity, dystonia, and rigidity). A preliminary list of items was generated from a panel, small group sessions, and telephone interviews with paediatric hypertonia experts. After the item generation stage the HAT had fourteen items.

2. Item Reduction
   The goal of item reduction was to decrease the number of items to make it practical to administer and retain the discriminative ability of the HAT. A test of homogeneity of items was used to calculate the internal consistency of items within the three subgroups. Items were eliminated from the HAT, if the internal consistency of items in the subgroup increased to 0.7-0.9 when the item was removed.

   The initial spasticity items verified moderate internal consistency and one item was eliminated. The dystonia items demonstrated high internal consistency and no dystonia items were removed. The rigidity items could not be evaluated as at least three items are required for the calculation.

3. Evaluation of Reliability and Validity
   To evaluate *Individual Item Validation, Inter-Rater Reliability, Test-Retest Reliability* and *Criterion Validity*, 25 children with cerebral palsy (CP) were recruited and were independently examined by three physicians who administered either the HAT or a paediatric neurological examination to identify the type(s) of hypertonia present. After 2 weeks, the same children were re-examined using the HAT.

   Individual Item Validation: Each item on the HAT was assessed for its ability to agree with the paediatric neurological examination hypertonia diagnosis. Four items were eliminated as they had less than 50% agreement.

   Inter-Rater Reliability: To evaluate inter-rater reliability, a comparison of the HAT diagnoses by the two physicians was completed. Inter-rater reliability ranged from fair to excellent across the three subgroups[3].

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[3] Statistical agreement was assessed with positive and negative agreement, and prevalence-adjusted bias-adjusted kappa (PABAK). The strength of the agreement was defined as slight (0-0.2), fair (0.21–0.4), moderate (0.41-0.6), substantial (0.61-0.8) or excellent (>0.80).

Test-Retest Reliability: To evaluate test-retest reliability a comparison of the HAT diagnoses at both time points. Test-retest reliability ranged from moderate to excellent[3].

Criterion validity: Criterion validity was measured by comparing the HAT diagnosis to the neurological diagnosis. Across the subgroups, the validity results were mixed. However, the HAT demonstrated higher positive agreement for identifying the presence of spasticity and dystonia, whereas the HAT showed higher positive agreement for identifying the absence of rigidity.

The current version of the HAT consists of seven items in total: 2 spasticity items, 2 rigidity items and 3 dystonia items.

Ongoing Work & Future Directions

Ongoing work will focus on improving the HAT's psychometric properties with a particular focus on the dystonia items. A research study evaluating the use of a videotape to assist with scoring of the dystonia items is currently underway. As well, future work on the HAT will include an evaluation of its use in children less than four years of age.

Before Administrating the HAT:
1. Children should be between 4 to 19 years of age and have hypertonia (increased resistance to passive stretch of the muscle) in at least one limb.
2. Determine the limb you will be assessing (you can assess all limbs with hypertonia, but do each limb separately and generate a HAT score for each limb).
3. The child/youth should be supine on the examining table in comfortable. unrestrictive clothing with their hand or foot of the limb you are examining bare (e.g. out of splints and socks). If possible, their hands should be placed gently on their upper abdomen.
4. Place a roll under the child's knees and a pillow under the child's head.

Administration of the HAT:
NOTE: Complete ALL 7 items on one extremity before moving to the next hypertonic extremity. It usually takes less than five minutes to complete the HAT assessment on one limb. Items are listed in the suggested order of administration.

1. <u>Increased Involuntary Movements or Postures of the Designated Limb with Tactile Stimulus of a Distal Body Part</u>

   A. With the child at rest:
      i. Rub the skin of a distal body part of another limb (e.g. shin or forearm). Rub the length of the limb from the knee to the ankle or the elbow to the wrist in a straight line down the front of the limb. completing 3 cycles. *Observe for any involuntary movements/postures of the designated limb (positive score). Involuntary movements/postures can be subtle and often consist of finger or toe flexion, or wrist flexion.*
      ii. Ensure the child does not have voluntary movements during this item. If you are unsure if movements are voluntary or involuntary in the designated limb, remind the child to stay still and repeat the item.
      iii. Score 0 = negative (no involuntary movements or postures observed) or 1 = positive (involuntary movements or postures observed) on the HAT Scoring Chart

2. <u>Increased Involuntary Movements or Postures with Purposeful Movement of a Distal Body Part</u>

   A. If the child has changed the resting posture of their limb following the administration of item 1, return the limb to its original resting posture.
   B. Ask the child to carry out up to **two** of the following tasks for 10 seconds each. Choose the task based on the child's ability but select from the top of the

list first and then move down the list if necessary. If the child has unilateral CP/hemiplegic CP and has mirror movements omit task ii.

  i.   Count to fifteen over a ten second period.
  ii. Open and close one hand (into a fist) 10 times.
  iii. Open and close eyes (tight blinking) 10 times.
  iv. Reach for an object placed at least a foot away from the hand. Ask or encourage the child to reach for the object 3 times.
  v.   Visually track a brightly coloured object (e.g. small toy) or light source (e.g.: flashlight) moved horizontally back and forth in front of the child. Complete 3 cycles.

C. *Observe for involuntary movements/postures of the designated limb while the child carries out the task (positive score). If you see involuntary movements/postures during the first task you do not need to complete a second task.*

D. Score 0 = negative (no involuntary movements or postures observed) or 1 = positive (involuntary movements or postures observed) on the HAT Scoring Chart

3. <u>Velocity Dependent Resistance to Stretch</u>

A. With the child at rest and supine:

  i.   Support designated limb against gravity
  ii. Start the joint in full flexion or adduction
  iii. Move joints of the limb through the child's *full range* to full extension or abduction as outlined in Table 1
  iv. Return to flexion or adduction

Table 1

IF the designated limb is an UPPER extremity:
- Shoulder adduction/abduction – begin with shoulder in full adduction and elbow in flexion
- Elbow flexion/extension – begin with elbow in full flexion
- Forearm pronation/supination – begin with forearm in full pronation and hold the child's wrist to assess supination
- Wrist flexion/extension – begin with wrist in full flexion

If the designated limb is a LOWER extremity:
- Hip adduction/abduction – begin with hip in full adduction and knee in full extension
- Knee flexion/extension – begin with knee flexed with hip in 90º flexion
- Ankle dorsiflexion/plantarflexion – begin with ankle in full plantarflexion

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B. Start with two slow stretches. Ensure that you move the limb the same speed of stretch in both directions. Note the end range of the stretch to ensure that you don't over-stretch the limb during the two fast stretches.

C. Repeat steps i-iv TWO times QUICKLY. Stretch the limb as quickly as you can to the limb's end range. Ensure that you don't stop the stretch at the

"Spastic Catch" if one is present. The "Spastic Catch" is defined as a rapid rise in resistance of the muscle. It is challenging to maintain the speed of the stretch in both directions. To aid in this, pause at the end range before you stretch the limb back to its starting position.

D. *Assess for an increase in muscle resistance to stretch between the slow and the fast stretch. If spasticity is present the fast stretch will have more resistance (positive score).*

E. Score 0 = negative (no increased resistance noticed during fast stretch as compared to slow stretch) or 1 = positive (increased resistance noticed during fast stretch compared to slow stretch) on the HAT Scoring Chart.

4. <u>Presence of a Spastic Catch</u>

A. *During the same maneuver described in item 3 (Table 1) assess for the presence of a rapid rise (spastic catch) in resistance at a particular joint angle when moving the limb during the two fast stretches (positive score).*

B. Score 0 = negative (no spastic catch noted) or 1 = positive (spastic catch noted) on the HAT Scoring Chart.

5. <u>Equal Resistance to Passive Stretch during Bi-Directional Movement of a Joint</u>

A. *During the same maneuver described in item 3 assess for the presence of equal resistance to passive stretch in both directions of limb movement during the two fast stretches (positive score).*

B. Score 0 = negative (equal resistance not present with bi-directional movement) or 1= positive (equal resistance present with bi-directional movement) on the HAT Scoring Chart.

6. <u>Increased Tone with Movement of a Distal Body Part</u>

A. Identify one joint of your designated limb that demonstrated resistance in the stretches performed during item 3 (e.g. elbow or ankle). Perform two additional fast stretches moving the limb as described in Table 1. Pause between the two stretches.

    i. Before starting the 2nd stretch ask the child to do one of the voluntary movements from item 2B (e.g. count to 15 over a 10 second period, open/close one hand into a fist 10 times). After they have completed 3 of the movements and continuing on to the fourth, do the second fast stretch.

    ii. *Assess for an increase in tone in the 2nd stretch compared to the first stretch (positive score)*

B. Score 0 = negative (no increased tone noted with purposeful movement) or 1 = positive (greater tone noted with purposeful movement) on the HAT Scoring Chart.

7. <u>Maintenance of Limb Position After Passive Movement</u>

> **Table 2**
> <u>IF the designated limb is the ARM:</u>
> - Note original position of the elbow
> - Move the elbow by 45 degrees into either flexion or extension and support the weight of the forearm against gravity with your hand.
>
> <u>If the designated limb is the LEG:</u>
> - Note original position of the ankle
> - Move the ankle by 45 degrees into further dorsi or plantar flexion.

A. *After you have stopped the passive stretch of the limb, observe if the forearm/ankle remains in the last position of stretch or moves in the direction of the original position (negative score). Please note the movement can be slight (10 degree arc of joint movement) and still score "negative".*

B. Score 0 = negative (limb returns (partially or fully) to the original position) or 1 = positive (limb remains in the final position of stretch) on the HAT Scoring Chart.

SCORING OF THE HAT

The HAT consists of seven items in total: 2 spasticity items, 2 rigidity items and 3 dystonia items. Each item is scored using a yes/no format. The presence of at least one item of the subgroup confirms the presence of the subtype of hypertonia and the presence of items from more than one subgroup identifies the presence of mixed tone.

HYPERTONIA ASSESSMENT TOOL (HAT) - SCORING CHART

Name: _____   **Chart/File #:** _____

Clinical Diagnosis: _____   **Date of Birth:** _____

Limb Assessed: **Gender:** ☐ Male   ☐ Female

    ☐ Arm   ☐ Left   ☐ Right   **HAT Assessor:** _____

    ☐ Leg   ☐ Left   ☐ Right   **Date of Assessment:** _____

HYPERTONIA ASSESSMENT TOOL (HAT)

HAT ITEM	SCORING GUIDELINES (0=negative or 1=positive)	SCORE 0=negative 1=positive (circle score)	TYPE OF HYPERTONIA
1. Increased involuntary movements/postures of the designated limb with tactile stimulus of a distal body part	0= No involuntary movements or postures observed	0	DYSTONIA
	1= Involuntary movements or postures observed	1	
2. Increased involuntary movements/postures with purposeful movements of a distal body part	0= No involuntary movements or postures observed	0	DYSTONIA
	1= Involuntary movements or postures observed	1	
3. Velocity dependent resistance to stretch	0= No increased resistance noticed during fast stretch compared to slow stretch	0	SPASTICITY
	1= Increased resistance noticed during fast stretch compared to slow stretch	1	
4. Presence of a spastic catch	0= No spastic catch noted	0	SPASTICITY
	1= Spastic catch noted	1	
5. Equal resistance to passive stretch during bi-directional movement of a joint	0= Equal resistance not noted with bi-directional movement	0	RIGIDITY
	1= Equal resistance noted with bi-directional movement	1	
6. Increased tone with movement of a distal body part	0= No increased tone noted with purposeful movement	0	DYSTONIA
	1= Greater tone noted with purposeful movement	1	
7. Maintenance of limb position after passive movement	0= Limb returns (partially or fully) to original position	0	RIGIDITY
	1= Limb remains in final position of stretch	1	

SUMMARY SCORE – HAT DIAGNOSIS

		Check box:
DYSTONIA →	Positive score (1) on at least one of the Items #1, 2, or 6	☐ Yes ☐ No
SPASTICITY →	Positive score (1) on either one or both of the Items #3 or 4	☐ Yes ☐ No
RIGIDITY →	Positive score (1) on either one or both of the Items #5 or 7	☐ Yes ☐ No
MIXED TONE →	Presence of 1 or more subgroups (e.g. dystonia, spasticity, rigidity)	☐ Yes ☐ No

HAT DIAGNOSIS:
(Fill in all that apply) _____