The Tremor Rating Scale (TRS)

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Abstract

We sought to develop a clinical rating scale for action tremor that is rapid, reliable and applicable to clinic and research settings. Several clinical rating scales have been developed to measure tremor. We sought to develop a scale for action tremor that is validated for both live and video administrations and requires minimal instrumentation. The Tremor Rating Scale (TRS) was developed by the members of the Tremor Research Group (TRG) and consists of items assessing action tremor in the head, voice, limbs and trunk. It requires only pen, paper and cups. Three patients were rated in person by 10 examiners and simultaneously videotaped. Approximately one year later, the examiners rated the videotapes to examine test-retest reliability and concordance between live and videotaped assessments. Inter-rater reliability was assessed using the unweighted statistic, for categorical variables and intraclass correlation coefficient (ICC) for ordinal variables. Intra-rater concordance between the video and live ratings was assessed using a weighted. Concordance was not above chance for face, tongue and voice, but the score range was very low. For the remainder of the subtests, concordance was poor to modest (0.11–0.67) using (assuming categorical data) but good to excellent (0.64–0.97, all $p < 0.001$) using ICC. Mean ± SD intra-rater weighted between live and video ratings was 0.87 ± 0.04 (range 0.81–0.96). This initial evaluation of the TRS revealed good concordance between raters and excellent concordance between live and video and repeat assessments, except possibly for voice and tongue tremor.

Objective

Develop a clinical rating scale for tremor that is rapid, reliable, requires little instrumentation and applicable to both a clinic and research setting.

Background

Several clinical rating scales have been developed to measure tremor. We sought to develop a scale for action tremor validated for both live and video administrations requiring minimal instrumentation.

Methods

- Developed by members of the Tremor Research Group (TRG)
- Consists of items assessing cranial, arms, and leg tremor.
- Requires only pen, paper and cups.
- Three patients with essential tremor were rated in person by 10 examiners and simultaneously videotaped.
- Approximately one year later, the examiners rated the videotapes.
  This represented a combined measure of test-retest reliability and concordance between live and videotaped assessments.
- Inter-rater reliability was assessedwith unweighted Kappa (κ) statistic, assuming categorical variables and intraclass correlation coefficients (ICC) for ordinal variables.
- Intra-rater concordance between the video and live ratings was assessed using a weighted (Cohen's) κ.

Tremor Research Group:

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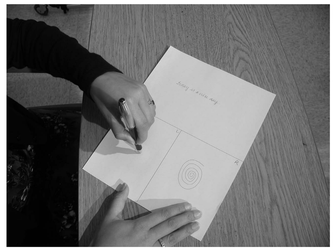

Figure 1. Handwriting and spirals (items #8 & 9). Plain paper is divided into sections at time of testing and examiner draws a model spiral. No pre-printed forms necessary.

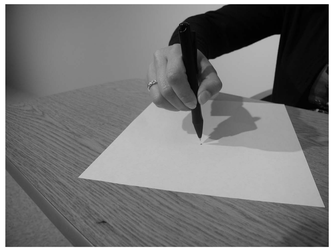

Figure 2. Dot approximation task (item #10). Subject is instructed to "Hold the pencil as close as you can" to a point drawn on a sheet of paper "without touching it."

Figure 3. Pouring (item #11). Styrofoam cups typically found at coffee dispensers are used.

TRG TREMOR RATING SCALE V 2.0, © 2003 Tremor Research Group

Instructions for completing the observed tremor portion

Scoring is 0 - 4 in 0.5 increments, excluding 0.5. Scores are defined for whole numbers, and in some cases for the .5 increments. Use 0.5 if you feel the rating is between two whole number ratings and not other wise defined. The scoring is for the highest amplitude seen at any point during the exam. In general, duration is not considered.

1) **HEAD TREMOR:** Subjects are seated upright. The head is rotated fully left and right and then observed for 10 seconds in mid position. Rate worst amplitude during exam.

0 = no tremor
1 = slight tremor seen or felt only during/after provocative maneuvers.
2 = mild tremor
3 = moderate tremor
4 = severe tremor

2) **FACE (Including JAW) TREMOR:** Smile, close eyes, open mouth. The highest amplitude of the most involved facial anatomy is scored, regardless of whether it occurs during rest or activation.

0 = no tremor
1 = barely perceptible
2 = mild tremor
3 = moderate tremor
4 = severe tremor

3) **TONGUE TREMOR:** Subjects are seated upright. They open their mouths for 5 seconds and protrude their tongue for 5 seconds.

0 = no tremor
1 = barely perceptible
2 = mild tremor
3 = moderate tremor
4 = severe tremor

4) **VOICE TREMOR:** First assess speech during normal conversation [for video, count from one to ten] then ask subject to produce an extended "aaa" sound and eee" sound for 5 seconds each.

0 = no tremor
1 = barely perceptible tremor only during aaa, and eee but not during speech passage
2 = mild but clear tremor present with speaking
3 = moderate tremor (no voice breaks)
4 = severe tremor (with voice breaks or unintelligible speech)

5) **ARM TREMOR:** Subjects are seated upright. Tremor is assessed during three arm maneuvers (forward horizontal reach posture, lateral "wing beating" posture and kinesis). Each arm is assessed for 5 seconds in each posture. Left and right arms may be assessed simultaneously. Amplitude assessment should be estimated using the maximally displaced point of the hand at the point of greatest displacement along any single plane. For example, the amplitude of a pure supination-pronation tremor, pivoting around the wrist would be assessed at either the thumb or fifth digit.

a. **Forward outstretched postural tremor:** Subjects should bring their arms forward, slightly lateral to midline and parallel to the ground. The wrist should also be straight and the fingers maximally abducted so that they do not touch each other.

b. **Lateral "wing beating" postural tremor:** Subjects will abduct their arms parallel to the ground and flex the elbows so that the two hands do not quite touch each other. The fingers are maximally abducted so that they do not touch each other, with the pointer finger at shoulder height.

c. **Kinetic tremor:** Subjects extend only their index finger. They then touch a set object or the examiners finger located to the full extent of their reach, which is located at the same height (parallel to the ground) and slightly lateral to the midline. Subjects then touch their own nose or chin and repeat this back and forth motion five times. Only the position along the trajectory of greatest tremor amplitude is assessed. This will typically be either at the nose/chin or at the point of full finger.

For all three hand tremor ratings:

0 = no tremor
1 = tremor is barely visible
1.5 = tremor is visible, but less than 1 cm
2 = tremor is 1 – <3 cm amplitude
2.5 = tremor is 3 – <5 cm amplitude
3 = tremor is 5 – <10 cm amplitude
3.5 = tremor is 10 – <20 cm amplitude
4 = tremor is > 20 cm amplitude

6) **LEG TREMOR ACTION:** Subjects are comfortably seated. They are then asked to raise each individual leg horizontally parallel to the ground for 5 seconds each. They then perform a standard heal to shin maneuver with each leg three iterations. The maximum tremor in either maneuver is scored.

0 = no tremor
1 = barely perceptible
2 = obvious but mild tremor
3 = moderate tremor, less than 5 cm at any point
4 = severe tremor, greater than 5 cm

7) **STANDING TREMOR:** Subjects are standing, unaided if possible. The knees are 10–20 cm apart and are flexed 10–20°. The arms are down at the subject's side. Tremor is assessed at any point on the legs or trunk.

0 = no tremor
1 = barely perceptible tremor
2 = obvious but mild tremor
3 = moderate tremor
4 = severe tremor

8) **SPIRAL DRAWINGS:** (Takes up half the page) Ask the subject to copy an Archimede's spiral (which approximately fills ¼ of an 8" X 10" unlined page. Test each hand without allowing that hand or arm on table. Only use a ballpoint pen. Subjects may hold the paper with the other hand.

0 = normal
1 = very slight intermittent - barely visible
2 = nearly continuous, mild tremor < 1 cm
3 = moderate - accomplishes the task with great difficulty; figure largely illegible > 1 cm deviation from ideal track
4 = unable to complete drawing; figure not recognizable

9) **HANDWRITING:** Have patient write the standard sentence "Today is a nice day" using their dominant hand, in their customary fashion; however use only cursive (i.e., no printing). They cannot hold (stabilize) their hand with the other hand — rate only for dominant hand.

0 = normal
1 = mildly abnormal; slightly untidy, tremulous
2 = moderately abnormal; legible, but with considerable tremor
3 = markedly abnormal, illegible
4 = severely abnormal; unable to keep pencil or pen on paper without holding down with the other hand

10) **HOLD PENCIL:** "As close as you can" to a point drawn on a sheet of paper "without touching it" (ideally approximately 1 mm) for 10 seconds.

0 = no tremor
1 = tremor is barely visible
1.5 = tremor is visible, but less than 1 cm
2 = tremor is 1 – <3 cm amplitude
2.5 = tremor is 3 – <5 cm amplitude
3 = tremor is 5 – <10 cm amplitude
3.5 = tremor is 10 – <20 cm amplitude
4 = tremor is > 20 cm amplitude

11) **POUR WATER FROM ONE GLASS INTO ANOTHER:** Relatively firm paper cups approximately 10 cm in height are preferred. Fill the cup 1 cm from top. Rate the worst of three tries with each hand. The "receiving" cup is placed on table, not held. If that cup is knocked over then it is replaced upright and the subject continues. If the subject knocks over the cup with the water while initially grasping for it, they are allowed to start over with a new full cup. Subject may be seated or standing, but cups should be about mid thorax.

0 = absolutely no visible tremor
1 = more careful than a person without tremor; no water is spilled
2 = spills a small amount < 10%
3 = spills considerable amount, 10–50%
4 = unable to pour without spilling most

Results

Table 1. Intra-Rater Concordance (Cohen's κ) Between Ratings of Live Subjects and Videos Examined One Year Later

Mean	0.87
S.D.	0.04
Minimum	0.80
Maximum	0.95

Table 2. Inter-Rater Reliability

Item #	Tremor Location	Side	Kappa †	ICC	Kendalls W ‡
1	Head	—	0.31	0.80	0.8941 **
2	Face	—	0.21	0.29	0.6300 *
3	Tongue	—	-0.04	0.08	-1.3000
4	Voice	—	-0.02	0.20	0.2792
5 a	Arm forward	Right	0.25	0.67	0.6737 *
		Left	0.11	0.64	0.6781 **
5 b	Arm lateral	Right	0.34	0.64	0.8949 **
		Left	0.23	0.71	0.7194 **
5 c	Arm kinetic	Right	0.35	0.79	0.8829 **
		Left	0.33	0.72	0.8771 **
6	Leg	Right	0.26	0.87	0.9121 **
		Left	0.30	0.75	0.8233 **
7	Orthostatic	—	0.37	0.94	0.9500 **
8	Writing	—	0.23	0.92	0.8600 **
9	Spiral	Right	0.53	0.97	0.9500 **
		Left	0.23	0.84	0.8829 **
10	Dot Approximation	Right	0.24	0.85	0.8844 **
		Left	0.26	0.72	0.8314 **
11	Pour	Right	0.55	0.95	0.9769 **
		Left	0.67	0.97	0.9769 **

* $p < 0.01$, ** $p < 0.001$
† Kappa > 0.75 is excellent. Kappa < 0.4 is poor (http://department.obg.cuhk.edu.hk/ResearchSupport/Kappa.asp)

‡ Kendall's W is a measurement of concordance based on ordinal data, and can cope with multiple raters. Reference: Siegel S and Castellan Jr. N.J. Nonparametric Statistics for the Behavioral Sciences (1988) International Edition. McGraw-Hill Book Company New York. pp. 262-272.

Conclusions

- The TRS requires minimal equipment.
- This initial evaluation of the TRS revealed good to excellent reliability.
  - Concordance is good between raters.
  - Concordance is excellent between live and video and repeat assessments except possibly for voice and tongue tremor, but the score range was very low, insufficiently testing this.
- Validity remains to be demonstrated.

Poster designed by Kevin Day Vuong, MA^