MOVEMENT SYSTEM DIAGNOSES
NEUROMUSCULAR CONDITIONS

Examination

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Introduction

The following examination items are those that are needed to make a movement system diagnosis for neuromuscular patients. The examination is a combinatorial examination (all tests must be considered together) and is focused on movement system deficits that impact upper and lower extremity functions. There is a combination of analysis of performance of key tasks and traditional tests for impairments. There are screening tests for musculoskeletal (mechanical) pain problems and cardiopulmonary problems, however, these tests are insufficient for making movement system diagnoses in these areas. Positive results on these screening tests should prompt the therapist to examine the cardiopulmonary and musculoskeletal areas more closely.

The examination focuses on movement system aspects of the patient’s presentation only. The examination does not include tests that measure prior function, care giver burden, or personal and environment factors that are considered when managing an entire case. Likewise, the examination does not include all tasks or activities that may be of interest to the patient. This examination only consists of tests that are believed to be diagnostic in determining a movement system diagnosis.

The examination consists of observational task analysis of tasks which we believe to be diagnostic for our purposes and tests for impairments. Most of the impairment tests we use in this examination are standard parts of physical therapy practice. Consequently, we have not described how to perform these tests in detail. We have provided interpretive comments that relate the test result to the diagnostic process. We have 2 specific impairment tests, the Motorneuron Response Assessment and the Fractionated Movement tests which are not traditional impairment tests. The detailed instructions for these tests are provided in the appendix to this document.

The examination describes the tests as they are performed on an adult patient. We believe that the diagnostic categories are relevant to the pediatric population, however, the examination procedures with the pediatric patient need to be modified to be consistent with a child’s ability to follow instructions, e.g. deriving information about strength, fractionated movement, and non-equilibrium coordination from observations of play and other movement behaviors rather than from specific testing. Similarly, the specific tasks used in the Task Analysis portion of the examination may need to be modified to reflect a particular child’s functional performance. Tasks that require force generating capacity, capacity to stabilize in a static position, timing of postural responses during base of support transitions, and capacity to stabilize under varying sensory conditions will provide the most information about the child’s movement system performance.

The examination does not include specific outcome assessment tools. We highly encourage the use of these tools in documenting patient status; however, they are generally not designed to identify specific movement system faults affecting a patient’s overall performance.

There is a sample clinical form in the Appendix to this document that illustrates how to implement the examination elements into practice.
History/Systems Review

From the patient and/or the medical record, obtain the following information:

- medical diagnosis(es)
- medical treatments which have an effect on muscle, nerve, or movement
- prior level of function including use of assistive devices (what and how long)
- complaint of motion sensitivity such as dizziness watching television, in crowds, or with driving

Objective

TASK ANALYSIS

Analysis of mobility consists of systematic observation of the kinematic changes that occur during changes in position or alignment. These changes in angles and displacement of limbs and limb segments are the movement components of a task. While we appreciate that there are many movement patterns that a patient may use to be successful in completing a task, we have identified essential movement components for each task. We believe that the essential movement components describe the movement pattern for each task that is the most common, potentially the most efficient given the demands of the task, and the least likely to produce unnecessary stress on the musculoskeletal system.

We have included in the examination, those tasks on which we believe patients of different types perform differently. Our purpose is not to examine every task that a person needs to perform in everyday life, but rather, to examine those tasks we feel are necessary in order to diagnose the patient’s movement system problem.

The tasks that are included in the examination are:
- quiet sitting
- sit to stand
- quiet standing
- standing feet together
- step-up
- gait
- complex gait

And for patients with primary upper extremity involvement:
- reach
- grasp
- in-hand manipulation

Additional tasks may be needed to identify deficits, especially for higher level adult patients and in children. This additional testing may especially be necessary when making distinctions among patients with Movement Pattern Coordination Deficit, Force Production Deficit, or Sensory Selection and Weighting Deficit. Examples of these tasks in adults might include:
- Standing on foam
- Standing on a tilt board
- Standing on a narrow beam
- Stair climbing
- Walking on heels and toes

Examples of additional or substitute tasks in children might include:
- Prone on elbows
- Rolling
- Pull to sit
- Creeping
- Floor to stand
- Running
- Jumping
- Hopping
Analysis of movement tasks in phases is useful for precise systematic observation. For all mobility tasks, the tester must observe all 3 of the following phases:

- **Initiation**: those changes that occur in order to overcome inertia of the body at rest
- **Execution**: intersegmental movements that allow for the movement of COM into a new position
- **Termination**: those changes that occur to decelerate the movement of the COM as the body stabilizes into a new position

The following is a description of how to perform the examination of each task followed by guidelines for interpreting the test results. It is important to remember that this is a combinatorial examination. No one test determines the diagnosis but rather, it is the collection of examination results that are important.

**Quiet Sitting:**

**Testing Procedures:**

1. Ask the patient to sit quietly with feet supported, arms resting quietly, equal weight bearing on left and right hips, and hips flexed and lumbar spine in slight extension, eyes open, and head up for 30 seconds.

   Ask the patient to sit in his most upright posture possible. If the patient has structural deformities such as thoracic kyphosis, scoliosis, etc. note them and use his most upright posture possible (structurally) as the position you are asking him to hold for the 30 seconds.

2. Observe the first attempt and note presence or absence of essential movement components of task:
   - feet and knees hip width apart
   - weight evenly distributed
   - flexion of hips with extension of trunk
   - head balanced on level shoulders
   - trunk still (no oscillation)


   Appropriate cues may include, but are not limited to, the following:
   - “keep even pressure on both hips”
   - “keep shoulders in line over hips”
   - “look straight ahead and stare at ( ) on the wall”
   - “relax your arms at your sides”

   Manual guidance should be proximal. Patients should be discouraged from using UE to maintain sitting.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>gross abnormality; COM shifted significantly from midline</td>
<td>Biomechanical deficit (modifier)</td>
</tr>
</tbody>
</table>
| unable to sit unsupported; appears weak; would fall without support | Force Production Deficit (FPD)  
Sensory Detection Deficit |
| sits asymmetrically; may require assistance but only minimal | FPD if not impacting trunk musculature  
Fractionated Movement Deficit  
Sensory Selection and Weighting Deficit |
<table>
<thead>
<tr>
<th>Observation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>sits with center of mass lateral or posterior to midline and resists correction of altered midline position or loss of balance</td>
<td>Postural Vertical Deficit</td>
</tr>
<tr>
<td>sits with center of mass posterior to midline and demonstrates stiffness and/or slowness with correction</td>
<td>Hypokinesia</td>
</tr>
<tr>
<td>improvement in performance with repetition/practice</td>
<td>Movement Pattern Coordination Deficit (MPCD)</td>
</tr>
<tr>
<td></td>
<td>Fractionated Movement Deficit</td>
</tr>
<tr>
<td></td>
<td>FPD</td>
</tr>
<tr>
<td></td>
<td>Sensory Selection and Weighting Deficit</td>
</tr>
<tr>
<td>decrement in performance with repetition</td>
<td>FPD (may demonstrate brief initial improvement followed by decrement in performance)</td>
</tr>
<tr>
<td>excessive sway at trunk; requires UE support; no improvement with practice</td>
<td>Dysmetria</td>
</tr>
</tbody>
</table>

**Sit to Stand:**

**Testing Procedures:**

1. Ask the patient to come to standing from bed or chair without UE support.

2. Position the patient so that the femoral-tibial angle is no greater than 110°, the buttocks are toward the edge of the surface, and the feet are on the floor as much as possible and hip width apart.

3. Observe first attempt and note presence or absence of essential components of task:  
   - feet on floor  
   - hip flexion with lumbar and cervical extension  
   - movement of knees forward during execution  
   - extension of hips and knees for final standing alignment at termination

   Appropriate cues may include, but are not limited to, the following:  
   - “come to the edge of the chair”  
   - “place feet flat on floor”  
   - “bend forward at your hips”  
   - “lift buttocks from chair”  
   - “use your legs to stand”  
   - “put pressure on the balls of your feet”  
   - “do not let your toes come off of the floor”  
   - “tuck your bottom under you”  
   - “don’t pull back”  

   Manual guidance may be used to assist with the essential components of the task. Patients should not be allowed to pull themselves up using UEs.

5. If physical assistance is required, give only the assistance necessary at each phase. At each phase, relax or release the assistance at least momentarily and observe patient’s movement response.
<table>
<thead>
<tr>
<th>Observation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>initiation</td>
<td>requires assistance to initiate lift of buttocks from chair; if support removed, patient falls rapidly into chair  ▪ FPD</td>
</tr>
<tr>
<td>unable to passively position feet appropriately resulting in a more challenging starting position; may require assistance</td>
<td>▪ Biomechanical deficit (modifier)</td>
</tr>
<tr>
<td>lack of preparatory movements or very slow preparatory movements; may require assistance; if support removed, patient falls slowly into chair</td>
<td>▪ Hypokinesia</td>
</tr>
<tr>
<td>abnormal movement synergy during preparatory movements</td>
<td>▪ Fractionated Movement Deficit</td>
</tr>
<tr>
<td>increased BOS</td>
<td>▪ FPD</td>
</tr>
<tr>
<td>repeated efforts; momentum strategy</td>
<td>▪ FPD</td>
</tr>
<tr>
<td>excessive trunk sway</td>
<td>▪ Dysmetria</td>
</tr>
<tr>
<td>resists assistance of movement of trunk forward or in midline; pushes back or to side with UE</td>
<td>▪ Postural Vertical Deficit</td>
</tr>
<tr>
<td>execution</td>
<td>extends knees before hips in first half of movement sequence; may push on legs to extend trunk; may require assistance; if support removed segments rapidly fall in direction opposite of movement</td>
</tr>
<tr>
<td>requires assistance; associated with joint pain or stiffness</td>
<td>▪ Biomechanical deficit (modifier)</td>
</tr>
<tr>
<td>arrest of ongoing movement; may require assistance</td>
<td>▪ Hypokinesia</td>
</tr>
<tr>
<td>altered sequencing of segmental movement (most commonly insufficient DF of leg over foot); improves with guidance and practice</td>
<td>▪ MPCD</td>
</tr>
<tr>
<td>shifts COM toward weaker side or back; resists correction; early PF of tibia relative to foot or may fix foot (feet) and push away; resists changes to strategy with practice and guidance</td>
<td>▪ Postural Vertical Deficit</td>
</tr>
<tr>
<td>shifts COM to one side; improves with practice and instruction</td>
<td>▪ Sensory Selection and Weighting Deficit</td>
</tr>
<tr>
<td>abnormal movement synergy in UE and/or LE; no change with guidance and practice</td>
<td>▪ Fractionated Movement Deficit</td>
</tr>
<tr>
<td>excessive trunk sway</td>
<td>▪ Dysmetria</td>
</tr>
<tr>
<td>termination</td>
<td>sway at ankle; may require a step</td>
</tr>
<tr>
<td>shifts COM toward weaker side or back; resists correction; may fix foot (feet) and push away</td>
<td>▪ Postural Vertical Deficit</td>
</tr>
<tr>
<td>repeated stepping to find and maintain balance</td>
<td>▪ Dysmetria</td>
</tr>
<tr>
<td>excessive trunk sway at hips</td>
<td>▪ FPD</td>
</tr>
<tr>
<td>Observation</td>
<td>Interpretation</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Knee hyperextension against surface; improves with manual cues and instruction</td>
<td>MPCD</td>
</tr>
<tr>
<td>Knee hyperextension against surface; no change with manual cues and instruction</td>
<td>FPD</td>
</tr>
<tr>
<td>Altered alignment of LE limb position; may require a step to find and maintain balance; no change in limb alignment with practice and guidance</td>
<td>Fractionated Movement Deficit</td>
</tr>
<tr>
<td>Slow and stiff in extending hips and knees; may sustain hip and knee flexion and need UE assist support to reach full extension</td>
<td>Hypokinesia</td>
</tr>
</tbody>
</table>

**Quiet Standing (eyes open/closed):**

**Testing procedures:**

1. Ask the patient to stand quietly with feet shoulder width apart, arms at sides, equal weight bearing on left and right, eyes open, and head up for 30 seconds.

   Ask the patient to stand in his most upright posture possible. If the patient has structural deformities such as thoracic kyphosis, knee flexion contractures, etc. note them and use his most upright posture as the position you are asking him to hold for the 30 seconds.

   Provide support at the patient’s trunk until his feet are positioned and he appears to be in a stable position.

2. Observe the patient’s first attempt to maintain the standing position and note the presence or absence of essential components of the task:²⁴
   - feet under shoulders
   - hips in front of ankles
   - shoulders over hips
   - head balanced on level shoulders
   - erect trunk


   Appropriate cues may include, but are not limited to, the following:
   - “keep even pressure on the balls of your feet”
   - “keep shoulders in line over hips”
   - “look straight ahead and stare at ( ) on the wall”
   - “relax your arms at your sides”
   - “let your legs support you”

   Manual guidance should be proximal. Patients should be discouraged from using UE to maintain stance.

4. If the patient is able to hold the position with eyes open, while he is standing unsupported, ask him to close his eyes and hold for 15 seconds.
### Quiet Standing

<table>
<thead>
<tr>
<th>Observation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>unable to stand unsupported; appears weak; would fall without support</td>
<td>FPD</td>
</tr>
<tr>
<td>gross abnormality; COM shifted toward limits of stability</td>
<td>Biomechanical Deficit (modifier)</td>
</tr>
<tr>
<td>unable to maintain alignment at one or two segments; may appear worse the longer the patient attempts to stand</td>
<td>FPD</td>
</tr>
<tr>
<td>altered alignment of LE limb position; may require UE support or repeated stepping to maintain balance; slow with postural responses</td>
<td>• Fractionated Movement Deficit&lt;br&gt;• Hypokinesia</td>
</tr>
<tr>
<td>hesitation or multiple efforts to assume position; improves with practice</td>
<td>MPCD</td>
</tr>
<tr>
<td>excessive sway at trunk/hips; repeated stepping to maintain balance; no change with practice or repetition</td>
<td>Dysmetria</td>
</tr>
<tr>
<td>shifts COM away from midline; resists correction</td>
<td>Postural Vertical Deficit</td>
</tr>
<tr>
<td>increased sway with eyes closed; improves with practice</td>
<td>MPCD</td>
</tr>
<tr>
<td>increased sway with eyes closed or loss of balance; no change with practice under this condition</td>
<td>Sensory Detection Deficit</td>
</tr>
<tr>
<td>loss of balance in a consistent direction; much increase in sway with eyes closed; improves with a visual target</td>
<td>Sensory Selection and Weighting Deficit</td>
</tr>
</tbody>
</table>

### Feet Together (eyes open/closed):

Perform this test if the patient is successful with Quiet Standing with eyes open.

**Testing procedures:**

1. Ask the patient to stand quietly with feet touching at toes and heels, arms at sides, equal weight bearing on left and right, eyes open, and head up for 15 seconds.

   Ask the patient to stand in his most upright posture possible. If the patient has structural deformities such as thoracic kyphosis, knee flexion contractures, etc. note them and use his most upright posture as the position you are asking him to hold for the 15 seconds.

   Provide support at the patient’s trunk until his feet are positioned and he appears to be in a stable position.

2. Observe the patient’s first attempt to maintain the feet together position and note the presence or absence of essential components of the task:

   - feet together
   - hips in front of ankles
   - shoulders over hips
   - head balanced on level shoulders
   - erect trunk


   Appropriate cues may include, but are not limited to, the following:
   - “keep even pressure on the balls of your feet”
   - “keep shoulders in line over hips”
   - “look straight ahead and stare at ( ) on the wall”
   - “relax your arms at your sides”
“let your legs support you.”

Manual guidance should be proximal. Patients should be discouraged from using UE to maintain stance.

4. If the patient is able to hold the position with eyes open, while he is standing unsupported, ask him to close his eyes and hold for 15 seconds.

### Feet Together

<table>
<thead>
<tr>
<th>Observation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>unable to stand unsupported; shifts COM to side or back; resists correction; may be unable to attempt this test</td>
<td>Postural Vertical Deficit</td>
</tr>
<tr>
<td>unable to stand unsupported; appears weak; would fall without support</td>
<td>FPD</td>
</tr>
<tr>
<td>unable to maintain alignment at one or two segments; may appear worse the longer the patient attempts to stand</td>
<td>FPD</td>
</tr>
</tbody>
</table>
| altered alignment of LE limb position; may require UE support to maintain balance; slow with postural responses | • Fractionated Movement Deficit  
• Hypokinesia |
| hesitation or multiple efforts to assume position; improves with practice | MPCD |
| excessive sway at trunk/hips; likely needs UE support to maintain balance | Dysmetria |
| increased sway with eyes closed; improves with practice | MPCD |
| increased sway with eyes closed or loss of balance; no change with practice under this condition | Sensory Detection Deficit |
| loss of balance in a consistent direction; much increase in sway with eyes closed; improves with a visual target | Sensory Selection and Weighting Deficit |

### Step-Up:

**Testing procedures:**

The following test should be eliminated if the patient was unable to stand without any support in any fashion for 5 seconds.

1. Put a 4 to 6 inch step in front of the patient. Ask the patient to put the left foot on the step then return it to the floor without UE support then repeat with the right foot for one cycle. The patient may need a demonstration of the task.

2. Observe the first attempt and note the presence or absence of essential components of the task:
   - weight shift to stance limb
   - hip and knee extension on stance limb
   - erect trunk
   - hip flexion on moving limb
   - controlled foot placement of moving limb


Appropriate cues may include, but are not limited to, the following:

- “shift your weight to your ( )”
- “lift your leg from your hip”
- “don’t let your hip collapse”
- “put your foot down quietly”
- “don’t lean back before you put your foot on the floor”
Manual guidance should be used to support the patient proximally as needed.

4. If support is needed during the task, momentarily relax the support and note the patient’s movement response.

5. Perform 2 cycles, i.e. left-right-left-right.

<table>
<thead>
<tr>
<th>Step-up</th>
<th>Observation</th>
<th>Interpretation</th>
</tr>
</thead>
</table>
| Initiation | hesitation and/or multiple starts before moving a foot; improves with practice | ▪ MPCD  
▪ Sensory Selection and Weighting Deficit |
|          | hesitation and/or multiple starts before moving a foot; no consistent improvement with practice | ▪ FPD  
▪ Fractionated Movement Deficit  
▪ Sensory Detection Deficit  
▪ Hypokinesia |
|          | unable to attempt without UE support                                        | ▪ Sensory Detection Deficit  
▪ Hypokinesia  
▪ Dysmetria  
▪ Postural Vertical Deficit |
| Execution (swing limb) | insufficient hip flexion range of motion; momentum strategy to lift limb; circumduction; lateral trunk flexion toward stance limb; fatigues with practice and repetition | FPD |
|          | increased movement time; insufficient hip flexion range of motion; abnormal movement synergy; no improvement with practice | Fractionated Movement Deficit |
|          | increased movement time; insufficient hip flexion range of motion; limited improvement with repetition | Hypokinesia |
|          | lateral trunk flexion toward stance limb; improves with practice             | ▪ MPCD  
▪ Sensory Selecting and Weight Deficit |
|          | excessive movement amplitude and variable movement path                     | ▪ Sensory Detection Deficit  
▪ Dysmetria |
| Execution (stance limb) | hip flexion and/or hip drop; lateral trunk flexion; knee flexion             | ▪ FPD  
▪ Fractionated Movement Deficit |
|          | hyperextension of knee                                                       | ▪ FPD  
▪ Sensory Detection Deficit |
| Termination | loss of balance in a consistent direction; improvement with a visual target | Sensory Selection and Weighting Deficit |
|          | posterior sway of stance limb; poor control of foot placement; improves with practice and repetition | MPCD |
|          | unable to reach top of step; may need assistance to recover balance          | ▪ FPD  
▪ Fractionated Movement Deficit  
▪ Hypokinesia |
|          | excessive sway at trunk/hips; may overshoot foot placement on step; repeated stepping to maintain balance | ▪ Dysmetria  
▪ Sensory Detection Deficit |
Gait:

**Testing Procedures:**

1. Ask the patient to walk at least 10-20 feet (but longer if possible) and turn around without an assistive device or assistance from you.

2. Observe the first attempt and note presence or absence of essential components of task:
   - **Stance**
     - extension of hip throughout
     - lateral shift of pelvis and trunk
     - flexion of knee at heel contact followed by extension then flexion prior to toe off
   - **Swing**
     - flexion of knee with initial hip extension
     - flexion of hip
     - rotation of pelvis forward on swing leg
     - extension of knee with dorsiflexion prior to heel contact
   - **Turns**
     - no loss of balance
   - **Overall**
     - straight line of progression

Appropriate cues may include, but are not limited to, the following:
- “stay nice and tall”
- “take long even steps”
- “walk heel to toe”
- “push off of the floor”
- “swing your arms”
- “walk faster”

Manual guidance should be used to support the patient proximally as needed. Support should be decreased as much as possible as the test proceeds.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Observation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>stance</td>
<td>lateral trunk flexion</td>
<td>FPD</td>
</tr>
<tr>
<td></td>
<td>hip/trunk flexion</td>
<td>FPD</td>
</tr>
<tr>
<td></td>
<td>hip drop</td>
<td>FPD</td>
</tr>
<tr>
<td></td>
<td>altered limb alignment often impacting the position of the foot</td>
<td>Fractionated Movement Deficit</td>
</tr>
<tr>
<td></td>
<td>hyperextension of knees; no change with visual guidance</td>
<td>FPD</td>
</tr>
<tr>
<td></td>
<td>hyperextension of knees; some improvement with visual guidance</td>
<td>Sensory Detection Deficit</td>
</tr>
<tr>
<td>swing</td>
<td>circumduction, hip hiking, vaulting</td>
<td>FPD</td>
</tr>
<tr>
<td></td>
<td>insufficient hip flexion and/or DF</td>
<td>FPD</td>
</tr>
<tr>
<td></td>
<td>abnormal movement synergy; short step length</td>
<td>Fractionated Movement Deficit</td>
</tr>
<tr>
<td>Observation</td>
<td>Interpretation</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>variable foot placement; improves with practice and cues</td>
<td>MPCD</td>
<td></td>
</tr>
<tr>
<td>variable foot placement; no improvement with practice and cues</td>
<td>Dysmetria</td>
<td></td>
</tr>
<tr>
<td>variable foot placement; some improvement with visual guideline</td>
<td>Sensory Detection Deficit</td>
<td></td>
</tr>
<tr>
<td>multiple stops and starts; decreased step length</td>
<td>Hypokinesia</td>
<td></td>
</tr>
<tr>
<td>overall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>variable line of progression; improves with practice and repetition</td>
<td>• MPCD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sensory Selection and Weighting Deficit</td>
<td></td>
</tr>
<tr>
<td>variable line of progression; no improvement with practice and repetition</td>
<td>Dysmetria</td>
<td></td>
</tr>
<tr>
<td>line of progression deviates toward one side</td>
<td>• Disregard (modifier)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sensory Selection and Weighting Deficit</td>
<td></td>
</tr>
<tr>
<td>lack of forward progression; needs UE support</td>
<td>Postural Vertical Deficit</td>
<td></td>
</tr>
</tbody>
</table>

**Complex Gait:**

**Testing Procedures:**

While walking, ask the patient to perform the following:

1. turn head to left for 2-3 steps, to center for 2-3 steps, and to right for 2-3 steps.
2. step forward a few steps and step backward a few steps without stopping
3. step over a small obstacle

Give time to settle into a normal walking pattern between each of these tasks. Note change in performance with each task such as decreasing speed, deviation in line of progression, stopping, or stumbling.

**Interpretation:**

1. Deviation in line of progression while walking with head turning may indicate Sensory Selection and Weighting Deficit if coupled with other positive tests or Movement Pattern Coordination Deficit.
2. Hesitation or extra steps in changing direction while walking but improvement with practice is indicative of Movement Pattern Coordination Deficit.
3. Hesitation and inability to step backward or extra steps may be indicative of Force Production Deficit.
4. Hesitation in stepping over obstacle or poor adjustment to step length when stepping over obstacle but improvement in practice is indicative of Movement Pattern Coordination Deficit.
5. Stopping movement with long hesitation before stepping and lack of support moment at hip of stance limb is indicative of Force Production Deficit.
6. Hesitation, stopping and starting, small steps, and poor control of momentum associated with Hypokinesia
7. Difficulty transitioning from one sensory condition to another associated with Sensory Selection and Weighting Deficit
8. Consistent variability with extra steps for balance and wide base of support without change with practice associated with Dysmetria
Dual Task Performance:
Testing Procedures:
While walking, ask the patient to perform the following:
1. walk while performing a cognitive task such as count backward by 3s, say the alphabet backward, or do multiplication tables
2. walk while performing a secondary manual tasks such as carrying a full cup of water, retrieving a coin from a pocket, or retrieve keys from a purse
Give time to settle into a normal walking pattern between each of these tasks. Note change in gait performance with each tasks such as decreasing speed, deviation in line of progression, stopping, or stumbling. Note change in the secondary task such has stopping, having to start the secondary task again, or errors. Note which task takes priority for the patient, ambulation and stability or the secondary task.

Interpretation:
³Deterioration in performance of either ambulation or the secondary task indicates the need for a descriptor, “with dual task difficulty” or similar language. Priority of the secondary task over ambulation stability may indicate a greater risk for falls.

Reach and Grasp:
Testing Procedures:
1) Ask the patient to perform the following tests:²
   a) point to objects in front, at the ipsilateral and contralateral side, at shoulder height, and overhead
   b) reach for objects in the front, at the ipsilateral and contralateral side, at shoulder height, and overhead
   c) lift and release 3 objects of different size, weight, shape, and texture
   d) stack 3-4 small objects
2) Observe the reach and grasp components of each task and determine the following:
   a) is the motion fractionated
   b) is there sufficient active range of motion
   c) is the hand position being shaped during reach
   d) is the hand position awkward
   e) is the hand opening wide enough
   f) do the fingers contact the object before the web space
   g) is appropriate force applied to the object

Interpretation:
¹Insufficient active range of motion but motion is fractionated is associated with Force Production Deficit.
²Inability to sustain grasp to lift object and motion is fractionated is associated with Force Production Deficit.
³Fractionated movement and dyscoordination of the hand movement during reach or of the hand about objects is associated with Movement Pattern Coordination Deficit.
⁴Significant failure in accuracy of test indicates Dysmetria.

In-Hand Manipulation
Testing Procedures:
1) Place a pencil in the open palm of the patient’s hand and ask him to adjust the position of the pencil for use. (An alternate test is to place a quarter in the palm and ask the patient to adjust it as if to put it in a vending machine.)²⁵
2) Observe the task and determine the following:
   a) is the motion fractionated
   b) is there sufficient active range of motion
   c) is the hand movement awkward
   d) is the hand movement slow
   e) is appropriate force applied to the object
Interpretation:
1. Insufficient active range of motion but motion is fractionated is associated with Force Production Deficit.
2. Inability to sustain grasp and motion is fractionated is associated with Force Production Deficit.
3. Fractionated movement and dyscoordination or slowness of the hand are associated with Movement Pattern Coordination Deficit.

MENTAL STATUS

Perform traditional tests of mental status and basic cognitive functioning to determine:

- Level of consciousness (LOC)
- Attention
- Ability to apply meaning to situational demands
- Ability to follow instructions

Interpretation:
1. Significant deficits may indicate the classification, Cognitive Deficit.
2. Moderate to significant deficits coupled with other movement related impairments indicate the use of a modifier to the diagnosis, e.g. confusion, cognitive deficits.
3. Mild deficits are relevant to treatment but are unlikely to be relevant to diagnosis.

JOINT LIMITATION

Perform traditional tests of joint range of motion.

Interpretation:
1. Use information about joint limitation to guide the use of a descriptor to the diagnosis, e.g. with biomechanical deficit, hip. Significant limitation should guide the therapist to examine for a specific musculoskeletal diagnosis.

MUSCLE TONE / HYPEREXCITABILITY

- Motorneuron Response Assessment
  For the purposes of diagnosis, assessment of muscle tone / hyperexcitability is important in its relationship to a patient’s ability to fractionate movement. Patient’s with more signs of hyperexcitability such as spasticity, the inability to relax after effort, and associated reactions, are likely to have difficulty isolating movement of one limb segment from movement of other limb segments. At different points in time of a patient’s recovery from a neurological deficit, the signs of hyperexcitability may be apparent before there is return of active movement. In these situations, the signs of hyperexcitability may give an earlier indication of the patient’s movement system diagnosis than the patient’s ability to fractionate movement. The Motorneuron Response Assessment (MRA) is a tool that is designed specifically to identify the multiple signs of hyperexcitability. The tool is reliable among multiple testers and valid when compared with the Ashworth scale. The MRA is the preferred test for measuring hyperexcitability for the purposes of diagnosis. It is described in the Appendix to this document.

- Ashworth or Modified Ashworth Scales
  The Ashworth or Modified Ashworth Scales are commonly used measures of spasticity. We have not formally studied the relationship between scores on the Ashworth or Modified Ashworth scale and the results of the Fractionated Movement test.

- Rigidity
  Rigidity is defined as persistent muscle activity at rest. Determine “yes” or “no” rigidity is present by slowly moving the extremities and observing them at rest. It may be useful to have the patient attend to a secondary task during testing.

  yes = resistance is present in both directions and there is the appearance of persistent muscle activity at rest.
Interpretation:  
1 MRA Classification of Moderate, Marked, or Severe or Modified Ashworth scores of 3 or 4 are indicative of Fractionated Movement Deficit.  
2 MRA Classification of Flaccid is indicative of Force Production Deficit with poor prognosis.  
3 MRA Classification of Normal or Mild when there is a CNS lesion is indicative of Movement Pattern Coordination Deficit or Force Production Deficit with good prognosis.  
4 If the LE MRA category is different from the UE MRA category, consider making an UE and LE diagnosis.  
5 Patients with rigidity related to brain injury often demonstrate varying levels of muscle tone based on position. In this situation, attempt to measure the amount of excitability during functional tasks and consider that level when making a diagnosis.

MOVEMENT

- Spontaneous Movement
  Determine "yes" or "no" there is spontaneous movement by observing the patient and noting whether the patient can move against gravity.

  yes = movement against gravity in at least 2 extremities

- Fractionated Movement (FM)
  Determine "yes" or "no" there is fractionated movement by completing the following standardized examination detailed in the Appendix.

  Interpretation:  
 1 FM is an important test for patients with CNS lesions. Patients who have non-fractionated movement are likely to be associated with higher degrees of hyperexcitability and are likely to have a diagnosis of Fractionated Movement Deficit.

- Selective Control Assessment of the Lower Extremity (SCALE)
  The SCALE is commonly used in the pediatric population to measure the ability to fractionated movement. We have not formally studied the relationship between scores on the SCALE and the MRA or other muscle tone scale. However, we expect that values ≤ 5 for either LE would indicate Fractionated Movement Deficit.

- Strength
  Follow principles of manual muscle testing as defined by Kendall in testing the following muscle groups: shoulder flexion, elbow flexion, elbow extension, wrist extension, hip extension, hip flexion, hip abduction, knee extension, dorsiflexion, weight bearing plantarflexion. According to these principles, only fractionated movement is tested. Use the following scale:

  0 = no contraction felt in muscle  
 1 = a feeble contraction may be felt or the tendon may become prominent but there is not visible movement  
 2 = able to move the part through a small arc of motion with gravity lessened  
 3 = able to move the part into the test position and hold against gravity  
 4 = able to hold the test position against gravity and moderate pressure  
 5 = able to hold the test position against gravity and maximum pressure

  Interpretation:
  1 Muscles grades less than 4/5 in the majority of muscles in one or more limbs or more focal weakness in a key muscle group is indicative of Force Production Deficit with a good prognosis.  
  2 A muscle grade less than 3+/5 in the majority of muscles in one or more limbs or more focal weakness in a key muscle group is indicative of Force Production Deficit.
• **Fatigue**

The purpose of this test is to determine if the patient demonstrates signs of skeletal muscle fatigue. Determine “yes” or “no,” the patient demonstrates skeletal muscle fatigue by performing one of the following tests. Two levels of testing are described; the lower level test is used only if the patient cannot participate in the higher level test.

Low level test: the patient is supine
- flex the shoulder to 90° and support the upper arm; ask the patient to **extend the elbow 10 times**
- flex the hip to 90° and support the upper leg; ask the patient to **extend the knee 10 times**

High level test: ask the patient to come to standing from an 18-20 inch surface without UE support 10 times. If the patient cannot initiate standing without UE support, he may use UE support during the initiation phase only.

For either test note a decrease in range of motion of the movement and change in speed.

**yes = decrement in range of motion observed**

**Interpretation:**
1. Fatigue noted during either test is indicative of Force Production Deficit.
2. The purpose of these tests is to draw out skeletal muscle fatigue; if the patient fails for other reasons, such as shortness of breath, increased heart rate, etc, see test for activity tolerance and consider a cardiopulmonary diagnosis.

• **Motor Planning**

Determine “yes” or “no” the patient has deficits in motor planning as evidenced by difficulty organizing necessary movement patterns into purposeful actions

**yes = inconsistency between the degree of fractionated movement produced in isolated testing and in functional activities**

**Interpretation:**
1. Patients with significant motor planning deficits are not likely to fit into one of the defined categories.

• **Non-equilibrium Coordination**

**UE Accuracy:** ask the patient to touch the examiner’s finger then touch his (the patient’s) nose. The examiner’s finger should be at a distance that requires the patient to extend his upper extremity fully and should be placed at 5 varying points before the patient. The patient is told to try to hit the target, i.e. the tip of the finger and the tip of the nose. Count the number of times the patient hits the target (nose or finger), and determine if the patient is:

- not impaired: 0-1 inaccuracies
- mildly impaired: 2-6 inaccuracies
- markedly impaired: 7-10 inaccuracies

**LE Accuracy:** ask the patient to place the heel of one foot on the knee of the other leg and slide the heel down and up the tibia 5 times. Tell the patient to be as precise as possible. Count the number of times the heel does not maintain contact with the tibia. Determine if the patient is:

- not impaired: 0-1 inaccuracies
- mildly impaired: 2-6 inaccuracies
- markedly impaired: 7-10 inaccuracies

**UE Reciprocal Movement:** ask the patient to rapidly supinate and pronate the forearm for 10-20 seconds. Determine if the patient is:

- normal
LE Reciprocal Movement: ask the patient to sit with the heel on the ground and rapidly tap the toe for 10-20 seconds.\textsuperscript{19} Determine if the patient is:

- normal
- slow

Interpretation:

\textsuperscript{1}More than mild deficits are indicative Dysmetria.

**SENSATION**

- Joint Position Sense
  
  Have the patient sit or lie with the heel and leg supported. Grasp the lateral aspect of the great toe and move the toe into flexion and extension passively.\textsuperscript{19} Encourage the patient to relax. Show the patient that a position into flexion is “down” and a position into extension is “up.” Ask the patient to close his eyes. Move the toe into flexion or extension randomly 5 times. After each movement, ask the patient to tell you if the toe is up or down. Determine the accuracy of the patient’s responses using the following scale:

  - not impaired = no inaccuracies
  - mildly impaired = inaccurate 1-2 times
  - moderately impaired = inaccurate 3-4 times
  - severely impaired = inaccurate 5 or more times

Repeat the test in the same fashion at the ankle and knee.

Interpretation:

\textsuperscript{1}More than mild deficits at the toe and ankle or mild deficits at the ankle and knee are indicative of Sensory Detection Deficit.

\textsuperscript{2}If a loss of joint position sense is coupled with a marked motor impairment, the diagnosis is most likely to be related to the motor impairment; in this circumstance consider using “with sensory loss” as a modifier to the diagnosis.

- Contraversive Pushing or Backward Disequilibrium Behavior
  
  This movement behavior may be observed in either the medial/lateral (contraversive pushing) or posterior (retropulsive pushing) directions. The hallmark of contraversive pushing behavior is: 1) abduction and extension of the limbs in sitting or standing either spontaneously or when changing position and 2) resistance to passive correction. Contraversive pushing behavior can be measured using the Scale for Contraversive Pushing.\textsuperscript{22, 23}

Retropulsive pushing behavior is characterized by: 1) trunk extension in sitting or posterior displacement of COM through ankle PF in standing and 2) resistance to passive correction. Retropulsive pushing behavior may be measured using the Backward Disequilibrium Scale.\textsuperscript{24}

\begin{itemize}
  \item yes = both hallmark signs of either contraversive or retropulsive pushing behavior present or scores > 0 on the “Use of the nonparetic extremities” and “Resistance to passive correction of tilted posture” subscales on the SCP.\textsuperscript{25}
\end{itemize}

Interpretation:

\textsuperscript{1}Contraversive or Retropulsive pushing behavior is indicative of Postural Vertical Deficit.

\textsuperscript{2}If the deficit related to pushing behavior is significant and coupled with a motor deficit, the diagnosis is most likely Postural Vertical Deficit.

- Vertical Orientation (without pushing behavior)
Observe the patient during postural control tests and ambulation for displacement of the center of mass toward one side or in the posterior direction. Provide physical assistance and/or visual cues to see if the patient can correct his vertical orientation.

| yes | COM consistently shifted away from the COM alignment; able to correct with physical assistance or cues |

**Interpretation:**
1. *Altered vertical orientation without pushing behavior is indicative of Sensory Selection and Weighting Deficit*

- **Disregard**

  Observe the patient’s attention to his environment and note any inconsistencies in attention to one side more than the other. Examples may include lying on one side of the bed or positioning himself toward one side of a chair, lack of head turning to one side, inability to clear objects on one side during locomotion.

| yes | decreased attention to one side |

**Interpretation:**
1. Although disregard for a side of the body is often associated with altered perception of midline, it is not always the case.
2. If the test for disregard is positive but the test for midline perception is not, use “with disregard,” as a modifier to the diagnosis; in this situation the diagnosis should be consistent with the motor deficit.

- **Sensitivity to Sensory Stimuli**

  Ask the patient to visually track your finger to the side, up and down, and randomly while holding the head still. Ask the patient if he has any symptoms while performing this test such as dizziness, headache, nausea, etc. Note any signs of gaze aversion. If the patient is not impaired in this test but reports other specific motion related triggers of symptoms, modify test in accordance with the patient’s specific complaints, e.g. 180° or 360° turns, repeated turns, repeated head turning, etc.

Observe the patient’s response to auditory and visual motion cues in the environment. Look for increased postural sway, loss of balance, and/or stoppage of movement in the presence of these sensory cues.

Observe the patient for self-stimulation behaviors such as repeated rocking, spinning, or hitting of the limb or head.

| yes | dizziness or dizziness related symptoms and/or signs of movement deterioration related to sensory stimuli while performing any of the above tests |

**Interpretation:**
1. Symptoms with eye and/or head movements may indicate the diagnosis Sensory Selection and Weighting Deficit.
2. If there are abnormal motor findings with eye movements and no diagnosed neurological pathology, consult a physician.
3. Signs of movement deterioration with sensory stimuli or efforts to increase sensory stimuli may indicate the diagnosis Sensory Selection and Weighting Deficit.

**PAIN**

Ask the patient to rate the severity of pain on a scale of 0 to 10 where:

| 0  | no pain |
| 10 | extreme pain |

Determine “yes” or “no” the pain is musculoskeletal in origin.

| yes | pain decreases with change in alignment, positioning, or support |

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**ACTIVITY TOLERANCE**

Determine “yes” or “no” the patient is able to tolerate activity by assessing vital signs and signs of distress during exertion.

\[ \text{No} = \begin{align*} & \text{decrease in heart rate, irregular rhythm, or inability to recover to resting rate after two minutes} \\ & \text{or} \\ & \text{decrease in systolic blood pressure, increase in diastolic blood pressure greater than 10 mm HG} \\ & \text{or} \\ & \text{labored breathing as evidenced by increased use of accessory muscles and increased rate} \\ & \text{or} \\ & \text{sustained decreased in O}_2\text{ saturation below 90 or other medical guideline} \\ & \text{or} \\ & \text{increase in intracranial pressure above 15 or other medical guideline} \end{align*} \]

**Interpretation:**

1. This test is used as a screening test for musculoskeletal pain; this system of diagnoses does not address musculoskeletal pain syndromes.

1. This test is a screening test for cardiopulmonary impairments; this system of diagnoses does not address specific cardiopulmonary syndromes.
Motorneuron Response Assessment

Following the description and interpretation of the MRA are comments related to other standardized tools used to assess muscle tone and their use for the purposes of diagnosis.

Motorneuron Response Assessment (MRA)

The following is the description of the 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 in different patient types.

1) Purpose
   a) examine the overall level of excitability
   b) tests for spasticity, ability to relax after attempted active movement, and associated reactions

2) General guidelines
   a) test all movements in supine
   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 (PROM) of each extremity involved
   d) explain to the patient that he should remain as relaxed as possible except for those tests in which he is to perform a movement actively
   e) instruct the patient that with active movements, his effort should be just enough to accomplish the movement requested
   f) determine that the patient understands the directions before rating his response; if he has difficulty with directions, note this.
   g) assure the patient that the test will not harm him
   h) perform 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) Upper Extremity (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 to the test; they are as follows:
      i) Passive movement of the entire upper extremity (PROM): Instruct the patient to remain relaxed and not assist with the movements. With the extremity in the described testing position, passively range 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° 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 lower extremity (IPSIL LE): From the starting position, passively flex the involved LE to assess ROM and to demonstrate to the patient the motion you will want him to attempt.
Ask the patient to attempt to flex his 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 each attempt.

v) Active hip and knee flexion of the contralateral lower extremity (CONTRA LE): In the same position as describe above, perform the same test with the uninvolved LE. Monitor for activity in the involved UE.

4) Lower Extremity test
   a) position the patient supine with both lower extremities 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 to the test; they are as follows:
      i) Passive movement of the entire lower extremity (PROM): Instruct the patient to remain relaxed and not to assist with the movement. Passively range 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 lower extremity 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 the criteria of 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 is then classified appropriately.
   c) Note the patient’s response on the other items of the test as well, but base the overall classification according to the asterisked criteria.

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
   While the MRA has been tested in our clinic on patients with hemiplegia, it is suggested 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 may also 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 hamstrings.

Fractionated Movement (FM)

Determine “yes” or “no” there is fractionated movement by completing the following standardized examination:

1) General Guidelines
   a) test all movements in sitting 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 and/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) perform all tests on the involved extremities
2) Upper Extremity test  
   a) there are 5 components of the test  
      i) Ask the patient to flex his shoulder. Movement is fractionated if the patient moves the shoulder through at least 50% of available range 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 available range 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 available range 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 available range 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 available range without substitution or other associated reactions.  

3) Lower Extremity test  
   a) there are 3 components to 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 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 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 available range of motion without substitution or other associated reactions.  

4) Fractionated Movement Category Criteria  
   a) Upper Extremity  
      Each joint is rated separately. If the patient is able to complete the task as defined, he is given a “yes” on the data sheet for that task. All tasks are rated for each patient.  
      If the patient is unable to complete the task because he has no movement at a given segment, mark it on the data sheet.  

   b) Lower Extremity  
      Each joint is rated separately. If the patient is able to complete the task as defined, he is given a “yes” on the data sheet for that task. All tasks are rated for each patient.  
      If the patient is unable to complete the task because he has no movement at a given segment, mark it on the data sheet.
SAMPLE CLINICAL FORM - Physical Therapy Initial Examination (Objective, Assessment, Plan)

O:

Observation: ..........................................................................................................................................................

Vital signs: rest HR _____ BP _____ RR _____ O₂ sat _____
            activity HR _____ BP _____ RR _____ O₂ sat _____
            recovery HR _____ BP _____ RR _____ O₂ sat _____

Mental status: _____ no deficits noted _____ impaired in the following: __________________________________________

Special senses: (vision, hearing, etc.) .................................................................................................................

SUPINE TESTS

Edema: _____ no deficits noted _____ present in the following: __________________________________________________

Skin: _____ no deficits noted _____ problems noted in the following: __________________________________________

ROM: _____ no deficits noted _____ deficits noted in the following: ____________________________________________

Muscle tone: _____ normal _____ abnormal ........................................................................................................

Sensation: _____ no deficits noted

_____ impaired in the following:

  I touch: ............................................................................................................................................................
  pain/temperature: ..............................................................................................................................................
  joint position sense: ...........................................................................................................................................
  protective sensation: ...........................................................................................................................................

Strength:

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Skeletal muscle fatigue:

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<tr>
<td>fatigue with 10 reps knee extension?</td>
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Rolling left: (without rails)

assistance: with task: ___________________________

analysis: (check all that apply)

☒ essential movement components present
☒ generates momentum with upper body on initiation
☒ insufficient shoulder flexion/horizontal add. on initiation
☒ insufficient trunk rotation during execution
☒ shifts left hip under right hip during execution
☒ insufficient hip flexion/pelvic rotation on initiation

response to practice: improves fatigue no change

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Rolling right: *(without rails)*

**assistance:** with task: ___________________

**analysis:** *(check all that apply)*
- ☐ essential movement components present
- ☐ generates momentum with upper body on initiation
- ☐ insufficient head/upper trunk rotation on initiation
- ☐ insufficient shoulder flexion/horizontal add. on initiation
- ☐ insufficient trunk rotation during execution
- ☐ shifts left hip under right hip during execution
- ☐ insufficient hip flexion/pelvic rotation on initiation

**response to practice:** improves  
fatigues  
no change

Rolling left: *(with rail)*

**assistance:** with task: ___________________

**response to practice:** improves  
fatigues  
no change

Rolling right: *(with rail)*

**assistance:** with task: ___________________

**response to practice:** improves  
fatigues  
no change

Supine to Sit:

**assistance:** with task: ___________________

**response to practice:** improves  
fatigues  
no change

Sit to Supine:

**assistance:** with task: ___________________

**response to practice:** improves  
fatigues  
no change

**SITTING TESTS**

**Special tests:**

Deficits/symptoms noted in the following:
- field cut  
- smooth pursuit  
- saccades  
- DVA  
- head thrust  
- Dix-Hallpike  
- tolerance to busy visual backgrounds

**Fractionated movement:**

<table>
<thead>
<tr>
<th>Movement</th>
<th>L</th>
<th>R</th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder flexion</td>
<td>yes</td>
<td>no</td>
<td>Hip flexion</td>
<td>yes</td>
</tr>
<tr>
<td>Elbow flexion</td>
<td>yes</td>
<td>no</td>
<td>Knee extension</td>
<td>yes</td>
</tr>
<tr>
<td>Wrist flex/ext</td>
<td>yes</td>
<td>no</td>
<td>DF</td>
<td>yes</td>
</tr>
<tr>
<td>Hand</td>
<td>yes</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finger</td>
<td>yes</td>
<td>no</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Non-equilibrium coordination:**

<table>
<thead>
<tr>
<th>Test</th>
<th>L Impaired</th>
<th>R Impaired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left UE RAM</td>
<td>not impaired</td>
<td>slow</td>
</tr>
<tr>
<td>Right UE RAM</td>
<td>not impaired</td>
<td>slow</td>
</tr>
<tr>
<td>Left FNF</td>
<td>not impaired</td>
<td>mildly impaired</td>
</tr>
<tr>
<td>Right FNF</td>
<td>not impaired</td>
<td>mildly impaired</td>
</tr>
<tr>
<td>Left LE RAM</td>
<td>not impaired</td>
<td>slow</td>
</tr>
<tr>
<td>Right LE RAM</td>
<td>not impaired</td>
<td>slow</td>
</tr>
<tr>
<td>Left HKS</td>
<td>not impaired</td>
<td>mildly impaired</td>
</tr>
<tr>
<td>Right HKS</td>
<td>not impaired</td>
<td>mildly impaired</td>
</tr>
</tbody>
</table>
Reach and Grasp:

- **Y** N NT point to and reach for objects in front and to sides at shoulder height
- **Y** N NT point to and reach for objects overhead
- **Y** N NT lift and release 3 objects of different size, weight, shape, and texture
- **Y** N NT stack 3-4 small blocks or cubes

### Analysis:
- (Check all that apply)
  - [ ] essential movement components present
  - [ ] motion is non-fractionated
  - [ ] insufficient active motion at shoulder
  - [ ] insufficient active motion at elbow
  - [ ] insufficient active motion at wrist
  - [ ] insufficient active motion in hand
  - [ ] overshooting for target
  - [ ] lack of hand positioning during reach
  - [ ] awkward hand position on object
  - [ ] insufficient hand opening to grasp object
  - [ ] contact with object at web space before fingers
  - [ ] poor modulation of force for object type

### Response to Practice:
- improves
- fatigues
- no change

In-Hand Manipulation:

- **Y** N NT Adjust pencil from palm to ready for use
- **Y** N NT Rotate pencil in hand

### Analysis:
- (Check all that apply)
  - [ ] essential movement components present
  - [ ] motion is non-fractionated
  - [ ] insufficient active motion
  - [ ] overshoots for pencil
  - [ ] movement slow and awkward
  - [ ] poor modulation of force for pencil

### Response to Practice:
- improves
- fatigues
- no change

Postural Control:

- (Firm surface, feet supported, back unsupported, arms across chest; check all that apply)

  - ______ unable to sit unsupported; assistance required:
  - **Y** N NT unsupported with eyes open (10 s)
  - **Y** N NT move UE or LE without displacing trunk and without loss of balance
  - **Y** N NT displace trunk during reaching and return to starting position without loss of balance

### Analysis:
- (Check all that apply)
  - [ ] structural alignment fault
  - [ ] falls without support
  - [ ] sits asymmetrically
  - [ ] COM shifted away from midline; corrects with cues or instruction
  - [ ] COM shifted away from midline; resists correction
  - [ ] excessive sway at trunk; requires UE

### Response to Practice:
- improves
- fatigues
- no change
### Sit to Stand: *(without UE support)*

**Assistance:**

- □ essential movement components present
- □ unable to assume normal starting position; stiffness
- □ absent or delayed preparatory movements

**Initiation:**
- □ increased base of support
- □ posterior displacement of trunk
- □ insufficient force production
- □ uses a momentum strategy
- □ excessive trunk sway
- □ resists assistance of trunk movement forward or to midline

**Execution:**
- □ medial hip rotation
- □ hip adduction
- □ valgus of knee
- □ varus of knee
- □ extends knees before hips in first half
- □ pushes on thighs to extend trunk
- □ decreased weight bearing
- □ insufficient translation of tibia over foot

**Response to practice:**
- □ improves

**Analysis:**
- □ essential movement components present
- □ unable to assume normal starting position; stiffness
- □ absent or delayed preparatory movements

**Initiation:**
- □ increased base of support
- □ posterior displacement of trunk
- □ insufficient force production
- □ uses a momentum strategy
- □ excessive trunk sway
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- □ medial hip rotation
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- □ varus of knee
- □ extends knees before hips in first half
- □ pushes on thighs to extend trunk
- □ decreased weight bearing
- □ insufficient translation of tibia over foot

**Response to practice:**
- □ improves

### Stand to Sit: *(without UE support)*

**Assistance:**

- □ essential movement components present
- □ insufficient hip flexion during execution

**Response to practice:**
- □ improves

**Analysis:**
- □ essential movement components present
- □ insufficient hip flexion during execution

**Response to practice:**
- □ improves

### Sit to Stand: *(with UE support)*

**Assistance:**

- □ shifts COM to one side
- □ shifts COM to one side or back; corrects with cues/instruction
- □ shifts COM to one side or back; resists correction
- □ slow
- □ abnormal movement synergy
- □ arrests of ongoing movement
- □ excessive trunk sway

**Termination:**
- □ steps to find balance
- □ repeated stepping to find and maintain balance
- □ increased lumbar extension
- □ inadequate hip extension
- □ inadequate knee extension
- □ posterior sway
- □ shifts COM to one side
- □ shifts COM to one side or back; corrects with cues/instruction
- □ shifts COM to one side or back; resists correction
- □ increased BOS with excessive sway at hips

**Response to practice:**
- □ improves

**Analysis:**
- □ essential movement components present
- □ unable to assume normal starting position; stiffness
- □ absent or delayed preparatory movements

**Initiation:**
- □ increased base of support
- □ posterior displacement of trunk
- □ insufficient force production
- □ uses a momentum strategy
- □ excessive trunk sway
- □ resists assistance of trunk movement forward or to midline

**Execution:**
- □ medial hip rotation
- □ hip adduction
- □ valgus of knee
- □ varus of knee
- □ extends knees before hips in first half
- □ pushes on thighs to extend trunk
- □ decreased weight bearing
- □ insufficient translation of tibia over foot

**Response to practice:**
- □ improves

**Response to practice:**
- □ improves

**Response to practice:**
- □ improves

Property of Scheets, Crowner, Norton, Sahrmann, and Stith –
DO NOT COPY WITHOUT PERMISSION
March, 2017
Stand to Sit: (without UE support)

**assistance:**

- □ essential movement components present
- □ insufficient knee flexion on initiation and during execution
- □ insufficient hip flexion during execution
- □ inadequate control of descent into chair

**response to practice:** improves

**fatigues**

**no change**

Surface to Surface Transfers:

**assistance:** with task: ___________________ with set-up: ___________________

**analysis:** (check all that apply)

- □ essential movement components present
- □ insufficient force production to initiate transfer
- □ insufficient weight bearing on LE during transfer
- □ poor judgment during transfer

**response to practice:** improves

**fatigues**

**no change**

**STANDING TESTS**

**Alignment:** (check all that apply)

<table>
<thead>
<tr>
<th>Cervical</th>
<th>Thoracic</th>
<th>Lumbar</th>
<th>Pelvis</th>
<th>Hip/femur</th>
<th>Knee/tibia</th>
<th>Ankle</th>
<th>Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>head forward</td>
<td>kyphosis</td>
<td>flexion</td>
<td>ant. tilt</td>
<td>medial rot.</td>
<td>hyperextension</td>
<td>flexion</td>
<td>pronation</td>
</tr>
<tr>
<td>extension</td>
<td>scoliosis</td>
<td>extension</td>
<td>post. tilt</td>
<td>lateral rot.</td>
<td>plantarflexion</td>
<td>valgus</td>
<td>supination</td>
</tr>
<tr>
<td>lateral tilt</td>
<td>flat</td>
<td>scoliosis</td>
<td></td>
<td>varus</td>
<td></td>
<td>valgus</td>
<td></td>
</tr>
</tbody>
</table>

**Postural control** (without assistive device): (check all that apply)

- □ unable to stand unsupported; assistance required:
  - Y N NT unsupported feet hip width apart once placed
  - Y N NT unsupported feet shoulder width apart with eyes open (30 s)
  - Y N NT unsupported feet shoulder width apart with eyes closed (30 s)
  - Y N NT move UE or LE without changing base of support without loss of balance
  - Y N NT displace trunk during reaching and return to starting position without loss of balance
  - Y N NT feet together with eyes open (15 s)
  - Y N NT feet together with eyes closed (15 s)

**analysis:** (check all that apply)

- □ structural alignment fault
- □ hesitation or multiple efforts to assume position
- □ falls without support
- □ stands asymmetrically
- □ shifts COM away from midline; resists correction
- □ shifts COM away from midline; improves with cues and instruction
- □ aversion to eyes closed condition

**response to practice:** improves

**fatigues**

**no change**
Advanced Postural Control (without assistive device): (check all that apply)

Y N NT step-up (alternate placement of foot on 4-6 inch step)
Y N NT one foot (10 s)

additional measures: ______________________________________________________________________

analysis: (check all that apply)

☐ prefers wide BOS
☐ hesitation and/or multiple starts when changing BOS or initiating movement
☐ UE guarding, grabbing, or reaching
☐ circumduction or insufficient hip flexion of swing limb for step-up
☐ lateral trunk flexion toward stance limb
☐ hip flexion or hip drop on stance limb
☐ knee flexion of stance limb
☐ knee hyperextension of stance limb

response to practice: improves fatigues no change

posterior sway of stance limb
loss of balance with forward movement of swing limb during step-up
loss of balance with backward movement of swing limb during step-up
loss of balance to left or right
inconsistent foot placement on step during step-up
excessive sway at trunk/hips; repeated stepping to maintain balance

Modified CTSIB: (feet almost touching; hands on hips; record duration patient can stand in each condition up to 30 s; use medium density 4inch Tempur foam)

Firm surface eyes open ______
Firm surface eyes closed ______
Foam surface eyes open ______
Foam surface eyes closed ______

Gait:

assistance: with task: ________________ with set-up: ________________
device: walker wheeled walker cane quad cane crutches other ________________
speed: _______ ft in _______ seconds (normal for older adults 2.2-3.3 ft/s; MCID 0.32 ft/s)

analysis: (check all that apply)

☐ essential movement components present

Stance:

☐ decreased base of support
☐ increased base of support
☐ decreased weight bearing
☐ increased pelvic/lumbar rotation
☐ lateral trunk shift toward stance limb
☐ ↓ hip extension mid- to terminal stance
☐ hip drop
☐ hyperextension of knee
☐ sustained hip/knee flexion
☐ decreased plantarflexion
☐ increased pronation

Swing:

☐ hip hiking
☐ circumduction
☐ vaulting
☐ inadequate hip flexion
☐ inadequate dorsiflexion
☐ decreased step length
☐ increased step length

Overall:

☐ variable foot placement
☐ variable line of progression
☐ line of progression deviates left or right

response to practice: improves fatigues no change

Six-minute walk test: (normal for older adults about 1366 ft; MCID 164 ft)

Distance/device: __________________________________________________________________________

RPE and vital signs: __________________________________________________________________________
Complex Gait: assistance:

<table>
<thead>
<tr>
<th></th>
<th>Y</th>
<th>N</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk and turn head side to side</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step forward/backward</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Step over obstacle</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>180° turn</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Carry</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Compliant surface</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dim lighting</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**analysis:** (check all that apply)
- deviation in line of progression with head turning
- symptoms with head turning
- hesitates or takes extra steps when changing direction
- poor control of momentum when stepping forward or back
- hesitates before stepping over obstacle
- poor adjustment in step length to step over obstacle
- insufficient hip flexion to step over obstacle

**response to practice:** improves fatigues
difficulty clearing second limb when stepping over obstacle
steps to recover balance with stepping over
insufficient hip/knee extension moment when stepping over
instability with carrying
increased loss of balance on varying surfaces
increased loss of balance in dim lighting
slow/increased loss of balance when transitioning from one sensory context to another
no change

**Stairs: (with rails)**

**assistance:**

**analysis:** (check all that apply)
- essential movement components present
  Up:
  - insufficient hip flexion of swing limb
  - insufficient hip extension on stance limb
  - insufficient knee extension on stance limb
  - increased sway on stance limb

**Down:**
- medial hip rotation on stance limb
- poor control of forward momentum

**Stairs: (without rails)**

**assistance:**

**analysis:** (check all that apply)
- essential movement components present
  Up:
  - insufficient hip flexion of swing limb
  - insufficient hip extension on stance limb
  - insufficient knee extension on stance limb
  - increased sway on stance limb

**Down:**
- medial hip rotation on stance limb
- poor control of forward momentum

Floor to/from stand transfers:

Stand directly: yes no
UE support: yes no unable

Activity tolerance: (check all that apply)
- No deficits noted
- SOB with recovery within 2-5 minutes
- SOB with recovery > 5 minutes
- Irregular heart rhythm
- Abnormal BP response
- Requires frequent rests during exam

Pain scale: (0=none; 10=intolerable) ______/10 noted in the following: (circle)
- incision
- abdomen
- wound
- neck
- shoulder
- back
- hip
- knee
- feet
- ______ other

Type of pain: dull sharp aching stinging deep ______ other

Change in pain during session: ________________________________
A:
Patient’s examination is consistent with a movement system impairment diagnosis/working diagnosis of:

- Movement Pattern Coordination Deficit
- Force Production Deficit
- Sensory Detection Deficit
- Sensory Selection and Weighting Deficit
- Postural Vertical Deficit
- Fractionated Movement Deficit
- Hypokinesia
- Dysmetria

Additional data needed to confirm a working diagnosis: __________________________________________________________

Patient’s movement faults (impairments) associated with the diagnosis are believed to contribute to the following problems:

- decreased independence with mobility
- inability to perform tasks with sufficient:
  - consistency
  - flexibility
  - efficiency
- inability to tolerate continuous activity
- instability in sitting
- instability in standing
- instability with walking
- impaired safety awareness
- need for home exercise program to promote further gains, to maintain status, and to prevent decline
- need for education in __________________ to promote further gains, to maintain status, and to prevent decline
- need for fall prevention
- need for family instruction in to promote further gains, to maintain status, and to prevent decline
- pain during functional activities or at rest

Prognosis for improvement in impairments in body structure/function: good fair poor

Prognosis for improvement in activity limitations: good fair poor

Patient’s personal factors that are likely to contribute to outcome: __________________________________________________

Patient’s environmental factors that are likely to contribute to outcome: __________________________________________________

P:
Patient participated in planning and goal setting to the fullest extent possible.

Treatment frequency: ____________________________  Duration of sessions: ____________________________

Duration of services: __________________________________________________

Direct interventions include:

- functional training
- gait training
- monitored mobility
- aerobic conditioning
- positioning
- postural control activities
- ROM/stretching
- therapeutic exercise
- task practice
- w/c training
- other

Coordination/Communication: __________________________________________________
## Patient related instruction:

____________________________________________________________________________________________

Patient to demonstrate the following:

### STG:

<table>
<thead>
<tr>
<th>Activity or Task</th>
<th>Performance Conditions</th>
<th>Assistance Needed</th>
<th>Goal Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

### LTG: (by final discharge from physical therapy services in ________________ wks or mos):

<table>
<thead>
<tr>
<th>Activity or Task</th>
<th>Performance Conditions</th>
<th>Assistance Needed</th>
<th>Goal Date</th>
</tr>
</thead>
<tbody>
<tr>
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