Supplemental Appendix 2.
Description of Motorneuron Response Assessment and Fractionated Movement Test

Motorneuron Response Assessment (MRA)

The MRA was developed for patients with hemiplegia. The tool, as written, will be presented first. It will be followed by instructions for how to use the tests of the tool with different patient types.

(1) Purpose
   (a) Examine the overall level of excitability.
   (b) Test for spasticity, ability to relax after attempted active movement, and associated reactions.

(2) General guidelines
   (a) Test all movements with patient in supine position.
   (b) Perform each movement with the uninvolved extremity first in order to compare with the involved extremity.
   (c) Prior to testing, check the passive range of motion of each extremity involved.
   (d) Explain to the patient that he or she should remain as relaxed as possible except for those tests in which he or she is to perform a movement actively.
   (e) Instruct the patient that with active movements, his or her effort should be just enough to accomplish the movement requested.
   (f) Determine that the patient understands the directions before rating his or her response; if the patient has difficulty with directions, note this.
   (g) Assure the patient that the test will not harm him or her.
   (h) Administer each test 3 times in order to measure the consistency of response.
   (i) Occasionally, during testing of a specific item, a patient may not respond consistently; if one of the responses is atypical, rate the item based on the response during the other movements and not the inconsistent response.
   (j) Determine the overall classification according to the appropriate criteria.
   (k) Record any additional information that would influence or help to interpret the results of the test.

(3) UE test
   (a) Position the UE to be tested in approximately 45° of abduction.
   (b) Position the upper arm in neutral shoulder rotation and stabilize testing by holding onto the upper arm as needed.
   (c) Position the forearm in neutral pronation/supination.
   (d) There are 5 components of the test:
      (i) Passive movement of the entire UE (PROM): Instruct the patient to remain relaxed and not to assist with the movements. With the extremity in the described testing position, passively move each joint at varying speeds, noting any resistance to stretch. Note all deviations from normal.
      (ii) Passive flexion of the elbow to 90° and drop into extension (PROM with drop): Instruct the patient to remain relaxed, not to push the forearm down, and to let the arm drop. Support the upper arm and passively flex the elbow to 90°. Release the forearm, allowing it to fall into extension. Make sure the patient does not internally rotate the shoulder to extend the elbow. Note the speed of the fall into extension.
      (iii) Active flexion of the elbow to 90° and drop into extension (AROM with drop): From the starting position, ask the patient to bend the elbow to 90° and then relax, allowing the forearm to drop into extension. Remind the patient not to “push” the forearm into extension. Stabilize the upper arm with one hand and use the other hand as a “target” to which the patient is to flex the elbow. Note the speed of the fall into extension.
      (iv) Active hip and knee flexion of the ipsilateral LE (IPSIL LE): From the starting position, passively flex the involved LE to assess range of motion and to demonstrate to the patient the motion you will want him or her to attempt. Ask the patient to attempt to flex the involved LE. Note the presence or absence of associated reactions in the involved UE with effort to move the LE. The patient should relax between attempts.
      (v) Active hip and knee flexion of the contralateral LE (CONTRA LE): In the same position as described above, administer the same test with the uninvolved LE. Monitor for activity in the involved UE.

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(4) LE test
(a) Position the patient supine with both LEs extended and the arms resting in approximately 45° of shoulder abduction, neutral shoulder rotation, elbow extension, neutral supination/pronation, and wrist extension.
(b) There are 3 components of the test:
   (i) Passive movement of the entire LE (PROM): Instruct the patient to remain relaxed and not to assist with the movement. Passively move each joint at varying speeds and note any resistance to stretch. Note all deviations from normal.
   (ii) Passive extension of the knee and drop into flexion (PROM with drop): Instruct the patient to remain relaxed, not to push the leg down, and to let the leg drop. While supporting the upper leg in approximately 60° of flexion, passively extend the knee. Release the lower leg, allowing it to fall into flexion. Note the speed of the fall into flexion.
   (iii) Activity (ACT): Monitor the involved LE throughout the entire examination for the presence of associated reactions.

(5) MRA criteria
(a) Below are listed the criteria for classifying a patient’s MRA response.
(b) Because patients do not always meet all of the criteria for each classification, those criteria that are most clinically significant are designated. These criteria are marked with an asterisk (*). If the patient meets the asterisked criteria, he or she is then classified appropriately.

(6) UE categories
(a) Flaccid
   □ PROM: no resistance
   □ PROM with drop: falls faster than uninvolved UE*
   □ AROM with drop: unable or falls faster than uninvolved UE
   □ IPSIL LE: no activity in UE
   □ CONTRA LE: no activity in UE

(b) Mild
   □ PROM: resistance*
   □ PROM with drop: falls equal to uninvolved UE
   □ AROM with drop: unable or falls equal to uninvolved UE
   □ IPSIL LE: no activity in UE
   □ CONTRA LE: no activity in UE

(c) Moderate
   □ PROM: resistance
   □ PROM with drop: falls slower than uninvolved UE*
   □ AROM with drop: falls slower than uninvolved UE*
   □ IPSIL LE: no activity in UE
   □ CONTRA LE: no activity in UE

(d) Marked
   □ PROM: resistance
   □ PROM with drop: falls slower than uninvolved UE
   □ AROM with drop: falls slower than uninvolved UE
   □ IPSIL LE: activity in UE
   □ CONTRA LE: no activity in UE

(e) Severe
   □ PROM: resistance
   □ PROM with drop: falls slower than uninvolved UE
   □ AROM with drop: falls slower than uninvolved UE
   □ IPSIL LE: activity in UE
   □ CONTRA LE: activity in UE*
(f) Normal
- PROM: no resistance
- PROM with drop: falls equal to uninvolved UE
- AROM with drop: falls equal to uninvolved UE
- IPSIL LE: no activity in UE
- CONTRA LE: no activity in UE

(7) LE categories
(a) Flaccid
- PROM: no resistance
- PROM with drop: falls faster than uninvolved LE
- ACT: no activity
(b) Mild
- PROM: resistance
- PROM with drop: falls equal to uninvolved LE
- ACT: no activity
(c) Moderate
- PROM: resistance
- PROM with drop: falls slower than uninvolved LE
- ACT: no activity
(d) Severe
- PROM: resistance
- PROM with drop: falls slower than uninvolved LE
- ACT: activity
(e) Normal
- PROM: no resistance
- PROM with drop: falls equal to uninvolved LE
- ACT: no activity

(8) Application to patients other than those with hemiplegia

Although the MRA has been tested in our clinic on patients with hemiplegia, we suggest that the test be considered as a series of tests that identify degrees of hyperexcitability. The test could be used on any patient with the upper motorneuron syndrome, and patients with more positive responses on the tests would be considered more severe.

The test position for the drop tests also may be changed in order to observe the speed of fall of a segment while different muscle groups are being stretched (e.g., prone with a lower leg drop test that passively stretches the hamstring muscles).

Fractionated Movement (FM) Test

Determine (“yes” or “no”) whether there is fractionated movement by completing the following:

(1) General guidelines
(a) Test all movements with the patient in a sitting position with back supported unless medical status prohibits.
(b) Prior to testing, check the PROM for each extremity and joint involved.
(c) Beginning with the shoulder, ask the patient to perform isolated movements; instruction may be verbal or visual.
(d) Note the category with which the patient’s movement best corresponds.
(e) Record any additional information that would influence or help to interpret the results of the test.
(f) Administer all tests on the involved extremities.
Supplemental Appendix 2.

Continued

(2) UE test
(a) There are 5 components of the test:
   (i) Ask the patient to flex the shoulder. Movement is fractionated if the patient moves the shoulder through at least 50% of the available range of motion without substitution or other associated reactions.
   (ii) Ask the patient to flex and extend the elbow while maintaining neutral supination/pronation. Movement is fractionated if the patient moves the elbow through at least 50% of the available range of motion without substitution or other associated reactions.
   (iii) Ask the patient to flex and extend the wrist against gravity. Movement is fractionated if the patient moves the wrist through 100% of the available range of motion without substitution or other associated reactions.
   (iv) Ask the patient to flex and extend the fingers against gravity. Movement is fractionated if the patient moves the fingers through 100% of the available range of motion without substitution or other associated reactions.
   (v) Ask the patient to flex and extend the index finger with the other fingers fully flexed. Movement is fractionated if the patient moves the index finger through 100% of the available range of motion without substitution or other associated reactions.

(3) LE test
(a) There are 3 components of the test:
   (i) Ask the patient to flex the hip in the sagittal plane. Movement is fractionated if the patient flexes the hip at least 50% of the available range of motion without substitution or other associated reactions.
   (ii) Ask the patient to extend the knee in the sagittal plane. Movement is fractionated if the patient extends the knee at least 50% of the available range of motion without substitution or other associated reactions.
   (iii) Ask the patient to dorsiflex the ankle in the sagittal plane. Movement is fractionated if the patient dorsiflexes the foot 100% of the available range of motion without substitution or other associated reactions.

(4) Fractionated movement category criteria
(a) UE
   Each joint is rated separately. If the patient is able to complete the task as defined, he or she is given a “yes” for that task. All tasks are rated for each patient. If the patient is unable to complete the task because he or she has no movement at a given segment, indicate it on the evaluation form.
(b) LE
   Each joint is rated separately. If the patient is able to complete the task as defined, he or she is given a “yes” for that task. All tasks are rated for each patient. If the patient is unable to complete the task because he or she has no movement at a given segment, indicate it on the evaluation form.

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