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# Neuro Notes

Clinical Pocket Guide

Claudia B. Fenderson  
Wen K. Ling

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- ...and more!

# Neuro Notes

Clinical Pocket Guide

**Claudia B. Fenderson, PT, EdD, PCS  
Wen K. Ling, PT, PhD**

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A Davis Note's Book



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## Preface

This book is written for physical therapists, physical therapy students, and related health professionals. It is a clinical guide for the assessment of patients with neuromuscular disorders. Please use the tables in the INTRO tab to quickly find information on specific diseases/disorders or test and measures.

In addition to the content you'll find here, we have also provided bonus content on the DavisPlus Web site for this book. On the Web site you will find content regarding neurological diagnostic tests and additional information about diseases and disorders, including special tests, additional assessments, differential diagnosis, prognosis, surgery, and referrals to other health-care providers. There is also a glossary of neurological terms commonly used by PTs.

Please visit <http://davisplus.fadavis.com> to review the bonus material.

*Claudia B. Fenderson  
Wen K. Ling*

## Directory of Diagnoses and Tests and Measures

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**ICD-9-CM CODES—*Cont'd***

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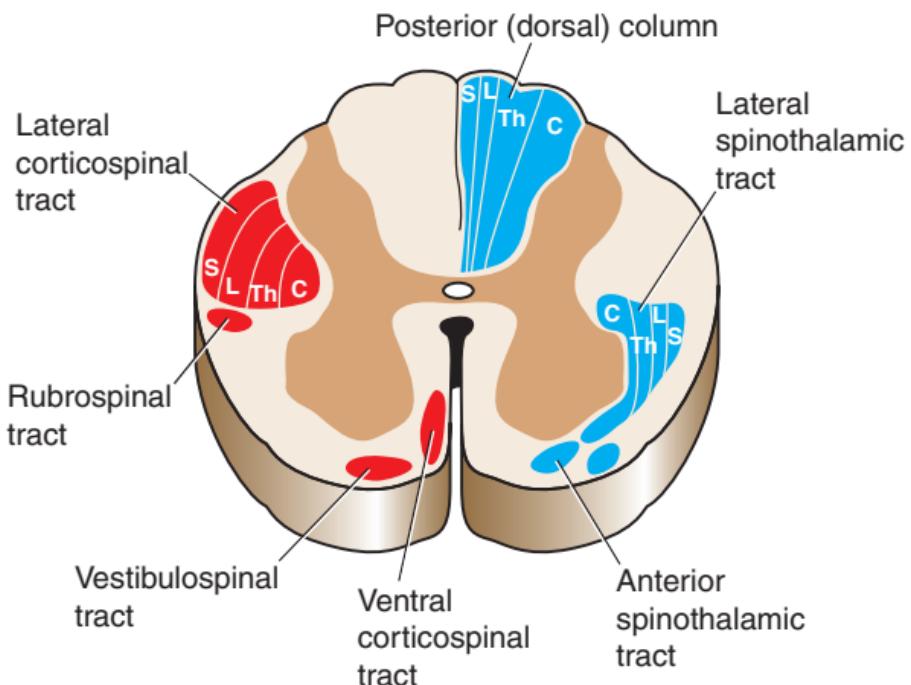
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## Physical Therapy Examination for Patients with Neuromuscular Disorders

### Sensory Function Neuroanatomy and Pathology

Pathways	Sensations	Symptoms
Posterior (dorsal) columns	Deep touch, 2-point discrimination, vibration, joint position	Ipsilateral loss
Lateral spino-thalamic tract	Pain & temperature	Contralateral loss
Anterior spino-thalamic tract	Nondiscriminative touch	Contralateral loss



**S:** Sacral **L:** Lumbar **TH:** Thoracic **C:** Cervical

## Motor Function Neuroanatomy and Pathology

Pathways	Functions	Symptoms
Lateral corticospinal tract	Contralateral limb voluntary movement	Spasticity, Babinski's sign, synergistic movement
Ventral corticospinal tract	Ipsilateral limb voluntary movement	Spasticity, Babinski's sign, synergistic movement
Rubrospinal tract	Muscle tone of flexors	Spasticity
Vestibulospinal tract	Ipsilateral upright posture & anti-gravity musculature	Impaired posture & balance

## Autonomic Nervous System Functions

Organ and System	Sympathetic Nervous System	Parasympathetic Nervous System
Pupils	Dilates	Constricts
Saliva & tear glands	Inhibits salivation & tearing	Stimulates salivation & tearing
Bronchi (airways)	Relaxes	Constricts
Blood vessels	Constricts	
Heart	Accelerates heartbeat	Slows heartbeat
Gastrointestinal system	Inhibits digestion (slows peristalsis & decreases digestive enzyme secretion)	Stimulates digestion (increases peristalsis & dilates intestinal blood vessels)
Adrenal medulla	Stimulates epinephrine & norepinephrine secretion	
Urinary bladder	Relaxes	Contracts

## Medical Red Flags

Red Flags indicate medical emergency situations. If the following signs or symptoms are demonstrated, terminate examination and intervention; then immediately call for medical assistance.

- Abnormal breath or heart sounds
- Blood pressure (systolic blood pressure >200 mm Hg or <90 mm Hg; diastolic blood pressure >110 mm Hg)
- Chest pain caused by exertion
- Clonus onset
- Cyanosis
- Diaphoresis (excessive sweating)
- Drastic mental status changes (sudden disorientation, confusion, drowsiness, lethargy)
- Drastic mood changes (anxiety, apprehension)
- Myasthenia crisis: muscle weakness interfering with vital functions (e.g., breathing, swallowing)
- Nausea & vomiting in patients with shunts
- Oxygen saturation <90%
- Seizure (lasting more than 5 minutes; two or more sequential seizures without recovery of consciousness)
- Sudden:
  - Ataxia onset
  - Blood pressure changes (increase or decrease)
  - Coordination changes
  - Muscle tone changes (increase or decrease)
  - Pulse changes (regular to irregular; dropping by >15 bpm; exceeding 75% of age-expected maximum)
  - Severe headache
  - Weakness, hemiparesis or paralysis
- Syncope
- Transient paralysis
- Vision or speech distortion (slurred or hoarse voice)

### Instruments Used for a Neuromuscular Examination

- Blood pressure cuff
- Circular disk (two point discrimination)
- Extracts (vanilla & lemon) to test olfactory nerve
- Flashlight
- Frenzel lenses
- Monofilament test kit
- Cotton swab or a cotton ball to test light touch
- Reflex hammer (with a small brush and sharp/dull metal component)

- Stereognosis testing materials  
(penny, key, paper clip, & a small brown bag)
- Stethoscope
- Tape measure
- Tongue depressor
- Tuning fork (512 Hz)
- Universal goniometer

## Physical Therapy Examination

### History:

Date of birth:	Age:				
Gender: M F	Marital status: M S D W				
Race: Native American	Caucasian	African American	Hispanic	Asian	Other
Primary language:					
Highest level of education					
Employment/school:					
Chief complaint:					
Date of onset:					
Handedness:	Right	Left			
Family support/living arrangements					
Medications:					
Herbal supplements:					
Previous hospitalizations:					
Previous surgery:					
Developmental history					
Do you smoke?	If yes, how often?				
Do you drink alcohol?	If yes, how often?				
Do you use illegal drugs?	If yes, what drugs & how often?				
Do you use illegal IV drugs?	If yes, what drugs & how often?				



**Consideration:** When discussing prenatal history of child, ask questions sensitively to avoid having parents feel that they are at fault for their child's problems.

### Medical Screening

Have you ever experienced or been told that you have any of the following?

	Y/N		Y/N
Asthma		Chronic bronchitis	
Emphysema		Shortness of breath	
Chest pain		High blood pressure	
Heart disease		Blood clot	
Stroke		Head injury/concussion	
Dizziness		Fainting	
Epilepsy/seizures		Migraine/other headaches	
Arthritis		Osteoporosis	
Gout		Cancer	
Diabetes		Visual loss	
Ear infections		Hearing loss	
Allergies		Chemical dependency	
AIDS/HIV		Depression	
Kidney disease		Urinary tract infection	
Hepatitis/jaundice		Thyroid problems	
Bowel/bladder problem			
Blood disorder		Anemia	
Pregnancy		Fibromyalgia	
Other: describe			

## Medical Tests

Have you had any of the following?

Test	Yes/No	Results
Radiograph		
CT Scan		
MRI		
PET		
SPECT		
Ultrasound		
Bone Scan		
Blood tests		
Biopsy		
EMG or NCV		
ECG/stress test		
Other (list)		

## Vital Signs

Should be taken:

- Initially on all patients for baseline
- For all sessions for patients who are medically unstable or have risk factors for cardiopulmonary complications
- To assess response to intervention

Temperature		
Pulse	Rate	
	Rhythm	
	Quality	
Respiratory rate		
Blood pressure		

Normal body temp is  $98.6^{\circ}\text{F} \pm 1^{\circ}$  or  $37^{\circ}\text{C} \pm 1.5^{\circ}$

Older adults' body temp may be lower ( $96.5\text{--}97.5^{\circ}\text{F}$ ).

Age	Pulse (beats/min)	Respiratory Rate	Systolic Blood Pressure	Diastolic Blood Pressure
Preterm	120–160	30–60	32–52	13–29
Newborn	100–160	30–60	50–70	29–45
3 months	100–160	30–60	65–105	34–68
6 months	110–160	24–38	70–118	50–70
1 year	90–150	22–30	66–126	41–91
3 years	80–125	22–30	74–124	39–89
5 years	70–115	20–24	79–119	45–85
10 years	60–100	16–22	92–132	53–83
14 years	60–100	14–20	100–140	60–90
Adults	60–90	12–20	95–119	60–79
Older adults	60–90	15–22	90–140	60–90
Findings				

Source: Available at: [http://www.emedicinehealth.com/pediatric\\_vital\\_signs/article\\_em.htm](http://www.emedicinehealth.com/pediatric_vital_signs/article_em.htm). Accessed January 16, 2007.

## Tests and Measures

### Aerobic Capacity/Endurance

- Assess blood pressure (BP), respiratory rate (RR), & heart rate (HR) (wrist, carotid, and/or pedal) in supine, sitting, & standing, at rest & during & after exercise
- If available, review pulse oximetry, blood gas, tidal volume, & vital capacity
- Administer a 2- or 6-minute walk test
- Administer Borg Rating of Perceived Exertion after walk test or other physical activity

**The Borg Rating of Perceived Exertion**

Instruct the patient to rate their perception of exertion while performing exercise by combining all sensations and feelings of physical stress, effort and fatigue. Explain that the scale ranges from 6 to 20, where 6 means "no exertion at all" and 20 means "maximal exertion."

Image rights not available.

## Energy Expenditure Index

Walking heart rate	
Resting heart rate	
Walking speed	
Energy expenditure index (beats/meter)	
(Walking HR – Resting HR ÷ Walking speed)	

Source: Rose J, et al. The energy expenditure index: A method to quantitate and compare walking energy expenditure for children and adolescents. *J Ped Orthopedics*. 1991;1(5):571–578.

 Calculated as the walking heart rate minus the resting heart rate divided by the walking speed to cover 55 meters; recorded as beats per meter.

## Anthropometric Characteristics

### Assessment

- Record weight, height, & body mass index (BMI)
  - Underweight  $\leq 18.5$
  - Normal 18.5–24.9
  - Overweight 25–29.9
  - Obese  $\geq 30$

Source: Available at: <http://www.nhlbisupport.com/bmi/bmicalc.htm>. Accessed November 27, 2007.

Weight (kg) (2.2 lbs = 1 kg)	Height (m) (1 in. = 0.025 m)	BMI ( $\text{kg}/\text{m}^2$ ) (weight/ $\text{height}^2$ )

- Measure body dimensions (girth measurements, head circumference, leg length, arm length, & torso length)
-  For children's normal weight, height, & head circumference, see following graphs:

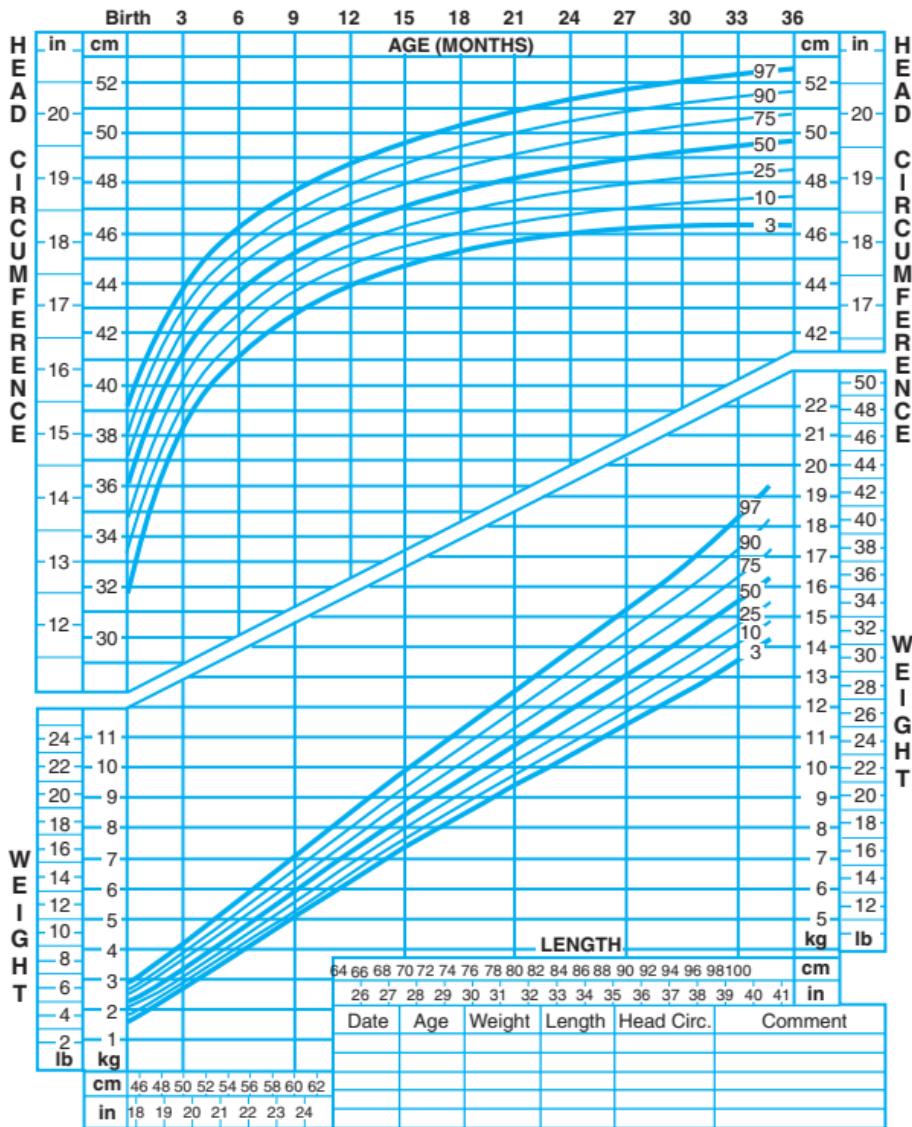
## **Birth to 36 months—Boys**

#### **Birth to 36 months: Boys**

## **Head circumference-for-age and Weight-for-length percentiles**

**NAME** \_\_\_\_\_

**RECORD #** \_\_\_\_\_



Source: Available at: <http://www.cdc.gov/nchs/data/nhanes/growthcharts/set1clinical/cj41c017.pdf>. Accessed October 1, 2007.

## Birth to 36 months—Girls

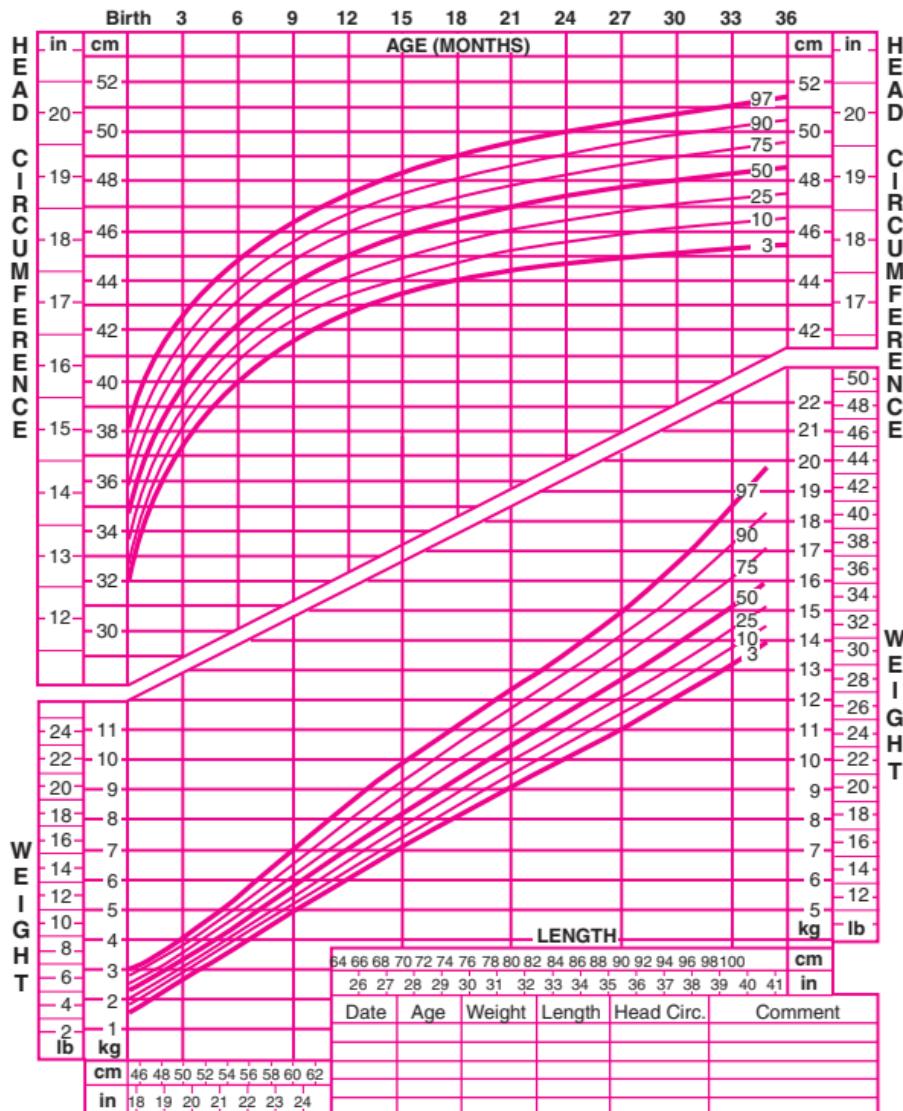
Birth to 36 months: Girls

Head circumference-for-age and

Weight-for-length percentiles

NAME \_\_\_\_\_

RECORD # \_\_\_\_\_



Source: Available at: <http://www.cdc.gov/nchs/data/nhanes/growthcharts/set2clinical/cj41c070.pdf>. Accessed October 1, 2007.

## Arousal, Attention, and Cognition:

### *Assessment*

- Administer:
  - **Glasgow Coma Scale:** (refer to Tab 4)
  - **Galveston Orientation and Amnesia Test (GOAT):** (refer to Tab 4)
  - **Rancho Los Amigos Levels of Cognitive Function—Revised:** (refer to Tab 4)
  - **Mini-Mental State Examination (MMSE):** to assess cognition, mental status, & orientation (30 point max; anything  $>24$  is normal)

### MMSE Sample Items

#### **Orientation to Time**

"What is the date?"

#### **Registration**

"Listen carefully. I am going to say three words. You say them back after I stop.

Ready? Here they are . . .

APPLE (pause), PENNY (pause), TABLE (pause). Now repeat those words back to me."

(Repeat up to 5 times, but score only the first trial.)

#### **Naming**

"What is this?" (Point to a pencil or pen.)

#### **Reading**

"Please read this and do what it says." (Show examinee the words on the stimulus form.)

CLOSE YOUR EYES

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## Assess

- Communication
  - Determine primary language
  - Ask patient to point to named objects (door or window) in the vicinity to assess receptive language
  - Ask patient to state name, address, & occupation to assess expressive language
- Orientation to time, place, & person
- Recall ability including:
  - Short-term memory: ask patient to repeat three unrelated words & recite them a couple of minutes later
  - Long-term memory: ask patient to name three former U.S. presidents (consider other option for patients who are foreign born)
- Ability to calculate: ask patient to add, multiply, & subtract a few numbers

## Pediatric Arousal, Attention, Cognition, and Communication

 Also see the Neuromotor Development and Sensory Integration section later in this Tab

- Pediatric Glasgow Coma Scale (Refer to Tab 4)

## Assistive and Adaptive Devices

- Determine the need for assistive or adaptive devices & equipment for functional activities
- Assess components, alignment, fit, & ability to care for assistive or adaptive devices & equipment
- Assess safety during use of assistive or adaptive devices & equipment
- Assess wheelchair mobility skills:
  - Propulsion on level surfaces & ramps
  - Opening doors
  - Completing a wheelie (if appropriate)
  - Negotiating curbs
-  Administer the Pediatric Evaluation of Disability Inventory (available at: <http://harcourtassessment.com/pedi>)

## Circulation (Arterial, Venous, and Lymphatic)

("Circulation" in subsequent Tabs)

### Assessment

Assess vital signs:

- Initially for baseline (all patients)
- In all sessions involving patients who are medically unstable or who have cardiopulmonary risk factors
- To assess the response to intervention

Depending on severity of patient's condition, consider assessing:

- BP in supine, sitting, & standing
- HR, rhythm & sounds in supine, sitting, & standing (wrist, pedal, or carotid)
- BP & HR at rest & during & after activities
- Perceived exertion rate after activity (see Borg Rating of Perceived Exertion under Aerobic Capacity/Endurance)
- Pulse oximetry
- Edema via upper & lower limb girth measurements in supine, sitting, & standing



## Edema Rating Scale

Score	Descriptor(s)	Findings
1+	Mild pitting, slight indentation, barely perceptible swelling	
2+	Moderate pitting with indentation of less than 5 mm that subsides rapidly	
3+	Deep pitting, indentation of 5 to 10 mm that remains for a short while; extremity is visibly swollen	
4+	Very deep pitting, indentation of more than 10 mm that lasts for a long time; extremity appears very swollen	

## Cranial and Peripheral Nerve Integrity

### Cranial Nerves

- Assess motor and sensory components of cranial nerves

### I Olfactory Nerve

**Function:** Sense of smell

**Test:** Test one nostril at a time (close off the other nostril)



**Test:** Use two bottles of artificial extract (e.g., vanilla & lemon); ask patient to sniff & identify the scents

## II Optic Nerve

**Function:** Visual acuity

**Test:** Test one eye at a time (cover the other eye)

**Test:** Use Snellen eye chart placed 20 ft from the patient

**Function:** Visual fields

**Test:** Standing directly in front of patient, give instruction to look at your nose; extend arms so fingers are in line with patient's eyes; wiggle fingers in each quadrant and ask patient to say "now" when fingers are seen



## II Optic & III Oculomotor Nerves

**Function:** Pupillary light response

**Test:** Shine a light into the lateral edge of each eye; both pupils should constrict



**Function:** Convergence

**Test:** Instruct the patient to look at a picture on the wall & then at your finger (positioned 8 in. from the patient's nose); the eyes should converge



**III Oculomotor Nerve****(Tested With IV Trochlear & VI Abducens)**

**Function:** Innervates six extraocular muscles that open the eyelid and control elevation, adduction, & depression of the eye

**Test:** Note the position of eyes in forward gaze; ask the patient to follow your finger (positioned at arms length from pt.) as it moves vertically, horizontally, & diagonally

**IV Trochlear Nerve****(Tested With Cranial Nerves III & VI)**

**Function:** Depression, inward rotation, abduction of the eye

**Test:** See Oculomotor

**V Trigeminal Nerve**

**Function:** Light touch of the face

**Test:** Use a cotton ball to test light touch on forehead, cheek, & chin (three branches of trigeminal nerve)



**Function:** Temperature

**Test:** Use a cold tuning fork & vial of warm water to test the forehead, cheek, & chin

**Function:** Pin prick

**Test:** Explain to the patient that you will be touching the face with a pin; test the forehead, cheek, & chin

**Function:** Corneal reflex

**Test:** Explain to the patient that you will be using a tissue to touch the eye; instruct the patient to look up & to the opposite side; touch the cornea (not the sclera) lightly with the tissue; both eyes should blink; test the opposite side



## Temporalis Muscle/Masseter Muscle

**Function:** Muscles of mastication

**Tests:** Instruct the patient to open mouth & then to bite down; palpate the temporalis & masseter muscle bellies & observe the size; note any asymmetry



**Function:** Jaw jerk reflex

**Test:** Instruct the patient to open the mouth slightly; using a reflex hammer, gently tap on a finger placed on the middle of the chin; jaw jerk should be absent or weak with no deviation to either side



## VI Abducens

(Tested With Cranial Nerves III & IV)

**Function:** Lateral eye movement

**Test:** See Oculomotor

## VII Facial Nerve

**Function:** Taste of anterior two thirds of tongue

**Test:** Use a cotton swab dipped in salty & sweet water to test taste on lateral side of the front half of the tongue



**Function:** Muscles of facial expression

**Test:** Instruct the patient to: Raise eye brows (frontalis)



**Test:** Frown (corrugator supercilli)



**Test:** Wrinkle nose (procerus & nasalis)



**27**

**Test:** Close eyes tightly (orbicularis oculi)



**Test:** Smile & show top teeth (zygomaticus major)



**Test:** Purse lips (orbicularis oris)



**Test:** Compress the cheeks against the teeth (buccinators)



## VIII Vestibulocochlear Nerve (Acoustic Nerve)

**Function:** Cochlear branch— Auditory acuity

**Test:** In a quiet environment, stand in front of the patient with hands a few inches from the ears; repeatedly rub fingers together on one side & ask patient to indicate when sound is heard



**Test:** Rinne Test: Vibrate a 512 Hertz tuning fork & place it against the mastoid bone; have patient indicate when sound is no longer heard; then place the fork beside the patient's ear & have patient indicate if the sound is heard & when it disappears; an inability to hear the sound with the tuning fork placed by the ear indicates a possible conduction hearing loss



**Test:** Weber Test: Apply the vibrating tuning fork to the center of the forehead & ask patient to indicate where they hear the sound; the sound should be heard equally on both sides



**Function:** Vestibular branch—Balance nystagmus postural control & balance

**Test:** Test Vestibular-Ocular Reflex; have the patient focus on your nose with head flexed 30 degrees; quickly rotate patient's head a small amplitude to one side and stop; eyes should remain focused on initial target

## IX Glossopharyngeal Nerve

**Function:** Taste in the posterior one third of tongue

**Test:** Use a cotton swab dipped in salty & sweet water to test taste on lateral side of the back portion of the tongue



**Function:** Swallowing

**Test:** Ask the patient to swallow saliva

**Function:** Gag reflex

**Test:** Use a tongue depressor to gently stimulate each side of the soft palate to observe for a gag reflex



**Function:** Phonation (IX & X)

**Test:** Listen for the quality of the patient's voice

## X Vagus Nerve

**Function:** Phonation & swallowing (tested previously with CN IX)

**Test:** Refer to glossopharyngeal nerve

**Function:** Autonomic nervous system

**Test:** Assess BP & HR

## XI Accessory Nerve

**Test:** Examine muscle strength, size, & symmetry

**Function:** Trapezius muscle

**Test:** Ask the patient to shrug their shoulders



**Function:** Sternocleidomastoid muscle

**Test:** Ask the patient to turn the head to each side (turn head to right to test left sternocleidomastoid muscle); use resistance



### Hypoglossal Nerve

**Function:** Tongue movement

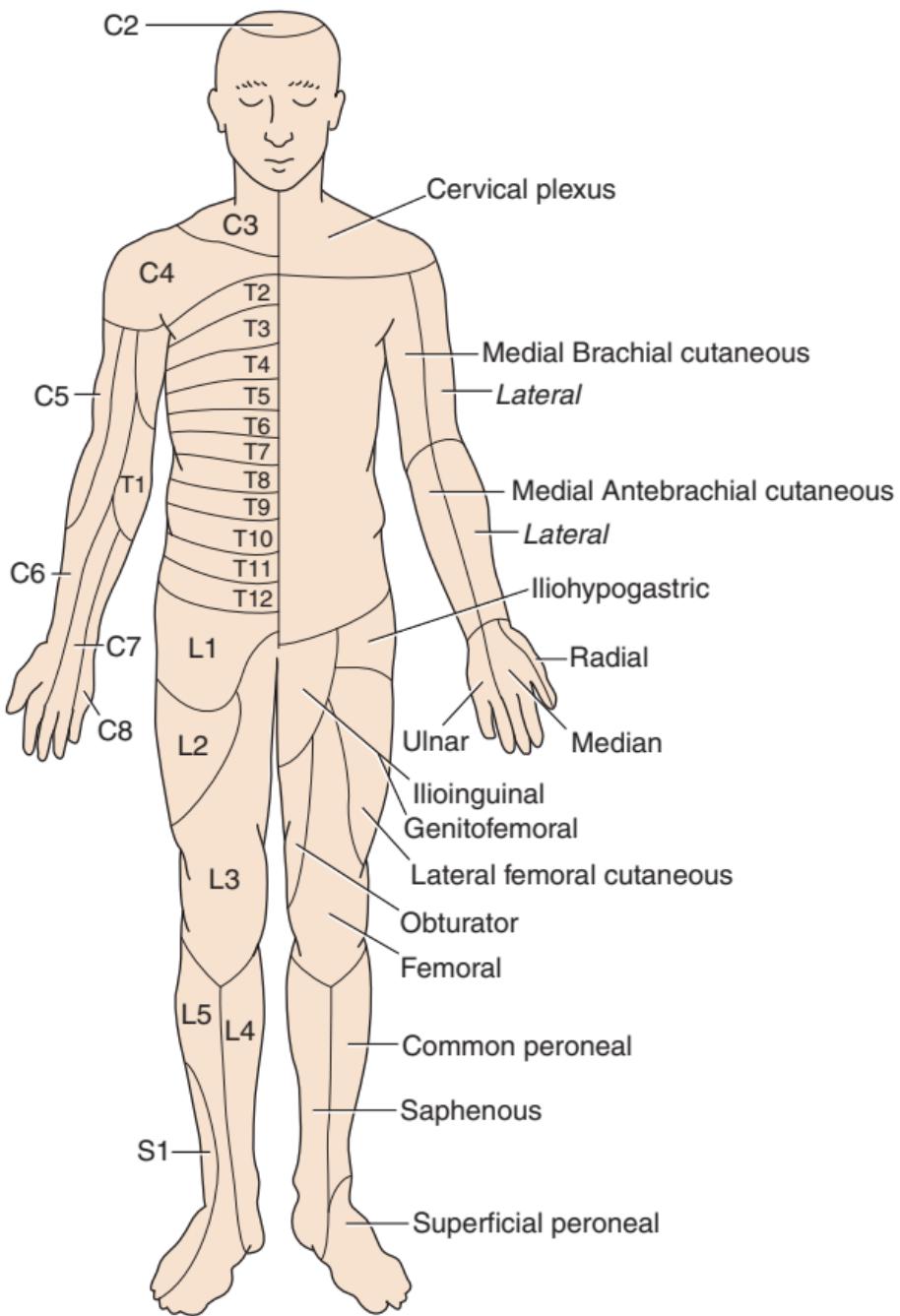
**Test:** Ask the patient to "stick out your tongue;" it should be symmetric with smooth movement; then ask them to move the tongue from side to side

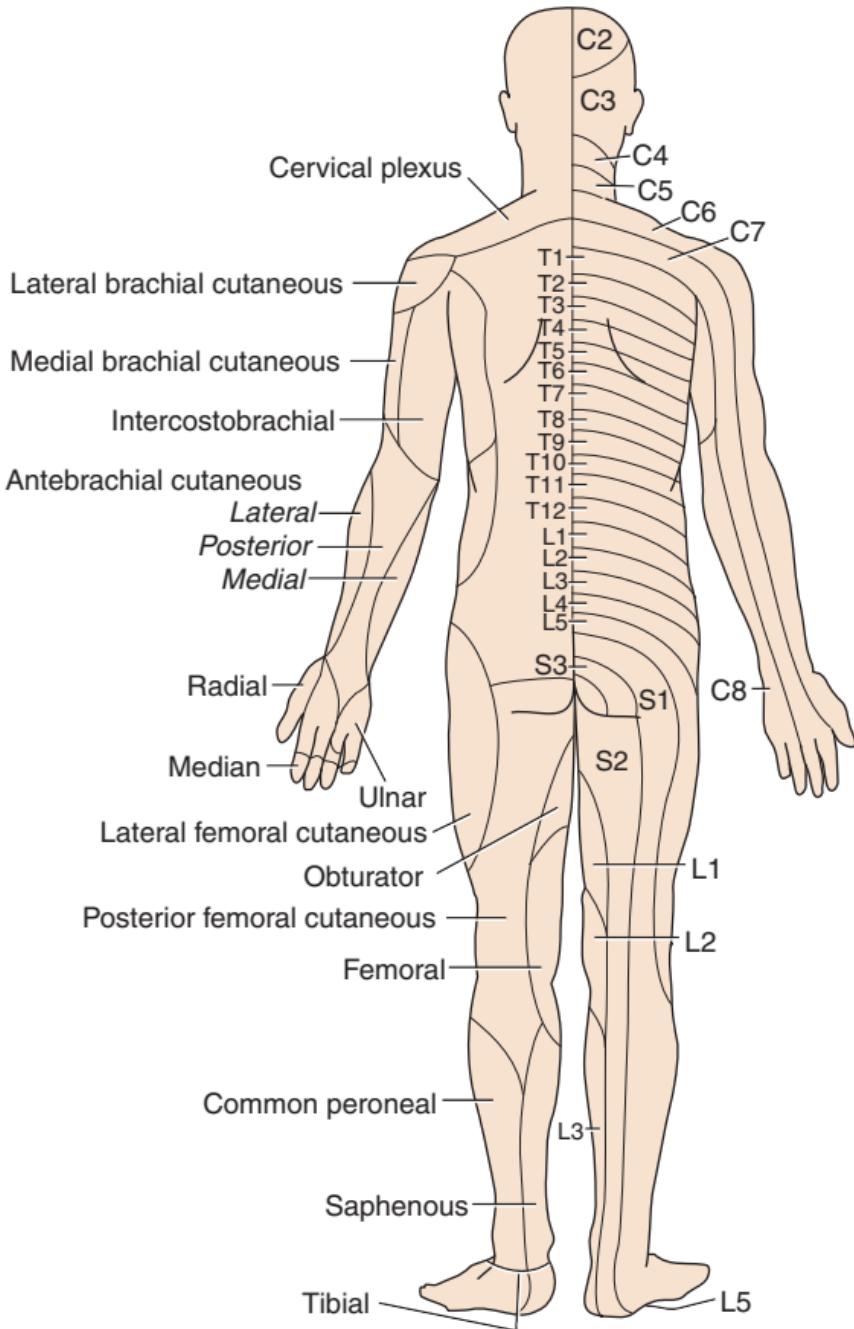


### Peripheral Nerves

Considerations

- Follow myotomes for spinal motor nerve & dermatomes for spinal sensory nerve root involvement
- Follow peripheral nerve innervation patterns for peripheral nerve involvement





## Assessment

- Assess spinal nerve motor distribution (see Tab 8 for Clinically Relevant Myotomes)
- Assess the following peripheral nerve sensory distributions (assess intact area first & block vision during testing following either dermatome or specific peripheral nerve innervation pattern according to pathology)
  - Sharp & dull discrimination
    - Randomly touch patient with one sharp object (e.g., paper clip end or sharp end of reflex hammer pin) & one dull object (e.g., pencil eraser or blunt end of reflex hammer pin) & see if patient can accurately discriminate between objects



- Light touch
  - Using a cotton swab lightly touch patient randomly to see if patient can accurately perceive touch location



■ Temperature

- Touch test tubes (one filled with warm water, the other with cold water) randomly against patient's skin to see if patient can accurately perceive temperature



## Environmental, Home, and Work (Job/School/Play) Barriers

("Environmental, Home, and Work Barriers" in subsequent Tabs)

Environment, Home, and Work Recommendations		
Category	Areas to Be Assessed	Recommendations
Entry route	Driveway surfaces	Make smooth, level & well-lit
	Stairs	Adjust height to <7 in.; adjust depth to >11 in.
	Handrail height	Adjust height to 34–38 in.
	Handrail location	Install handrails on both sides
	Ramp grade	1 in. in height is required for every 12 in. in length If ramp is >30 ft, a platform is required for rest

**Environment, Home, and Work Recommendations—*Cont'd***

<b>Category</b>	<b>Areas to Be Assessed</b>	<b>Recommendations</b>
<b>Entrance</b>	Door clearance	Adjust space beyond swing-out door to 5 × 5 ft & swing-in door to 3 × 5 ft
	Door handles	Adapt door handles depending on patient's hand function
	Door thresholds	Remove, if any
	Door width	Adjust to 32–34 in.
<b>Furniture</b>	Sofas & chairs	Use furniture with height that is even with WC; seating should be firm
<b>Lighting</b>	Room lighting	Make well-lit
	Night lights	Install in hallways & rooms
<b>Halls</b>	Hallway width	Adjust to 36 in.
<b>Smoke &amp; carbon monoxide detectors, fire extinguishers</b>	Smoke detector	Install on each level; one in each sleeping area
	Carbon monoxide detectors	Install on each level; one in each sleeping area; one by any major gas burning appliances
	Fire extinguishers	Install in the kitchen, garage, basement, & sleeping areas
<b>Floors</b>	Floor surfaces	Use nonskid surface
	Small area rugs	Remove, if any
	Large area rug	Secure with carpet tape
<b>Electrical controls</b>	Switches & outlets	Make accessible
	Types of switch	Adapt switches for patient with limited control
<b>Interior doors</b>	Door handles	Adapt door handles depending on patient's hand function
	Door thresholds	Remove, if any
	Door width	Make at least 32 in.

*Continued*

**Environment, Home, and Work Recommendations—Cont'd**

Category	Areas to Be Assessed	Recommendations
<b>Heating units</b>	Heating units	Insulate & screen off
<b>Bedroom</b>	Beds	Make stationary & allow sufficient room for transfer
	Mattress	Adjust height for patient in WC; mattress should be firm
	Closet width	Adjust to at least 32 in.
	Closet shelves & rods	Adjust height to allow accessibility
<b>Bathroom</b>	Toilet seats	Adjust height for ease in use
	Grab bars	Install by toilet & bath
	Tub bench & chair	Install for patient with weakness or poor balance
	Floor & tub surfaces	Use nonskid surfaces
	Shower heads	Add a handheld control
<b>Bathroom &amp; kitchen</b>	Faucets	Modify for patient with limited hand function
	Hot water pipes	Insulate pipes
	Sinks	Adjust height for patient in WC
	Leg room beneath sinks	Make sufficient for WC accessibility
<b>Kitchen</b>	Counters	Adjust height for patient in WC
	Stove controls	Use stove with controls in front. Modify for patient with limited hand function
	Wall-mounted ovens	Adjust to 30–34 in. from floor
	Dishwashers	Use front-loading with pull-out shelves
	Refrigerators	Use side-by-side doors
	Washers & dryers	Use front-loading with front-mounted controls

## Environment, Home, and Work Recommendations—*Cont'd*

Category	Areas to Be Assessed	Recommendations
<b>Driving</b>	Opening & closing door, including locks	Modify for patient with limited hand function
	Driver's seat	Adjust height to ensure easy transfer from WC or scooter
	WC or scooter storage	Ensure sufficient storage space
	Driving ability	Adapt steering, brake, & acceleration systems for patient with limited hand function

 School Function Assessment—measures the performance of students in grades K through 6 in the classroom, bathroom, & playground/recess, as well as during transitions, mealtime, & transportation. It includes the supports & assistance needed. Available at <http://www.proedinc.com/Scripts/prodList.asp>

## Ergonomics & Body Mechanics

### Ergonomics

#### Assessment

- Assess hand dexterity & coordination during work
- Assess functional capacity & performance during work
- Determine safety in work environment

### Body Mechanics

- Assess during self-care, home management, work, community, or leisure activities

## Gait, Locomotion, and Balance

### Balance

- Perform assessment of balance during functional activities, with or without the use of assistive, adaptive, orthotic, & prosthetic devices
- Assess static & dynamic balance
  - Static Balance Tests
    - *Romberg Test*
      - Patient stands with feet together & eyes opened for 20 sec
    - Patient stands with feet together & eyes closed for 20 sec
    - Positive (indicating balance problems) if patient sways excessively, takes a step or falls
  - *Tandem (Sharpened) Romberg Test*
    - Patient stands with one foot in front of the other in a heel-to-toe position with eyes open for 30 sec



- Patient then stands with one foot in front of the other in a heel-to-toe position with eyes closed for 60 sec
- Positive (indicating balance problems) if patient sways excessively, takes a step or falls



- *One-Legged Stance Test*

- With arms over chest, patient lifts one leg & holds it with hip in neutral & knee flexed to 90° for 30 sec (lifted leg may not press into stance leg)
- Patient then repeats test with other leg
- Examiner stops timing if patient's legs touch each other or foot touches the floor



■ Dynamic balance tests

- *Functional Reach Test (4 years and up)*
  - Patient reaches forward as far as possible from a comfortable standing position
  - Using a yardstick placed on the wall at shoulder level, examiner measures (in inches) the excursion of arm reach from start to finish



## Normal values

Age	Men (inches)	Women (inches)	Findings
20–40 years	16.7 +/– 1.9	14.6 +/– 2.2	
41–69 years	14.9 +/– 2.2	13.8 +/– 2.2	
70–87 years	13.2 +/– 1.6	10.5 +/– 3.5	

Source: From Duncan PW, Weiner DK, Chandler J, et al. Functional reach: A new clinical measure of balance. *J Gerontol.* 1990;45:M192–M197, with permission.

- *Multidirectional Reach Test*



- From a comfortable standing position, patient reaches forward as far as possible without moving feet or taking a step, leans as far back as possible & reaches sideways (to either side) as far as possible
- Using a yardstick fixed on a tripod or attached to the wall at shoulder level, examiner measures the starting & ending positions of the index finger of the patient's outstretched hand

## Normal Values for Older Adults (Mean Age 74 Years)

Reach Direction	Distance (mean +/- SD) in inches	Findings
Forward	8.9 +/- 3.4	
Backward	4.6 +/- 3.1	
Right lateral	6.2 +/- 3.0	
Left lateral	6.6 +/- 2.8	

Source: From Newton RA. Validity of the multi-directional reach test: A practical measure for limits of stability in older adults. *J Gerontol A Biol Sci Med Sci.* 2001;56:M248–M252, with permission.

## Berg Balance Scale

Test Item	Possible Score	Score
<b>Sitting to standing</b>	4—able to stand without using hands and stabilize independently 3—able to stand independently using hands 2—able to stand using hands after several tries 1—needs min aid to stand or to stabilize 0—needs mod/max assist to stand	
<b>Standing unsupported for 2 minutes</b>	4—able to stand safely 2 min 3—able to stand safely 2 min with supervision 2—able to stand 30 sec unsupported 1—needs several tries to stand 30 sec unsupported 0—unable to stand 30 sec unassisted	
<b>Sitting with back unsupported but feet supported on the floor or on a stool</b>	4—able to sit safely 2 min 3—able to sit 2 min with supervision 2—able to sit 30 sec 1—able to sit 10 sec 0—unable to sit 10 sec without support	
<b>Standing to sitting</b>	4—sits safely with min use of hands 3—controls descent by using hands 2—uses back of legs against chair to control descent 1—sits independently but has uncontrolled descent 0—needs assistance to sit	

*Continued*

**Berg Balance Scale—Cont'd**

Test Item	Possible Score	Score
<b>Transfers (bed ↔ chair or chair ↔ chair)</b>	4-transfers safely with minor use of hands 3-transfers safely with definite need for hands 2-transfers with supervision 1-needs 1 person to assist 0-needs 2 people to assist	
<b>Standing unsupported with eyes closed (10 seconds)</b>	4-stands 10 sec safely 3-stands 10 sec safely with supervision 2-stands 3 sec safely 1-unable to keep eyes closed 3 sec but stays steady 0-needs help to keep from falling	
<b>Standing unsupported with feet together</b>	4-independent 1 min safely 3-independent 1 min with supervision 2-independent but unable to hold for 30 sec 1-need help to attain position but can maintain for 15 sec 0-need help to attain position and cannot maintain for 15 sec	
<b>Reaching forward with outstretch arm while standing</b>	4->25 cm with confidence 3->12 cm safely 2->5 cm safely 1-reaches but needs supervision 0-loses balance while trying	
<b>Pick up object from the floor from a standing position</b>	4-able to pick up safely and easily 3-able to pick with supervision 2-unable to pick up but reaches 2-5 cm from floor and keeps balance independently 1-unable to pick up and needs supervision while trying 0-unable to try/needs assistance to keep from losing balance	
<b>Turning to look behind over your left and right shoulders while standing</b>	4-looks behind from both sides and wt shifts well 3-looks behind from 1 side only, shows less wt shift 2-turns sideways only but maintains balance	

**Berg Balance Scale—Cont'd**

Test Item	Possible Score	Score
	1-needs supervision when turning 0-needs assist to keep from losing balance or falling	
<b>Turn 360 degrees</b>	4-turns 360 degrees safely in $\leq 4$ sec 3-turns 360 degrees safely to 1 side only in $\leq 4$ sec 2-turns 360 degrees safely but slowly 1-needs close supervision 0-needs assistance while turning	
<b>Place alternate foot on step or stool while standing unsupported</b>	4-independently and safely completes 8 steps in 20 sec 3-independently and safely completes 8 steps in more than 20 sec 2-completes 4 steps without aid and with supervision 1-completes $>2$ steps with min assist 0-needs assist to keep from falling	
<b>Standing unsupported one foot in front (tandem standing)</b>	4-tandem independently and hold 30 sec 3-able to place foot ahead of other independently and hold 30 sec 2-takes small step independently and hold 30 sec 1-needs help to take step but can hold 15 sec 0-loses balance while stepping or standing	
<b>Standing on one leg</b>	4-lifts leg independently and holds for $>10$ sec 3-lifts leg independently and holds 5-10 sec 2-lifts leg independently and holds $\geq 3$ sec 1-tries to lift leg, unable to hold 3 sec but remains standing independently 0-unable to try or needs assist to prevent fall	
(5 years and up) (max score = 56; $\leq 45$ is predictive of falls in the elderly)		
<b>Total Score</b>		

Source: From Berg KO, Wood-Dauphinee S, Williams JL, Gayton D. Measuring balance in the elderly: preliminary development of an instrument. *Physiother Can.* 1989;41:304-311, with permission.

**■ Timed Get Up and Go Test**

- Patient sits comfortably in a firm chair with back resting against backrest
- Patient stands, walks 10 ft toward a target at normal walking speed, turns around without touching the target, walks back to the chair, turns around & sits down
- Examiner times performance with a stop watch beginning with the verbal instruction "go" & ending when the patient returns to starting position
- Patient gets one practice & two test trials
- Examiner records test trial average (in sec)
- Most healthy adults can complete the test in 10 sec
- 10 to 20 seconds is acceptable for the frail elderly or patients with disabilities

**Clinical Test for Sensory Interaction in Balance (CTSIB)  
(for children 4 years and up, and adults)**

Instruct the patient to stand with arms folded across the chest & with feet shoulder width apart. The patient should be able to maintain balance in each condition for 30 seconds & is allowed three trials. Two or more falls are considered to be indicative of deficits of sensory information required for standing balance. A condition is failed if the person steps, unfolds arms, or opens eyes (in eyes closed conditions).

Observation of sway in each condition is graded as:

1 = minimal sway

2 = mild sway

3 = moderate sway

4 = fall

<b>Condition</b>	<b>Condition Tested</b>	<b>Deficit Condition</b>
1. Eyes opened (baseline)	Visual, vestibular, & somatosensory	
2. Eyes closed	Vestibular & somatosensory	Visual




<b>Condition</b>	<b>Condition Tested</b>	<b>Deficit Condition</b>
3. Dome used	Vestibular & somatosensory	Sensory conflict from inaccurate visual feedback
4. Standing on foam; eyes opened	Visual & vestibular  Somatosensory	 

<b>Condition</b>	<b>Condition Tested</b>	<b>Deficit Condition</b>
5. Standing on foam; eyes closed	Vestibular	Visual & inaccurate somatosensory feedback
6. Foam & dome	Vestibular	Inaccurate visual & somatosensory feedback

Source: From Black FO, Wall C, Nashner LM. Effects of visual and support surface orientation references upon postural control in vestibular deficit subjects. *Acta Otolaryngology*. 1983;95:199-210, with permission.

## Modified Clinical Test for Sensory Interaction in Balance (M-CTSIB)

Uses Conditions 1, 2, 4, and 5 in previous material (eliminating the conditions using the dome).

### Performance-Oriented Mobility Assessment

Balance		Score
<b>1. Sitting balance</b>	0-leans or slides in chair 1-leans in chair slightly or slight increased distance from buttocks to back of chair 2-steady, safe, upright	
<b>2. Arising from chair</b>	0-unable without help or loses balance 1-able but uses arm to help or requires more than two attempts or excessive forward flexion 2-able without use of arms in one attempt	
<b>3. Immediate standing balance</b> (first 3–5 seconds)	0-unsteady, marked staggering, moves feet, marked trunk sway, or grabs object for support 1-steady but uses walker or cane, or mild staggering but catches self without grabbing object 2-steady without walker or cane or other support	
<b>4. Standing balance</b>	0-unsteady 1-unsteady, but wide stance (medial heels more than 4 inches apart) or uses cane, walker, or other support 2-narrow stance without support	
<b>5. Balance with eyes closed</b> (with feet as close together as possible)	0-unsteady 1-steady with feet apart 2-steady without holding onto any object with feet together	

**Performance-Oriented Mobility Assessment—Cont'd**

<b>Balance</b>		<b>Score</b>
<b>6. Turn balance</b> (360 degrees)	0-unsteady 1-steady but steps discontinuous 2-No grabbing or staggering; steady and steps continuous	
<b>7. Nudge on sternum</b> (patient stands with feet as close together as possible, examiner pushes with light even pressure over sternum 3 times)	0—begins to fall, or examiner has to help maintain balance 1—needs to move feet, but able to maintain balance 2—steady	
<b>8. Neck turning</b>	0—unsteady 1—decreased ability to turn side to side to extend neck, but no staggering or grabbing 2—able to turn head at least half way side to side and be able to bend head back to look at ceiling	
<b>9. One leg standing balance</b>	0—unable 1—some staggering, swaying or moves foot slight 2—able to stand on one leg for 5 seconds without holding object for support	
<b>10. Back extension</b> (ask patient to lean back as far as possible, without holding onto object if possible)	0—will not attempt or no extension seen or staggers 1—tries to extend, but decreased ROM 2—good extension without holding object or staggering	
<b>11. Reaching up</b> (have patient attempt to remove an object from a shelf high enough to require stretching or standing on toes)	0—unable or unsteady 1—able to get object but needs to steady self by holding onto something for support 2—able to take down object without needing to hold onto other object for support and without becoming unsteady	

*Continued*

## Performance-Oriented Mobility Assessment—*Cont'd*

Balance		Score
<b>12. Bending down</b> (patient is asked to pick up small objects, such as pen, from the floor)	0-unable to bend down, or unable to get upright after bending down, or takes multiple attempts to upright 1-able to get object and get upright in single attempt but needs to pull self up with arms or hold onto something for support 2-able to bend down and pick up the object and is able to get up easily in single attempt without needing to pull self up with arms	
<b>13. Sitting down</b>	0-unsafe (misjudged distance; falls into chair) 1-uses arms or not a smooth motion 2-safe, smooth motion	
<b>Gait</b>		
<b>1. Initiation of gait</b> (patient asked to begin walking down hallway)	0-hesitates; multiple attempts; initiation of gait not a smooth motion 1-no hesitation; initiation of gait is single, smooth motion	
<b>2. Step height</b> (begin observing after first few steps: observe one foot, then the other; observe from side)	0-swing foot is not completely raised off floor 1-swing foot completely clears floor by no more than 1–2 in.	
<b>3. Step length</b> (observe distance between toe of stance foot and heel of swing foot; observe from side; do not judge first few or last few steps; observe one side at a time)	0-step length less than described under normal 1-at least the length of individual's foot between the stance toe and the swing heel	

**Performance-Oriented Mobility Assessment—*Cont'd***

Gait		Score
<b>4. Step symmetry</b> (observe middle part of the patch not the first or last steps; observe from side; observe distance between heel of each swing foot and toe of each stance foot)	0-step length varies between sides or patient advances with same foot with every step 1-step length same or nearly same on both sides for most step cycles	
<b>5. Step continuity</b>	0-places entire foot on floor before beginning to raise other foot; or stops completely between steps; or step length varies over cycles 1-begins raising heel of one foot as heel of other foot touches floor; no breaks or stops in stride; step lengths equal over most cycles	
<b>6. Path deviation</b> (observe from behind; observe one foot over several strides; observe in relation to line on floor if possible)	0-foot deviates from side to side or toward one direction 1-foot follows close to straight line as patient advances	
<b>7. Trunk stability</b> (observe from behind; side-to-side motion of trunk may be normal gait pattern, need to differentiate this from instability)	0-any of preceding features presents 1-trunk does not sway; knees or back are not flexed; arms are not abducted in effort to maintain stability	
<b>8. Walk stance</b> (observe from behind)	0-feet apart with stepping 1-feet should almost touch as one passes other	
<b>9. Turning while walking</b>	0-staggers; stops before initiating turn; or steps are discontinuous 1-no staggering; turning continuous with walking; and steps are continuous while turning	
<b>Total score</b>	<b>Maximum 44 points</b>	

Source: From Tinetti ME. Performance-oriented assessment of mobility problems in elderly patients. *J Am Geriatr Soc*. 1986;Feb;34(2):119–126, with permission.

## Postural Reactions (Pediatrics and Adults)

Test these reactions by displacing the patient's center of gravity or base of support:

- *Righting reactions* are responsible for aligning the head & trunk in a vertical orientation when the patient is in a nonupright position
- *Equilibrium reactions* serve to maintain the center of mass within the base of support when balance is challenged



- *Protective extension reactions* occur when equilibrium reactions are not adequate to prevent a fall. They should be of sufficient speed & strength to prevent falling



## Pediatric Balance

 *Protective extension reactions* occur when equilibrium reactions are not adequate to prevent a fall. They can occur in any direction & should be of sufficient speed & strength to prevent falling. Infant development is as follows:

- **Forward**—6 months: With the child in sitting, if weight is displaced, the arms will extend to prevent a fall



- **Sideward**—8 months



- **Backward**—10 months



Text rights not available.

### Tinetti's Falls Efficacy Scale (higher score indicates lower self-efficacy or confidence)

On a scale of 1 to 10, 1 being extremely confident and 10 having no confidence at all, how confident are you at . . .

Question	Circle Best Answer									
	Most Confident					Least Confident				
Taking a bath or shower?	1	2	3	4	5	6	7	8	9	10
Reaching into cupboards?	1	2	3	4	5	6	7	8	9	10
Preparing a meal (not requiring carrying heavy or hot objects)?	1	2	3	4	5	6	7	8	9	10
Walking around the house?	1	2	3	4	5	6	7	8	9	10
Getting in and out of bed?	1	2	3	4	5	6	7	8	9	10
Answering the door or telephone?	1	2	3	4	5	6	7	8	9	10
Getting in and out of a chair?	1	2	3	4	5	6	7	8	9	10
Getting dressed or undressed?	1	2	3	4	5	6	7	8	9	10
Doing light housekeeping?	1	2	3	4	5	6	7	8	9	10
Doing simple shopping?	1	2	3	4	5	6	7	8	9	10
<b>Score</b>										

Source: From Tinetti ME, Richman D, Powell L. Falls efficacy as a measure of fear of falling. *J Gerontology*. 1990;45:239–243, with permission.

## Gait and Locomotion

### Assessment

- Assess on level & uneven surface, ramp, curbs, & stairs
- Assess with or without the use of adaptive, assistive, orthotic, or prosthetic devices or equipment at self-selected speed
- Describe arm swing, ankle, knee, hip, trunk, & head movements
- Record cadence, velocity, spatial (step and stride length & base of support) & temporal (step, stride, single-limb-support time & double-limb-support time) parameters
- Describe the level of assistance needed
- Document safety issues observed

Timed walking test (requires a 50-ft walkway, a stop watch, a tape measure)

- Instruct patient to walk at self-selected (preferred) speed, & then fast speed and measure:
  - Overall walking speed
  - The distance needed for acceleration & deceleration
  - Stride length

### 4-Item Dynamic Gait Index

(A fall risk is present for a score of less than 10 of 12)

Item	Grading: Mark the Lowest Category That Applies	Score
<b>1. Gait level surface</b> Instructions: Walk at your normal speed from here to the next mark (20 ft)	3-Normal: Walks 20 ft, no assistive devices, good speed, no evidence of imbalance, normal gait pattern 2-Mild Impairment: Walks 20 ft, uses assistive devices, slower speed, mild gait deviations 1-Moderate Impairment: Walks 20 ft, slow speed, abnormal gait pattern, evidence for imbalance 0-Severe Impairment: Cannot walk 20 ft without assistance, severe gait deviations or imbalance	
<b>2. Change in gait speed</b> Instructions: Begin walking at your normal pace (for 5 ft), when I tell you "go," walk as fast as you can (for 5 ft); when I tell you "slow," walk as slowly as you can (for 5 ft)	3-Normal: Able to smoothly change walking speed without loss of balance or gait deviation; shows a significant difference in walking speeds between normal, fast, and slow speeds 2-Mild Impairment: Is able to change speed but demonstrates mild gait deviations, or not gait deviations but unable to achieve a significant change in velocity, or uses an assistive device	

**4-Item Dynamic Gait Index—Cont'd**

(A fall risk is present for a score of less than 10 of 12)

Item	Grading: Mark the Lowest Category That Applies	Score
	<p>1–Moderate Impairment: Makes only minor adjustments to walking speed, or accomplishes a change in speed with significant gait deviations, or changes speed but has significant gait deviations, or changes speed but loses balance but is able to recover and continue walking</p> <p>0–Severe Impairment: Cannot change speeds, or loses balance and has to reach for wall or be caught</p>	
<p><b>3. Gait with horizontal head turns</b></p> <p><b>Instructions:</b> Begin walking at your normal pace; when I tell you to "look right," keep walking straight, but turn your head to the right; keep looking to the right until I tell you "look left," then keep walking straight and turn your head to the left; keep your head to the left until I tell you "look straight," then keep walking straight, but return your head to the center</p>	<p>3–Normal: Performs head turns smoothly with no change in gait</p> <p>2–Mild Impairment: Performs head turns smoothly with slight change in gait velocity, i.e., minor disruption to smooth gait path or uses walking aid</p> <p>1–Moderate Impairment: Performs head turns with moderate change in gait velocity, slows down, staggers but recovers, can continue to walk</p> <p>0–Severe Impairment: Performs task with severe disruption of gait, i.e., staggers outside 15 in. path, loses balance, stops, reaches for wall</p>	

*Continued*

## 4-Item Dynamic Gait Index—Cont'd

(A fall risk is present for a score of less than 10 of 12)

Item	Grading: Mark the Lowest Category That Applies	Score
<b>4. Gait with vertical head turns</b> Instructions: Begin walking at your normal pace; when I tell you to "look up," keep walking straight, but tip your head up; keep looking up until I tell you, "look down," then keep walking straight and tip your head down; keep your head down until I tell you "look straight," then keep walking straight, but return your head to the center	<p>3-Normal: Performs head turns smoothly with no change in gait</p> <p>2-Mild Impairment: Performs head turns smoothly with slight change in gait velocity, i.e., minor disruption to smooth gait path or uses walking aid</p> <p>1-Moderate Impairment: Performs head turns with moderate change in gait velocity, slows down, staggers but recovers, can continue to walk</p> <p>0-Severe Impairment: Performs task with severe disruption of gait, i.e., staggers outside 15 in. path, loses balance, stops, reaches for wall</p>	

Source: From Marchetti GF, Whitney SL. Construction and validation of the 4-item dynamic gait index. *Phys Ther.* 2006;86(12):1651–1660, with permission.

## Integumentary Integrity

### Considerations

#### ■ Potential pressure sore areas:

- Occiput
- Scapula (includes shoulders)
- Elbows
- Ribs
- Spinous process
- Sacrum (includes sacro-iliac & coccygeal areas)
- Genitalia
- Ischium (includes gluteal, intergluteal, & buttocks area)
- Trochanter
- Knee (includes pre-tibial, tibial & fibular condyles, shin, & popliteal areas)

- Malleoli
- Heel

- Foot (includes any part other than heel)

**Prone****Supine****Side-lying****Semi-reclined**

## Classification of Pressure Sores (National Spinal Cord Injury Data Collection System)

Grade	Descriptions	Findings
I	Limited to superficial epidermal and dermal layers; includes redness that does not blanch to the touch and redness that requires intervention	
II	Involving the epidermal and dermal layers and extending into the adipose tissue	
III	Extending through the superficial structures and adipose tissue down to and including muscle	
IV	Destroying all soft tissue structures down to bone and communication with bone and joint structures	

Source: NSCISC. National spinal cord injury statistical system. University of Alabama at Birmingham Department of Physical Medicine and Rehabilitation. Available at: <http://main.uab.edu/show.asp?durki=10766>. Accessed August 21, 2007.

## Skin Integrity

### Assessment

- Expose area to observe:
  - Skin color
  - Texture (dry or shiny)
  - Turgor & elasticity (ability of the skin to return to its original state after being pinched)
  - Hair growth
  - Mobility
  - Nail versus skin growth
- Check for the appearance of erythema

## Wound

### Assessment

- Describe
  - The location, size, depth, color, smell, & sign of infection
  - Bleeding or discharge
  - Wound or scar characteristics
  - Activities & positions that aggravate the wound & scar

## Joint Integrity and Mobility

### *Assessment*

- Perform appropriate tests of joint integrity & mobility, (e.g., shoulder joint integrity for patients with hemiplegia)

## Motor Function (Motor Control and Motor Learning)

### *Consideration*

- Describe movement quality

### *Assessment*

- Assess the ability to initiate or terminate movement
- Describe the ability to adjust movement speed (acceleration & deceleration)
- Determine the accuracy (or error) in reaching to a target (i.e., ability to correct movement in mid-course)
- Conduct the following upper extremity coordination tests with patient seated in a comfortable position:

- Finger-to-nose
  - With shoulder abducted & elbow extended, patient touches nose with tip of index finger, then extends arm & touches nose with other index finger
- Finger-to-examiner's finger
  - Examiner sits in front of patient & holds up one hand
  - Patient touches tip of index finger to tip of examiner's index finger
  - Examiner alters hand positions & asks patient to repeat finger-to-finger movement
- Alternate nose-to-finger
  - Patient alternately touches his/her nose & then tip of examiner's index finger
  - Examiner alters hand positions & asks patient to repeat nose-to-finger movement



■ Finger opposition

- Starting with the index finger, patient touches thumb tip to each finger tip



■ Alternate pronation & supination

- While keeping the arm close to the side of the body, patient flexes elbow to 90°
- Patient then alternately turns the palm up (supination) & down (pronation)



■ Tapping hand following a rhythm

- While keeping forearms pronated, patient flexes both elbows to 90°
- Patient then alternately taps hands on knees



- Rebound (sitting or standing)
  - Patient holds both arms steady & forward at shoulder level
  - Examiner pushes down on patient's arms in a quick, firm motion
  - Patients with cerebellar problems will demonstrate rebounding in which arms move down, rebound above the shoulder, & finally return to shoulder level
  
- Conduct the following lower extremity coordination tests with patient in comfortable position:
  - Heel-on-shin
    - While lying in supine, patient slides heel of one foot up & down shin of opposing leg
  - Drawing a circle
    - While lying in supine, patient draws a circle in the air with either foot
  - Tapping foot following a rhythm
    - While seated comfortably with both feet flat on the floor, patient alternately taps floor by lifting forefoot & keeping heel on floor
  
- Describe tremors (intentional or resting)
- Assess synergistic movement patterns (Refer to Tab 4)



## Rivermead Mobility Index

(Score 0 = No 1 = Yes)

**Score**

1. Do you turn over from your back to your side without help?	
2. From lying in bed, are you able to get up to sit on the edge of the bed on your own?	
3. Could you sit on the edge of the bed without holding on for 10 seconds?	
4. Can you (using hands and an aid if necessary) stand up from a chair in less than 15 seconds, and stand there for 15 seconds?	
5. Observe patient standing for 10 seconds without any aid.	
6. Are you able to move from bed to chair and back without any help?	
7. Can you walk 10 meters (32.8 ft) with an aid if necessary but with no standby help?	
8. Can you manage a flight of steps alone, without help?	
9. Do you walk around outside alone, on pavements?	
10. Can you walk 10 meters (32.8 ft) inside with no caliper, splint, or aid and no standby help?	
11. If you drop something on the floor, can you manage to walk 5 (16.4 ft) meters to pick it up and walk back?	
12. Can you walk over uneven ground (grass, gravel, dirt, snow, or ice) without help?	
13. Can you get in and out of a shower or bath unsupervised, and wash yourself?	
14. Are you able to climb up and down four steps with no rail but using an aid if necessary?	
15. Could you run 10 meters (32.8 ft) in 4 seconds without limping? (A fast walk is acceptable.)	

Copyright: Rivermead Rehabilitation Centre, Abingdon Road, Oxford Oxi 4xd.

-  Administer the Bruininks Oseretsky Test of Motor Proficiency 2nd ed. (BOT-2) (4 to 21 years); measures balance, strength, coordination, running speed & agility, upper limb coordination (ball skills), dexterity, fine motor control, & visual-motor skills in children; available at: [www.pearsonassessments.com](http://www.pearsonassessments.com)
- Administer the Quick Neurological Screening Test II (5 years & up); screens for soft neurological signs in areas including manual dexterity, spatial orientation, & gross- & fine-motor abilities; available at: [www.academictreatment.com/](http://www.academictreatment.com/)

### Muscle Performance (Including Strength, Power, and Endurance)

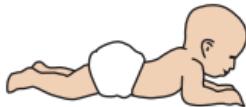
("Muscle Performance" in subsequent Tabs)

#### Assessment

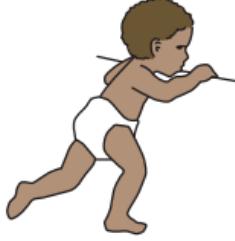
- Assess muscle length when testing strength (e.g., knee & hip positions while testing quadriceps & hamstring strength)
- Assess muscle performance using manual muscle testing, hand-grip, hand-held or isokinetic dynamometer
- Describe substitutions that may be used to compensate for muscle weakness
- Complete endurance testing using timed activity tests
- Describe functional strength for completion of activities of daily living (ADLs) (e.g., dressing, lifting, negotiating stairs, etc.).
- Complete the Motor Assessment Scale for Stroke (see Tab 4)

## Neuromotor Development and Sensory Integration

### Pathways Awareness Foundation—Growth and Development Chart

	Typical Speech Development*	Typical Play Development*	Typical Physical Development*
<b>By 3 Months</b>	<ul style="list-style-type: none"> <li>• Sucks and swallows well during feeding</li> <li>• Quiets or smiles in response to sound or voice</li> <li>• Coos or vocalizes other than crying</li> <li>• Turns head toward direction of sound</li> </ul>	<p><i>While lying on their back...</i></p> <ul style="list-style-type: none"> <li>• Visually tracks a moving toy from side to side</li> <li>• Attempts to reach for a rattle held above their chest</li> <li>• Keeps head in the middle to watch faces or toys</li> </ul>	 <p><i>While lying on their tummy...</i></p> <ul style="list-style-type: none"> <li>• Pushes up on arms</li> <li>• Lifts and holds head up</li> </ul>
<b>By 6 Months</b>	<ul style="list-style-type: none"> <li>• Begins to use consonant sounds in babbling, e.g. "dada"</li> <li>• Uses babbling to get attention</li> <li>• Begins to eat cereals and pureed foods</li> </ul>	<p><i>While lying on their back...</i></p> <ul style="list-style-type: none"> <li>• Reaches for a nearby toy while on their tummy</li> <li>• Transfers a toy from one hand to the other</li> <li>• Reaches both hands to play with feet</li> </ul>	<ul style="list-style-type: none"> <li>• Uses hands to support self in sitting</li> <li>• Rolls from back to tummy</li> <li>• While standing with support, accepts entire weight with legs</li> </ul> 

## Pathways Awareness Foundation—Growth and Development Chart—*Cont'd*

	<b>Typical Speech Development*</b>	<b>Typical Play Development*</b>	<b>Typical Physical Development*</b>
<b>By 9 Months</b>	<ul style="list-style-type: none"> <li>Increases variety of sounds and syllable combinations in babbling</li> <li>Looks at familiar objects and people when named</li> <li>Begins to eat junior and mashed table foods</li> </ul>	<ul style="list-style-type: none"> <li>In a high chair, holds and drinks from a bottle</li> <li>Explores and examines an object using both hands</li> <li>Turns several pages of a chunky (board) book at once</li> <li>In simple play imitates others</li> </ul>	<ul style="list-style-type: none"> <li>Sits and reaches for toys without falling</li> <li>Moves from tummy or back into sitting</li> <li>Creeps on hands and knees with alternate arm and leg movement</li> </ul> 
<b>By 12 Months</b>	<ul style="list-style-type: none"> <li>Meaningfully uses "mama" or "dada"</li> <li>Responds to simple commands, e.g., "come here"</li> <li>Produces long strings of gibberish (jargon) in social communication</li> <li>Begins to use an open cup</li> </ul>	<ul style="list-style-type: none"> <li>Finger feeds self</li> <li>Releases objects into a container with a large opening</li> <li>Uses thumb and pointer finger to pick up tiny objects</li> </ul>	<ul style="list-style-type: none"> <li>Pulls to stand and cruises along furniture</li> <li>Stands alone and takes several independent steps</li> </ul> 

*Continued*

## Pathways Awareness Foundation—Growth and Development Chart—*Cont'd*

	<b>Typical Speech Development*</b>	<b>Typical Play Development*</b>	<b>Typical Physical Development*</b>
<b>By 15 Months</b>	<ul style="list-style-type: none"> <li>• Vocabulary consists of 5-10 words</li> <li>• Imitates new less familiar words</li> <li>• Understands 50 words</li> <li>• Increases variety of coarsely chopped table foods</li> </ul>	<ul style="list-style-type: none"> <li>• Stacks two objects or blocks</li> <li>• Helps with getting undressed</li> <li>• Holds and drinks from a cup</li> </ul>	<ul style="list-style-type: none"> <li>• Walks independently and seldom falls</li> <li>• Squats to pick up toy</li> </ul> 

\*Remember to correct your child's age for prematurity.

### Signs to Watch for in Physical Development\*

<b>By 3 Months</b>	 <ul style="list-style-type: none"> <li>• Difficulty lifting head</li> </ul>  <ul style="list-style-type: none"> <li>• Stiff legs with little or no movement</li> </ul>	 <ul style="list-style-type: none"> <li>• Pushes back with head</li> <li>• Keeps hands fisted and lacks arm movement</li> </ul>
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## Signs to Watch for in Physical Development\*—Con'd

By 6 Months



- Rounded back
- Unable to lift head up
- Poor head control



- Difficult to bring arms forward to reach out
- Arches back and stiffens legs



- Arms held back
- Stiff legs

By 9 Months



- Uses one hand predominately
- Rounded back
- Poor use of arms in sitting



- Difficulty crawling
- Uses only one side of body to move



- Inability to straighten back
- Cannot take weight on legs

By 12 Months



- Difficulty getting to stand because of stiff legs and pointed toes
- Only uses arms to pull up to standing



- Sits with weight to one side
- Strongly flexed or stiffly extended arms
- Needs to use hand to maintain sitting

Continued

**Signs to Watch for in Physical Development\*—Con'd****By 15 Months**

- Unable to take steps independently
- Poor standing balance, falls frequently
- Walks on toes

\*Remember to correct your child's age for prematurity  
 Pathways Awareness Foundation—Growth and Developmental Chart, Pathways Awareness Foundation. Available at: <http://www.pathwaysawareness.org/product>, 1-800-955-2445, with permission.



**Administer the following pediatric assessments as appropriate for age:**

Bruininks Oseretsky Test of Motor Proficiency 2nd ed. (BOT-2) (4 to 21 years); measures balance, strength, coordination, running speed & agility, upper limb coordination (ball skills), dexterity, fine motor control, & visual-motor skills in children; available at: [www.pearsonassessments.com](http://www.pearsonassessments.com)

- Gross Motor Function Measure (5 months to 16 years); used to measure gross motor development over time; for children with cerebral palsy & Down syndrome; available at: <http://www.blackwellpublishing.com/searchres.asp>
- Gubbay Test of Motor Proficiency (8 to 12 years); assesses coordination (see Tab 3)
- Milani-Comparetti Motor Development Screening Test (birth to 2 years); assesses motor development, including primitive reflexes, righting, & equilibrium reactions (see Tab 3)
- Movement Assessment of Infants (birth to 12 months); assesses tone & disability in preterm & term infants; available at MAI, P.O. Box 4361, Rolling Bay, WA 98061
- Peabody Developmental Motor Scales, 2nd ed. (PDMS-2) (birth to 72 months); consists of six tests of gross- & fine-motor development; available at <http://www.proedinc.com>

- Pediatric Evaluation of Disability Index (PEDI); used to assess self care, mobility, & social functioning in children 6 months to 7.6 years; includes a scale for caregiver assistance & environmental modification; available at: <http://harcourtassessment.com/pedi>
- Quick Neurological Screening Test II (5 years & up); screens for soft neurological signs in areas including manual dexterity, spatial orientation, & gross- & fine-motor abilities; available at: [www.academictherapy.com/](http://www.academictherapy.com/)
- Sensory Integration and Praxis Test (4 to 8 years 11 months); available at: <http://portal.wpspublish.com>
- Test of Infant Motor Performance (TIMP) is used to assess infants 34 weeks postconception to 4 months post-term in areas of functional motor performance; available at: <http://thetimp.com>

## Orthotic, Protective, and Supportive Devices

### *Assessment*

- Determine need for orthotic, protective, & supportive devices
- Assess orthotic, protective & supportive device alignment & fit (e.g., pressure areas resulting from the device)
- Determine the ability to don & doff the devices
- Assess the ability to safely use the devices

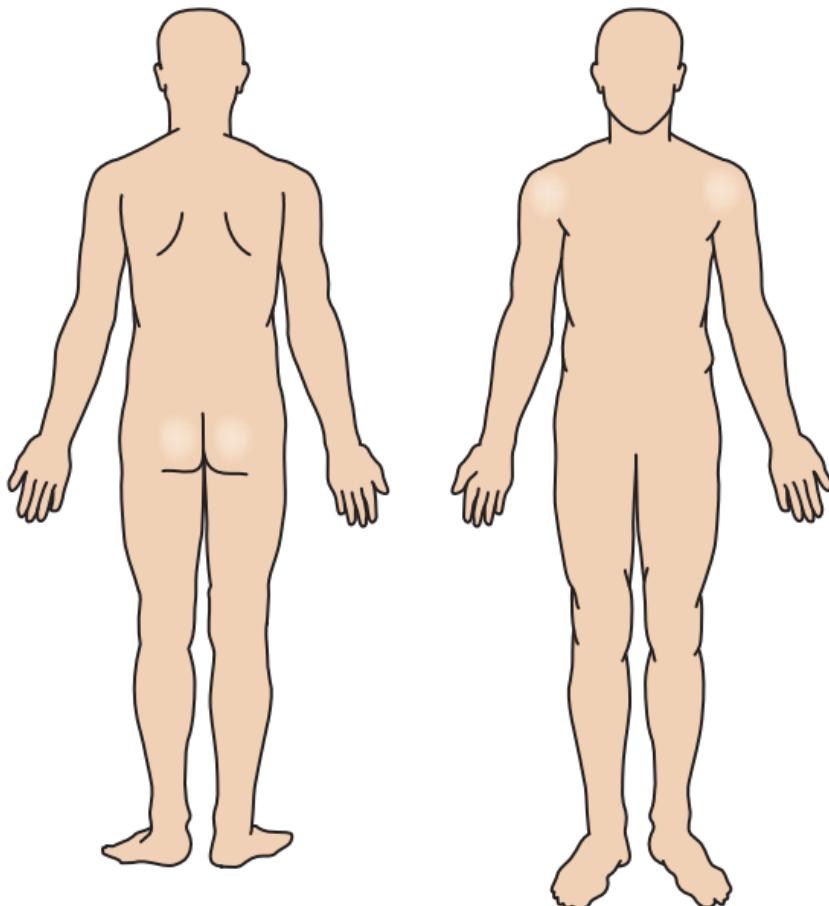
## Pain

### *Assessment*

- Assess overall pain, soreness & nociception in specific body parts

## Ransford Pain Drawings

Numbness	Pins & needles	Burning	Stabbing
=====	0000	XXXX	////
=====	0000	XXXX	////
	0000	XXXX	////



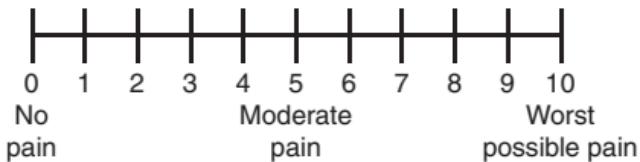
Source: From Ransford AO, Cairns D, Mooney V. The pain drawing as an aid to the psychological evaluation of patients with low back pain. *Spine*. 1976;1:127–134, with permission.

## Wong Faces Scale and Universal Pain Assessment Tool

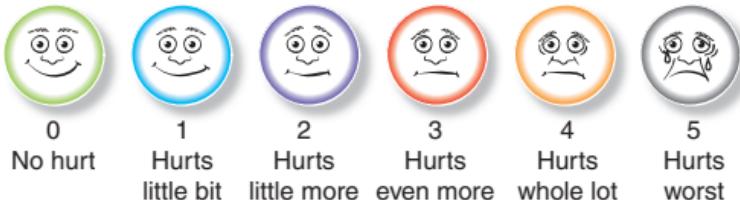
### Universal Pain Assessment Tool

This pain assessment tool is intended to help patient care providers assess pain according to individual patient needs.

Explain and use 0-10 Scale for patient self-assessment. Use the faces or behavioral observations to interpret expressed pain when patient cannot communicate his/her pain intensity.



Wong-Baker Facial Grimace Scale



Activity Tolerance Scale	No pain	Can be ignored	Intereferes with tasks	Intereferes with concentration	Intereferes with basic needs	Bedrest required
Spanish	Nada de dolor	Un poquito de dolor	Un dolor leve	Dolor fuerte	Dolor demasiado fuerte	Un dolor insoportable
French	Aucune douleur	Légère douleur	Douleur moderee	Forte douleur	Très forte douleur	Douleur extreme
German	Keine schmerzen	Leichte schmerzen	Massige schmerzen	Starke schmerzen	Sehr starke schmerzen	Extreme schmerzen
Tagalog	Hindi Masakit	Kauntig sakit	Medyo masakit	Talagang masakit	Masakit na masakit	Pinaka-masakit
Hindi	Dard nahi hai	Bahut kam	Hilnese taklef hoti hai	Soch nahin sak te	Kuch nahin kar sakte	Dard bahut hai

Source: From Hockenberry MJ, Wilson D, Winkelstein ML. *Wong's Essentials of Pediatric Nursing*. 7th ed. St. Louis: Mosby, 2005, with permission; Universal Pain Assessment Tool available at: <http://www.anes.ucla.edu/pain>. Accessed May 4, 2007, with permission.

**FLACC Scale**

Administer the FLACC (face, legs, activity, cry, consolability) Scale; a behavioral pain assessment scale for use in nonverbal patients unable to provide numeric reports of pain.

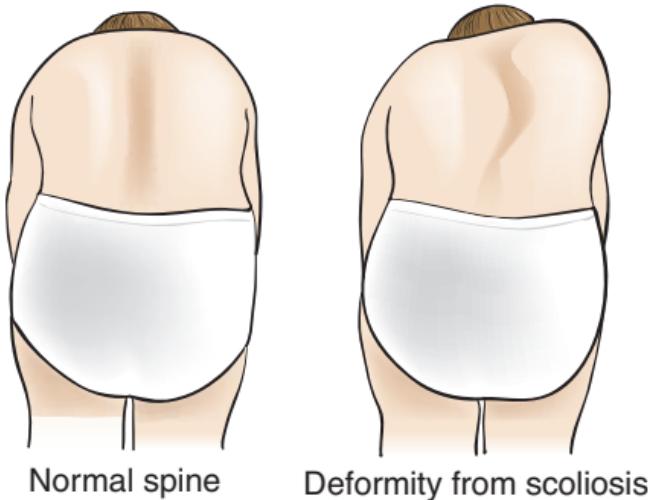
Categories	Scoring		
	0	1	2
<b>Face</b>	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
<b>Legs</b>	Normal position or relaxed.	Uneasy, restless, tense	Kicking, or legs drawn up
<b>Activity</b>	Lying quietly, normal position moves easily.	Squirming, shifting back and forth, tense	Arched, rigid, or jerking
<b>Cry</b>	No cry, (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams, or sobs; frequent complaints
<b>Consolability</b>	Content, relaxed	Reassured by occasional touching, hugging, or being talked to, distractible	Difficulty to console or comfort

Source: Merkel SI, et al. The FLACC: A behavioral scale for scoring postoperative pain in young children. *Pediatr Nurs.* 1997;23(3):293–297, with permission.

**Posture****Assessment**

- Assess postural alignment from the frontal & sagittal planes in sitting & standing
- Describe symmetry & deviation from midline

- Administer the Adam's Forward Bend Test for detection of scoliosis; a rib hump warrants a referral to an orthopedist



## Range of Motion (Including Muscle Length)

("Range of Motion" in subsequent Tabs)

### *Assessment*

- Assess functional range of motion (e.g., squat testing, toe touch tests)
- Assess active & passive range of motion to determine muscle length & flexibility

## Reflex Integrity

### *Consideration*

- When testing muscle tone, keep head in neutral to avoid influences from tonic reflexes
- Muscle tone & reflexes may fluctuate and are influenced by volitional movement, medications, stress, etc.

**Assessment – Assess**

- Muscle tone
- Findings may include:
  - Dystonia including athetosis
  - Hypotonia (flaccidity)
  - Hypertonia (provide a quick stretch to the muscle)
    - Spasticity
    - Rigidity (cogwheel, lead pipe, decorticate, decerebrate)
- For the presence of clonus: provide a quick stretch, usually to wrist & ankle
  - Record the number of beats or whether clonus is sustained
- Deep tendon reflexes
  - Chin reflex—trigeminal nerve
  - Biceps (C5–6)



- Brachioradialis (C5–C6)



- Triceps (C6–8)



■ Patellar/quadriceps reflex (L2–4)



■ Achilles/plantarflexors (S1–2)



■ Use standardized tools to assess muscle tone.

### Grading of Reflexes

Grade	Definition	Descriptors	Grade
0	Absent	No response	
+/-	Inconsistent		
1+	Slight reflex	Low normal; present but depressed	
2+	Normal	Typical reflex	
3+	Brisk	May be normal or pathological	
4+	Very brisk/clonus	Hyperactive; pathological	

# Text rights not available.

Assess the following:

- Abdominal reflex (above umbilicus T8–T10, below umbilicus T10–T12)
  - Stroke the abdomen laterally to medially using reflex hammer tip
  - Positive reflex—localized contraction occurs causing umbilicus to move toward stimulus
  - Absence response—indicates damage to the segmental reflex arc; can occur in upper motor neuron (UMN) and lower motor neuron (LMN) disorders



■ Plantar reflex (S1, S2)

- Stroke the plantar surface from heel up and over lateral border of foot & ending on the base of big toe
- Positive reflex—extension of the big toe; often observed in patients with UMN involvement (Babinski's sign)
- Negative reaction—flexion of all toes



■ Hoffman's sign

- Tap the nail of the middle finger
- Positive reflex—contraction of the thumb & index finger; may indicate a UMN disease

■ Equilibrium reactions which should be tested in sitting & standing  
(See Tab 2 Postural Reactions section)

■ Righting reflexes should be tested in sitting, & standing

■  Administer the Movement Assessment in Infants

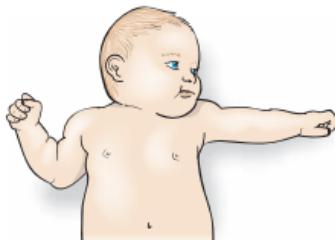
- See protective extension reactions to the side & rear (see Tab 2 Pediatric Balance section)

 Primitive reflexes occur as stages of normal development; Persistence beyond the expected age represents neurological involvement; unless otherwise noted, the response should always be symmetric.

### Asymmetrical Tonic Neck Reflex

**Age of Appearance:** Appears at 3 to 6 months but should never be obligatory

**Description:** Rotation of the head to the side elicits extension of arm and leg on that side and flexion of the extremities on the skull side



## Grasp—Palmar Reflex

**Age of Appearance:** Appears at 28 weeks' gestation; suppressed by 4–5 months

**Description:** An object placed transversely in an infant's palm will elicit flexion of the fingers



## Grasp—Plantar Reflex

**Age of Appearance:** Appears in newborn; suppressed by 9–12 months

**Description:** Pressure on the plantar surface of the foot by the metatarsal joint elicits flexion of the toes



## Landau Reflex

**Age of Appearance:** Appears at 6–9 month

**Description:** When the infant is supported in prone on examiner's hand, reflexive extension of trunk occurs causing infant to lift head and extend trunk



## Moro Reflex

**Age of Appearance:** Appears at 28–32 weeks' gestation; diminishes at 3–5 months; disappears by 6 months

**Description:** Allowing the infant's head to drop in relation to the trunk elicits opening of the hands, extension and abduction of the upper extremities followed by adduction and flexion



## Parachute Reaction Reflex

**Age of Appearance:** Appears between 6 and 9 months

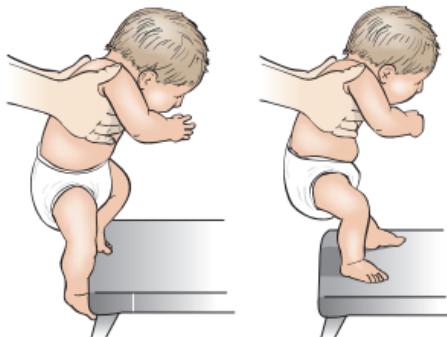
**Description:** When the infant is suspended at the waist in prone and suddenly moved towards the floor, the arms extend and fingers spread



## Placing Reaction Reflex

**Age of Appearance:** Appears to 35 weeks' gestation; suppressed at 2–4 months

**Description:** When the dorsum of foot is brushed against the examination table, the infant flexes the hip and knee, and places foot on table



## Rooting Response Reflex

**Age of Appearance:** Appears at 28 weeks' gestation; diminishes at 3–4 months

**Description:** Stroking the infant's mouth and cheek results in turning of the head toward the same side; usually accompanied by sucking



## Stepping Reaction Reflex

**Age of Appearance:** Appears at 37 weeks' gestation; suppressed at 2–4 months

**Description:** When supported in an upright position and inclined forward, an infant with its feet on a table will take alternating, rhythmical stepping movements



## Suckling Reflex

**Age of Appearance:** Appears at 28 weeks' gestation; integrated at 2–5 months

**Description:** An object is placed in the infant's mouth will result in rhythmical sucking movements



## Self-Care and Home Management (Including ADL and IADL)

("Self-Care and Home Management" in subsequent Tabs)

### Assessment

- Assess ability to perform ADLs, (e.g., dressing, grooming, transfers), & instrumental activities of daily living (e.g., driving)
- Assess functional abilities, including getting up from a chair (anti-gravity control), walking on level surface, & sitting down (eccentric control), etc.
- Assess ability to perform self-care & home management activities with & without assistive, adaptive, orthotic, protective, supportive, or prosthetic devices & equipment
- Quality of life measures, e.g., the Short Form 36 (available at: [www.sf-36.org](http://www.sf-36.org))
- Evaluate patient safety in performance of self-care & home management activities

- Administer the following ADL/IADL scales:
  - Katz Index of Activities of Daily Living
  - Functional Independence Measure (FIM) (available at: [www.udsmr.org/fim2\\_about.php](http://www.udsmr.org/fim2_about.php))
  -  Pediatric Evaluation of Disability Index (PEDI) (Refer to Neuromotor Development section)
  - Wee-FIM—available at: [http://www.udsmr.org/wee\\_index.php](http://www.udsmr.org/wee_index.php)
- Assess bladder & bowel control using the following:

Questions	Yes/No/Comment
Can the patient feel the need to have a bowel/bladder movement?	
Can the patient voluntarily empty bowel/bladder with ease?	
Does the patient require digital stimulation, laxatives, or enemas to have a bowel movement?	
Can the patient perform digital stimulation or insert enemas to facilitate bowel movements independently?	
What is the frequency of bowel movements each day?	
What is the frequency of voiding each day?	
What are the day & night voiding patterns?	
How many accidental voidings occur in a day?	
Is a small or large amount of urine lost?	
What protective devices are used? (diaper, catheter, etc.)	
Can the patient don the protective device independently?	
What is the daily fluid intake?	
Does the patient restrict his/her fluid intake for fear of accidents?	

## Sensory Integrity

### Assessment

Assess combined & cortical sensations

- Stereognosis: put a number of objects (key, coin, & safety pin) in a brown bag or box; show the patient the objects & name them. Place the objects in the bag & have the patient choose one. Without looking at the object, have the patient name it.



- Graphesthesia: with patient's eyes closed, use a pencil eraser or blunt object to trace numbers or letters on the patient's palm; ask the patient to name the number or letter



Assess tactile discrimination

- Two-point discrimination: use a circular disk to determine the exact distance the patient can clearly identify two pressure points



- Double simultaneous stimulation/extinction: with eyes closed, touch a body part & have patient indicate the area touched to ensure normal light touch sensation; then touch the patient in two places on opposite sides of the body; have the patient point to the areas in which they felt sensation



#### Assess kinesthesia

- Move patient's joint & ask patient to describe direction & range of movement

#### Assess vibration

- Place tip of vibrating tuning fork on bony prominence & determine if patient can sense the vibration; ask patient to report when vibration stops



#### Assess joint position sense (proprioception)

- Move patient's joint, hold it in a medial-lateral grip in a static position to avoid pressure cues & ask patient to describe the position of the joint; avoid terminal range of motion for additional sensory cues



## Ventilation and Respiration/Gas Exchange

("Ventilation and Respiration" in subsequent Tabs)

### Assessment

- Perform auscultation to check breath sounds of each lobe (segment)
- Using spirometer, assess tidal volume & vital capacity
- Assess respiratory muscle strength
- Assess ability to cough & strength of cough
- Assess breathing pattern, including the use of the diaphragm & accessory muscles
- Determine blood O<sub>2</sub> level via pulse oximetry
- Assess the affect of exercise on respiration, using the dyspnea scale

### The Medical Research Council Dyspnea Scale

Score	Descriptors	Findings
0	Not troubled with breathlessness except with strenuous exercise	
1	Trouble by shortness of breath when hurrying or walking up a slight hill	
2	Walks slower than people of the same age due to breathlessness or has to stop for breath when walking at own pace on the level	
3	Stops for breathing after walking ~100 m or after a few minutes on the level	
4	Too breathless to leave the house or breathless when dressing or undressing	

Source: From Fletcher CM, Elmes PC, Fairbairn AS, Wood CH. The significance of respiratory symptoms and the diagnosis of chronic bronchitis in a working population. *Br Med J.* 1959;Aug 29;2(5147):257–266, with permission

## Work (Job/School/Play), Community, and Leisure Integration or Reintegration (Including IADL)

("Work, Community, and Leisure" in subsequent Tabs)

### **Assessment**

- Assess patient's ability to resume work, school, community, & leisure activities with & without a wheelchair, a modified car, or orthotics
- Assess patient's ability to gain access to work, school, community, & leisure environments
- Evaluate safety in work/school, community, & leisure environments
- Administer Craig Handicap Assessment & Reporting Technique (CHART), a standardized tool to assess societal participation for patients with disabilities (available at: [www.tbims.org/combi](http://www.tbims.org/combi))
- The U.S. Department of Labor provides guidelines for job accommodations as assessment of work reintegration (<http://www.dol.gov/dol/topic/disability/ada.htm>)
- Complete the Katz Index of Activities of Daily Living

### Katz Index of Activities of Daily Living

<b>Activities</b>	<b>Independence</b>	<b>Dependence</b>
Points (1 or 0)	(1 Point) NO supervision, direction or personal assistance	(0 Points) WITH supervision, direction, personal assistance or total care
BATHING Points: _____	(1 POINT) Bathes self completely or needs help in bathing only a single part of the body such as the back, genital area, or disabled extremity	(0 POINTS) Need help with bathing more than one part of the body, getting in or out of the tub or shower Requires total bathing
DRESSING Points: _____	(1 POINT) Get clothes from closets and drawers and puts on clothes and outer garments complete with fasteners May have help tying shoes	(0 POINTS) Needs help with dressing self or needs to be completely dressed

*Continued*

**Katz Index of Activities of Daily Living—Cont'd**

<b>Activities</b>	<b>Independence</b>	<b>Dependence</b>
TOILETING Points: _____	(1 POINT) Goes to toilet, gets on and off, arranges clothes, cleans genital area without help	(0 POINTS) Needs help transferring to the toilet, cleaning self or uses bedpan or commode
TRANSFERRING Points: _____	(1 POINT) Moves in and out of bed or chair unassisted Mechanical transfer aids are acceptable	(0 POINTS) Needs help in moving from bed to chair or requires a complete transfer
CONTINENCE Points: _____	(1 POINT) Exercises complete self control over urination and defecation	(0 POINTS) Is partially or totally incontinent of bowel or bladder
FEEDING Points: _____	(1 POINT) Gets food from plate into mouth without help Preparation of food may be done by another person	(0 POINTS) Needs partial or total help with feeding or requires parenteral feeding
Total Points: _____		
Score of 6 = High, Patient is independent		
Score of 0 = Low, patient is very dependent		

Katz S, Down TD, Cash HR, et al. Index of activities of daily living. *Gerontologist*. 1970;1:20–30, with permission.

-  Administer the Pediatric Evaluation of Disability Index
- Complete the Functional Independence Measure For Children (WeeFIM) (Available from Uniform Data System for Medical Rehabilitation at [www.udsmr.org](http://www.udsmr.org).)

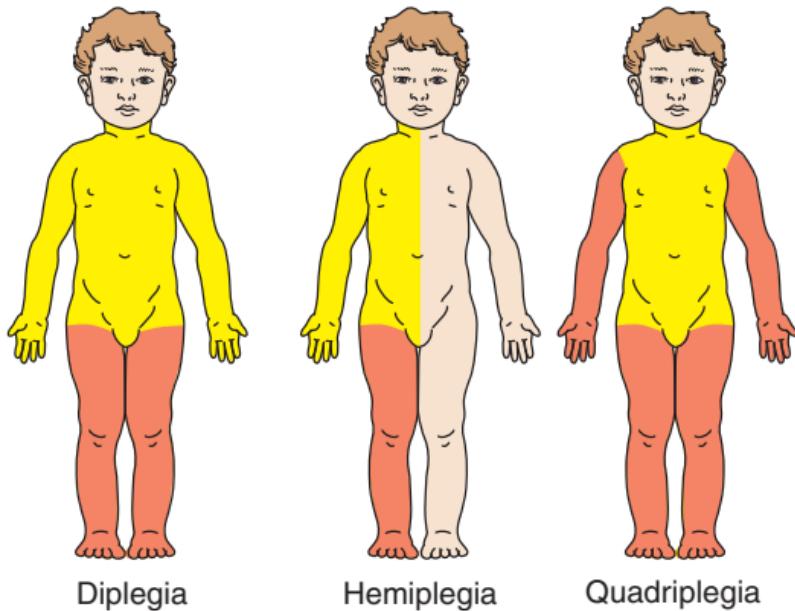
**Pediatric Disorders****Cerebral Palsy (CP)****Description/Overview**

"Cerebral palsy (CP) describes a group of disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain."<sup>1</sup>

CP may result in spastic, athetoid, ataxic, hypotonic or mixed tone.

The distribution of CP includes diplegia, quadriplegia, and hemiplegia.

- **Diplegia** involves all four limbs with greater involvement in the lower limbs
- **Hemiplegia** involves the limbs, neck, and trunk of one side of the body
- **Quadriplegia** involves changes in tone in the entire body



Less affected areas

More affected areas

Complications may include cognitive impairment, mental retardation and learning disabilities; seizures; feeding and communication difficulties; respiratory compromise; gastrointestinal abnormalities contributing to digestive problems; bladder and bowel control problems; dental issues; and hearing and vision problems.

### ***Medical Red Flags***

Immediate medical attention should be sought for:

- A sudden or rapid change in function or tone because CP is considered to be non-progressive
- Onset of seizure or uncontrolled seizure

### ***Medical Yellow Flags***

In the neonate, physiological and behavioral responses to painful and noxious stimuli should be carefully observed. Pain can be manifested by changes in blood pressure, oxygen saturation, heart rate, and respiration as well as change in tone and facial expression.

## **Precautions**

The immobility and lack of weight-bearing activities is associated with reduced bone mass, osteopenia, osteoporosis, and fracture.

## **Physical Therapy Examination**

### **History**

- A review of complications of pregnancy and delivery, birth weight, gestation, and any neonatal and perinatal difficulties; discussion of medical issues, feeding problems, and other health-related problems
- Developmental milestones (Refer to Tab 2)

## **Tests and Measures**

### **Aerobic Capacity/Endurance**

#### **Assessment**

- Energy Expenditure Index (Refer to Tab 2)
- Six-Minute Walk Test (for children 5 years and older)

### *Potential findings*

- The level of involvement will affect aerobic capacity; generally people with CP have considerably lower levels of cardiorespiratory fitness than their non-disabled peers.<sup>2</sup>

## **Anthropometric Characteristics**

### *Assessment – Assess*

- Girth of limbs for asymmetry
- Limb-length measurement of the upper and lower limbs should be taken periodically

### *Potential findings*

- Limb underdevelopment or shortening are common especially in a more affected side

## **Assistive and Adaptive Devices**

### *Consideration*

- Infant walkers should not be used; the American Academy of Pediatrics has called for a ban on infant walkers, stressing that they can result in serious injury, offer no benefits, and may delay motor development;<sup>3</sup> problems occur when infant walkers are used by children with CP because they may encourage toe walking and abnormal patterns of extension

### *Assessment – Assess the need for*

- Therapy walkers including rollator and posterior walkers and gait trainers
- Prone and supine standers



- Adapted tricycles
- Custom seating, strollers, or wheelchair (Refer to Tab 2)
- Mechanical lifting devices
- Adaptive equipment including specialized toilet seats, bath seats, rolling shower, adaptive beds

## Circulation

Refer to Tab 2 for age-appropriate values for blood pressure, pulse, and respiratory rate for children.

*Assessment*-In infants and medically fragile children, assess

- All vital signs before, during, and after new therapy programs
- For breathing pattern, strength of cough, signs of respiratory distress
- Color of lips and nail beds for possible cyanosis

## Environmental, Home, Work Barriers

*Assessment*

- Assess ability to navigate the environment with orthotic and assistive devices and/or wheelchair
- School Function Assessment (Refer to Tab 2)

## Gait, Locomotion, and Balance

*Balance assessment* (Refer to Tab 2)

Consideration: Balance should be assessed in functional positions including sitting, kneeling, standing both with and without perturbations and with and without orthotics and assistive devices.

*Assessment*

- Pediatric Balance Scale
- Timed Up and Go

*Gait and locomotion assessment* (Refer to Tab 2)

- Components of gait should be described including stride length, base of support, heel contact, weight shifting, velocity, and balance

*Potential findings*

- Individuals with spastic diplegia are generally independent ambulators with or without assistive devices and orthotics

- Individuals with spastic hemiplegia usually ambulate without assistive devices, although they may require orthotics for positioning and stability of the knee, foot or ankle
- Some individuals with athetosis can ambulate; gait is often poorly graded and unsteady

## Integumentary Integrity

### *Consideration*

- Orthotics should be modified if their use results in redness that persists for more than 20 minutes

### *Assessment*

- Observe potential areas of pressure from casts or orthotic devices

## Joint Integrity and Mobility

### *Assessment – Assess*

- Mobility of the neck and spine
- Pelvic and shoulder girdle mobility
- Joint extensibility and rotational and torsional alignment of the limbs

### Motor Function (Refer to Tab 2)

*Assessment* Refer to Neuromotor Development section of Tab 3

## Muscle Performance

### *Considerations*

Although strength can be assessed with dynamometry, its accuracy is affected by abnormal muscle tone and reflexes. Describe strength in terms of functional abilities and ability to perform motions in and out of synergistic patterns.

## Neuromotor Development and Sensory Integration

### *Considerations*

- In addition to standardized tests, a narrative should include a description of movement patterns, postural responses, strategies used in movement, adjustments made to achieve desired tasks, and how the individual responds to sensory input and being moved/handled

**Assessment** (Refer to Tab 2 for details of age-appropriate assessment tools)

- Pathway's Growth and Developmental Chart
- Test of Infant Motor Performance (34 weeks post conception to 4 months post term)
- Milani-Comparetti Motor Development Screening Test (birth to 2 years; see Tab 3)
- Peabody Developmental Motor Scales, 2nd ed. (birth to 72 months)
- Gross Motor Function Measure (5 months to 16 years)
- Pediatric Evaluation of Disability Inventory (6 months to 7.5 years)
- Sensory Integration and Praxis Test (4 to 8 years, 11 months)
- Bruininks Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2)

## **Orthotic, Protective, and Supportive Devices**

**Assessment–Assess the need for**

- Night resting splints to prevent contractures
- Shoe lifts in the presence of limb length discrepancy
- Serial casting to improve range of motion
- Inhibitory casting to reduce tone in the foot and ankle
- Orthotics to improve joint stability and prevent contractures:
  - Fixed ankle-foot orthosis for proper foot alignment and prevention of genu recurvatum
  - Dynamic ankle-foot orthosis (DAFO) or articulating ankle-foot orthosis (A-AFO) to obtain proper ankle alignment while allowing dorsiflexion and plantarflexion
  - Supramalleolar orthosis (SMO) which allows medial-lateral stability
- Kinesio-taping and TheraTogs™(orthotic undergarment and strapping system) to promote mobility and improved postural alignment

## **Pain**

**Considerations**

- In the neonate, pain can be manifested by changes in blood pressure, oxygen saturation, heart rate, and respiration as well as change in tone and facial expression

**Assessment** (Refer to Tab 2)

- FLACC (face, legs, activity, cry, consolability) Scale
- Universal Pain Assessment Tool

## Posture

*Assessment (Refer to Tab 2)*

*Potential findings*

- Kyphosis in the cervical and thoracic regions may develop secondary to tightness of the pectoral and hamstring muscles
- Scoliosis may develop especially in the presence of asymmetrical muscle tone
- A windswept position (deformity characterized by pelvic obliquity and flexion, abduction and external rotation of one hip; flexion, adduction and internal rotation of the opposite hip) may develop with severe spastic quadriplegia
- Quadriplegia involving hypotonicity may result in a frog-legged position

## Range of Motion

*Considerations*

- Muscle imbalance can contribute to subluxation or dislocation of the hip

*Assessment*

- Goniometric measurement should include active and passive range, joint play, and muscle extensibility; the affect of weight-bearing activities on joints should be noted
- Hip
  - Use Thomas test to identify a hip flexion contracture
  - Determine the presence of subluxation/dislocation especially of the hip, which can be tested in infants with the Ortolani and Galeazzi procedures
  - Assess for pelvic obliquity and femoral anteversion
- Knee
  - Assess for tibial torsion, genu varus or valgus
- Foot
  - Dorsiflexion should be assessed with the subtalar joint in neutral alignment

### Potential findings

- The most common contractures in the upper limb involve flexion of the elbow, wrist and fingers and adduction of the thumb; a “cortical” thumb position in which the thumb is significantly adducted and flexed, is associated with spastic hemiplegia and quadriplegia
  
- The most common contractures of the lower limb are equinus of the foot/ankle; knee flexion; and hip flexion, adduction, and internal rotation
- Hyperextension of the knee may result to compensate for limitations in ankle dorsiflexion



### Reflex Integrity

#### *Considerations*



- Include a narrative description of the effects of muscle tone on motor achievement and functional abilities, how tone is affected by movement and the severity and distribution of abnormal tone

### Assessment (Refer to Tab 2)

- Deep tendon reflexes using scale of 0 to 4+
- Primitive and tonic reflexes to determine the presence and influence on movement
- Modified Ashworth scales (although reliable only in adult populations)
- Muscle tone section of the Motor Assessment of Infants

### Potential findings

- There may be considerable variation of tone from day to day based on factors such as volitional movement, stressful situations, medical status and medication. Conditions during assessment should be noted

## Ventilation and Respiration

### *Considerations*

- In individuals with feeding difficulties, there is an increased risk of aspiration pneumonia
- Prematurity is associated with bronchopulmonary dysplasia

### *Assessment*

- Chest expansion/respiratory excursion
- Vital capacity and tidal volume, if possible
- Pattern of breathing
- Strength of cough

## **Self-Care and Home Management (Refer to Tab 2)**

### *Assessment*

- Pediatric Evaluation of Disability Index (PEDI)
- Functional Independence Measure For Children (WeeFIM)

## Infant-Specific Test and Measure

MILANI-COMPARETTI MOTOR DEVELOPMENT SCREENING  
TEST REVISED SCORE FORM

NAME	RECORD NO.		TEST DATE	YR	MO	DAY												
			BIRTH DATE															
AGE IN MONTHS			1	2	3	4	5	6	7	8	9	10	11	12	15	18	21	24
Body lying supine																		
Hand Grasp																		
Foot Grasp																		
Supine Equil.																		
Body pulled up from supine																		
Sitting				L3														
Sitting Equil.																		
Sideway Parachute																		
Backward Parachute																		
Body held vertical																		
Head Righting																		
Downwards Parachute																		

Standing		supporting reactions	astasia	takes weight																			
Standing Equil.																							
Locomotion				roll P-S roll S-P GI crawling						crawls	cruising	walks									runs		
automatic stepping																						high/medium/no guard	
Landau																							
Forward Parachute																							
Body lying prone																							
Prone Equil.																							
All fours					forearms	hands	4 pt		kneeling												plantigrade		
																					standing		
All fours Equil.																							
Sym T.N.																							
Body Derotative																							
Standing up from supine																		with rotation and support				without support	
Body Rotative																		rotates out of sitting	rotates into sitting				
Asym. T.N.																							
Moro																							
MONTHS	1	2	3	4	5	6	7	8	9	10	11	12	15	18	21	24							

TESTER: \_\_\_\_\_

\*Record General Observations on Back of Score Form

Source: From Stuberg WA, Dehne PR, Miedaner JA, Romero, P. *Milani-Comparetti Motor Development Screening Test: Test Manual*, 1987 ed. Media Resource Center, C Louis Meyer Children's Rehabilitation Institute, University of Nebraska Medical Center, Omaha, NE, 1987, with permission.

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Chronic and severe spasticity	Botulinum toxin—type A	Botox, Dysport, BT-A	Weakness, pain at injection site
	Dantrolene	Dantrium	Drowsiness, weakness, diarrhea
Spasticity and pain	Baclofen via intrathecal pump	Lioresal	Dizziness, drowsiness, weakness, over-relaxation of muscles, headache, nausea, vomiting, constipation
	Phenol nerve block		Dysesthesia, skin sloughing, vascular complications

## Developmental Coordination Disorder

### Description/Overview

Developmental Coordination Disorder (DCD), also known as developmental dyspraxia, is defined “as a marked impairment in the development of motor coordination which significantly interferes with academic achievement or activities of daily living, but is not caused by a general medical condition.”<sup>4</sup>

### Precautions

- Children with DCD are often labeled “clumsy;” because of difficulties with apraxia and motor planning, they should be guarded during gross motor activities

## Physical Therapy Examination

### History

- A review of any complications associated with birth history and the neonatal period
- Developmental milestones (Refer to Tab 2)

## Tests and Measures

Descriptions of tests and measures are found in Tab 2.

### Aerobic Capacity/Endurance (Refer to Tab 2)

#### Assessment

- Energy Expenditure Index
- Nine Minute Walk Test of the Health-Related Fitness Test (5 years and older)

#### Potential findings

- Low muscle tone that accompanies DCD may result in diminished endurance and stamina in gross motor activities and even long-term sitting
- Aerobic capacity and endurance may be limited because the child avoids physical activity because of the decreased ability to perform such activities

### Arousal, Attention, and Cognition

#### Potential findings

- Because a great deal of attention must be given to completing a motor task, children with DCD may have difficulty maintaining concentration and attention to tasks

### Environmental, Home, Work Barriers

#### Assessment

- School Function Assessment (Refer to Tab 2)
- Developmental tests listed in Neuromotor Development and Sensory Integration in this category

#### Potential findings

- DCD affects day-to-day gross and fine motor activities in school settings as well as ADLs such as dressing, using utensils, and handwriting

## Gait, Locomotion, and Balance

### *Considerations*

- Testing should distinguish between issues of balance and motor planning; balance may be WNL but the motor planning involved in closing eyes and standing on one foot may be difficult

### *Assessment*

- Pediatric Balance Scale

### *Potential findings*

- Romberg testing may be negative

## Gait, Locomotion, and Balance

### *Potential findings*

- DCD can result in delays in acquisition of independent ambulation, running, and maneuvering in environment

## Joint Integrity and Mobility

### *Potential findings*

- Hyperextensibility of the wrist, elbow, hips, ankles, and knees are common findings

## Motor Function

### *Assessment*

- Refer to the Neuromotor Development section in this category
- Coordination tests

### *Potential findings*

DCD is associated with:

- Delayed early motor tasks such as running, jumping, kicking a ball; also fine motor skills such as handwriting, dressing (difficulty with buttons, zippers), using utensils, etc.
- Deficits in the ability to use past experiences to plan and execute a task which results in:
  - Dyspraxia
  - Diminished timing and rhythm
  - Slow reaction time

- Diminished quality and grading of movement
- Difficulty with coordination tests such as finger-to-nose; diadochokinesia; heel to shin

## Muscle Performance

### *Consideration*

- Although there may be sufficient muscle performance, a deficit in retaining previous knowledge may interfere with the understanding of the force or power needed for a particular activity

## Neuromotor Development and Sensory Integration

### *Assessment* (Refer to Tab 2)

- Pathway's Growth and Developmental Chart
- Miller Assessment for Preschoolers
- Bruininks Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2)
- Gubbay Test of Motor Proficiency (8 to 12 years) (see following)

### *Potential findings*

Individuals with CDC may exhibit:

- Soft neurological findings such as low muscle tone, diminished coordination, tactile discrimination deficits, and slow response times
- Difficulty processing visual, auditory, tactile, olfactory information; may have hypo- or hypersensitivity
- Deficits in visual perceptual and visual motor development

## Posture

### *Assessment*

- Adam's Bend Forward Test (Refer to Tab 2)

### *Potential findings*

- Low muscle tone may result in open-mouth, lordotic low back posture
- "Fixing" to compensate for low muscle tone may result in hyperextension of the knees and elbows

## Range of Motion

### *Considerations*

- Low muscle tone can result in ankle pronation

### *Assessment (Refer to Tab 2)*

## Reflex Integrity

### *Assessment*

- Deep tendon reflexes (DTRs) and muscle tone

### *Potential findings*

- DTRs and muscle tone may be decreased

## Sensory Integrity

### *Assessment (Refer to Tab 2)*

### *Potential findings*

- Deficits in graphesthesia, stereognosis, and tactile discrimination

## Disease-Specific Tests and Measures

### Gubbay Test of Motor Proficiency

(Standardized for children between the ages of 8 and 12 years)

Test	Scoring
<b>Test 1</b> Whistle through pouted lips. The child is required to make a musical note of any pitch and intensity by blowing air through pouted lips.	Pass/Fail
<b>Test 2</b> Skip forward five steps. Three attempts are allowed after demonstration of the test by examiner (i.e., single hop on left leg, step, single right leg, etc., without skipping rope).	Pass/Fail

**Gubbay Test of Motor Proficiency—*Cont'd***

(Standardized for children between the ages of 8 and 12 years)

<b>Test</b>	<b>Scoring</b>
<b>Test 3</b> *Roll ball with foot. The child is required to roll a tennis ball under the sole of the preferred foot (with or without footwear) in spiral fashion around 6 matchboxes placed 30 cm apart. The ball is to touch a maximum of 3 matchboxes before disqualification. Three attempts are allowed before failure. Score: Expressed in seconds' time or as failure.	Seconds of time ____ or Fail
<b>Test 4</b> Throw, clap hands, then catch tennis ball. *Child is required to clap his or her hands to a maximum of 4 times after throwing a tennis ball upward and catching the ball with both hands. If able to catch the ball after 4 claps, the child is then required to catch the ball with one (either) hand after 4 claps. Three attempts are allowed before failure at any point. Score: Expressed in one of the following seven categories: 1. Cannot catch the ball with both hands. 2. Can catch the ball with both hands after 0 claps. 3. Can catch the ball with both hands after 1 clap. 4. Can catch the ball with both hands after 2 claps. 5. Can catch the ball with both hands after 3 claps. 6. Can catch the ball with both hands after 4 claps. 7. Can catch the ball with preferred hand after 4 claps.	
<b>Test 5</b> Tie one shoelace with double bow (single knot). The examiner's right shoelace with approximately 20-cm lengths protruding from the shoe is offered. Score: Expressed in seconds' time or failure if greater than 60 seconds.	Seconds of time ____ or Fail

*Continued*

## Gubbay Test of Motor Proficiency—Cont'd

(Standardized for children between the ages of 8 and 12 years)

Test	Scoring
<b>Test 6</b> *Thread 10 beads. The wooden beads are 3 cm in diameter with a bore of 0.8 cm and the terminal 6 cm of the string is stiffened. (The beads are patented Kiddicraft toys that can be readily purchased.) Score: Expressed in seconds' time.	Seconds of time ____ or Fail
<b>Test 7</b> Pierce 20 pinholes. The child is supplied with a stylus (long hatpin) and asked to pierce two successive rows of 0.1 inch × 0.1 inch (2.5 mm × 2.5 mm) squares on graph paper. Score: Expressed in seconds' time.	Seconds of time ____ or Fail
<b>Test 8</b> Posting box. *The child is required to fit six different plastic shapes in appropriate slots. (The posting box is a patented Kiddicraft toy that can be readily purchased.) Score: Expressed in seconds' time or failure if greater than 60 seconds.	Seconds of time ____ or Fail

\* These items represent an abbreviated version of the Gubbay which can serve as a quick screening for DCD.

Source: Gubbay, SS. *The Clumsy Child: A study of developmental apraxic and diagnostic ataxia*. London: WB Saunders, 1975.

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Decreased attention span	Methylphenidate	Ritalin Concerta	Nervousness, hyperactivity, insomnia, restlessness, tremor, hypertension, palpitations, tachycardia, anorexia

## Epilepsy

### Description/Overview

"Epilepsy is a brain disorder in which clusters of nerve cells, or neurons, in the brain sometimes signal abnormally."<sup>5</sup>

A diagnosis of epilepsy is not given unless a person has had more than two seizures. Seizures may occur in the presence of precipitating factors such as a high temperature (febrile seizures), alcohol or drug withdrawal, and hypoglycemia.

### Generalized Seizures

(produced by electrical impulses from the entire cortex)

Seizure Type	Description	Post ictal (post-seizure) Status
Tonic-clonic (previously referred to as "grand mal" seizure)	<ul style="list-style-type: none"> <li>Loss of consciousness</li> <li>Tonic phase (stiffening)—usually fall to the ground</li> <li>Clonic phase—jerking of extremities; may bite tongue, drool, foam at mouth, or have bladder and bowel incontinence</li> </ul>	<ul style="list-style-type: none"> <li>Lethargic, often sleep</li> <li>Confused for minutes to hours</li> <li>May have slurred speech; headache, muscle soreness, disorientation, and agitation</li> </ul>
Absence (previously referred to as "petit mal" seizure)	<ul style="list-style-type: none"> <li>Brief loss of consciousness in which there is blank staring for 2 to 15 seconds</li> <li>May be preceded by rapid eye blinking</li> <li>Complex absence seizure may have a motoric component such as mouth or hand movement</li> <li>May have numerous seizures in a day</li> </ul>	<ul style="list-style-type: none"> <li>Unaware of the seizure but may realize that they have "lost time"</li> </ul>

*Continued*

## Generalized Seizures—Cont'd

(produced by electrical impulses from the entire cortex)

Seizure Type	Description	Post ictal (post-seizure) Status
Myoclonic	<ul style="list-style-type: none"> <li>Sporadic, synchronous, bilateral jerking movements of body and extremities</li> <li>May result in dropping or involuntarily throwing things</li> <li>Lasts for about 20 seconds</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
Atonic	<ul style="list-style-type: none"> <li>Sudden, brief loss of consciousness and postural tone, lasting less than 15 seconds</li> <li>Head may drop</li> <li>May fall to the ground; drop objects</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>

## Partial Seizures

(produced by electrical impulses associated with a structural abnormality of the brain)

Seizure Type	Description	Post ictal (post-seizure) Status
Simple partial		
Autonomic	<ul style="list-style-type: none"> <li>Change in heart or breathing rate, sweating</li> </ul>	<ul style="list-style-type: none"> <li>Has memory of seizure</li> </ul>
Motor	<ul style="list-style-type: none"> <li>Stiffening, jerking, spasms of one body part; may spread to other parts</li> </ul>	<ul style="list-style-type: none"> <li>Weakness of involved areas for a few hours</li> </ul>
Sensory	<ul style="list-style-type: none"> <li>Experience unusual sensations of vision, hearing, smelling, taste, or touch</li> </ul>	
Psychic	<ul style="list-style-type: none"> <li>Sensations of fear, anxiety, déjà vu, depersonalization</li> </ul>	
Complex partial (previously called temporal or psychomotor)	<ul style="list-style-type: none"> <li>Automatic movements, such as lip smacking, chewing, fidgeting, picking</li> </ul>	

**Status Epilepticus**

Symptoms	Management
<ul style="list-style-type: none"> <li>• A seizure lasting more than 5 minutes OR</li> <li>• Two or more seizures occurring without a return of consciousness between the seizures</li> </ul>	<ul style="list-style-type: none"> <li>• Seek immediate medical attention</li> <li>• Follow safety procedures for seizures (see following)</li> </ul>

Follow these safety procedures for seizures that involve loss of consciousness

- Lower person to the ground
- Turn person on their side (vomiting may occur)
- Protect the head
- Move any objects in the vicinity that may cause injury
- Loosen any restrictive clothing
- Keep a record of the length of the seizure
- **DO NOT INSERT ANYTHING IN MOUTH**
- Do not restrain the person
- If the seizure lasts more than 5 minutes, get medical attention
- Stay with the person until he or she regains consciousness or medical attention arrives

**Physical Therapy Examination****History**

- Include history of the onset, nature of the seizures and any precipitating factors
- Obtain information about medications and their side effects

There are no therapy tests and measures specific to epilepsy. Therefore, assessment should be based on the medical conditions for which a referral was made.

## Medications Commonly Used in Pediatrics

Indications	Generic Name	Brand Name	Common Side Effects
Seizures—tonic clonic, absence, complex partial	Valproic Acid	Depakene, Depakote, Depacon	Nausea, vomiting, confusion, dizziness, headache, tremor
	Clonazepam	Klonopin	Drowsiness, fatigue, ataxia, behavioral changes
Generalized tonic-clonic or partial seizures	Phenytoin	Dilantin, Diphenylan	Slurred speech, dizziness, incoordination, diplopia, nystagmus, and nausea; with long-term use, coarsening of facial features and overgrowth of gums
	Primidone	Mysoline	Muscular incoordination, dizziness, vertigo, headache, hyperactivity
	Carbamazepine	Tegretol	No serious side effects
	Phenobarbital	Phenobarbital, Luminal	Drowsiness, depression, headache
Absence seizures	Ethosuximide	(Zarontin)	
Myoclonic seizures	Phenytoin	Dilantin	See Phenytoin above
	Clonazepam	Klonopin	See Phenytoin above
Status Epilepticus	Diazepam	Valium	Dizziness, drowsiness, ataxia, nausea, blurred vision, headache, slurred speech, confusion, impaired memory

## Hydrocephalus

### Description/Overview

Hydrocephalus is a pathologic accumulation of cerebral spinal fluid (CSF) resulting from an imbalance between the formation of CSF and its absorption.

#### Hydrocephalus

In infants, symptoms of hydrocephalus include:

- An increase in head circumference beyond normal values
- Bulging fontanelles
- Excessive widening of sutures
- Dilated scalp veins
- Vomiting
- Lethargy
- Feeding difficulties including regurgitation, and aspiration
- Deviation of the eyes below the horizon (setting sun sign)



In childhood, signs may include mild pyramidal tract signs resulting in:

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>■ Fine motor incoordination</li> <li>■ Perceptual motor deficits</li> </ul> | <ul style="list-style-type: none"> <li>■ Visual-spatial disorganization</li> <li>■ Decreased intellectual performance</li> </ul> |
|--|--|

### Medical Red Flags

#### Shunt Malfunction

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Headache</li> <li>• Vomiting</li> <li>• Seizure activity</li> <li>• Lethargy</li> <li>• Change in neurologic status including decline in cognitive function, speech, vision, or strength</li> <li>• Irritability</li> </ul>	<ul style="list-style-type: none"> <li>• Increased pressure from buildup of CSF</li> </ul>	<ul style="list-style-type: none"> <li>• Immediate referral to physician</li> </ul>

## Shunt Infection

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Fever</li> <li>• Erythema or tenderness along path of shunt</li> <li>• Lethargy</li> <li>• Irritability</li> <li>• Abdominal discomfort</li> </ul>	<ul style="list-style-type: none"> <li>• Exposure to <i>staphylococcus epidermidis</i> and <i>staphylococcus aureus</i></li> </ul>	<ul style="list-style-type: none"> <li>• Immediate referral to physician</li> </ul>

## Physical Therapy Examination

### History

Obtain birth, developmental and surgical history. (Refer to Tab 2)

## Tests and Measures

Descriptions of tests and measures are found in Tab 2.

### Anthropometric Characteristics

#### Assessment

- Head circumference (Refer to Tab 2)

#### Potential findings

- Head circumference will be greater than normal ranges
- Frontal bossing (prominent forehead) is a feature of hydrocephalus

### Arousal, Attention, and Cognition (Refer to Tab 2)

- Pediatric Evaluation of Disability Inventory

### Cranial/Peripheral Nerve Integrity (Refer to Tab 2)

#### Assessment

- Cranial nerves II, III, IV, VI, IX, X, and XII

*Potential findings may include:*

- Optic atrophy
- Ptosis
- Ocular muscle palsy
- Pharyngeal and laryngeal dysfunction
- Nystagmus
- Swallowing difficulties

## **Environmental, Home, Work Barriers**

*Assessment*

- School Function Assessment (Refer to Tab 2)

## **Gait, Locomotion, and Balance**

*Balance Assessment (Refer to Tab 2)*

- Balance should be assessed in functional positions including sitting, kneeling, standing both with and without perturbations; assessment measures can include:
  - Pediatric Balance Scale
  - Timed Up and Go

## **Muscle Performance**

*Assessment*

- When age-appropriate, MMT and ROM should be performed

*Potential findings*

- Upper limb weakness is a common feature

## **Neuromotor Development and Sensory Integration**

*Assessment (Refer to Tab 2)*

- Milani-Comparetti Motor Development Screening Test
- Pediatric Evaluation of Disability Inventory (PEDI)
- Bruininks Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2)
- Sensory Integration and Praxis Test
- Pathway's Growth and Developmental Chart

*Potential findings*

- Neuromotor development will be dependent on the timing of surgical intervention and existing comorbidities such as myelomeningocele

## Reflex Integrity

### *Assessment*

- Primitive reflexes should be tested in infants
- Deep tendon reflexes

### *Potential findings*

- Moderate spasticity of the lower limbs and mild spasticity of the upper limbs
- An opisthotonic posture may develop

## Muscular Dystrophy (MD)

### Description/Overview

There are more than 30 genetic muscular dystrophies that are characterized by progressive muscle weakness and degeneration of skeletal muscles. The age of onset and course of disease varies with each type.

### Common Forms of Muscular Dystrophy and Disease Progression

**Type:** Becker (BMD)

**Age of Detection:** 2 years to early 20s

**Early Symptoms:** Pelvis, upper arms, upper legs

**Later Symptoms:** Slow progression; can ambulate until 30+ years

**Muscle Involvement:** See DMD

**Life Expectancy:** 3rd to 4th decade

**Type:** Congenital (CMD)—several types including Fukuyama MD

**Age of Detection:** At birth

**Early Symptoms:** Severe weakness of facial & limb muscles; hypotonia; joint contractures develop

**Later Symptoms:** Slow progression; speech delays; seizures; may ambulate late but often do not develop this ability

**Muscle Involvement:** See illustration

**Life Expectancy:** Teens to 3rd decade



**Type:** Duchenne (DMD)

**Age of Detection:** 3 to 5 years

**Early Symptoms:** Difficulty with stairs; coming to stand

**Later Symptoms:** Unable to walk by 12 years; respiratory and cardiac compromise

**Muscle Involvement:** See illustration

**Life Expectancy:** Late teens to 3rd decade



**Type:** Facioscapulo-humeral (FSH)

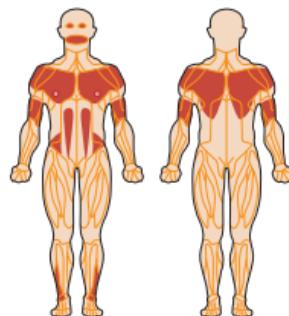
**Age of Detection:** Teens/early adulthood

**Early Symptoms:** Weakness in face, shoulder girdle, upper limbs and chest

**Later Symptoms:** Slow progression to the abdomen, feet, pelvic girdle, and lower limbs; impaired chewing, swallowing and speaking; may not lose ability to ambulate

**Muscle Involvement:** See illustration

**Life Expectancy:** Variable but can have normal life span



**Type:** Limb-girdle (LGMD)

**Age of Detection:** Teens/early adulthood

**Early Symptoms:** Weakness of pelvic and shoulder girdles

**Later Symptoms:** Slow progression of weakness of the limbs; loss of ambulation within 20 years of onset

**Muscle Involvement:** See illustration

**Life Expectancy:** May have normal life span



## Precautions

- Immobility and lack of weight-bearing activities are associated with reduced bone mass, osteopenia, osteoporosis, and fracture

## Physical Therapy Examination

### History

- A review of complications of pregnancy and delivery, birth weight, gestation, and any neonatal and perinatal difficulties. Discussion of medical issues, feeding problems, and other health-related problems

### Tests and Measures

Descriptions of tests and measures are found in Tab 2.

### Aerobic Capacity/Endurance (Refer to Tab 2)

#### Potential findings

- Fatigue is a common factor with MD
- Aerobic capacity decreases as physical activity lessens

### Anthropometric Characteristics (Refer to Tab 2)

#### Potential findings

- DMD and BMD are associated with hypertrophy of the gastrocnemius and possibly of the deltoid, quadriceps, and forearm extensor muscle groups

### Assistive and Adaptive Devices

#### Consideration

- Patients with DMD usually require regular use of a wheelchair by the age of 12
- Manual and power wheelchairs may both be needed for independence with mobility

#### Assessment – Assess the need for

- Night resting splints to prevent contractures
- Walkers or rollator walkers
- Custom seating, stroller, custom mobility, or wheelchair
- Mechanical lifting device
- Adaptive equipment such as specialized toilet and bath seats, rolling shower, adaptive beds

## Circulation (Refer to Tab 2)

### Potential findings

- DMD is often associated with enlargement of the heart, persistent tachycardia, myocardial failure

## Environmental, Home, and Work Barriers

### Assessment

- School Function Assessment (Refer to Tab 2)
- Assess ability to navigate the environment with orthotic and assistive devices and/or wheelchair

## Gait, Locomotion, and Balance

### Balance Assessment (Refer to Tab 2)

- Pediatric Balance Scale

### Gait Assessment

- Describe components of gait including stride length, base of support, heel contact, velocity, and balance

### Potential findings

- Refer to earlier table for expectations for ambulation, which is very variable depending on the type of MD
  - In DMD and BMD as the ability to ambulate is compromised, lateral trunk sway increases resulting in a "waddling" gait

## Integumentary Integrity

### Considerations

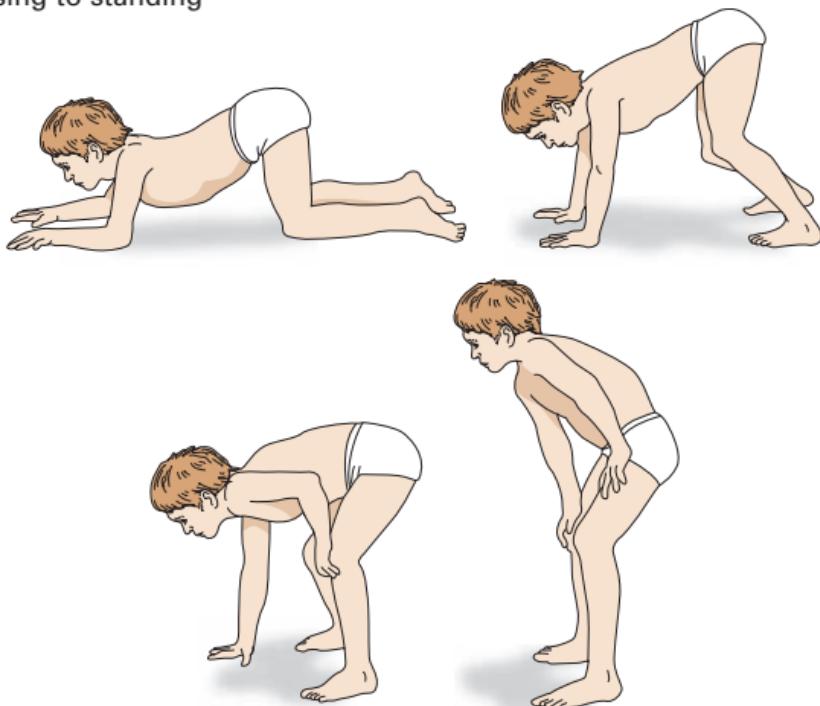
- Inspection of skin should occur as appropriate for the level of immobility

### Assessment (Refer to Tab 2)

## Motor Function

### Potential findings

- Individuals with DMD use Gower's maneuver, a distinctive pattern of rising to standing



## Muscle Performance

### Assessment

- MMT and dynamometry

### Potential findings

- Refer to earlier table for patterns of weakness
- Muscle weakness is usually symmetric
- DMD results in pseudohypertrophy of the calves and sometimes of the deltoid and infraspinatus
- FSH results in prominent winging of the scapulae; weakness of the muscles around the mouth

## Neuromotor Development and Sensory Integration (Refer to Tab 2)

### *Assessment*

- Pediatric Evaluation of Disability Inventory (PEDI) (6 months to 7.5 years)
- Bruininks Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2)
- Vignos Functional Rating Scale for Duchenne Muscular Dystrophy (see following)

## Orthotic, Protective, and Supportive Devices

### *Considerations*

- Ongoing assessment of the fit of orthotic devices is required for the growing child

### *Assessment-Assess the need for*

- Ankle-foot orthotic for ambulation
- Thoracolumbosacral orthotics for scoliosis

## Posture

### *Assessment (Refer to Tab 2)*

### *Potential findings*

- Scoliosis is a common finding in all forms of MD
- DMD associated with progressive lumbar lordosis; DMD and FSH often result in winging of the scapulae

## Range of Motion

### *Assessment*

- Complete goniometric measurement of all extremities

### *Potential findings*

- BMD is associated with pes cavus deformity
- CMD is associated with joint contractures early in the course of disease, especially in the LEs and elbows; subluxation/dislocation of hips may develop
- DMD results in tightness in the gastrocnemius-soleus and tensor fasciae latae



## Reflex Integrity

*Assessment* (Refer to Tab 2)

*Potential findings*

- DMD and BMD are associated with diminished DTRs

## Self-Care and Home Management (See Tab 2 for details)

*Assessment*

- Pediatric Evaluation of Disability Index
- Functional Independence Measure For Children (WeeFIM)

## Ventilation and Respiration

*Assessment* (Refer to Tab 2)

- Chest expansion/respiratory excursion and pattern of breathing
- Strength of cough

*Potential findings*

- Decreased respiratory capacity and frequent infections occur with all forms of MD

## Disease-Specific Tests and Measures

### Vignos Functional Rating Scale for Duchenne Muscular Dystrophy

1. Walks and climbs stairs without assistance
2. Walks and climbs stairs with aid of railing
3. Walks and climbs stairs slowly with aid of railing (more than 25 seconds for eight standard steps)
4. Walks, but cannot climb stairs
5. Walks assisted, but cannot climb stairs or get out of chair
6. Walks only with assistance or with braces
7. In wheelchair: sits erect and can roll chair and perform bed and wheelchair ADL
8. In wheelchair: sits erect and is unable to perform bed and wheelchair ADL without assistance
9. In wheelchair: sits erect only with support and is able to do only minimal ADL
10. In bed: can do no ADL without assistance

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Muscle deterioration	prednisone	Deltasone, Orasone, Pred-Pak	Weight gain, Cushing appearance, osteoporosis, decreased wound healing
Respiratory infection	Wide range of antibiotics		Varies depending on antibiotic used

Source: Vignos PJ, Spencer, GE, Archibald, KC. Management of progressive muscular dystrophy. JAMA. 2963;184:103–112.

## Neonatal Neurological Conditions

Many medical conditions occurring during the pre- and perinatal period have similar effects on infant/child development. The following conditions are listed together because the neonatal assessment process for each diagnostic category is similar. This section includes:

### Hypoxic Ischemic Encephalopathy (HIE)

Hypoxic ischemic encephalopathy (HIE) is caused by either hypoxia (diminished oxygen supply) or ischemia (a reduction of blood supply) that results in cell destruction.

Sequelae of HIE vary and may include a weak suck, irritability, cognitive impairment, varying degrees of cerebral palsy (CP) accompanied by hypotonicity, spasticity, or athetosis. In moderate HIE, the infant may be extremely lethargic, exhibit seizures and weak Moro and suck reflexes.

### Intraventricular Hemorrhage (IVH)

IVH results from factors that include unstable respiratory status, hypoxemia, and an inability to tolerate change in blood pressure. A grading system of hemorrhage is used in which grade I represents an isolated bleed and IV involves intraventricular bleeding in addition to periventricular hemorrhagic infarction. A grade of IV carries the most significant risk of mental retardation, seizures, and CP.

## Low Birth Weight

There are three classifications of low birth weight (LBW) in the neonate:

- Low birth weight (LBW)                      Less than 2500 grams (5.51 lb)
- Very low birth weight (VLBW)              Less than 1500 grams (3.31 lb)
- Extremely low birth weight (ELBW)        Less than 1000 grams (2.20 lb)

Infants with LBW are more likely to develop CP, and have a higher occurrence of seizures, sensorineural hearing loss, learning disabilities, and attention-deficit disorder. These complications worsen for those in the VLBW and ELBW categories.

## Periventricular Leukomalacia (PVL)

PVL is the necrosis of the periventricular cerebral white matter of the brain, which is responsible for motor control and muscle tone in the lower limbs. One of the primary long-term neurological consequences of PVL is spastic diplegia, often accompanied by intellectual and visual-motor deficits.

## Prematurity

Infants born earlier than 37 weeks' gestation are considered premature.

### Medical Red Flags

Infants seen in the neonatal care unit are extremely fragile. Health professionals working with this population must recognize the physiological and behavioral signs of distress that indicate that the neonate is struggling to maintain homeostasis. At such times, intervention should cease or be modified. Some of the signs of stress include:

- Change in color including cyanosis and skin mottling
- Change in blood pressure, respiratory and heart rates
- Decreased oxygen saturation
- Yawning and/or sneezing
- Facial grimacing
- Hiccups
- Vomiting
- Change in muscle tone
- Disorganized movements
- Irritability
- Staring; glassy-eyed appearance

Seizures may take the form of subtle changes such as increased muscle tension and stiffening of the extremities, lip smacking, or sucking.

## Physical Therapy Examination

### History

- A thorough neonatal history that includes details of the pregnancy, delivery, medical problems, and the gestational age is needed before any assessment can be done
- Developmental milestones (See Tab 2)

## Tests and Measures

### Anthropometric Characteristics

#### Assessment

- Head circumference
- Narrative description of the head shape including plagiocephaly (asymmetric occipital flattening)

### Arousal, Attention, and Cognition

#### Considerations

- Observation of the infant's behavioral state should be observed and considered in all assessment and treatment
- Assessment should only occur when an infant is in an alert state and not demonstrating signs of behavioral or physiological stress

#### Assessment

- Peabody Developmental Motor Scales
- Test of Infant Motor Performance (34 weeks post conception to 4 months post term)

### Circulation

#### Assessment

- Regular monitoring of oxygen saturation, HR, BP, and blood gas values

## Neuromotor Development and Sensory Integration

### *Considerations*

- Begin with an observation of posture and spontaneous movements when the infant is at rest and in an alert state

### *Assessment (Refer to Tab 2)*

- Describe the quality and patterns of movement
- Pathway's Growth and Developmental Chart
- Test of Infant Motor Performance
- Milani-Comparetti Motor Development Screening Test (birth to 2 years)
- Movement Assessment of Infants (birth to 12 months)

## Pain

### *Consideration*

- A lack of response to painful stimuli is indicative of brainstem dysfunction or severe diffuse cortical damage

### *Assessment*

- FLACC Scale (Refer to Tab 2)

## Posture

### *Assessment (Assess for)*

- Torticollis
- Postural alignment at rest and when alert; note any asymmetry or deviations

## Range of Motion

### *Considerations*

- Newborns have limitations due to the physiological flexion accompanying intrauterine positioning; as a result, they may have limited hip and knee extension and ankle plantarflexion
- Note any restrictions in passive range of motion

## Reflex Integrity

### *Considerations*

- Infant posturing can provide evidence of abnormality of muscle tone

- Tone will be variable depending on:
  - State of arousal/alertness
  - Time of day/feeding
  - Volitional movement
  - Stressful vs. non-stressful situations
  - Medical status
  - Medication

### *Assessment*

- Use the muscle tone section of the Motor Assessment of Infants
- Palpate the muscle belly to determine if it is taut or soft
- A narrative assessment should include a description of:
  - How muscle tone affects motor and functional abilities
  - How tone is affected by quick stretch and active movement
  - The severity and distribution of abnormal tone

### **Ventilation and Respiration**

- Observe breathing pattern, coughing, and sneezing
- Signs of distress including labored breathing, chest retractions, nasal flaring, inspiratory stridor, grunting, and use of accessory respiratory muscles
- Cyanosis of lips and nail beds

## **Obstetrical Brachial Plexus Palsy**

### **Description/Overview**

This section covers **obstetrical** brachial plexus injuries (OBPP) including Erb-Duchenne, Klumpke, and Erb-Klumpke palsies.

## Obstetrical Brachial Plexus Palsy

OBBP	Nerve Roots	Clinical Presentation	Sensory Loss Deficit
Erb's or Erb-Duchenne's palsy	C5–C6	Limb is held in shoulder adduction, internal rotation; elbow extension; forearm pronation and wrist flexion; scapular winging may occur; grasp is intact	Distribution of musculo-cutaneous nerve
Klumpke's palsy	C7–T1	Normal elbow and shoulder function; weakness of triceps; forearm pronators; wrist and finger flexors and extensors; there is no hand function; C7 involvement can result in Horner's syndrome (Refer to p. 133)	Distribution of first thoracic dermatome (ulnar side of the hand/forearm)
Erb-Klumpke (total plexus) palsy	C5–T1	Total extremity paralysis	Distribution of C5–T1



### Ipsilateral Paralysis of the Diaphragm

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Decreased thoracic movement</li> <li>Unilateral diaphragmatic elevation</li> <li>Respiratory distress</li> <li>Cyanosis</li> </ul>	<ul style="list-style-type: none"> <li>Phrenic nerve injury resulting in ipsilateral paralysis of diaphragm</li> </ul>	<ul style="list-style-type: none"> <li>Stop treatment</li> <li>Seek immediate medical attention</li> </ul>

### Precautions

- Assessment and intervention should not occur until after the first 1 to 2 weeks of life so that hemorrhaging and edema can decrease; during that period the limb should be partially immobilized by securing the arm across the chest
- OBPP is associated with fractures of the clavicle and humerus and subluxation of the shoulder
- Patterns of paralysis/weakness may result in shoulder or elbow dislocation; precautions should be taken with lifting and performing range of motion

### Physical Therapy Examination

#### History

Refer to Tab 2.

- Obtain prenatal, birth, and infant history

### Tests and Measures

Descriptions of tests and measures are found in Tab 2.

#### Anthropometric Characteristics

*Potential findings*

- Paralysis may cause decreased growth in the affected limb.

## Assistive and Adaptive Devices

*Assessment – Assess the need for*

- Resting hand splints for positioning and protection
- Dorsal cock-up splint for decreased wrist extension
- Air splints for positioning and to permit weight-bearing activities
- Splinting to assist with maintaining range and assisting with function

## Cranial and Peripheral Nerve Integrity

*Assessment*

- Perform peripheral nerve assessment of involved limb (Refer to Tab 2)

## Integumentary Integrity

*Assessment*

- Examine nails, fingers, and hands of infants and young children

*Potential findings*

- Infants and children with sensory loss due to OBPP may bite their nails and hands, which can result in tissue damage and infection; this is most common in cases of total-plexus palsy

## Joint Integrity and Mobility

*Considerations*

- Caution should be taken when moving the arm into elbow supination because of risk of dislocation of the radio-humeral joint
- Avoid overstretching involved muscles

*Assessment*

- Range and mobility of the upper limb, scapula, neck, and trunk

*Potential findings*

- The shoulder and elbow may be subluxed or dislocated
- Scapular mobility may be diminished

## Motor Function

*Consideration*

- OBPP can involve incomplete lesions or mixed lesions so it is important to facilitate movement and thoroughly assess motor function

**Assessment**

- Assess self-initiated and facilitated movement

**Muscle Performance****Assessment**

- Observe and facilitate active, spontaneous movements
- Strength of individual muscles and muscle groups, as possible
- Manual muscle testing in older child and adult

**Potential findings**

- Erb's palsy will affect rhomboids, levator scapulae, serratus anterior, subscapularis, deltoid, supraspinatus, infraspinatus, teres minor, biceps, brachialis, brachioradialis, supinator, and long extensors of the wrist, fingers, and thumb
- Total plexus palsy will affect the muscles associated with Erb's palsy and the intrinsic muscles of the hand and wrist and finger flexors and extensors
- Horner's syndrome can accompany OBPP; it involves paralysis of the cervical sympathetic nerve trunk, resulting in constriction of the pupil, recession of the eyeball into the orbit, ptosis of the eyelid, and possible loss of sweating over the affected side of the face

**Neuromotor Development and Sensory Integration****Assessment (Refer to Tab 2)**

- Pediatric Evaluation of Disability Inventory
- Bruininks Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2)
- Pathway's Growth and Developmental Chart

**Orthotic, Protective, and Supportive Devices****Assessment – Assess the need for**

- Dynamic and static splinting, kinesio-taping, TheraTogs™ (orthotic undergarment and strapping system) and orthotic devices to assist with shoulder stability, mobility, and improved postural alignment

## Posture

### Assessment

- Ongoing assessment for asymmetry in the neck and/or trunk
- Adam's Forward Bending Test (Refer to Tab 2)

### Potential findings

- Scoliosis may develop from muscle imbalance and asymmetric motor patterns

## Range of Motion

### Assessment

- Goniometric measurement of active and passive range of motion of the affected limb
- In infants and toddlers, observe active range of motion
- Scapulohumeral angles for development of contractures

### Potential findings

- Contractures frequently occur in scapular protraction; shoulder extension, adduction and internal rotation; elbow flexion; forearm pronation; and wrist and finger flexion

## Reflex Integrity

### Assessment

- Moro, bicep, and radial reflexes
- Primitive reflexes

### Potential findings

- There may be unilateral absence of most reflexes in affected limb

## Sensory Integrity

### Assessment

- Complete full sensory testing with consideration of age of patient

### Potential findings

- While sensation may follow the path of dermatomes, this is not always the case, especially in the presence of incomplete lesions

## Ventilation and Respiration

### Assessment

- Respiratory status because there may be phrenic nerve involvement, which can result in paralysis of the diaphragm

### Potential findings

- Symptoms could include breathing difficulty, asymmetric chest movement during respiration, and frequent lung infections

## Disease-Specific Tests and Measures

Text rights not available.

## Rett Syndrome

(Other specified cerebral degenerations in childhood)

## Description/Overview

Rett syndrome (RS) results in diffuse cerebral atrophy and involves arrest of development rather than a progressive process. It is the leading cause of mental retardation in females, although it can also affect males.

There are four stages of RS with varying dates of onset:

Stage	Typical Age of Onset	Signs and Symptoms
I Early onset	6 to 12 months of age	<ul style="list-style-type: none"> <li>• Hypotonia</li> <li>• Subtle developmental delay with decreased interest in environment</li> </ul>
II Rapid destructive	1 to 4 years	<ul style="list-style-type: none"> <li>• Slowing of head growth</li> <li>• Repetitive hand movements such as hand-to-mouth motions and clapping; hand wringing is a classic sign</li> <li>• Oral motor dysfunction including loss of communication and feeding difficulties</li> <li>• Gastroesophageal reflux</li> <li>• Breathing irregularities including apnea, breath holding, and hyperventilation</li> <li>• Autistic-like behavior including loss of eye contact, social interaction, and communication</li> <li>• Sleep apnea and sleep difficulty</li> <li>• Movement apraxia</li> <li>• Gait ataxia</li> <li>• Autonomic dysfunction with cyanosis and decreased temperature of the extremities</li> </ul>
III Plateau	2 to 10 years	<ul style="list-style-type: none"> <li>• Apraxia</li> <li>• Seizure activity</li> <li>• Decreased autistic-like behaviors</li> <li>• Some improvement in social interaction, communication, and attention</li> </ul>
IV Late motor deterioration	2nd decade of life—although this stage may not occur	<ul style="list-style-type: none"> <li>• Reduced mobility</li> <li>• Muscle rigidity</li> <li>• Dystonia</li> <li>• Scoliosis</li> <li>• Some improvement in functional hand skills</li> <li>• Seizure activity may decrease</li> </ul>

## Physical Therapy Examination

### History: Complete Developmental History should be Obtained

Refer to Developmental Milestones in Tab 2.

### Tests and Measures

Descriptions of tests and measures are found in Tab 2.

### Anthropometric Characteristics

#### Assessment

- Head circumference measurements

#### Potential findings

- There is a slowing of head growth between 3 months and 4 years of age

### Assistive and Adaptive Devices

#### Assessment – Assess the need for

- Custom seating, stroller, or wheelchair (Refer to Tab 2)
- Walkers, gait trainers, and other assistive devices
- Mechanical lifting devices

### Circulation

#### Considerations

RS is associated with diminished circulation in the extremities, which are often cold and cyanotic.

### Gait, Locomotion, and Balance

#### Assessment

- Observational gait assessment

#### Potential findings

- Apraxia and ataxia are usually present; a wide base of support is accompanied by a stiff-legged gait pattern; toe walking is seen at times

## Motor Function

### *Considerations*

- Hypotonia is one of the early signs of RS; it is then followed by dystonia
- Apraxia occurs with all body movements including eye gaze and speech

## Neuromotor Development and Sensory Integration

### *Assessment*

- Bruininks Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2)
- Pathway's Growth and Developmental Chart

## Orthotic, Protective, and Supportive Devices

### *Considerations*

- If used, the fit of scoliosis orthosis should be monitored

## Posture

### *Assessment*

- Plumb line
- Adam's Forward Bend Test for detection of scoliosis (Refer to Tab 2)

### *Potential findings*

- Scoliosis occurs in approximately 80% of individuals with RS.<sup>6</sup>

## Range of Motion

### *Considerations*

- Immobility that occurs in stage IV often leads to joint contractures

### *Assessment*

- Goniometric measurements should be taken periodically as contractures may develop as physical activity lessens

## Self-Care and Home Management (See Tab 2 for Details)

### *Assessment*

- Pediatric Evaluation of Disability Index
- Functional Independence Measure For Children (WeeFIM)

## Ventilation and Respiration

### *Assessment*

- Vital signs at rest, during and after activity

### *Consideration*

- Breathing irregularities including apnea, breath holding, and hyper-ventilation occur in RS

## Medications

Medication may be used for the control of seizures. Refer to section on Epilepsy in this tab.

## Shaken Baby Syndrome

### Description/Overview

Shaken baby syndrome (SBS) generally occurs in infants less than 3 years of age who have been shaken vigorously, usually in an attempt to stop crying or other unwanted behaviors. SBS can result in serious, sometimes fatal, injury and disability.

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>■ Traumatic brain injury</li> <li>■ Seizures</li> <li>■ Cerebral palsy (CP)</li> <li>■ Brain damage</li> <li>■ Death</li> </ul> | <ul style="list-style-type: none"> <li>■ Subarachnoid hemorrhage</li> <li>■ Blindness</li> <li>■ Spinal paralysis</li> <li>■ Mental retardation</li> <li>■ Learning disabilities</li> </ul> |
|--|---|

Symptoms of SBS include:

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>■ Irritability</li> <li>■ Seizures</li> <li>■ Vomiting</li> </ul> | <ul style="list-style-type: none"> <li>■ Diminished eating</li> <li>■ Decreased responsiveness</li> <li>■ Changes in breathing</li> </ul> |
|--|---|

### Medical Red Flags

Symptoms of SBS warrant emergency attention.

## Physical Therapy Examination

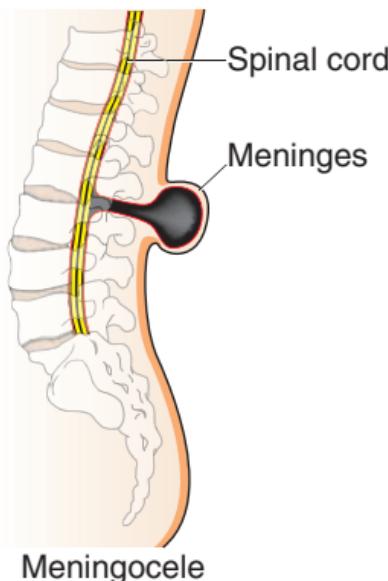
Physical therapy assessment will be dependent on the sequelae of SBS. Refer to appropriate sections, i.e., CP, traumatic brain injury, etc., for further information.

### Spina Bifida (SB)

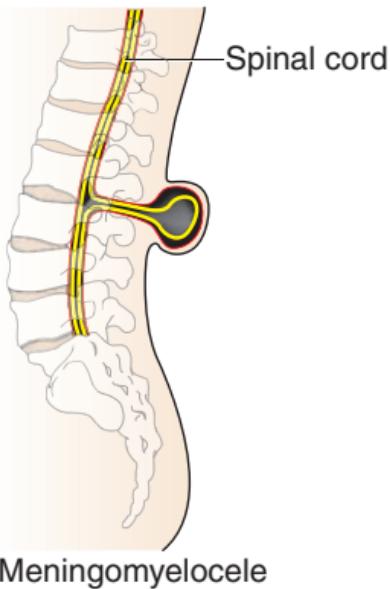
#### Description/Overview

Spina bifida (spinal dysraphism) is a neural tube defect (NTD) in which the bones of the spine fail to close properly during the first month of gestation. There are three types of SB:

- *Spina bifida occulta* involves incomplete closure of one or more of the vertebrae but no involvement of the spinal cord or nerves
- *Meningocele* occurs when the meninges, that cover the spinal cord, protrude through the opened vertebrae in a sac referred to as "meningocele;" the spinal cord remains intact and is covered with skin with little or no resultant damage to the nerve pathways



- *Myelomeningocele* results when the meninges and spinal cord nerve roots protrude through an opening in the spine; the cord and nerves are often exposed, resulting in paralysis and sensory loss below the level of the myelomeningocele



- *Tethered Cord Syndrome* occurs when the spinal cord or cauda equina attach to the spine; complications can include loss of muscle function, increased muscle tone, deterioration of bladder and bowel control, and back pain

#### Medical Red Flags

#### Pathological Fractures of the Bones

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Pain (this may be absent depending on sensation at the area of the fracture)</li> <li>• Warmth</li> <li>• Swelling</li> <li>• Limited range</li> </ul>	<ul style="list-style-type: none"> <li>• Osteoporosis secondary to paralysis and inactivity</li> </ul>	Immediate referral to physician

## Precautions

- Latex allergies often develop due to long-term contact with products such as catheters, shunt tubing, linings of splints, therapy balls, TheraBand, and exam gloves; these allergies can be severe enough to cause anaphylaxis
- Range of motion, positioning, and handling should be done with consideration of paralysis and diminished sensation; bones may be osteoporotic due to decreased weight-bearing status and muscle inactivity
- Even short periods of immobilization can result in demineralization of the bones making them more susceptible to fracture

## Physical Therapy Examination

### History

- Obtain birth history and history of all surgical procedures

## Tests and Measures

### Aerobic Capacity/Endurance

#### *Consideration*

- Energy consumption measures should be used to determine feasibility of community ambulation and participation in functional activities

#### *Assessment*

- Energy Expenditure Index (Refer to Tab 2)

### Assistive and Adaptive Devices

#### *Consideration*

- Requirements for assistive and adaptive devices should be evaluated throughout the life span as mobility may decrease with age

#### *Assessment – Assess the need for*

- Ambulatory devices including crutches, walkers, prone or supine standers, and/or parapodium
- Strollers and/or wheelchairs
- Adaptive seating devices for infants and children
- Assistive ADL devices such as reachers & transfer board

## Bowel and Bladder Control

### *Assessment*

- Functional Independence Measure For Children (WeeFIM)
- Pediatric Evaluation and Disability Inventory (PEDI)

### *Potential findings*

- Voluntary bowel and bladder control is rarely achieved

## Circulation

### *Consideration*

- Kyphoscoliosis often associated with SB can result in significant cardiopulmonary compromise

### *Assessment*

- HR, BP, RR at rest and during and after activity

## Environmental, Home, Work Barriers

### *Assessment (Refer to Tab 2)*

- Home Assessment Form
- School Function Assessment

## Gait, Locomotion, and Balance

### *Balance Assessment (Refer to Tab 2)*

- Balance in sitting, kneeling, standing, if patient is able to assume these positions
- Pediatric Balance Scale
- Refer to "Neuromotor Development" section

### *Gait and Locomotion Assessment*

- Descriptive assessment of gait
- Gait with any assistive devices and orthotics
- Gait in environments and terrains

### Potential findings

- The ability to ambulate is dependent on the level of involvement; the likelihood of being a community ambulator is best when there is a motor level of L5 with good strength in the quadriceps
- Ambulation generally requires the use of orthotics and assistive devices

## Integumentary Integrity

### Considerations

- Sensory loss contributes to the development of pressure sores
- Latex sensitivity can result in skin rash and breakdown

### Assessment

- Skin integrity (refer to "Potential areas for pressure sores" in Tab 2)
- Record any pressure sores on the Classification of Pressure Sores form in Tab 2

### Potential findings

- Common sites of decubiti include the perineum; the location above the apex of a kyphotic curve; bony prominences, especially of the lower limbs; areas of pressure from casts and orthosis; and skin maceration from urine and stool

## Joint Integrity and Mobility

### Assessment

- Joint alignment and mobility, especially during growth spurts

### Potential findings

- Muscle imbalance can cause laxity around involved joints

## Motor Function

### Assessment (Refer to Tab 2)

- Bruininks Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2)
- Peabody Developmental Motor Scales, 2nd ed. (PDMS-2)
- Pediatric Evaluation of Disability Index (PEDI)

**Muscle Performance***Assessment*

- Initial assessment of muscle strength to determine the distribution/severity of muscle involvement and the level of lesion
- Infant: in an alert state, assess all active movement using various methods to elicit active movement, including stroking, tickling, pin-prick, or holding in anti-gravity positions; estimate strength of muscle/muscle group or designate "present" or "absent"
- In a growing child, periodic reassessment because abnormalities in and surrounding the spinal cord can cause changes in muscle strength

**Neurological Syndromes with Myelomeningoceles**

Above L3	<ul style="list-style-type: none"> <li>• Complete paraplegia and dermatomal para-anesthesia</li> <li>• Bladder and rectal incontinence</li> <li>• Nonambulatory</li> </ul>
L4 and below	<ul style="list-style-type: none"> <li>• Same as for "Above L3" except preservation of hip flexors, hip adductors, knee extensors</li> <li>• Ambulatory with aids, bracing, orthopedic surgery</li> </ul>
S1 and below	<ul style="list-style-type: none"> <li>• Same as for "L4 and below" except preservation of feet dorsiflexors and partial preservation of hip extensors and knee flexors</li> <li>• Ambulatory with minimal aids</li> </ul>
S3 and below	<ul style="list-style-type: none"> <li>• Normal lower extremity motor function</li> <li>• Saddle anesthesia</li> <li>• Variable bladder-rectal incontinence</li> </ul>

## Segmental Nerve Supply of Lumbar and Sacral Nerve Roots

Root	Urinogenital		Bladder
L1	Hip	Knee	Ejaculation
L2	Flexors 2, 3	Adductors and internal rotators	Urination
L3	Knee jerk	Extensors 2, 3, 4	Sphincter tone
L4	Extensors 2, 3, 4	Abductors 4, 5	L1
L5	External rotators	Flexors 5, 1	L2
S1	Ankle jerk	Dorsiflexors 1, 4	L3
S2	External rotators	Evertors 1, 2	L4
S3	Plantarflexors 2, 3	Intrinsic 1, 2	L5
	Plantarflexors 2, 3	Intrinsic 1, 2	S1
		Flexors 1, 2	Erection
		Intrinsic 2, 3	S2
			Bladder (para-sympathetic)
			S3
			Dribbling incontinence

## **Neuromotor Development and Sensory Integration**

**Assessment** (Refer to Tab 2)

- Pediatric Evaluation of Disability Index (PEDI)
- Bruininks Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2)
- Test of Visual-Motor Integration
- Test of Visual Perceptual Skills
- Pathway's Growth and Developmental Chart

## **Orthotic, Protective, and Supportive Devices**

**Considerations**

- Braces/orthosis are often required to prevent contractures/deformities and aid mobility

**Assessment – Assess the need for**

- Parapodium/standing frame, reciprocal gait orthosis (RGO), hip-knee-ankle-foot (HKAFO), knee-ankle-foot (KAFO) or ankle-foot orthosis (AFO)
- Spinal orthotics including thoracolumbosacral or lumbrosacral orthosis

## **Pain**

**Considerations**

- Back pain can result from increased lumbar lordosis, hip flexion contractures, and from a tethered cord syndrome

**Assessment** (Refer to Tab 2)

- Universal Pain Assessment Scale
- FLACC (face, legs, activity, cry, consolability) Scale (Refer to Tab 2)

## **Posture**

**Considerations**

- Malformation of vertebral bodies, rib abnormalities, and muscle imbalance result in several postural deformities including increased lumbar lordosis, forward head, rounded shoulders, kyphosis, and scoliosis

**Assessment**

- Adam's Forward Bend Test for detection of scoliosis (Refer to Tab 3)

### Potential findings

- Scoliosis frequently occurs
- Lordosis occurs as the result of congenital defects and hip flexion contractures
- Kyphosis frequently occurs in high level SB

### Range of Motion

#### Considerations

- ROM and joint alignment need to be monitored throughout the life span
- Congenital hip subluxation and dislocation often occur; because of this, hip adduction past neutral should be avoided
- ROM should be done with consideration of paralysis, diminished sensation and the tendency for bones to be osteoporotic

#### Assessment

- Goniometric measures of all ROM performed as a baseline; then at least biannual ROM of involved joints

### Potential findings

- Limitations in ROM and joint deformities frequently occur due to congenital deformities, overall residual weakness, and paralysis of muscles and the imbalance of muscle activity around joints
- Clubfoot and rocker-bottom foot deformities may occur
- Most common contractures involve:
  - High level lesions—hip flexion, abduction, and external rotation; knee flexion, and ankle plantarflexion with talipes equinovarus
  - Mid thoracic to low lumbar lesions—hip and knee flexion contractures, calcaneal valgus, and ankle pronation
  - Sacral lesions—hip and knee flexion and ankle varus or valgus

### Reflex Integrity

#### Assessment

Refer to Tab 2 for descriptions.

#### Assessment

- DTRs
- Primitive reflexes

- Postural responses, including equilibrium and righting reactions
- Modified Ashworth Scales

#### *Potential findings*

- Muscle tone can range from flaccid to spastic

### **Self-Care and Home Management (See Tab 2 for Details)**

#### *Assessment*

- Pediatric Evaluation of Disability Index
- Functional Independence Measure For Children (WeeFIM)

### **Sensory Integrity**

#### *Assessment*

- With consideration of the age of the individual, aspects of sensory integrity, including sensation, two-point discrimination, proprioception, kinesthesia, light touch, pinprick, vibration, position sense and temperature should be assessed throughout the body (Refer to Tab 2)
- In infants and very young children, sensation should be assessed for deep and light touch and pinprick
- Test areas of perception including spatial awareness and figure-ground discrimination
- Testing should be completed along the level of the sensory dermatomes and graded as normal, impaired or absent

#### *Potential findings*

- Often there are not clearly delineated sensory and motor levels and there may be "skip" areas in which sensation is absent even within a dermatome

### **Ventilation and Respiration**

#### *Consideration*

- Scoliosis and other spinal deformities can result in decreased ventilatory capacity

#### *Assessment*

- Tidal volume
- Use of diaphragm

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Symptoms of neurogenic bladder (frequent urination, overactive bladder, incontinence)	oxybutynin	Ditropan, Oxytrol	Dizziness, drowsiness, blurred vision, constipation
Urinary tract infection	Wide range of antibiotics		Varied, depending on antibiotic used

## Nonprogressive Disorders of the Central Nervous System

### Central Vestibular Dysfunction

#### Vertigo of Central Origin Description/Overview

Central vestibular dysfunction (CVD) symptoms include:

- Severe balance loss
- Vertigo, that is persistent; not diminished by visual fixation
- Nausea
- Severe oscillopsia (feeling that stationary objects are moving)
- Nystagmus (vertical and/or pendular) in which speed is constant

CVD is often accompanied by:

- Incoordination (dysdiadochokinesia, ataxia)
- Postural imbalance
- Hearing loss

#### *Medical Red Flags*

Symptoms	Possible Causes	Management
Syncope with light-headedness	Postural or exercise-induced hypotension Cardiac dysrhythmia or defects	Cease treatment Take BP Refer to physician
Dizziness accompanied by decreased arousal or change in consciousness	Brainstem infarct	Cease treatment Seek immediate medical attention

## Physical Therapy Examination

### History

Refer to Tab 2 for full details of history.

- Obtain a description and circumstances of falls and loss of balance
- Hx of eye glasses, including any recent changes and date of last ophthalmologic exam

### Subjective

- Have the patient describe their “dizziness,” including situations that worsen symptoms and duration of symptoms
- With a visual analog scale (10 cm line), have the patient rate their level of:
  - Disequilibrium
  - Oscillopsia
  - Vertigo
  - Head-movement induced symptoms

## Tests and Measures

### Cranial and Peripheral Nerve Integrity

#### *Consideration*

- Frenzel lenses magnify the eyes allowing assessment of nystagmus

#### *Assessment*

- Cranial nerves with attention to II, III, IV, VI, & VIII
- Refer to Tab 6 for testing of vestibular system including:
  - Dix-Hallpike maneuver
  - Vestibular ocular reflex (VOR)
  - Head-thrust test
  - Head-shaking nystagmus test

#### *Potential findings*

- Smooth pursuit and saccadic eye movements are usually impaired
- Abnormalities of cranial nerves IX through XII may result from neoplasms

## Gait, Locomotion, and Balance

### *Balance assessment*

- Perform during functional activities with or without the use of assistive, adaptive, and orthotic devices/equipment
- Static Balance Tests (Refer to Tab 2)
  - Romberg Test
  - Tandem (Sharpened) Romberg Test
  - One-legged Stance Test
- Dynamic Balance Tests (Refer to Tab 2)
  - Functional Reach Test
  - Multi-Directional Reach Test
  - Berg Balance Test
  - Clinical Test for Sensory Interaction in Balance (CTSIB) or modified CTSIB
  - Performance-Oriented Mobility Assessment

### *Potential findings*

- Falls to one direction may indicate vestibular system imbalance
- Unsteadiness in Romberg “eyes-open” may indicate cerebellar dysfunction
- Tandem Romberg is usually positive
- One-legged stance is often not possible

### *Gait and locomotion assessment* (Refer to Tab 2)

- 4-Item Dynamic Gait Index
- Assess gait while turning head from side to side

### *Potential findings*

- Ataxic gait may be present
- Loss of balance and ataxia increase when turning head from side to side

### *Falls Efficacy and Falls Prediction*

#### *Assessment*

- Tinetti’s Falls Efficacy Scale (Refer to Tab 2)

### *Potential findings*

- CVD is associated with a high risk for falls

## Motor Function

### *Assessment – Assess*

- Coordination of the upper and lower limbs (Refer to Tab 2)
- Rivermead Mobility Index (Refer to Tab 2)

### *Considerations*

- Severe ataxia often accompanies CVD
- There are often deficits in initiating and coordinating movements needed to maintain balance

## Posture

### *Assessment (Refer to Tab 2)*

### *Potential findings*

- A lateral head tilt may be noted in patients with central vestibular pathology

## Range of Motion

### *Assessment – Assess*

- Neck ROM should be established prior to using Dix-Hallpike, VOR, head-thrust, and head-shaking tests

## Disease-Specific Tests and Measures

- Dizziness Handicap Inventory (Refer to Tab 6)

## Peripheral versus Central Vestibular Dysfunction

Symptom	Peripheral Nervous System	Central Nervous System
Balance loss	Mild to moderate without affecting ambulation ability	Significant; unable to maintain stance or walk
Hearing loss	Common; low frequency loss (Meniere's disease)	Rare but does occur with insults to anterior-inferior cerebellar artery
Nausea	Moderate to severe	Can vary but usually mild

**Peripheral versus Central Vestibular Dysfunction—Cont'd**

<b>Symptom</b>	<b>Peripheral Nervous System</b>	<b>Central Nervous System</b>
Neurological symptoms	Rare	May have motor or sensory deficits; Babinski sign; dysarthria; limb ataxia; or hyperreflexia
Nystagmus	Present; direction-specific response pattern with positional testing; usually unidirectional; fatigues with repetition	Often present; does not fatigue; may be vertical; unidirectional, or multidirectional depending on head position
Nystagmus – effect of visual fixation	Reduced or suppressed horizontal and vertical nystagmus	No effect
Oscillopsia	Mild unless the lesion is bilateral	Severe
Saccades	No effect	Diminished
Tinnitus	Present with Meniere's disease; may be present with acoustic neuroma	Absent

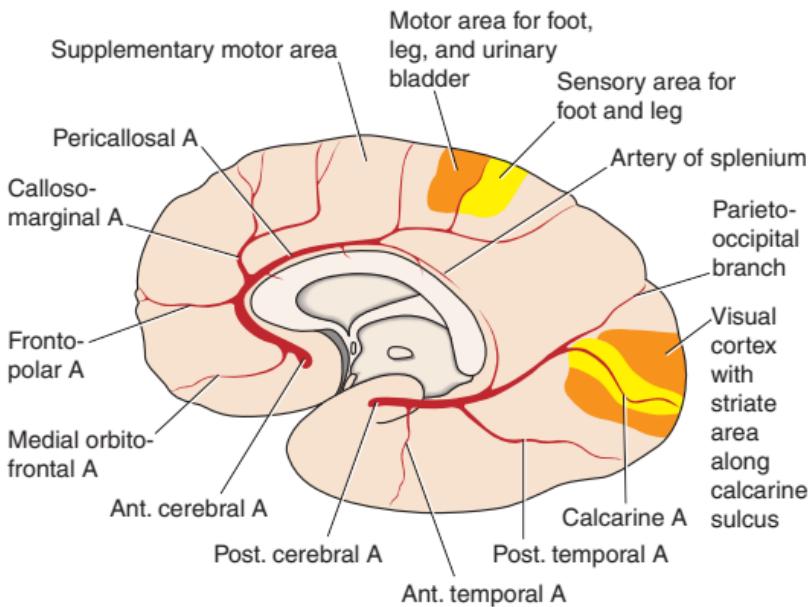
**Medication**

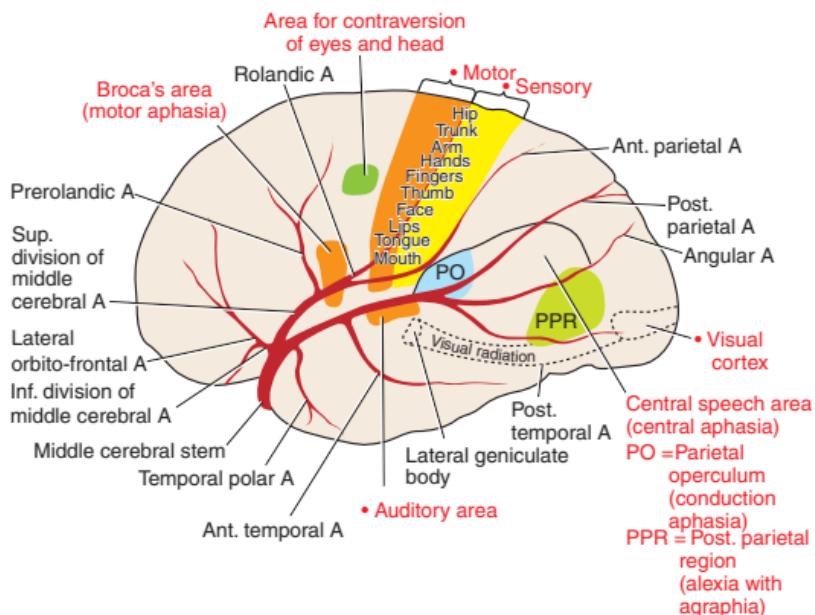
<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
Dizziness, motion sickness, vertigo	meclizine	Bonamine, Bonine	Blurred vision, confusion, drowsiness, urinary retention

## Cerebrovascular Accident

### Description/Overview

Cerebrovascular accident (CVA), or stroke, is an interruption of blood flow to the brain resulting in transient or permanent neurological deficit.<sup>1</sup>





Source: Adapted from Ropper AH, ed. *Adams and Victor's Principles of Neurology*. 8th ed. New York: McGraw-Hill Medical Pub; 2005, pp. 668, 670, with permission.

Common syndromes related to disrupted blood flow include:

### Ischemic stroke

Middle cerebral artery (MCA):

- Contralateral hemiplegia
- Ideomotor apraxia
- Homonymous hemianopsia
- Contralateral sensory loss
- Cortical sensory loss, including two-point discrimination, texture, and sense of weight

Left hemisphere infarction

- Contralateral neglect
- Possible contralateral visual field deficit
- Aphasia: Broca's (expressive) or Wernicke's (receptive)

### Posterior cerebral artery (PCA)

- Coordination disorders such as tremor or ataxia
- Contralateral homonymous field deficit
- Cortical blindness
- Cognitive impairment including memory impairment
- Contralateral sensory impairment
- Dysesthesia
- Thalamic syndrome (abnormal sensation of severe pain from light touch or temperature changes)
- Weber's syndrome (third nerve palsy)

### Anterior cerebral artery (ACA) syndrome

- Contralateral monoplegia of the lower limb
- Contralateral sensory loss of the lower limb
- Cortical sensory loss
- Apraxia
- Amnesia

### Basilar artery

- Hemiparesis, quadriplegia or locked-in syndrome (quadriplegia with intact consciousness and eye movement)
- Ipsilateral Horner's syndrome (Refer to Tab 3)
- Contralateral decrease in some or all sensory systems in the trunk and limbs

### Vertebral artery

- Hemiplegia
- Contralateral decrease in pain and temperature
- Horner's syndrome (ptosis, miosis, anhidrosis)
- Involvement of cranial nerves XII, IX, X

### Hemorrhagic stroke

- Hemiplegia
- Sensory loss
- Homonymous visual field deficit

### **Changes in Neurological Status**

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Decreased level of arousal, enlargement of pupil on side of stroke, sudden change in muscle tone and/or DTRs</li> </ul>	<ul style="list-style-type: none"> <li>Cerebral edema</li> <li>Another stroke</li> </ul>	<ul style="list-style-type: none"> <li>Cease treatment and seek immediate medical attention</li> </ul>

### **Deep Vein Thrombosis (DVT)**

Occurs most often in legs

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Swelling, heat, and erythema in the affected area (especially prevalent on the affected side)</li> <li>Positive Homans' sign</li> </ul>	<ul style="list-style-type: none"> <li>Thrombus may form in deep veins in legs due to immobilization</li> </ul>	<ul style="list-style-type: none"> <li>Cease treatment and seek immediate medical attention</li> </ul>

### **Dysphagia**

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Pain on swallowing</li> <li>Choking</li> <li>Aspiration</li> <li>Airway obstruction</li> <li>Pneumonia</li> </ul>	<ul style="list-style-type: none"> <li>Decreased coordination of swallowing muscles</li> <li>Diminished swallow reflex</li> <li>Reduced lingual and pharyngeal control</li> <li>Cranial nerve deficits</li> </ul>	<ul style="list-style-type: none"> <li>For aspiration, seek immediate medical attention</li> <li>Administer the Heimlich maneuver or CPR, if warranted</li> <li>Speech-language feeding program</li> </ul>

- Stroke is often associated with vascular disease so physician clearance should be obtained before initiating therapy

## Physical Therapy Examination

### History

Refer to Tab 2 for complete details.

#### Considerations

- Previous history of stroke can affect recovery and can lead to multi-infarct dementia

## Tests and Measures

### Aerobic Capacity/Endurance

Assessment (Refer to Tab 2)

- 2-minute or 6-minute walk test (with monitoring of vital signs)
- Following walk tests, perform:
  - Medical Research Council Dyspnea Scale (Refer to Tab 2)
  - Borg CR10 Scale of Perceived Exertion (Refer to Tab 2)

#### Potential findings

- Oxygen consumption is considerably greater in ambulatory persons who have had a stroke<sup>1</sup>

### Arousal, Attention, and Cognition

#### Considerations

- If there are language deficits, establish a form of communication via pictures, gestures, visual prompts, etc; use of short, clear directions

Assessment (Refer to Tab 2)

- Glasgow Coma Scale (Tab 4)
- Mini-Mental State Exam (Tab 2)

#### Potential findings include

- Expressive and/or receptive aphasia
- Attention disorders

- Memory deficits, including declarative and procedural memory
- Executive function deficits

## Assistive and Adaptive Devices

*Assessment – Assess the need for*

- Ambulatory devices, including straight canes, quad canes, hemi walkers, and walkers (if there is adequate UE function)
- Assistive devices to aid in dressing and other ADLs
- Complete the Wheelchair checklist

*Potential findings*

There may be a need for:

- A one-arm drive WC
- A sling for glenohumeral support

## Circulation

*Considerations*

- Existing cardiac issues may impact rehabilitation

*Assessment – Assess*

- Vital signs and assess for dyspnea during assessment and intervention
- Edema (Refer to Tab 2)

*Potential findings*

- Edema may occur in affected limbs and is associated with shoulder-hand syndrome

## Cranial and Peripheral Nerve Integrity (Refer to Tab 2)

*Assessment – Assess*

- Cranial nerve function
- Superficial sensations

*Potential findings include*

- Visual field deficits
- Weakness and sensory loss in facial musculature
- Deficits in laryngeal and pharyngeal function
- Hypoactive gag reflex
- Diminished, but perceived, superficial sensations

## Environmental, Home, and Work Barriers

### *Assessment*

- Environmental Assessment (Refer to Tab 2)

## Gait, Locomotion, and Balance

### *Balance assessment (Refer to Tab 2)*

- Berg Balance Scale
- Timed Get Up and Go
- Postural Assessment Scale for Stroke (see following)

### *Gait and locomotion assessment (Refer to Tab 2)*

- Record parameters of gait as listed in Tab 2
- Describe the level of assistance needed
  - Timed Get-Up and Go
  - 6-minute Walk Test
  - 4-Item Dynamic Gait Index
  - Performance Oriented Mobility Assessment

### *Potential findings*

Common deviations following stroke include:

- Decreased extension of the hip and hyperextension of the knee
- Decreased flexion of the knee and hip during swing phase
- Decreased knee flexion at pre-swing and mid-swing
- Increased knee extension during forward progression
- Decreased ankle dorsiflexion at initial contact and during stance
- Retraction of the pelvis and trunk throughout the gait cycle
- Increased ankle plantarflexion and hip circumduction
- Trendelenburg or compensated Trendelenburg

## Integumentary Integrity

### *Considerations*

- Sensory loss and neglect can result in injury and pressure sores
- Patient may not be able to describe pain associated with skin breakdown

## *Assessment*

- Assess all areas in terms of color, texture, and temperature of skin, concentrating on “potential areas for pressure sores” (Tab 2)
- Use “Classification of Pressure Sores” (Refer to Tab 2)

## **Joint Integrity and Mobility**

### *Assessment – Assess*

- Affected joints for soft tissue swelling, inflammation, or restriction
- Suprahumeral space; compare to nonaffected side
- Describe the nature/quality of movement of joint or body parts during movement tasks

### *Potential findings*

- Glenohumeral subluxation
- Shoulder impingement syndrome
- Adhesive capsulitis
- Complex Regional Pain Syndrome I and Shoulder-Hand Syndrome

## **Motor Function**

### *Assessment*

- Describe any intentional or resting tremors
- Coordination tests (Refer to Tab 2)
- Motor Assessment Scale for Stroke
- Fugl-Meyer Assessment<sup>2</sup>

### *Potential findings include*

- Synergistic patterns of movement include:
  - Upper limb flexion: scapular retraction, shoulder abduction and external rotation, elbow flexion,\* forearm supination, wrist and finger flexion
  - Upper limb extension: scapular protraction, shoulder adduction,\* elbow extension, forearm pronation,\* wrist and finger flexion
  - Lower limb flexion: hip flexion,\* external rotation and abduction, knee flexion, ankle dorsiflexion
  - Lower limb extension: hip extension and adduction,\* knee extension,\* ankle plantarflexion\*

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\* Indicates components that are generally the strongest.

- Associated movements or synkinesis (unintentional movements that occur in stressful situations and may accompany volitional movements)
- Apraxia including motor and verbal apraxia

## Orthotic, Protective, and Supportive Devices

### *Considerations*

Instruction for inspection for proper fit/areas of potential skin breakdown

- Permanent devices should not be given until the patient has stabilized

### *Assessment – Assess the need for*

- Air stirrup brace
- Dorsiflexor assist strapping
- Rigid or semi-rigid, posterior leaf, solid or hinged ankle-foot orthosis
- Double upright/dual channel AFO
- Swedish knee cage to prevent knee hyperextension
- Resting or neutral functional splints for the hand

## Pain

### *Considerations*

- Use nonverbal indicators of pain for patients with language deficits

### *Assessment*

- Universal Pain Scale (Refer to Tab 2)

### *Potential findings*

- Changes in muscle tone, muscle imbalances, sensory impairments and joint immobility contribute to joint pain, soft tissue and joint changes, and tendonitis
- Shoulder pain, secondary to subluxation, is a common issue
- Shoulder-hand syndrome involves swelling and tenderness in the hand and pain in the entire limb
- Complex Regional Pain Syndrome involves pain and swelling of the hand and neurovascular disturbance and changes in the skin and bone; severe pain can limit rehabilitation

## **Posture**

### *Assessment – Assess*

- Alignment and positioning at rest and during activities

### *Potential findings*

- Spastic patterns can involve flexion and abduction of the arm, flexion of the elbow, and supination of the elbow with finger flexion; hip and knee extension with ankle plantarflexion and inversion

## **Range of Motion**

### *Assess all active and passive range of motion and muscle length.*

### *Potential findings*

- Soft tissue shortening and contractures
- Increased muscle stiffness
- Joint immobility
- Disuse-provoked soft tissue changes
- Overextensibility of the capsular structures of the glenohumeral joint

## **Reflex Integrity**

### *Assessment*

- Modified Ashworth Scale for Spasticity (Tab 2)

### *Assess*

- Muscle tone in terms of hypertonicity, hypotonicity, or dystonia
- Deep tendon reflexes (Tab 2)
- Plantar reflex for possible Babinski's sign
- Righting, equilibrium, and protective reactions in all positions

### *Potential findings*

- Initially, muscle tone will be low, followed by increasing spasticity

## **Self-Care and Home Management**

### *Assessment (Refer to Tab 2)*

- Functional Independence Measure (FIM)
- Katz Index of Activities of Daily Living (Tab 2)
- Bowel and bladder control (Refer to Tab 2)

### *Potential findings*

- Urinary incontinence is common in the early stages of stroke

## **Sensory Integrity**

### *Considerations*

- Sensory assessment should involve both sides of the body
- Accurate assessment may be difficult due to cognitive and language deficits
- Establish sensory system functional status (somatosensory, vision, hearing) before completing cognitive/perceptual testing

### *Assessment (Refer to Tab 2) – Assess*

- Superficial (pain, temp, touch), deep (proprioception, vibration), and combined cortical sensations
- Figure-ground discrimination
- Spatial relationships
- Form constancy

### *Potential findings*

The following deficits may occur:

- Agnosia—can include auditory, somatosensory, tactile, visual, astereognosis, and/or somatoagnosia (deficit in understanding body scheme)
- Sensory loss, dysesthesia, or hyperesthesia
- Joint position and movement sense
- Perceptual problems including deficits in body schema/image, figure-ground discrimination, and form constancy
- Unilateral spatial neglect
- Visual-perceptual deficits
- Pusher syndrome—patient leans toward hemiplegic side and resists upright positioning

## **Ventilation and Respiration**

### *Considerations*

- Ambulation, especially with orthotics, increases energy demands so vital signs should be taken frequently

**Assessment**

- Medical Research Council Dyspnea Scale (Refer to Tab 2)
- Assess tidal volume and vital capacity
- Assess respiratory muscle strength and cough

**Work, Community, and Leisure Integration and Reintegration****Assessment**

- FIM
- Motor Assessment Scale for Stroke
- Rivermead Mobility Index (Refer to Tab 2)

**Medications**

Indications	Generic Name	Brand Name	Common Side Effects
Coronary artery thrombosis, acute ischemic stroke, pulmonary embolism, (must administer within 3 hours of onset of stroke symptoms)	alteplase	Tissue plasminogen activator (tPA); Activase	GI bleeding, intracranial hemorrhage
Increased intracranial pressure and cerebral edema	mannitol	Osmotrol, Resectisol	Dizziness, confusion, blurred vision, nausea
Hypertension	labetalol	Normodyne	Arrhythmia, bradycardia, fatigue, weakness, orthostatic hypotension
	enalapril	Vasotec	Headache, dizziness, and fatigue
Venous thrombosis, pulmonary embolism	warfarin	Coumadin	Hemorrhage in any organ or tissue

## Disease-Specific Tests and Measures

Motor Assessment Scale for Stroke (Circle Score)			Date/Pt Score
	Score		
1. Supine to side-lying onto intact side (starting position must be supine lying; knees not flexed)	1	Pulls into side-lying. (Patient pulls self into side-lying with intact arm, moves affected leg with intact leg).	
	2	Moves leg across actively and the lower half of the body follows. (Arm is left behind.)	
	3	Arm is lifted across body with other arm. Leg is moved actively and body follows in a block.	
	4	Moves arm across body actively and the rest of body follows in a block.	
	5	Moves arm and leg and rolls to side but overbalances. (Shoulder protracts and arm flexes forward.)	
	6	Rolls to side in 3 sec. (Must not use hands.)	
2. Supine to sitting over side of bed	1	Side-lying, lifts head sideways but cannot sit up. (Patient assisted to side-lying.)	
	2	Side-lying to sitting over side of bed. (Therapist assists patient with movement. Patient controls head position throughout.)	
	3	Side-lying to sitting over side of bed. (Therapist gives standby help by assisting legs over side of bed.)	
	4	Side-lying to sitting over side of bed (with no standby help).	
	5	Supine to sitting over side of bed (with no standby help).	
	6	Supine to sitting over side of bed within 10 sec (with no standby help).	

**Motor Assessment Scale for Stroke (Circle Score)—Cont'd**

	<b>Score</b>		<b>Date/Pt Score</b>
3. Balanced sitting	1	Sits only with support. (Therapist should assist patient into sitting.)	
	2	Sits unsupported for 10 sec (without holding on, knees and feet together, feet can be supported on floor).	
	3	Sits unsupported with weight well forward and evenly distributed. (Weight should be well forward at the hips, head and thoracic spine extended, weight evenly distributed on both sides.)	
	4	Sits unsupported, turns head and trunk to look behind. (Feet supported, together on floor. Do not allow legs to abduct or feet to move. Have hands resting on thighs, do not allow hands to move onto plinth.)	
	5	Sits unsupported, reaches forward to touch floor, returns to starting position. (Feet supported on floor. Do not allow patient to hold on. Do not allow legs and feet to move, support affected arm if necessary. Hand must touch floor at least 10 cm [4 in.] in front of feet.)	
	6	Sits on stool unsupported, reaches sideways to touch floor and returns to starting position. (Feet supported on floor. Do not allow patient to hold on. Do not allow legs and feet to move, support affected arm if necessary. Patient must reach sideways, not forward.)	
4. Sitting to standing	1	Gets to standing with help from therapist (any method).	
	2	Gets to standing with standby help (weight unevenly distributed, uses hands for support).	

*Continued*

**Motor Assessment Scale for Stroke (Circle Score)—Cont'd**

	<b>Score</b>		<b>Date/Pt Score</b>
	3	Gets to standing (do not allow uneven weight distribution or help from hands).	
	4	Gets to standing and stands for 5 sec with hips and knees extended (do not allow uneven weight distribution).	
	5	Sitting to standing to sitting with no standby help. (Do not allow uneven weight distribution. Full extension of hips and knees.)	
	6	Sitting to standing to sitting with no standby help three times in 10 sec. (Do not allow uneven weight distribution.)	
5. Walking	1	Stands on affected leg and steps forward with other leg. (Weight-bearing hip must be extended. Therapist may give standby help.)	
	2	Walks with standby help from one person.	
	3	Walks 3 m (10 ft) alone or uses any aid but no standby help.	
	4	Walks 5 m (16 ft) with no aid in 15 sec.	
	5	Walks 10 m (33 ft) with no aid, turns around, picks up a small sandbag from floor, and walks back in 25 sec (may use either hand).	
	6	Walks up and down four steps with or without an aid but without holding on the rail three times in 35 sec.	
6. Upper arm function	1	Lying, protract shoulder girdle with arm in elevation (therapist places arm in position and supports it with elbow in extension).	
	2	Lying, hold extended arm in elevation for 2 sec. (Therapist should place arm in position and patient must maintain position with some external rotation.) Elbow must be held within 20° of full extension.	
	3	Flexion and extension of elbow to take palm to forehead with arm as in No. 2. (Therapist may assist supination of forearm.)	

**Motor Assessment Scale for Stroke (Circle Score)—Cont'd**

	<b>Score</b>		<b>Date/Pt Score</b>
	4 5 6	Sitting, hold extended arm in forward flexion at 90° to body for 2 sec. (Therapist should place arm in position and patient must maintain position with some external rotation and elbow extension. Do not allow excess shoulder elevation.)  Sitting, patient lifts arm to above position, holds it there for 10 sec, then lowers it. (Patient must maintain position with some external rotation. Do not allow pronation.)  Standing, hand against wall. Maintain arm position while turning body toward wall (have arm abducted to 90° with palm flat against the wall).	
7. Hand movements	1 2 3	Sitting, extension of wrist. (Therapist should have patient sitting at a table with forearm resting on table. Therapist places cylindrical object in palm of patient's hand. Patient is asked to lift object off the table by extending the wrist. Do not allow elbow flexion.)  Sitting, radial deviation of wrist. (Therapist should place forearm in midpronation-supination, i.e., resting on ulnar side, thumb in line with forearm and wrist in extension, fingers around a cylindrical object. Patient is asked to lift hand off table. Do not allow elbow flexion or pronation.)  Sitting, elbow into side, pronation and supination. (Elbow unsupported and at right angle. Three-quarter range is acceptable.)	

*Continued*

**Motor Assessment Scale for Stroke (Circle score)—Cont'd**

	<b>Score</b>		<b>Date/Pt Score</b>
	4	Reach forward, pick up large ball of 14 cm (5 in.) diameter with both hands and put it down. (Ball should be on table so far in front of patient that he has to extend arms fully to reach it. Shoulders must be protracted, elbows extended, wrist neutral or extended. Palms should be kept in contact with the ball.)	
	5	Pick up a polystyrene cup from table and put it on table across other side of body. (Do not allow alteration in shape of cup.)	
	6	Continuous opposition of thumb and each finger more than 14 times in 10 seconds. (Each finger in turn taps the thumb, starting with the index finger. Do not allow thumb to slide from one finger to the other, or to go backward.)	
8. Advanced hand activities	1	Picking up the top of a pen and putting it down again (patient stretches arm forward, picks up pen top, releases it on table close to body).	
	2	Picking up one jellybean from a cup and placing it in another cup. (Teacup contains 8 jellybeans. Both cups must be at arms' length. Left hand takes jellybean from cup on right and releases it in cup on left.)	
	3	Drawing horizontal lines to stop at a vertical line 10 times in 20 seconds. (At least five lines must touch and stop at the vertical line.)	
	4	Holding a pencil, making rapid consecutive dots on a sheet of paper. (Patient must do at least two dots per second for 5 sec. Patient picks up a pencil and positions it without assistance. Patient must hold pen as for writing. Patient must make a dot not a stroke.)	

**Motor Assessment Scale for Stroke (Circle Score)—Cont'd**

	<b>Score</b>		<b>Date/Pt Score</b>
	5	Taking a dessert spoon of liquid to the mouth. (Do not allow head to lower toward spoon. Do not allow liquid to spill.)	
	6	Holding a comb and combing hair at back of head.	
9. General tonus	1	Flaccid, limp, no resistance when body parts are handled.	
	2	Some resistance felt as body parts are moved.	
	3	Variable, sometimes, flaccid, sometimes good tone, sometimes hypertonic.	
	4	Consistently normal response.	
	5	Hypertonic 50% of the time.	
	6	Hypertonic at all times.	

Source: Carr JH, Shepherd RB, Nordholm L, Lynne D. Investigation of a new motor assessment scale for stroke patients. *Phys Ther.* 1985;65(2):175–180, with permission.

**Traumatic Brain Injury (TBI)****Description/Overview**

Traumatic brain injury (TBI) is an injury resulting in intracranial disruption secondary to external forces on the brain.

TBI can result in two types of concussions:

Simple concussion: “an injury that progressively resolves without complication over 7–10 days.”<sup>3</sup>

Complex concussion: one in which the person has “persistent symptoms (including persistent symptom recurrence with exertion), specific sequelae (such as concussive convulsions), prolonged loss of consciousness (more than one minute) or prolonged cognitive impairment after the injury.”<sup>3</sup>

Following a concussion, the 2nd International Conference on Concussion in Sport recommends this protocol for athletes:

1. No activity, complete rest. Once asymptomatic, proceed to level 2.
2. Light aerobic exercise such as walking or stationary cycling, no resistance training.
3. Sport specific exercise (e.g., skating in hockey, running in soccer), progressive addition of resistance training at steps 3 or 4.
4. Noncontact training drills.
5. Full-contact training after medical clearance.
6. Game play<sup>3</sup>

Source: McCrory P, Johnston K et al. Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. *Clin J Sport Med*. 2005;15(2):48–55, with permission.

### Medical Red Flags

#### Deep Vein Thrombosis (DVT)

Occurs most often in legs

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Swelling, heat, and erythema in the affected area</li> <li>• Positive Homans' sign</li> </ul>	<ul style="list-style-type: none"> <li>• Due to immobilization, thrombus may form in deep veins in legs and/or arms</li> </ul>	<ul style="list-style-type: none"> <li>• Cease treatment and seek immediate medical attention</li> <li>• Avoid exercises to the lower limbs</li> </ul>

#### Orthostatic Hypotension (Postural Hypotension)

Symptoms	Possible Causes	Management
A sudden drop in blood pressure when moving to an upright position; may result in lightheadedness or loss of consciousness	Gravitational blood pooling due to poor distal/lower limb venous return after a period of immobility	<ul style="list-style-type: none"> <li>• Monitor blood pressure during position changes</li> <li>• Recline the patient or elevate the lower limbs</li> <li>• Assess the need for compression stockings</li> </ul>

## Dysphagia

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Pain on swallowing</li> <li>• Choking</li> <li>• Aspiration</li> <li>• Airway obstruction</li> <li>• Pneumonia</li> </ul>	<ul style="list-style-type: none"> <li>• Decreased coordination of swallowing muscles</li> <li>• Diminished swallow reflex</li> <li>• Reduced lingual and pharyngeal control</li> <li>• Cranial nerve deficits</li> </ul>	<ul style="list-style-type: none"> <li>• For aspiration, seek immediate medical attention</li> <li>• Administer the Heimlich maneuver or CPR, if warranted</li> <li>• Speech-language feeding program</li> </ul>

## Precautions

### Heterotopic Ossification

Symptoms	Possible Causes	Management
Pain, local tenderness, low-grade fever, swelling most commonly in hips, knees, & shoulders; may result in restriction in range of motion	Formation of bone in the extra-articular space, muscle, and soft tissue; may occur along the line of hypertonic muscle tone	<ul style="list-style-type: none"> <li>• Refer to physician for radiograph to confirm diagnosis</li> <li>• Passive ROM performed gently and without force</li> </ul>

### Seizures

Symptoms	Causes	Management
Loss of consciousness, followed by stiffening and then jerking of limbs; may bite tongue, cheek, or lip; drool, and have bladder and bowel incontinence	Multiple neurological, cardiovascular, psychological, and other causes of seizures and seizurelike episodes	<ul style="list-style-type: none"> <li>• Stop treatment</li> <li>• Protect the patient from injury</li> <li>• Alert the physician</li> </ul>

## Physical Therapy Examination

### History

- Obtain history of:
  - The nature of injury including cause, location, and extent of injury
  - The duration of retrograde and posttraumatic amnesia
  - Premorbid abilities and functioning
- Because domestic violence frequently involves injuries to the head, in a private setting, ask patients direct, nonjudgmental questions about domestic abuse (e.g., "Because domestic violence is so common, I ask all of my patients if they have been abused.")

### Tests and Measures

#### Arousal, Attention, and Cognition

##### Considerations

- Post-concussion syndrome can result in mild, fluctuating problems in memory, cognition, and personality that require careful testing
- Post-traumatic amnesia results in problems with perception, thinking, remembering and concentrating, impulsivity, and disinhibition

##### Assessment

- Glasgow Coma Scale
- Galveston Orientation and Amnesia Test (GOAT)
- Pediatric Glasgow Coma Scale
- Rancho Los Amigos Levels of Cognitive Function—Revised
- Mini-Mental State Exam (see Tab 2)

##### Potential findings

- Patient is considered to be in a vegetative state if there is no evidence of awareness of one's self and environment and no sustained behavioral response to stimuli; a persistent vegetative state exists when this state continues for more than 1 month<sup>4</sup>
- A minimally conscious state exists when there is sustained, reproducible evidence of self or the environment<sup>4</sup>
- Glasgow Coma, Rancho Los Amigos, and GOAT scales provide a guide to the return of attention and cognition

- The patient may have deficits in:
  - Orientation and attention
  - Memory, which may be declarative or procedural
  - Reasoning and problem-solving abilities
  - Attending to tasks
  - Impulse control that can result in safety risks
  - Language, including expressive or receptive aphasia and echolalia
- Common behavioral issues include:
  - Distractibility
  - Sexual, emotional, and aggressive disinhibition
  - Low frustration tolerance
  - Emotional lability

## **Assistive and Adaptive Devices**

Assess for the need, proper fit, and ability to safely use:

- Ambulatory devices
- Assistive devices to aid in ADLs
- WCs including reclining or tilt-in-space
- Positioning devices for WC, including belts, cushions, and head, pelvic, and lateral supports

## **Cranial and Peripheral Nerve Integrity**

### *Assessment*

- Cranial and peripheral nerve integrity (Tab 2)

### *Potential findings*

- Impairment in light touch, pain, deep pressure, and temperature
- Visual deficits including visual field cuts, hemianopsia, or cortical blindness
- Dysphagia

## **Environmental, Home, and Work Barriers (Refer to Tab 2)**

### **Gait, Locomotion, and Balance**

#### *Balance assessment*

- Assess balance (dynamic and static) with and without the use of assistive, adaptive, orthotic, and prosthetic devices and during functional activities
- Complete standardized balance assessments:

- Static Balance Tests (Refer to Tab 2)
  - Romberg Test
  - Tandem (Sharpened) Romberg Test
  - One-legged Stance Test
- Dynamic Balance Tests
  - The Berg Balance Scale
  - Timed Get Up and Go Test
  - Performance-Oriented Mobility Assessment
- Falls efficacy and falls prediction
  - Tinetti's Falls Efficacy Scale

#### *Potential findings*

- Balance issues are common
- Dizziness may result from peripheral vestibular, or visual dysfunction

#### *Gait and Locomotion Assessment (Refer to Tab 2)*

- Timed Get Up and Go (3 meter distance)
- 4-Item Dynamic Gait Index (Refer to Tab 2)
- Performance Oriented Mobility Assessment (Refer to Tab 2)
- Assess safety during gait and locomotion, including the level of assistance needed, and indicators of self judgment regarding safety

### **Integumentary Integrity**

#### *Assessment*

- Assess skin color, texture, turgor, and mobility
- Describe size, color, smell of any open wounds
- Use Classification of Pressure Sores (see Tab 2) to grade any pressure sores

### **Joint Integrity and Mobility**

#### *Assessment*

- Assess soft tissue swelling, inflammation, or restriction

### **Motor Function**

#### *Considerations*

- Motor involvement is variable and may be represented as mono-, hemi-, or tetraparesis depending on areas of insult

*Assessment—Provide narrative description of*

- Quality of movement during functional activities
- Ability to motor plan (praxis)
- Accuracy (or error) in reaching a target
- Coordination tests of the extremities (Refer to Tab 2)
- Rivermead Mobility Index (Refer to Tab 2)

*Potential findings*

- Depending on area of insult, there may be decorticate or decerebrate rigidity (see following Reflex Integrity section), spasticity, or ataxia
- Deficits may occur in:
  - Timing and sequencing of movement
  - Sequencing of multi-step tasks
  - Hand-eye coordination

## Muscle Performance

- Assess muscle strength when performing functional activities and ADL

## Orthotic, Protective, and Supportive Devices

*Considerations*

- Instruction in the use of assistive devices, including for proper fit and areas of potential skin breakdown
- Permanent devices should not be ordered until the patient has stabilized

*Assessment – Assess the need for*

- Orthotics, including rigid or semi-rigid, posterior leaf, solid, or hinged ankle-foot orthosis (AFO)
- Inhibitory or serial casting
- Positioning devices

## Pain (Refer to Tab 2)

*Assessment*

- Universal Pain Scale, considering existing communication deficits
- Note nonverbal indicators of pain

## Posture

### Potential findings

- The patient may display limb posturing with spasticity
- The patient may have decerebrate or decorticate rigidity

## Range of Motion

### Considerations

- Immobilization, abnormal tone and primitive reflexes increase the chance of contractures.

### Assessment – Assess

- Passive, active-assist, and/or active range of motion, as appropriate
- Muscle, joint, and soft tissue characteristics

### Potential findings

- Contractures often occur in ankle plantarflexors, hip, knee and elbow flexors.

## Reflex Integrity

### Assessment

- Modified Ashworth Scale for Spasticity (Refer to Tab 2)
- Assess
  - Resting posture and position of the limbs
  - Muscle tone in terms of hypertonicity, hypotonicity, or dystonia
  - Deep tendon reflexes (Refer to Tab 2)
  - Plantar reflex for Babinski's sign (Refer to Tab 2)
  - Righting, equilibrium, and protective extension reactions

### Potential findings

- Decorticate rigidity, (sustained posturing with upper limbs in flexion and lower limbs in extension occurs in lesions just above the upper brainstem)
- Decerebrate rigidity, sustained posturing with trunk and limbs in extension, occurs in brainstem injuries
- Spasticity
- Positive Babinski's sign
- Clonus

## Self-Care and Home Management

*Assessment (Refer to Tab 2)*

- Functional Independence Measure (FIM)
- Katz Index of Activities of Daily Living

## Sensory Integrity

*Considerations*

Patient may be unable to understand or respond to directions and questions

*Assessment-Assess*

- Superficial (pain, temp, touch), deep (proprioception, vibration) and combined cortical sensations

*Potential findings*

- Sensory deficits, that may be contralateral or ipsilateral, depending on lesion location
- Perceptual deficits may involve neglect and apraxia
- Impairments may be found in
  - Proprioception
  - Kinesthesia
  - Figure-ground discrimination
  - Spatial relationships

## Ventilation and Respiration

*Considerations*

- Patient may require intubation, tracheotomy, and mechanical ventilation

*Assessment*

- Auscultate to assess breath sounds of each segment
- Assess tidal volume, vital capacity, respiratory muscle strength, and cough
- Medical Research Council Dyspnea Scale (Refer to Tab 2)

## Disease-Specific Tests and Measures

Glasgow Coma Scale (GCS) is a simple quantitative assessment of level of consciousness, indicating the integrity of reticular formation.

Category	Score	Descriptor	Outcome
<b>Eye Opening</b>	4	Spontaneous	
	3	To speech	
	2	To pain	
	1	No response	
<b>Best Motor Response</b>	6	Follows motor commands	
To painful stimulus	5	Localizes	
To painful stimulus	4	Withdraws	
To painful stimulus	3	Abnormal flexion	
To painful stimulus	2	Extensor response	
To painful stimulus	1	No response	
<b>Verbal Response</b>	5	Oriented	
	4	Confused conversation	
	3	Inappropriate words	
	2	Incomprehensible sounds	
	1	No response	
<b>Total Score</b>			
Severe head injury	GCS of 8 or less		
Moderate head injury	GCS score of 9 to 12		
Mild head injury	GCS score of 13 to 15		

Source: Jennett B, Teasdale G. *Management of Head Injuries*. Philadelphia: FA Davis; 1981, p.78, with permission.

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## Pediatric Glasgow Coma Scale

		Infant	Pediatric	Outcome
 <b>Eye Opening</b>	4	Eyes opening spontaneously	Spontaneous eye opening	
	3	Eye opening to speech	Eye opening to verbal command	
	2	Eye opening to painful stimulation	Eye opening to painful stimulation	
	1	No eye opening	No eye opening	
<b>Best Motor Response</b>	6	Infant moves spontaneously or purposefully	Spontaneous (obeys verbal commands)	
	5	Infant withdraws from touch	Localizes to painful stimuli (brushes away with hand)	
	4	Infant withdraws from pain	Withdraws in flexion pattern from painful stimuli	
	3	Abnormal flexion to pain for an infant (decorticate)	Flexion posture in response to painful stimuli	
<b>Best Verbal Response</b>	2	Extension to pain (decerebrate)	Extension posture in response to painful stimuli	
	1	No motor response	No response to painful stimuli	
	5	Infant coos/babbles (normal activity)	Smiles, oriented to sounds, follows objects	
	4	Infant is irritable and continually cries	Crying, inappropriate interaction with others	
	3	Infant cries to pain	Intermittently consolable, moaning and irritable	

**Pediatric Glasgow Coma Scale—Cont'd**

		Infant	Pediatric	Outcome
	2	Infant moans to pain	Inconsolable, restless; incomprehensible sounds	
	1	No verbal response	No verbal output	
<b>Total score</b>				
<b>Total score</b> 3–15 Minor head injury 13–15 Moderate head injury 9–12 Severe head injury (coma) 8				

Source: Holmes JF, et al. Performance of the Pediatric Glasgow Coma Scale in children with blunt head trauma. *Acad Emerg Med*. 2005;12(9):814–819, with permission.

**Rancho Los Amigos Levels of Cognitive Function—Revised**

Level of Function	Behavioral Characteristics	Yes/No
Level 1 No Response	Complete absence of observable change in behavior when presented visual, auditory, tactile, proprioceptive, vestibular or painful stimuli.	
Total Assistance		
Level 2 Generalized Response	Demonstrates generalized reflex response to painful stimuli.	
	Responds to repeated auditory stimuli with increased or decreased activity.	
Total Assistance	Responds to external stimuli with physiological changes generalized, gross body movement and/or not purposeful vocalization.	
	Responses noted above may be same regardless of type and location of stimulation.	
	Responses may be significantly delayed.	

*Continued*

## Rancho Los Amigos Levels of Cognitive Function—Revised—*Cont'd*

Level of Function	Behavioral Characteristics	Yes/No
Level 3 Localized Response	Demonstrates withdrawal or vocalization to painful stimuli.	
	Turns toward or away from auditory stimuli.	
	Blinks when strong light crosses visual field.	
Total Assistance	Follows moving object passed within visual field.	
	Responds to discomfort by pulling tubes or restraints.	
	Responds inconsistently to simple commands.	
	Responses directly related to type of stimulus.	
	May respond to some persons (especially family and friends) but not to others.	
Level 4 Confused-Agitated	Alert and in heightened state of activity.	
	Purposeful attempts to remove restraints or tubes or crawl out of bed.	
	May perform motor activities such as sitting, reaching and walking but without any apparent purpose or upon another's request.	
Maximal Assistance	Very brief and usually nonpurposeful moments of sustained attention.	
	Absent short-term memory.	
	Absent goal directed, problem solving, self-monitoring behavior.	
	May cry out or scream out of proportion to stimulus even after its removal.	
	May exhibit aggressive or flight behavior.	
	Mood may swing from euphoric to hostile with no apparent relationship to environmental events.	
	Unable to cooperate with treatment efforts.	
	Verbalizations are frequently incoherent and/or inappropriate to activity or environment.	

### Rancho Los Amigos Levels of Cognitive Function—Revised—*Cont'd*

Level of Function	Behavioral Characteristics	Yes/No
Level 5 Confused-Inappropriate-Nonagitated  Maximal Assistance	Alert, not agitated but may wander randomly or with a vague intention of going home.	
	May become agitated in response to external stimulation and/or lack of environmental structure.	
	Not oriented to person, place, or time.	
	Frequent brief periods, nonpurposeful sustained attention.	
	Severely impaired recent memory, with confusion of past and present in reaction to ongoing activity.	
	Absent goal directed, problem-solving, self-monitoring behavior.	
	Often demonstrates inappropriate use of objects without external direction.	
	May be able to perform previously learned tasks when structure and cues provided.	
	Unable to learn new information.	
	Able to respond appropriately to simple commands fairly consistently with external structures and cues.	
	Responses to simple commands without external structure are random and nonpurposeful in relation to the command.	
	Able to converse on a social, automatic level for brief periods of time when provided external structure and cues.	
	Verbalizations about present events become inappropriate and confabulatory when external structure and cues are not provided.	

*Continued*

## Rancho Los Amigos Levels of Cognitive Function—Revised—Cont'd

Level of Function	Behavioral Characteristics	Yes/ No
Level 6 Confused-Appropriate	Inconsistently oriented to person, and place.	
	Able to attend to highly familiar tasks in nondistracting environment for 30 minutes with moderate redirection.	
	Remote memory has more depth and detail than recent memory.	
	Vague recognition of some staff.	
	Able to use assistive memory aid with maximal assistance.	
	Emerging awareness of appropriate response to self, family, and basic needs.	
	Emerging goal-directed behavior related to meeting basic personal needs.	
	Moderate assistance to problem solve barriers to task completion.	
	Supervised for old learning (e.g., self-care).	
	Shows carry over for relearned familiar tasks (e.g., self-care).	
Moderate Assistance	Maximal assistance for new learning with little or no carry over.	
	Unaware of impairments, disabilities and safety risks.	
	Consistently follows simple directions.	
	Verbal expressions are appropriate in highly familiar and structured situations.	
	Consistently oriented to person and place, within highly familiar environments.	
Level 7 Automatic-Appropriate	Able to use assistive memory devices with minimal assistance.	
	Minimal supervision for new learning.	

### Rancho Los Amigos Levels of Cognitive Function—Revised—*Cont'd*

Level of Function	Behavioral Characteristics	Yes/ No
Minimal Assistance for Routine Daily Living Skills	Demonstrates carry over of new learning.	
	Initiates and carries out steps to complete familiar personal and household routine, has shallow recall of what he/she has been doing.	
	Able to monitor accuracy and completeness of each step in routine personal and household ADLs and modify plan with minimal assistance.	
	Superficial awareness of his/her condition but unaware of specific impairments and disabilities and the limits they place on his/her ability to safely, accurately and completely carry out his/her household, community, work, and leisure ADLs.	
	Minimal supervision for safety in routine home and community activities.	
	Unrealistic planning for the future.	
	Moderate assistance or has significant difficulty thinking about consequences of a decision or action.	
	Overestimates abilities.	
	Limited awareness of others' needs and feelings.	
	Oppositional/uncooperative. May have difficulty recognizing inappropriate social interaction behavior.	
Level 8 Purposeful and Appropriate	Consistently oriented to person, place, and time.	
	Independently attends to and completes familiar tasks.	
	Able to recall and integrate past and recent events.	

*Continued*

## Rancho Los Amigos Levels of Cognitive Function—Revised—Cont'd

Level of Function	Behavioral Characteristics	Yes/ No
Standby Assistance	Uses assistive memory devices to recall daily schedule, "to do" lists and record critical information for later use with standby assistance.	
	Initiates and carries out steps to complete familiar personal, household, community, work, and leisure routines with standby assistance and can modify the plan when needed with minimal assistance.	
	Requires no assistance once new tasks/activities are learned.	
	Aware of and acknowledges impairments and disabilities when they interfere with task completion but requires standby assistance to take appropriate corrective action.	
	Thinks about consequences of a decision or action with minimal assistance.	
	Overestimates or underestimates abilities.	
	Acknowledges others' needs and feelings and responds appropriately with minimal assistance.	
	Depressed.	
	Irritable.	
	Low frustration tolerance/easily angered.	
	Argumentative.	
	Self-centered.	
	Uncharacteristically dependent/independent.	
	Able to recognize and acknowledge inappropriate social interaction behavior while it is occurring and takes corrective action with minimal assistance.	

### Rancho Los Amigos Levels of Cognitive Function—Revised—*Cont'd*

Level of Function	Behavioral Characteristics	Yes/ No
Level 9 Purposeful and Appropriate	Independently shifts back and forth between tasks and completes them accurately for at least two consecutive hours.	
	Uses assistive memory devices to recall daily schedule, "to do" lists and record critical information for later use with assistance when requested.	
	Initiates and carries out steps to complete familiar personal, household, work and leisure tasks with assistance when requested.	
Standby Assistance on Request	Aware of and acknowledges impairments and disabilities when they interfere with task completion and takes appropriate corrective action but requires standby assist to anticipate a problem before it occurs and take action to avoid it.	
	Able to think about consequences of decisions or actions with assistance when requested.	
	Accurately estimates abilities but requires standby assistance to adjust to task demands.	
	Acknowledges others' needs and feelings and responds appropriately with stand-by assistance.	
	Depression may continue.	
	May be easily irritable.	
	May have low frustration tolerance.	
	Able to self monitor appropriateness of social interaction with standby assist.	

*Continued*

## Rancho Los Amigos Levels of Cognitive Function—Revised—Cont'd

Level of Function	Behavioral Characteristics	Yes/ No
Level 10 Purposeful and Appropriate	Able to handle multiple tasks simultaneously in all environments but may require periodic breaks.	
	Able to independently procure, create and maintain own assistive memory devices.	
Modified Independent	Independently initiates and carries out steps to complete familiar and unfamiliar personal, household, community, work, and leisure tasks but may require more than the usual amount of time and/or compensatory strategies to complete them.	
	Anticipates impact of impairments and disabilities on ability to complete daily living tasks and takes action to avoid problems before they occur but may require more than the usual amount of time and/or compensatory strategies.	
	Able to independently think about consequences of decisions or action but may require more than the usual amount of time and/or compensatory strategies to select the appropriate decision or action.	
	Accurately estimates abilities and independently adjusts to task demands.	
	Able to recognize the needs and feelings of others and automatically respond in appropriate manner.	
	Periodic periods of depression may occur.	
	Irritability and low frustration tolerance when sick, fatigued, and/or under emotional stress.	
	Social interaction behavior is consistently appropriate.	

Source: Hagan C. *The Rancho Levels Of Cognitive Functioning: A Clinical Case Management Tool, The Revised Levels*. 3rd ed. Rancho Los Amigos, CA: 1998, with permission.

## Medications

<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
Agitation	carbamazepine	Tegretol	No serious side effects
	lorazepam	Ativan	Dizziness, drowsiness, weakness
Spasticity—overall	baclofen	Lioresal	Dizziness, drowsiness, weakness, fatigue, over-relaxation of muscles
	dantrolene	Dantrium	Drowsiness, weakness, diarrhea
Spasticity—specific muscles	phenol nerve block		Dysesthesia, skin sloughing, vascular complications
	botulinum toxin-type A	Botox, Dysport, BT-A	Weakness, pain at injection site
Seizures	phenobarbital	Phenobarbital, Luminal	Drowsiness, depression, headache
	valproic acid	Depakene, Depakote, Depacon	Nausea, vomiting, confusion, dizziness, headache, tremor

## Progressive Disorders of the Central Nervous System (CNS-P)

### Alzheimer's Disease

#### Description/Overview

Alzheimer's disease (AD) initially affects cognitive function & can be divided into 4 stages: preclinical, mild, moderate, & severe. In the preclinical stage, patients often demonstrate minimal cognitive impairment with memory loss usually being the first visible sign.

#### Physical Therapy Examination

##### General Considerations

- Use alerting cues & simple commands if patient demonstrates signs of dementia
- Provide reassurance & familiarity in place and activity selections
- May need family member assistance

##### History (Refer to Tab 2)

- May need to obtain history from a family member

##### Vital Signs

- Assess BP, HR, RR, & body temperature

#### Tests and Measures

##### Aerobic Capacity/Endurance

###### Assessment

- Assess BP, HR, & RR at rest & during & after activities
- If possible, administer 2-minute walk test & Borg Rating of Perceived Exertion (Tab 2) to determine measured & perceived exertion

###### Potential findings

- May have impaired responses to exercise due to deconditioning

## Anthropometric Characteristics

### Assessment

- Assess weight, height, & BMI

### Potential findings

- Patients with AD may experience drastic weight changes (gains or losses) due to changes in eating behavior

## Arousal, Attention, and Cognition

### Assessment

- Administer Mini-Mental State Exam (Tab 2) to assess orientation, cognition, short- & long-term memory, & communication

### Potential findings

- Patients with AD may
  - Become easily confused & disoriented regarding date, time, & place
  - Exhibit " sundowning" behaviors (increased risks of wandering, agitation, & confusion in late afternoon)
  - Experience hallucinations, agitation or delusions (for instance, believing "someone is trying to poison me")
  - Exhibit personality changes such as violent outbursts
  - Exhibit sleep-wake cycle changes (often sleep during the day & stay awake at night)
  - Experience difficulties in judgment
  - Show an inability to follow directions
  - Have difficulty performing complex tasks such as balancing a checkbook
  - Experience short-term memory loss (for instance, misplacing objects & being unable to follow multistep instructions)
  - Have trouble communicating (often substitute simple words for more complex words; some patients with AD eventually become completely noncommunicative)

## Circulation

### Considerations

- Most patients with AD are elderly & often have high blood pressure unrelated to the disease

### *Assessment – Assess for*

- BP, HR, & edema in supine, sitting, & standing
- BP & HR at rest & during & after activities

### **Environment, Home, and Work Barriers**

#### *Considerations*

- Check environment, home, & work to prevent potential falls (Tab 2)
- Patients with AD sometimes wander outside their homes (check & secure all exits)

### *Assessment (Refer to Tab 2)*

### **Gait, Locomotion, and Balance**

#### *Considerations*

- All three areas may be affected due to lack of environmental awareness
- Many patients with AD are referred to physical therapy after falling

### *Assessment*

- Observe gait in an uncluttered, well-lit hallway first & again with few obstacles placed in the path to observe patient for safety & maneuvering around obstacles
- Administer Timed Get Up & Go Test (Tab 2) to assess dynamic balance

### *Potential findings*

- Patients with AD may demonstrate
  - Impaired dynamic balance
  - An inability to respond to environmental changes
  - Difficulty in dealing with an obstacle course

### **Motor Function**

#### *Assessment*

- Assess movement quality by observing patients with AD performing familiar activities & ADLs
- Determine motor learning ability by observing patients with AD performing new motor tasks

### *Potential findings*

- Patients with AD
  - Often demonstrate apraxia with familiar tasks
  - Have difficulty learning new motor skills

### **Muscle Performance**

#### *Considerations*

- Difficult to assess due to cognitive deficits

#### *Assessment (Refer to Tab 2)*

- Observe patient rising from chair & sitting back down
- Observe patient walking on level surfaces for known distance or time & stairs

### *Potential findings*

- Patients with AD may demonstrate overall weakness & early fatigue for sustained activities due to deconditioning

### **Pain**

#### *Considerations*

- Difficult to assess
- Pay attention to nonverbal communication (facial expressions, limb retraction, agitation, etc.)

### **Reflex Integrity**

#### *Assessment*

- DTRs of patellar tendon, hamstring, biceps, & triceps
- Righting reflexes in sitting & standing
- Equilibrium reactions in sitting, standing, & perturbation responses
- Protective extension reactions

### *Potential findings*

- Minor parkinsonian symptoms including
  - Rigidity resulting in increased resistance to passive movements
  - Hyperactive reflexes
  - Bradykinesia

- Myoclonic jerking
- Frontal lobe signs such as:
  - Grasp reflex
    - Stroke palm & watch for individual to close hand around tester's finger
  - Snout reflex
    - Tap skin between upper lip & nose & watch for lip purse
  - Glabellar reflex
    - Tap between eyebrows while keeping hand out of sight & watch for eye blink
- Normal righting reactions
- Impaired or delayed equilibrium reactions
- Impaired or delayed protective extension reactions

## Self-Care and Home Management

### Assessment

- Observe patient with AD performing ADLs
- Interview primary caretaker regarding patient's dependence in ADLs
- Administer Bowel & Bladder Control Checklist (Tab 2)

### Potential findings

- Patients with AD may
  - Experience changes in appetite such as overeating due to an inability to feel full
  - Be unaware of their appearance
  - Become ADL-dependent
  - Initially experience infrequent bowel & bladder control loss followed by an unawareness of bowel & bladder movements and eventually complete bowel & bladder control loss (might require diapers)

## Work, Community, and Leisure

### Assessment (Refer to Tab 2)

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Cognitive & behavioral symptoms	cholinesterase inhibitors – tacrine	Cognex	Liver damage, nausea, indigestion, diarrhea
	donepezil	Aricept	Headache, generalized pain, fatigue, GI problems
	galantamine	Reminyl	Nausea, vomiting, diarrhea, weight loss
Moderate to severe AD symptoms	NMDA antagonists – Memantine	Namenda	Dizziness, headache, constipation, confusion

## Amyotrophic Lateral Sclerosis (ALS or “Lou Gehrig’s Disease”)

### Description/Overview

Amyotrophic lateral sclerosis (ALS) is characterized by a progressive degeneration of motor neurons in the spinal cord & cranial nerves. ALS generally does not involve sensory or autonomic nervous systems. Recent research shows that a small percentage of patients with ALS may experience cognitive problems.

### Physical Therapy Examination

#### History (Refer to Tab 2)

#### Vital Signs

- Assess BP, HR, RR, & body temperature

#### Potential findings

- RR may be affected due to respiratory muscle weakness

## Tests and Measures

### Aerobic Capacity/Endurance

#### *Considerations*

- Respiratory function deteriorates in patients with late-stage ALS

#### *Assessment*

- Assess respiratory muscle strength
- Use spirometer to assess tidal volume & vital capacity
- If possible, administer 6-minute or 2-minute walk test (Tab 2) & Borg Rating of Perceived Exertion (Tab 2) to determine measured & perceived exertion

#### *Potential findings*

Patients with ALS may

- Demonstrate dyspnea during exercise due to respiratory muscle weakness
- Fatigue easily
- Have difficulty with supine sleeping & may frequently awaken at night due to respiratory distress
- Experience morning headaches due to hypoxia

### Anthropometric Characteristics

#### *Assessment*

- Assess weight, height, & BMI

#### *Potential findings*

- Patients with late-stage ALS may experience weight loss & muscle mass loss due to nutritional deficiencies resulting from eating or swallowing difficulties

### Arousal, Attention, and Cognition

#### *Assessment*

- Administer Mini-Mental State Exam (Tab 2) to assess cognition, short- & long-term memory, & communication

**Potential findings**

- Pseudobulbar affect (affective changes often seen in patients with spastic bulbar palsy) including
  - Spontaneous crying or laughing without an emotional trigger
  - Exaggerated emotional responses
- Intact cognitive function, though a small percentage of patients may have memory loss or decision-making difficulty, & even dementia
- Communication difficulties such as dysarthria (slurred speech)

**Assistive and Adaptive Devices***Considerations*

- May need ambulatory aids in early-mid stages & wheelchair in late stages

**Assessment (Refer to Tab 2)****Cranial and Peripheral Nerve Integrity***Assessment*

- All cranial nerves, especially VII through XII
- Muscle strength to determine peripheral motor nerve integrity

*Potential findings*

- Lack of a gag reflex in advanced stages (IX)
- Dysphagia – chewing or swallowing difficulty (IX)
- Dysarthria (slurred speech) due to weakness of the tongue, lip, jaw, larynx, or pharynx muscles (VII, IX, & XII)
- Sialorrhea – excessive saliva production, drooling, or difficulty swallowing saliva (VII & IX)
- Symptoms of peripheral motor nerve involvement, such as fatigue, weakness, stiffness, twitches, or muscle cramps
- Symptoms are usually asymmetrical

**Environment, Home, and Work Barriers (Refer to Tab 2)****Gait, Locomotion, and Balance***Considerations*

- Patients with ALS may fatigue easily

## Assessment

- Administer:
  - Romberg Test (Tab 2), Functional Reach Test (Tab 2) or Multi-Directional Reach Test (Tab 2) to assess static balance for patients with advanced illness
  - Timed Get Up & Go Test (Tab 2) & Berg Balance Scale (Tab 2) to assess dynamic balance

## Potential findings

- Impaired static or dynamic balance due to weakness, fatigue, & frequent falls
- Gait deviations, such as slow speed, difficulty clearing feet from floor or shuffling
- Spastic gait pattern or clonus due to UMN involvement

## Integumentary Integrity

### Assessment (Refer to Tab 2)

## Potential findings

- Patients with late-stage ALS are at high risk for pressure sores due to an inability to move voluntarily

## Motor Function

### Assessment

- Assess movement quality by observing patients with ALS performing ADLs
- Examine motor learning ability by observing patients with ALS performing new motor tasks (such as using an assistive device or adopting new strategies for safety)

## Potential findings

- Fasciculation (muscle spasm, cramp, or twitch especially in the hands & feet)
- Difficulty learning new motor tasks due to limited cognitive function

## Muscle Performance

### Assessment

- Assess upper & lower limbs & cervical muscle strength

### *Potential findings*

- Muscle weakness progressing from distal to proximal
  - 60% of patients with ALS exhibit this pattern of muscle weakness as the initial sign of the disease<sup>1</sup>
- Fine motor movement difficulty such as problems holding & grasping things, buttoning, & writing
- Increased foot-slapping & tripping frequency
- Cervical extensor weakness causing a feeling of heavy headedness after reading or writing

### **Pain**

#### *Assessment*

- Administer Ransford Pain Drawing (Tab 2)

#### *Potential findings*

- Some patients with ALS report pain (or paresthesia) in the limbs due to immobility, adhesive capsulitis, & contractures
- Patients with ALS may report muscle cramps often associated with muscle weakness

### **Posture**

#### *Assessment (Refer to Tab 2)*

#### *Potential findings*

- Patients with ALS may experience postural deviations due to weakness or muscle tone changes

### **Range of Motion**

#### *Assessment*

- Assess active & passive ROM

#### *Potential findings*

- Decreased active ROM secondary to weakness
- Joint contractures due to immobility

### **Reflex Integrity**

#### *Assessment*

- DTR & muscle tone of biceps, triceps, & patellar & Achilles tendons
- Postural reflexes (righting reflexes, equilibrium, & protective reactions)

### Potential findings

- Hyporeflexia & decreased muscle tone due to LMN problems
- Spasticity due to UMN involvement
- Difficulty righting head due to cervical extensor weakness
- Delayed or impaired equilibrium reactions due to overall weakness

### Self-Care and Home Management

#### Assessment (Refer to Tab 2)

### Potential findings

- Patients with late-stage ALS may need ADL assistance & supportive seating for self-care & feeding activities

### Ventilation and Respiration

#### Assessment

- RR, tidal volume, & vital capacity
- Respiratory (including accessory) muscle strength
- Cough
- Response to mechanical ventilation support at night & during the day
- Administer pulse oximeter to determine blood oxygen level & review blood gas

### Potential findings

Patients with ALS may

- Have decreased tidal volume or vital capacity
- Experience impaired blood oxygen levels
- Exhibit respiratory muscle weakness
- Have low voice volume
- Demonstrate impaired cough
- Require mechanical ventilation support in late-stage illness

### Work, Community, and Leisure

#### Assessment (Refer to Tab 2)

### Potential findings

- Patients with late-stage ALS may be impaired in this category

## Disease-Specific Tests and Measures

### Amyotrophic Lateral Sclerosis Functional Rating Scale – Revised

Function	Score	Findings
1. Speech	4–Normal speech processes 3–Detectable speech disturbances 2–Intelligible with repeating 1–Speech combined with nonvocal communication 0–Loss of useful speech	
2. Salivation	4–Normal 3–Slight but definite excess of saliva; may have nighttime drooling 2–Moderately excessive saliva; may have minimal drooling 1–Marked excess of saliva with some drooling 0–Marked drooling; requires constant tissue or handkerchief	
3. Swallowing	4–Normal eating habits 3–Early eating problems & occasional choking 2–Dietary consistency changes 1–Needs supplemental tube feeding 0–NPO (exclusively parenteral or enteral feeding)	
4. Handwriting	4–Normal 3–Slow or sloppy; all words are legible 2–Not all words are legible 1–Able to grip pen but unable to write 0–Unable to grip pen	

*Continued*

## Amyotrophic Lateral Sclerosis Functional Rating Scale – Revised—Cont'd

Function	Score	Findings
5a. Cutting food & handling utensils (patient without gastrostomy)	4–Normal 3–Somewhat slow & clumsy, but no help needed 2–Can cut most foods, although clumsy & slow; some help needed 1–Food must be cut by someone, but can still feed slowly 0–Needs to be fed	
5b. Cutting food & handling utensils (alternate scale for patient with gastrostomy)	4–Normal 3–Clumsy but able to perform all manipulations independently 2–Some help needed with closures & fasteners 1–Provides minimal assistance to caregiver 0–Unable to perform any aspect of task	
6. Dressing & hygiene	4–Normal function 3–Independent & complete self-care with effort or decreased efficiency 2–Intermittent assistance or substitute methods 1–Needs attendant 0–Total dependence	
7. Turning in bed & adjusting bed clothes	4–Normal 3–Somewhat slow & clumsy, but no help needed 2–Can turn alone or adjust sheets, but with great difficulty 1–Can initiate, but not turn or adjust sheets alone 0–Helpless	
8. Walking	4–Normal 3–Early ambulation difficulties 2–Walks with assistance 1–Nonambulatory functional movement only 0–No purposeful leg movement	

### Amyotrophic Lateral Sclerosis Functional Rating Scale – Revised—*Cont'd*

Function	Score	Findings
9. Climbing stairs	4–Normal 3–Slow 2–Mild unsteadiness or fatigue 1–Needs assistance 0–Cannot do	
10. Dyspnea	4–None 3–Occurs when walking 2–Occurs with one or more of the following: eating, bathing, & dressing (ADL) 1–Occurs at rest; difficulty breathing when either sitting or lying 0–Significant difficulty; considering using mechanical respiratory support	
11. Orthopnea	4–None 3–Some difficulty sleeping at night due to shortness of breath; does not routinely use more than two pillows 2–Needs extra pillows in order to sleep (more than two) 1–Can only sleep sitting up 0–Unable to sleep	
12. Respiratory insufficiency	4–None 3–Intermittent use of BiPAP 2–Continuous use of BiPAP during the night 1–Continuous use of BiPAP during the night & day 0–Invasive mechanical ventilation by intubation or tracheostomy	

Source: Cedarbaum JM, Stambler N, Malta E. The ALSFRS-R: A revised ALS functional rating scale that incorporates assessments of respiratory function. *J Neurol Sci.* 1999;169:13–21, with permission.

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Disease progression	riluzole	Rilutek	Asthenia, nausea, dizziness, decreased lung function, diarrhea
Spasticity	baclofen either orally or intrathecal	Lioresal	Drowsiness, weakness, dizziness
	tizanidine	Zanaflex	Dizziness, GI problems, dry mouth
Pain	tramadol	Ultram	Agitation, anxiety, bloating & gas, constipation, drowsiness, dizziness

## Brain Tumor

### Description/Overview

Brain tumors (BT) primarily affect two groups of patients: children 0 to 15 years of age & adults 40 to 60 years of age. BT can be malignant or benign & can produce symptoms primarily by pressing against or destroying functioning brain tissue. Symptoms directly correlate to BT location (refer to CVA for specific cerebral lesion symptoms, page 156).

### Precautions

Stop examination & refer to physician if patient with BT demonstrates any of the following

- Severe headache combined with vomiting (brain stem may be compressed)
- Mental status changes
- Muscle tone changes
- Vision changes
- Seizures (may present in 20% to 70% of patients with BT)<sup>4</sup>
- Fever (chemotherapy may suppress immune system leading to infection)

## Physical Therapy Examination

### General Considerations

- May need family member assistance due to potential cognitive deficits
- Patients with BT often exhibit headaches, personality changes, seizures, & focal neurological signs (directly related to affected areas)

### History (Refer to Tab 2)

#### Vital Signs

- Assess BP, HR, RR, & body temperature

## Tests and Measures

### Aerobic Capacity/Endurance

#### Assessment

- Assess BP, HR, & RR at rest & during & after activity
- If possible, administer 2-minute walk test or 6-minute walk test & Borg Rating of Perceived Exertion (Tab 2) to determine measured & perceived exertion

#### Potential findings

- Unstable vital signs due to brain stem involvement
- Endurance & cardiovascular & pulmonary responses to exercise may be affected due to deconditioning & metabolic imbalance secondary to chemotherapy & radiation treatment

### Anthropometric Characteristics

#### Assessment

- Assess weight, height, & BMI

#### Potential findings

- Weight loss due to eating & swallowing difficulties or side effects of radiation treatment & chemotherapy

## Arousal, Attention, and Cognition

### Assessment

- Glasgow Coma Scale (Tab 4) if patient with BT is comatose
- Mini-Mental State Exam (Tab 2) to assess cognition, short- & long-term memory & communication if patient with BT is alert

### Potential findings

- Increased intracranial pressure causing drowsiness & decreased consciousness
- Short attention span (concentration problems), short- & long-term memory problems, initiative & abstract reasoning difficulties or confusion
- Broca's aphasia (also known as "expressive" or "motor" aphasia)
- Wernicke's aphasia (also known as "receptive" or "sensory" aphasia)
- Subtle personality changes, such as anxiety or depression

## Assistive and Adaptive Devices

### Considerations

- May need ambulatory assistive devices or wheelchair if motor area is affected

### Assessment (Refer to Tab 2)

## Circulation

### Assessment

- Assess BP, HR, edema, & girth

### Potential findings

- Patients with BT may experience BP or HR changes due to compression of brain stem or vagus nerve, especially in the head-down position

## Cranial and Peripheral Nerve Integrity

### Assessment

- All cranial nerves
- Peripheral motor & sensory nerves

### Potential findings

- Papilledema due to pituitary gland tumors & occipital lobe tumors

- Diplopia (III & IV), bitemporal hemianopsia (II) or facial numbness (V) due to pituitary gland tumors
- Hearing loss, ataxia, dizziness, tinnitus (VIII) or facial palsy (VII) due to cerebellopontine tumors
- Aphasia if BT affects dominant hemisphere
- Contralateral limb sensory loss, hemiparesis or hemiplegia if BT affects parietal lobe
- Upper or lower limb numbness or tingling due to chemotherapy-related neuropathy

## Gait, Locomotion, and Balance

### Assessment

- Romberg Test (Tab 2) or Functional Reach Test (Tab 2) to assess static balance
- Timed Get Up & Go Test (Tab 2) to assess dynamic balance

### Potential findings

- Patients with BT may demonstrate balance or gait problems

## Motor Function

### Assessment

- Observe patient with BT performing ADL
- Observe patient with BT performing new motor tasks
- Administer finger-to-nose & heel-to-shin tests to assess coordination

### Potential findings

- Abnormal synergistic movements if BT affects motor cortex
- Apraxia
- Difficulty learning new motor tasks
- Coordination problems if BT affects cerebellum

## Muscle Performance

### Assessment (Refer to Tab 2)

### Potential findings

- Muscle weakness due to deconditioning or cerebellar involvement
- Hemiparesis or hemiplegia if BT affects parietal lobe
- Early or severe fatigue

## Pain

### Assessment

- Administer Universal Pain Assessment Tool (see Tab 2) to assess headache severity
  - Has headache occurred recently?
  - Has headache worsened recently?
  - Does headache worsen with head position changes?

### Potential findings

- Headaches, nausea, vomiting, papilledema or focal neurological signs due to increased intracranial pressure
- Worsening headaches in the head-down position

## Posture

### Assessment

- Assess posture in sitting & standing

### Potential findings

- Poor postural alignment due to muscle weakness or impaired righting reflexes
- Asymmetry in sitting & standing (weight-bearing primarily on sound side), especially in patients with hemiparesis or hemiplegia

## Range of Motion

### Assessment

- Assess active & passive ROM

### Potential findings

- Limited active ROM due to weakness
- Limited passive ROM due to spasticity

## Reflex Integrity

### Assessment

- DTR of biceps, triceps, & patellar & Achilles tendons
- Muscle tone
- Babinski's sign
- Grasp reflex & snout reflex (see Reflex Integrity under Alzheimer's Disease)

- Tonic neck reflexes (ATNR & STNR)
- Righting reflexes (sitting & standing)
- Equilibrium reactions (sitting & standing)
- Protective extension reflexes

#### *Potential findings*

- Hypertonicity in affected limbs if BT affects motor cortex or corticospinal tract
- Babinski's sign (UMN lesion)
- Positive ATNR or STNR if BT affects midbrain
- Prominent grasp or snout reflexes if BT affects frontal lobe
- Impaired righting reflexes
- Delayed or impaired equilibrium reactions
- Delayed or impaired protective extension reflexes

## **Self-Care and Home Management**

#### *Assessment*

- Bowel & Bladder Control Checklist (Tab 2)
- Functional Independence Measure (Tab 2) to assess ADL

#### *Potential findings*

- Difficulty controlling bowel & bladder movements depending on affected areas
- Need assistance performing ADL

## **Sensory Integrity**

#### *Assessment*

- Cortical sensory functions (stereognosis & graphesthesia)
- Kinesthesia
- Vibration
- Proprioception

#### *Potential findings*

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>■ Astereognosis</li> <li>■ Agraphesthesia</li> <li>■ Neglect of the affected side</li> </ul> | <ul style="list-style-type: none"> <li>■ Visual-spatial disorder</li> <li>■ Agnosia</li> <li>■ Impaired vibration, movement or joint position sense</li> </ul> |
|---|--|

## Ventilation and Respiration

### Assessment

- Assess breathing pattern, including the use of the diaphragm & accessory muscles
- Assess mechanical ventilation support needs

### Potential findings

Patients with BT may:

- Have impaired ventilation or respiration if BT affects brain stem
- Need mechanical ventilation support

## Work, Community, and Leisure

### Assessment (Refer to Tab 2)

### Medications

Indications	Generic Name	Brand Name	Common Side Effects
Seizure	carbamazepine	Tegretol	Skin rash, flu symptoms, easy bruising, dizziness, weakness
	phenobarbital	Solfoton	Drowsiness, dizziness, headache, depression, excitement
	phenytoin	Dilantin	Drowsiness, gum swelling or bleeding, GI problems, loss of appetite, weight loss, confusion
Intracranial pressure	steroid drugs – prednisone	Deltasone	Headache, drowsiness, sleep problems, mood swings
	dexamethasone	Decadron	Upset stomach, headache, dizziness, insomnia

## Cerebellar Degeneration

### Description/Overview

Unilateral damage to a cerebellar hemisphere (vascular occlusion, tumor, or white matter demyelination in one or more cerebellar peduncles) results in symptoms affecting the same side of the body as the damaged hemisphere. Patients with middle cerebellum lesions or patients with multiple sclerosis show bilateral symptoms such as ataxic gait.

### Physical Therapy Examination

#### General Considerations

- Patients with CD often have balance problems & therefore may need contact guarding or assistance during examination

#### History (Refer to Tab 2)

##### Vital Signs

- Assess BP, HR, RR, & body temperature

### Tests and Measures

#### Aerobic Capacity/Endurance

##### Assessment

- Assess BP, HR, & RR at rest & during & after activities
- If possible, administer 2-minute walk test to determine perceived rate of exertion

##### Potential findings

- Patients with CD may have decreased aerobic capacity & endurance due to generalized muscle weakness

#### Arousal, Attention, and Cognition

##### Assessment

- Administer Mini-Mental State Exam (Tab 2) to assess cognition, short- & long-term memory & communication

### *Potential findings*

- Patients with alcoholic CD may exhibit delirium tremens (restlessness, irritability, tremors, confusion, disorientation or hallucination following a rapid reduction of alcohol consumed), dementia or short-term memory problems
- Patients with CD may experience dysarthria (slurred speech)

## **Assistive and Adaptive Devices**

### *Considerations*

- May need ambulatory assistive devices due to impaired balance
- Assessment (Refer to Tab 2)**

## **Cranial and Peripheral Nerve Integrity**

### *Assessment (Refer to Tab 2)*

### *Potential findings*

- Nystagmus
- Wernicke's syndrome (mainly patients with alcoholic CD) with symptoms including:
  - Ataxia
  - Disorientation
  - Dementia
  - Nystagmus followed by lateral rectus weakness & double vision
  - Dysarthria (slurred speech)

## **Environment, Home, and Work Barriers**

### *Assessment (Refer to Tab 2)*

## **Gait, Locomotion, and Balance**

### *Assessment*

- Romberg Test (Tab 2) or Functional Reach Test (Tab 2) to assess static balance
- Timed Get Up & Go Test (Tab 2) to assess dynamic balance & gait
- Tinetti Falls Efficacy Scale (Tab 2) to assess fall risk
- Observe: Gait on level & uneven surfaces & along a circle

### *Potential findings*

Patients with CD may

- Have impaired static & dynamic balance
  - Balance deteriorates due to vision problems & inadequate base of support

- Have a history of falls
- Demonstrate ataxic gait
- Stumble on uneven surfaces

## Joint Integrity and Mobility

*Assessment* (Refer to Tab 2)

*Potential findings*

- Some patients with CD may have joint hypermobility

## Motor Function

*Assessment*

- Administer the following to assess upper & lower limb coordination
  - Finger-to-nose test
  - Finger-to-examiner's finger test
  - Rhythmic hand tapping
  - Alternate supination & pronation
  - Rhythmic foot tapping
- Perform Rebound Test (Tab 2)
- Observe patient with CD performing ADL and new motor tasks

*Potential findings*

- Intention tremors
- Upper & lower limb coordination problems
- Positive Rebound Test
- Dysdiadochokinesia (inability to maintain rhythm range when foot-tapping or in supination or pronation)
- Dysmetria (undershooting or overshooting target during finger-to-nose & finger-to-examiner's finger tests)
- Movement decomposition (inability to move smoothly while performing ADL)
- Difficulty learning new motor tasks due to cognitive impairment

## Muscle Performance

*Assessment* (Refer to Tab 2)

*Potential findings*

- Asthenia (generalized muscle weakness)
- Need arm support to rise from floor or a chair due to lower limb or trunk weakness

## Orthotic, Protective, and Supportive Devices

Assessment (Refer to Tab 2)

### Posture

Assessment (Refer to Tab 2)

Potential findings

Patients with CD may:

- Sit with an increased thoracic kyphosis & forward head
- Sit with hyperlordosis due to abdominal muscle weakness
- Stand with a wide base of support

### Reflex Integrity

Assessment

- DTR
- Righting reflexes
- Protective extension & equilibrium reactions

Potential findings

- Decreased DTR due to hypotonia
- Normal righting reflexes
- Delayed or absent protective extension & equilibrium reactions

### Sensory Integrity

Assessment

- Assess proprioception & vibration

Potential findings

- Patients with CD may demonstrate impaired proprioception & vibration & therefore often require vision to perform motor tasks

### Ventilation and Respiration

Assessment (Refer to Tab 2)

Potential findings

- Impaired cough due to abdominal muscle weakness

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Alcoholic cerebellar degeneration	thiamine	Thiamine	Feeling of warmth, itchiness, weakness, sweating

## HIV Infection

### Description/Overview

There are a number of CNS opportunistic infections found in patients with HIV/AIDS, the most common of which is cerebral toxoplasmosis. Cryptococcal meningitis is the most common mycotic infection in patients with AIDS. Cytomegalovirus (CMV) encephalitis usually results in mental status changes often causes death.

## Physical Therapy Examination

### General Considerations

- Follow universal precautions during examination
- Use simple commands if patient demonstrates signs of dementia

### History (Refer to Tab 2)

#### Vital Signs

- Assess BP, HR, RR, & body temperature

#### Potential findings

- Patients with acute infections may have fever

## Tests and Measures

### Aerobic Capacity/Endurance

#### Assessment

- Assess BP, HR, & RR at rest & during & after activities
- If possible, administer 2-minute or 6-minute walk test to determine perceived rate of exertion

### Potential findings

Patients with HIV/AIDS may:

- Demonstrate abnormal blood pressure in response to exercise or positional changes
- Fatigue easily

### Anthropometric Characteristics

#### Assessment

- Assess weight, height, BMI, & girth

### Potential findings

- Patients with HIV/AIDS may experience weight loss

### Arousal, Attention, and Cognition

#### Assessment

- Glasgow Coma Scale (see Tab 4) if patient with HIV/AIDS is comatose or confused
- Mini-Mental State Exam (see Tab 2) if patient with HIV/AIDS is alert

### Potential findings

- |                               |                                  |
|-------------------------------|----------------------------------|
| ■ Coma                        | ■ Dementia, amnesia, or delirium |
| ■ Confusion or disorientation | ■ Impaired speech                |

### Assistive and Adaptive Devices

#### Assessment

- Determine needs for assistive & adaptive devices for ADL
- Assess fit & alignment of assistive & adaptive devices

### Potential findings

- Patients with advanced HIV/AIDS & dementia may need assistive & adaptive devices (e.g., wheelchair) to perform ADL

### Circulation

#### Assessment

- Assess BP, HR, & RR at rest & during & after activities
- Administer Edema Rating Scale (Tab 2) to assess edema

**Potential findings**

- Patients with HIV/AIDS may have resting tachycardia due to ANS involvement

**Cranial and Peripheral Nerve Integrity****Assessment** (Refer to Tab 2)**Potential findings**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>■ Photophobia</li> <li>■ Visual disturbances (impaired vision in CMV infection)</li> </ul> | <ul style="list-style-type: none"> <li>■ Aphasia</li> <li>■ Muscle weakness</li> </ul> |
|---|--|

**Environment, Home, and Work Barriers****Assessment** (Refer to Tab 2)**Gait, Locomotion, and Balance****Assessment**

- Romberg Test (Tab 2) or Functional Reach Test (Tab 2) to assess static balance
- Berg Balance Scale (Tab 2) to assess dynamic balance
- Observe gait on level & uneven surfaces & stairs

**Potential findings**

- Poor static or dynamic balance
- Ataxic gait
- Difficulty walking on uneven surfaces & stairs

**Integumentary Integrity****Assessment** (Refer to Tab 2)**Potential findings**

- Patients with advanced HIV/AIDS may have Kaposi's sarcoma

**Motor Function****Assessment**

- Observe patient with HIV/AIDS performing ADL & learning new motor tasks

**Potential findings**

- Patients with HIV/AIDS & CNS involvement may have difficulty learning new motor tasks due to dementia

## Muscle Performance

*Assessment* (Refer to Tab 2)

*Potential findings*

- Weakness due to deconditioning
- Hemiparesis or hemiplegia

## Pain

*Assessment*

- Administer Universal Pain Tool (Tab 2) or Ransford Pain Drawing (Tab 2)

*Potential findings*

- Headache due to meningitis
- Muscle or joint pain due to CMV infection

## Posture

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with HIV/AIDS may stand with a wide base of support as part of an ataxic gait pattern

## Range of Motion

*Assessment* (Refer to Tab 2)

*Potential findings*

- Limited active ROM due to weakness
- Limited passive ROM due to spasticity

## Reflex Integrity

*Assessment*

- Muscle tone
- DTR
- Postural reflexes (righting, equilibrium & protective extension reactions)
- Pathological reflexes (Babinski's sign)

### Potential findings

- Hypertonicity and increased DTR due to UMN involvement
- Impaired or absent righting, equilibrium and/or protective extension reactions
- Positive Babinski's sign

### Self-Care and Home Management

Assessment (Refer to Tab 2)

### Potential findings

Patients with HIV/AIDS may:

- Need assistance with ADL due to dementia or overall weakness
- Have difficulty with bowel & bladder control

### Sensory Integrity

#### Considerations

- May be difficult to assess due to dementia

#### Assessment

- |                                |                        |
|--------------------------------|------------------------|
| ■ Stereognosis                 | ■ Joint position sense |
| ■ Kinesthesia (movement sense) |                        |

### Potential findings

- Patients with HIV/AIDS & CNS involvement may have impaired stereognosis, movement, & joint position sense

### Ventilation and Respiration

Assessment (Refer to Tab 2)

### Potential findings

- Patients with late-stage AIDS may have limited pulmonary capacity & impaired pulmonary responses after exercise

### Work, Community, and Leisure

Assessment (Refer to Tab 2)

## Medications<sup>2</sup>

Indications	Generic Name	Brand Name	Common Side Effects
HIV/AIDS (Highly Active Anti-Retroviral Therapy, HAART) <sup>2</sup>	abacavir	Ziagen	Fever, fatigue, GI problems
	atazanavir	Reyataz	Hyperglycemia, headache, diarrhea
	didanosine	ddl, Videx, Videx EC	Upset stomach, diarrhea, peripheral neuropathy, pancreatitis
	efavirenz	Sustiva, Stocrin	GI problems, drowsiness, dizziness
	emtricitabine	Emitriva, FTC	Headache, diarrhea, changes in skin color
	fosamprenavir	Lexiva, Telzir	Hyperglycemia, diarrhea, upset stomach, headache
	lamivudine	3TC, Epivir	Diarrhea, headache, fatigue, chills
	lopinavir	Kaletra (lopinavir + ritonavir)	Diarrhea, weakness, heartburn
	nevirapine	Viramune	Headache, diarrhea
	ritonavir	Norvir	Nausea, vomiting, weakness, diarrhea
HIV/AIDS	zidovudine	AZT, Retrovir	Headache, fever, nausea, myopathy, neutropenia

**Medications<sup>2</sup>—Cont'd**

<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
CMV meningitis	ganciclovir	Ganciclovir, Cytovene	Upset stomach, vomiting, gas, constipation
	foscarnet	Foscavir	Hypocalcemia, hypomagnesemia, hyperphosphatemia Renal impairment
Cryptococcal meningitis	antifungal drugs – amphotericin B	Fungizone	Fever, chills, breathing difficulty, changes in heartbeat
Toxoplasmosis	sulfadiazine	Sulfadiazine	Diarrhea, upset stomach, dizziness
	pyrimethamine	Daraprim	Nausea, upset stomach, loss of appetite

**Huntington's Disease/Huntington's Chorea****Description/Overview**

Huntington's disease (HD), a chronic degenerative CNS disorder inherited in an autosomal dominant pattern, often presents between ages 35 & 42. HD symptoms include chorea (in the hands & facial muscles), rigidity, bradykinesia, dystonia, clumsiness, fidgetiness, behavioral abnormalities (personality changes, depression & psychosis), & dementia.<sup>3</sup>

**Physical Therapy Examination****General Considerations**

- Use simple commands if patient demonstrates signs of dementia
- May need family member assistance

## History (Refer to Tab 2)

### Vital Signs

- Assess BP, HR, RR, & body temperature

## Tests and Measures

### Aerobic Capacity/Endurance

#### Assessment

- Assess BP, HR, & RR at rest & during & after activity
- If possible, administer 2-minute or 6-minute walk test to determine perceived rate of exertion

### Anthropometric Characteristics

#### Assessment

- Assess weight, height, & BMI

#### Potential findings

- Patients with HD may experience weight loss due to eating or swallowing difficulties & chorea

### Arousal, Attention, and Cognition

#### Assessment

- If possible, administer Mini-Mental State Exam (Tab 2) to assess cognition, short- & long-term memory & communication

#### Potential findings

Patients with HD may demonstrate the following:

- Impaired attention span, short-term memory loss or organization difficulties
- Dementia
- Emotional disturbances (irritability, anxiety, aggressive outbursts, depression, mood swings, or social withdrawal)
- Psychosis

### Circulation

#### Assessment

- Assess BP & HR at rest & during & after activities

## Cranial and Peripheral Nerve Integrity

*Assessment* (Refer to Tab 2)

### Potential findings

- Impaired fast eye movements (saccades)
- Dysarthria (slurred speech)
- Hesitant or halting speech
- Dysphagia (swallowing difficulty)
- Chorea of facial muscles (grimacing)

## Environment, Home, and Work Barriers

*Assessment* (Refer to Tab 2)

## Gait, Locomotion, and Balance

*Assessment*

- Romberg Test (Tab 2) or Functional Reach Test (Tab 2) to assess static balance
- Berg Balance Scale or Timed Get Up & Go Test (Tab 2) to assess dynamic balance
- Tinetti Falls Efficacy Scale to determine fear of falls
- Observe gait on even & uneven surfaces & stairs

### Potential findings

- Severely impaired static or dynamic balance
- Gait disturbances (with a wide base of support)
- Frequent falls
- Fear of falls

## Motor Function

*Assessment*

- Observe patient with HD performing ADLs & learning new motor tasks
- Administer the following (Tab 2) to assess upper & lower limb coordination:
  - Finger-to-nose test
  - Finger-to-examiner's finger test
  - Alternate pronation & supination test
  - Heel-on-shin test
  - Alternate foot-tapping

**Potential findings**

- Chorea of hands & facial muscles
- Bradykinesia
- Loss of finger & hand dexterity

- Difficulty learning new motor tasks
- Upper & lower limb coordination problems

**Muscle Performance***Assessment (Refer to Tab 2)***Potential findings**

- Patients with HD may experience weakness due to deconditioning

**Range of Motion***Assessment*

- Assess active & passive ROM

**Potential findings**

- Patients with HD may have limited passive ROM due to rigidity

**Reflex Integrity***Assessment – Assess*

- Muscle tone
- DTR
- Postural reflexes (righting, equilibrium & protective extension reactions)

**Potential findings**

- Rigidity
- Increased DTR
- Dystonia
- Delayed or absent equilibrium & protective extension reactions

**Self-Care and Home Management***Assessment (Refer to Tab 2)***Potential findings**

- Patients with late-stage HD may become ADL-dependent

**Sensory Integrity***Assessment (Refer to Tab 2)*

**Work, Community, and Leisure**

Assessment (Refer to Tab 2)

**Medications**

<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
Chorea	dopamine receptor antagonists – haloperidol	Haldol	Drowsiness, dry mouth, constipation, restlessness, headache, weight gain
	chlorpromazine	Thorazine	Dry mouth, drowsiness
	drugs to deplete dopamine from nerve endings – reserpine	Harmonyl	Dizziness, loss of appetite, upset stomach, diarrhea
	tetrabenazine	Nitoman	Depression, slowness of movement, drowsiness, GI problems, hypotension
Psychiatric symptoms (aggressiveness or agitation)	haloperidol	Haldol	Drowsiness, dry mouth, constipation, restlessness, headache, weight gain
	quetiapine	Seroquel	Drowsiness, pain, dizziness, weakness, dry mouth
	olanzapine	Zyprexa	Drowsiness, dizziness, unusual behavior, restlessness, depression

*Continued*

## Medications—Cont'd

Indications	Generic Name	Brand Name	Common Side Effects
Depression & obsessive or compulsive behaviors	fluoxetine	Prozac, Sarafem	Nervousness, nausea, dry mouth
	sertraline	Zoloft	Nausea, diarrhea, constipation, dry mouth
	nortriptyline	Aventyl, Pamelor	Nausea, drowsiness, weakness, anxiety

## Lyme Disease

### Description/Overview

Lyme disease (LD) is a tick-borne disorder resulting from a systemic infection with spirochete *Borrelia burgdorferi*. Approximately 5% of untreated patients with LD develop chronic neurological symptoms months to years after infection.<sup>4</sup> Chronic neurological symptoms include:

- Brain dysfunction resulting in memory loss
- Cranial nerve damage
- Brain & spinal cord inflammation or meningitis
- Corneal inflammation causing vision impairment & eye pain
- Rapidly progressive motor neuron paralysis involving peripheral nerve inflammation

## Physical Therapy Examination

### General Considerations

- Patients with LD may experience dementia thereby requiring use of simple wording & instructions & family member assistance

### History (Refer to Tab 2)

- Ask about recent outdoor activities & potential tick contact

## Vital Signs

- Assess BP, HR, RR, & body temperature

## Tests and Measures

### Aerobic Capacity/Endurance

#### *Assessment*

- Assess BP, HR, & RR
- Administer 2-minute or 6-minute walk test to determine perceived rate of exertion

#### *Potential findings*

- Patients with LD may demonstrate aerobic capacity & endurance problems due to potential cardiac problems & impaired cardiac responses to exercise

### Arousal, Attention, and Cognition

#### *Assessment*

- Administer Glasgow Coma Score for patients with acute CNS infection (encephalomyelitis, encephalopathy, or meningitis) (see Tab 4)
- If possible, administer Mini-Mental State Exam (see Tab 2) to assess cognition, short- & long-term memory & communication

#### *Potential findings*

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>■ Difficulty concentrating</li> <li>■ Dementia</li> </ul> | <ul style="list-style-type: none"> <li>■ Short- &amp; long-term memory problems</li> <li>■ Mood swings</li> </ul> |
|--|---|

### Assistive and Adaptive Devices

#### *Assessment (Refer to Tab 2)*

### Circulation

#### *Assessment*

- BP & HR (especially HR rhythm) at rest & during & after activities
- Girth & administer Edema Rating Scale (Tab 2) to assess edema

#### *Potential findings*

- Patients with LD may demonstrate conduction defects resulting in arrhythmia

## Cranial and Peripheral Nerve Integrity

Assessment (Refer to Tab 2)

Potential findings

- Diplopia (III, IV, & VI)
- Facial numbness (V)
- Unilateral or bilateral facial palsy (VII)
- Hearing loss or dizziness (VIII)
- Dysphagia or hoarseness (IX & X)
- Dysarthria (slurred speech) (XI & XII)
- Neck muscle weakness (XII)
- Peripheral motor & sensory neuropathy (burning, paresthesia, & weakness)

## Environment, Home, and Work Barriers

Assessment (Refer to Tab 2)

## Gait, Locomotion, and Balance

Assessment

- Functional Reach Test (Tab 2) or Multi-Directional Reach Test (Tab 2) to assess static balance
- Timed Get Up & Go Test (Tab 2) to assess dynamic balance
- Observe gait in uncluttered & cluttered environments & on stairs

Potential findings

- Balance problems due to vestibular nerve involvement & muscle weakness
- Gait deviations due to muscle weakness & arthritis

## Joint Integrity and Mobility

Assessment

- Examine soft tissues around joints for swelling & tenderness
- Assess joint play & mobility

Potential findings

- If untreated, 80% of patients with LD may develop arthritis (most commonly in the knees & temporomandibular joints)<sup>4</sup>

## Motor Function

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with LD may demonstrate ataxia, chorea, or hemiplegia due to CNS involvement from encephalomyelitis, encephalopathy, or meningitis

## Muscle Performance

*Assessment*

- Muscle strength following peripheral nerve innervation patterns (Tab 2)
- Endurance

*Potential findings*

- Localized or widespread weakness (e.g., brachial or lumbosacral plexopathy)
- Progressive weakness (distal to proximal) resembling Guillain-Barré syndrome
- Decreased endurance

## Orthotic, Protective, and Supportive Devices

*Assessment* (Refer to Tab 2)

## Pain

*Assessment*

- Administer Ransford Pain Drawing (Tab 2)

*Potential findings*

- Patients with LD may experience burning, paresthesia, numbness, or pain following involved peripheral nerve patterns

## Posture

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with LD may stand with a wide base of support as part of an ataxic gait pattern from possible vestibular, dorsal column, or cerebellar involvement

## Range of Motion

### Assessment

- Assess active & passive ROM

### Potential findings

- Patients with LD may demonstrate limited active & passive range of motion due to arthritis

## Reflex Integrity

### Assessment

- DTR of biceps, triceps, & patellar & Achilles tendons
- Postural reflexes (righting reflexes, equilibrium reactions, & protection extension reactions)

### Potential findings

- Decreased DTR due to peripheral nerve or cerebellum involvement
- Babinski's sign or increased DTR due to upper motor neuron (UMN) involvement
- Delayed, impaired or absent righting reflexes, equilibrium reactions or protective reactions

## Self-Care and Home Management

### Assessment

- Administer Functional Independence Measure (Tab 2) to assess ADLs

### Potential findings

- Patients with LD & CNS involvement may need ADL assistance

## Sensory Integrity

### Assessment (Refer to Tab 2)

## Work, Community, and Leisure

### Assessment (Refer to Tab 2)

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Early-stage infection	antibiotics – doxycycline	Doryx, Vibramycin	Diarrhea, itchiness of rectum or vagina, sore mouth
	amoxicillin	Amoxil, Trimox	Upset stomach, vomiting, diarrhea
Acute & late-stage neurological symptoms	ceftriaxone (intravenous)	Rocephin	Diarrhea, stomach pain, upset stomach, vomiting
Joint & muscle pain	NSAID – aspirin	Aspirin	Stomach ulcer, nausea, tinnitus
	NSAID – ibuprofen	Motrin, Nuprin, Advil	GI problems, dizziness, fluid retention

## Multiple Sclerosis

### Description/Overview

The four types of multiple sclerosis (MS) are: relapsing-remitting MS (episodes of acute attacks with recovery & a stable course between attacks; most common type); secondary progressive MS (gradual neurological deterioration with or without acute attacks in a patient who previously had relapsing-remitting MS); primary progressive MS (gradual, nearly continuous neurologic deterioration from onset); & progressive-relapsing MS (gradual neurologic deterioration from onset with relapses).<sup>5</sup>

## Physical Therapy Examination

### General Considerations

- Pace examination to avoid fatigue
- If necessary, use simple words & instructions during examination in case of potential cognitive function changes & mood swings
- Keep examination room cool & dry (heat & humidity may worsen fatigue)

## History (Refer to Tab 2)

### Vital Signs

- Assess BP, HR, RR, & body temperature

## Tests and Measures

### Aerobic Capacity/Endurance

#### Assessment

- Assess BP, HR, & RR at rest & during & after activities
- If possible, administer 2-minute or 6-minute walk test & Borg Rating of Perceived Exertion (Tab 2) to determine perceived rate of exertion

#### Potential findings

- Cardiovascular dysautonomia during exercise resulting in cardioacceleration & a drop in blood pressure
- Fatigue may occur in late afternoon or following strenuous activity

### Arousal, Attention, and Cognition

#### Assessment

- Administer Mini-Mental State Exam (Tab 2) to assess cognition, short- & long-term memory, & communication

#### Potential findings

- Decreased attention & concentration
- Short-term memory & recall problems
- Diminished abstract reasoning, problem-solving abilities, & judgment skills
- Slowed information processing abilities
- Decreased motivation
- Diminished visual-spatial abilities
- Dysarthria (slurred speech)
- Diminished verbal fluency
- Dysphonia
- Depression due to the nature of a progressive disease & an inability to cope
- Emotional lability
- Pseudobulbar affective changes (uncontrollable laughing or crying)
- Inappropriate behavior (e.g., sexual disinhibition)

## Assistive and Adaptive Devices

### *Considerations*

Patients with MS may require:

- Ambulatory assistive devices (crutches, walker, or wheelchair)
- Assistive & adaptive devices for ADLs

### *Assessment (Refer to Tab 2)*

## Circulation

### *Assessment*

- Assess BP & HR in supine, sitting, & standing at rest & during & after activities

### *Potential findings*

- Cardiovascular dysautonomia during exercise resulting in cardioacceleration & a drop in blood pressure
- Postural hypotension

## Cranial and Peripheral Nerve Integrity

### *Assessment*

- All cranial nerves
- Peripheral nerves from distal to proximal

### *Potential findings*

- Optic neuritis or visual problems (double vision, blurring, decreased color perception, or occasional flashes) (II)
- The following oculomotor syndromes (III, IV, & VI)
  - Broken (saccadic) smooth pursuit
  - Nystagmus
  - Ocular dysmetria (overshooting target)
  - Internuclear ophthalmoplegia (one eye is unable to adduct while the other has abducting nystagmus)
- Facial numbness & trigeminal neuralgia (V)
- Facial palsy (VII)
- Dizziness, vertigo, or hearing loss (VIII)
- Dysphagia (IX & X)
- Numbness or decreased pain & temperature sensation in a glove & stocking distribution

## Environment, Home, and Work Barriers

Assessment (Refer to Tab 2)

## Gait, Locomotion, and Balance

Assessment

- Romberg Test (Tab 2) or Multi-Directional Reach Test (Tab 2) to assess static balance
- Timed Get Up & Go Test (Tab 2) or Berg Balance Scale (Tab 2) to assess dynamic balance
- Observe gait on level surfaces & if possible, administer 2-minute walk test (Tab 2) to determine perceived rate of exertion

Potential findings

- Impaired static & dynamic balance
- Ataxic gait
- Difficulty clearing feet during swing phase due to lower limb spasticity or weakness

## Integumentary Integrity

Considerations

- Patients with bowel & bladder control problems & limited mobility are at risk for skin rash or ulcer development & must check skin daily

Assessment (Refer to Tab 2)

## Joint Integrity and Mobility

Assessment (Refer to Tab 2)

Potential findings

- Patients with MS may demonstrate limited joint play movement due to spasticity

## Motor Function

Assessment

- |                                    |  |
|------------------------------------|--|
| ■ Finger-to-nose test              | ■ Heel-on-shin test                                  |
| ■ Finger-to-examiner's finger test | ■ Observe patient with MS performing new motor tasks |

*Potential findings*

- Dysmetria (overshooting or undershooting target; more apparent in upper limbs)
- Difficulty performing new motor tasks

**Muscle Performance***Assessment* (Refer to Tab 2)*Potential findings*

Patients with MS may:

- Demonstrate weakness or spasticity resulting in monoparesis, monoplegia, hemiparesis, hemiplegia, paraparesis, paraplegia, quadriplegia, or quadraparesis
- Fatigue easily
  - More severe than normal fatigue
  - Comes on quickly & suddenly
  - Occurs daily & worsens as the day progresses
  - Tends to be aggravated by heat & humidity

**Orthotic, Protective, and Supportive Devices***Assessment* (Refer to Tab 2)**Pain***Assessment*

- Administer Ransford Pain Drawing (see Tab 2)

*Potential findings*

- Dysesthesia
- Trigeminal neuralgia, atypical facial pain, or headache
- Numbness or decreased pain & temperature sensation in a glove or stocking distribution
- Lhermitte's sign (an electrical shock sensation, vibration or dysesthetic pain radiating down the back & often into the upper limbs & lower limbs that usually occurs with neck flexion)
- Musculoskeletal pain to compensate for spasticity or weakness

## Posture

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with MS may have difficulty maintaining upright postures due to weakness

## Range of Motion

*Assessment*

- Assess active & passive ROM

*Potential findings*

- Patients with MS may demonstrate limited active & passive range of motion due to spasticity

## Reflex Integrity

*Assessment*

- Muscle tone
- DTR (biceps, triceps, & patellar & Achilles tendons)
- Postural reflexes (righting reflexes, equilibrium reactions, & protective extension reactions)

*Potential findings*

- Spasticity due to UMN involvement
- Clonus
- Increased DTR due to UMN involvement
- Decreased DTR due to cerebellar involvement
- Babinski's sign
- Delayed or impaired equilibrium & protective extension reactions

## Self-Care and Home Management

*Assessment*

- Bowel & Bladder Control Checklist (Tab 2)
- Kurtzke Expanded Disability Status Scale (go to Davis Plus at <http://www.fadavis.com.davisplus.com>) & Expanded Disability Status Scale to assess ADLs

### Potential findings

- Constipation
- Bladder problems (frequent urination at night, urgency, hesitancy, or incontinence) due to a spastic, flaccid, or dyssynergic bladder
  - Bladder problems generally affect women with MS more often than men with MS<sup>5</sup>
- Sexual problems including
  - Decreased sensation in the genital area
  - Failure to achieve orgasm
  - ADL-dependency in late stage
  - Erectile dysfunction
  - Vaginal dryness
  - Libido loss

### Sensory Integrity

#### Assessment

- Assess proprioception & vibration

### Potential findings

- Sensory ataxia (impaired proprioception in lower limbs)
- Incomplete vibration loss

### Work, Community, and Leisure

Assessment (Refer to Tab 2)

### Medications

Indications	Generic Name	Brand Name	Common Side Effects
Disease progression	interferon beta-1a	Avonex	Flu-like symptoms (fever, chills, sweating, muscle aches, tiredness)
	interferon beta-1a	Rebif	Flu-like symptoms
	interferon beta-1b	Betaseron	Flu-like symptoms

Continued

**Medications—Cont'd**

<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
	glatiramer acetate	Copaxone	Itchiness, nausea, upset stomach, weakness, chest or joint pain
	mitoxantrone	Novantrone	Immunosuppression, heart muscle damage
Acute exacerbation	methylprednisolone (intravenous)	Solu-Medrol	Fluid retention, immunosuppression, mood swings
Depression	selective serotonin reuptake inhibitors (SSRIs) – fluoxetine	Prozac	Nausea, difficulty sleeping, drowsiness, anxiety, weakness
	paroxetine	Paxil	Mood swings, anxiety, panic attacks, trouble sleeping, irritability
	sertraline	Zoloft	Abdominal pain, agitation, anxiety, constipation, decreased sex drive
Spasticity	baclofen either orally or intrathecal	Lioresal	Drowsiness, weakness, dizziness
	dantrolene sodium	Dantrium	Weakness, drowsiness, dizziness
	diazepam	Valium	Drowsiness, cognitive slowing, fatigue, ataxia

**Medications—Cont'd**

<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
Male sexual dysfunction	tadalafil	Cialis	Headache, upset stomach, stuffy nose, flushing
	vardenafil	Levitra	Headache, flushing, stuffy nose, drop in blood pressure
	sildenafil	Viagra	Headache, flushing, chest pain, vision changes
Urinary dysfunction	propantheline	Pro-Banthine	Dry mouth, dizziness, drowsiness
	oxybutinin	Ditropan, Ditropan XL	Dry mouth, dizziness, constipation
	tolteridine	Detrol	Dry mouth, abdominal pain, constipation

**Parkinson's Disease****Description/Overview**

Parkinson's disease (PD), the most prevalent extra-pyramidal movement disorder, is characterized by a series of progressive neurological signs usually starting with resting tremor of one limb. The other major PD neurological signs include cogwheel rigidity, bradykinesia, & impaired postural reflexes.<sup>6</sup>

## Precautions

### Orthostatic Hypotension (Occurs in Late-Stage PD)

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Drop in blood pressure with position changes (e.g., supine to sitting or sitting to standing)</li> </ul>	<ul style="list-style-type: none"> <li>Medication side effect</li> <li>ANS dysfunction</li> </ul>	<ul style="list-style-type: none"> <li>Have patient sit back down or lie down</li> <li>Monitor blood pressure</li> </ul>

## Physical Therapy Examination

### General Considerations

Patients with PD

- Often demonstrate ANS dysfunction that may have an impact on cardiac & pulmonary responses to exercise
- May fall frequently due to impaired balance & equilibrium reactions
- May be depressed
- Monitor blood pressure frequently during examination due to hypotension

### History (Refer to Tab 2)

#### Vital Signs

- Assess BP, HR, RR, & body temperature

## Tests and Measures

### Aerobic Capacity/Endurance

#### Assessment

- Assess BP, HR, & RR at rest & during & after activities
- If possible, administer 2-minute or 6-minute walk test & Borg Rating of Perceived Exertion (Tab 2) to determine perceived rate of exertion

**Potential findings**

- Low resting blood pressure
- Impaired cardiac & pulmonary responses to exercise
- Decreased endurance

**Anthropometric Characteristics****Assessment**

- Assess height, weight, & BMI

**Potential findings**

- Weight loss

**Arousal, Attention, and Cognition****Assessment**

- Administer Mini-Mental State Exam (Tab 2) to assess cognition, short- & long-term memory, & communication

**Potential findings**

- Late-stage dementia
- Depression
- Dysarthria (slurred speech) & hypophonia (low volume)
- Micrographia

**Assistive and Adaptive Devices****Precaution**

- Due to poor balance, standard walker is not recommended (as patient may fall backward while lifting the walker)

**Assessment (Refer to Tab 2)****Circulation****Assessment**

- Assess BP & HR

**Potential findings**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>■ Low resting blood pressure</li> <li>■ Orthostatic hypotension</li> </ul> | <ul style="list-style-type: none"> <li>■ Poor cardiac responses to exercise</li> </ul> |
|---|--|

## Cranial and Peripheral Nerve Integrity

Assessment (Refer to Tab 2)

Potential findings

- A “masked face” NOT caused by facial nerve involvement
- Dysphagia (swallowing difficulty) (IX & XI)
- Dysarthria (slurred speech) (IX, XI, & XII)
- Sialorrhea (excessive increase of saliva) due to ANS dysfunction

## Environment, Home, and Work Barriers

Assessment (Refer to Tab 2)

## Gait, Locomotion, and Balance

Assessment

- Romberg Test (Tab 2), Functional Reach Test (Tab 2), & Multi-directional Reach Test (Tab 2) to assess static balance; most appropriate for patients with late-stage PD
- Berg Balance Scale (Tab 2), & Timed Get Up & Go Test (Tab 2) to assess dynamic balance; most appropriate for patients with early & middle stages PD
- Administer Tinetti Performance-Oriented Mobility Assessment (Tab 2) & Tinetti Falls Efficacy Scale (Tab 2) to determine fall risk & fear of falls
- Observe gait on even & uneven surfaces & walking through a doorway
- Observe & time a 10-meter forward & backward walk

Potential findings

- Impaired static or dynamic balance
- Anteropulsive (forward) or retropulsive (backward) festinating gait (a progressive increase in speed with a shortening of stride)
- Shuffling gait (dragging feet)
- Difficulty turning & changing directions (i.e., taking very slow, multiple steps)
- Initiating or stopping difficulties
- Freezing at a doorway
- Frequent falls & fear of falls

## **Integumentary Integrity**

*Assessment* (Refer to Tab 2)

*Potential findings*

- Excessive sweating
- Seborrhea (a skin condition characterized by greasy or dry, white, flaking scales over reddish patches)

## **Joint Integrity and Mobility**

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with PD may demonstrate limited joint play movement due to rigidity

## **Motor Function**

*Assessment*

- Observe patient with PD performing ADLs
- Administer MDS-Unified Parkinson's Disease Rating Scale (see following)

*Potential findings*

- Initiating or stopping movement difficulties
- Bradykinesia
- Resting tremor
- Dystonia or dyskinesia (may be medication-induced)

## **Muscle Performance**

*Considerations*

- It is easier to assess strength in supine & side-lying positions due to balance problems & stooped postures
- Strength can be difficult to assess due to bradykinesia

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with PD may demonstrate weakness due to deconditioning

## **Pain**

*Assessment*

- Administer Ransford Pain Drawing (Tab 2)

### Potential findings

- Aching pains, numbness, tingling or abnormal heat & cold sensations
- Intense pain during "off" period

### Posture

#### Assessment

- Assess sitting & standing posture in sagittal & frontal planes

### Potential findings

- Kyphosis with forward head
- A stooped, forwardly-flexed posture
- Asymmetry (leaning to one side)

### Range of Motion

#### Assessment

- Assess active & passive ROM

### Potential findings

Patients with PD may:

- Demonstrate increased resistance to passive movements throughout ROM (leadpipe or cogwheel rigidity)
- Keep muscles (especially flexors) in a shortened position

### Reflex Integrity

#### Assessment

- Muscle tone
- DTR
- Postural reflexes (righting reflexes, equilibrium reactions, & protective extension reactions)

### Potential findings

- Rigidity (leadpipe or cogwheel)
- Increased DTR
- Impaired righting reflexes
- Impaired, delayed, or absent equilibrium & protective extension reactions

## Self-Care and Home Management

### Assessment

- Bowel & Bladder Control Checklist (Tab 2)
- Movement Disorder Society-sponsored revision of the Unified Parkinson's Disease Rating Scale Version 3.0 (see following) to assess ADLs

### Potential findings

- Constipation
- Urinary bladder dysfunction
- Sexual dysfunction
- Late-stage ADL-dependency

## Sensory Integrity

### Assessment

- Assess cortical sensation, kinesthesia, & proprioception (joint position & movement)

### Potential findings

- Patients with PD may have impaired proprioception

## Ventilation and Respiration

### Assessment (Refer to Tab 2)

### Potential findings

- Decreased tidal volume & vital capacity due to stooped posture
- Low voice volume due to decreased tidal volume
- Impaired pulmonary responses to exercise
- Impaired cough

## Work, Community, and Leisure

### Assessment (Refer to Tab 2)

## Disease-Specific Tests and Measures

### Movement Disorder Society-Sponsored Revision of the Unified Parkinson's Disease Rating Scale (MDS-UPDRS)

Each question may be scored with five responses:

0 – Normal

1 – Slight (symptoms & signs cause no impact on function)

2 – Mild (symptoms & signs cause a modest impact on function)

3 – Moderate (symptoms & signs impact but do not prevent function)

4 – Severe (symptoms & signs prevent function)

Category	Clinical Descriptors	Findings
<b>Part 1: Nonmotor Aspects of Experiences of Daily Living</b>	Cognitive impairment	
	Hallucinations & psychosis	
	Depressed mood	
	Anxious mood	
	Apathy	
	Features of dopamine dysregulation syndrome	
	Sleep problems	
	Daytime sleepiness	
	Pain & other sensations	
	Urinary problems	
	Constipation problems	
	Lightheadedness on standing	
	Fatigue	

Category	Clinical Descriptors	Findings
<b>Part II: Motor Experiences of Daily Living</b>	Speech	
	Saliva & drooling	
	Chewing & swallowing	
	Eating tasks	
	Dressing	
	Hygiene	
	Handwriting	
	Doing hobbies & other activities	
	Turning in bed	
	Tremor impact on activities	
	Getting in & out of bed	
	Walking & balance	
	Freezing	
<b>Part III: Motor Examination</b>	Speech	
	Facial expression	
	Rigidity	
	Finger tapping	
	Hand movements	
	Pronation & supination movements of hands	
	Toe tapping	
	Leg agility	
	Arising from chair	
	Gait	
	Freezing of gait	
	Postural stability	
	Posture	
	Global spontaneity of movement (body bradykinesia)	
	Postural tremor of hands	
	Kinetic tremor of hands	
	Rest tremor amplitude	
	Constancy of tremor	

*Continued*

Category	Clinical Descriptors	Findings
<b>Part IV: Motor Complications</b>	Dyskinesias: time spent with dyskinesias	
	Dyskinesias: functional impact of dyskinesias	
	Dyskinesias: painful off state dystonia	
	Motor fluctuations: time spent in the off state	
	Motor fluctuations: functional impact of fluctuations	
	Motor fluctuations: complexity of motor fluctuations	

Source: Goetz CG, Fahn S, Martinez-Marin P, et al. Movement Disorder Society-sponsored revision of the Unified Parkinson's Disease Rating Scale (MDS-UPDRS): process, format & clinimetric testing plan. *Mov Disord.* 2007;22:41-47, with permission.

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Bradykinesia, tremor & rigidity	levadopa-carbidopa	Sinemet, Atamet	Dizziness, nausea, psychiatric symptoms, dyskinesia
Bradykinesia, tremor, rigidity, & high levadopa dose	dopamine receptor agonists-ropinirole	Requip	Nausea, drowsiness, sleepiness
	pramipexole	Mirapex	Dizziness, lightheadedness, fainting, nausea

**Medications—Cont'd**

<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
	enzymatic inhibitors – monoamine oxidase type B inhibitors (MAOB inhibitors) selegiline hydrochloride  catechol-O-methyl transferase (COMT) inhibitors tolcapone  entacapone  levadopa + carbidopa + entacapone	Eldepryl  Tasmar  Comtan  Stalevo	Dizziness, lightheadedness, fainting, dry mouth, nausea  Dizziness, orthostasis, diarrhea, dyskinesia  Dizziness, orthostasis, diarrhea, dyskinesia  Dyskinesia, nausea, irregular HR, orthostasis
Bradykinesia, tremor, & rigidity	amantadine  anticholinergic drugs – trihexyphenidyl  biperiden	Symmetrel  Artane  Akineton	Confusion, nausea, hallucinations  Confusion, dry mouth, nausea  Confusion, dry mouth, nausea

*Continued*

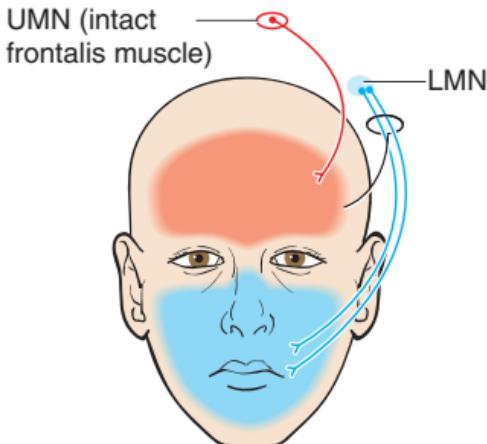
**Medications—Cont'd**

<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
	procyclidine	Kemadrin	Confusion, dry mouth, nausea
Cell death	MAOB inhibitors – selegiline hydrochloride	Selegiline, Eldepryl	Dizziness, lightheadedness, fainting, blurred vision, headache
	rasagiline	Azilect	Mild headache, joint pain, heartburn, constipation
	dopamine receptor agonists – ropinirole	Requip	Nausea, drowsiness, sleepiness
	pramipexole	Mirapex	Dizziness, lightheadedness, fainting, nausea
	bromocriptine	Parlodel	Nausea, constipation, orthostasis

## Peripheral Nerve Injury (PNI)

### Bell's Palsy

#### Description/Overview



Bell's palsy (BP) is facial muscle weakness or paralysis resulting from injury to one of the two facial nerves (LMN type). BP affects only one side of the face with the frontalis muscle of the same side being affected, though in UMN types of facial palsy, the frontalis muscle on both sides of the face remains intact.

#### Precautions

- Eye & cornea drying due to inability to close eye
- Balance, gait, & driving may be impaired especially if the patient with BP wears an eye patch

#### Physical Therapy Examination

##### History (Refer to Tab 2)

- Was onset of symptoms sudden?
- Does patient have any recent flu-like symptoms?
- Has patient had any recent dental treatment?

## Vital Signs

- Assess BP, HR, RR, & body temperature

## Tests and Measures

### Arousal, Attention, and Cognition

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with BP may demonstrate dysarthria (slurred speech) due to poor lip closure

### Cranial and Peripheral Nerve Integrity

*Assessment – Assess*

- Cranial nerves (focusing on VII) & peripheral nerves
- Corneal reflexes (cranial nerves V & VII)
- Taste (anterior 2/3 of tongue)
- Auditory acuity
- The following facial expressive muscles (Tab 2):
  - Frontalis (raise eyebrow)
  - Orbicularis oculi (close eyes tightly)
  - Corrugator supercilii (frown)
  - Nasalis & procerus (wrinkle nose)
  - Zygomaticus major (smile, show top teeth)
  - Orbicularis oris (lip closing)
  - Platysma (show bottom teeth)
  - Buccinators (suck in cheeks)

*Potential findings*

- Unilateral facial muscle weakness or paralysis (ipsilateral frontalis affected)
- An inability to fully close eye on affected side
- Drooling
- Impaired taste (anterior 2/3 of tongue on the affected side)
- Dry eye or excessive tearing on affected side
- Dry mouth
- Hyperacusis (hypersensitivity to sound)

## Gait, Locomotion, and Balance

*Assessment* (Refer to Tab 2)

*Potential findings*

- Balance and gait may be affected especially if patients with BP wear an eye patch

## Orthotic, Protective, and Supportive Devices

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with BP may need to wear an eye patch on the involved side to protect affected eye

## Pain

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with BP may experience posterior auricular pain

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Viral infection	acyclovir	Zovirax	Upset stomach, vomiting, dizziness
Inflammation	prednisone	Meticorten	Headache, dizziness, sleep disorders

## HIV Infection

### Description/Overview

Peripheral neuropathy observed among patients with HIV/AIDS can be divided into: HIV-associated sensory or toxic neuropathy, inflammatory demyelinating polyneuropathy, & autonomic neuropathy.<sup>1</sup>

*Medical Red Flags*

### **Postural (Orthostatic) Hypotension & Presyncope (Feeling Faint or Lightheaded)**

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Sudden drop in blood pressure or feeling faint &amp; lightheaded (usually after sudden position changes, e.g., supine to sitting)</li> </ul>	<ul style="list-style-type: none"> <li>• Poor distal &amp; lower limb venous return</li> <li>• ANS dysfunction (unable to regulate blood pressure)</li> </ul>	<ul style="list-style-type: none"> <li>• Have patient lie down</li> <li>• Monitor blood pressure constantly while changing positions</li> <li>• Have patient wear pressure stocking or abdominal binder</li> </ul>

### **Arrhythmia**

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Irregular heart rate</li> </ul>	<ul style="list-style-type: none"> <li>• ANS dysfunction</li> </ul>	<ul style="list-style-type: none"> <li>• Stop exam &amp; let patient rest in supine</li> <li>• Seek emergency medical care if arrhythmia persists</li> </ul>

### **Physical Therapy Examination**

#### **General Considerations**

- Follow universal precautions during examination

#### **History (Refer to Tab 2)**

#### **Vital Signs**

- Assess BP, HR, RR, & body temperature

#### *Potential findings*

- Patients with HIV/AIDS & ANS involvement may demonstrate postural hypotension, sweating abnormalities, presyncope, & arrhythmia

## Tests and Measures

### Aerobic Capacity/Endurance

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with advanced HIV/AIDS may demonstrate
  - Poor aerobic capacity & decreased endurance
  - Impaired cardiac responses to exercise due to ANS involvement

### Anthropometric Characteristics

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with advanced HIV/AIDS may have decreased BMI due to weight loss

### Arousal, Attention, and Cognition

*Assessment*

- Administer Mini-Mental State Exam (Tab 2) to assess cognition, short- & long-term memory, & communication

*Potential findings*

- Patients with advanced HIV/AIDS may have dementia due to CNS involvement

### Assistive and Adaptive Devices

*Considerations*

- Patients with advanced HIV/AIDS may need assistive & adaptive devices for ADL due to weakness & poor endurance

*Assessment* (Refer to Tab 2)

### Circulation

*Assessment* (Refer to Tab 2)

*Potential findings*

- Postural hypotension, presyncope or arrhythmia
- Impaired cardiac responses to position changes & exercise

## Cranial and Peripheral Nerve Integrity

### Assessment

- Assess peripheral motor & sensory functions from distal to proximal

### Potential findings

- Patients with advanced HIV/AIDS & peripheral neuropathy may experience lower & upper limb (distal > proximal) numbness, tingling, or pain in a sock or glove pattern

## Environmental, Home, and Work Barriers

### Considerations

- Patients with advanced HIV/AIDS may be wheelchair-dependent & may require barrier-free environments

### Assessment (Refer to Tab 2)

## Ergonomics and Body Mechanics

### Assessment (Refer to Tab 2)

### Potential findings

- Patients with advanced HIV/AIDS may demonstrate dexterity & hand function problems due to hand or forearm muscle weakness & decreased endurance

## Gait, Locomotion, and Balance

### Assessment

- Romberg Test (Tab 2) & Functional Reach Test (Tab 2) to assess static balance
- Berg Balance Scale (Tab 2) to assess dynamic balance
- Observe gait on level surfaces, ramps, & stairs

### Potential findings

- Patients with advanced HIV/AIDS may demonstrate dynamic balance & gait difficulties due to lower limb weakness

## Integumentary Integrity

### Assessment (Refer to Tab 2)

### Potential findings

- Kaposi's sarcoma
- Lower limb ulcers (most frequently in feet)

## **Motor Function**

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with advanced HIV/AIDS may demonstrate dexterity & hand function problems due to hand muscle weakness & sensory problems

## **Muscle Performance**

*Assessment* (Refer to Tab 2)

*Potential findings*

- Hand or foot muscle weakness or wasting
- Decreased distal limb muscle strength & endurance

## **Orthotic, Protective, and Supportive Devices**

*Considerations*

- Patients with advanced HIV/AIDS may need orthotic, protective, or supportive devices for ambulation & ADLs due to muscle weakness & decreased endurance

*Assessment* (Refer to Tab 2)

## **Pain**

*Assessment*

- Administer Universal Pain Assessment Tool (see Tab 2) & Ransford Pain Drawing (see Tab 2)

*Potential findings*

- Tingling, numbness, or burning sensations in upper or lower limbs (distal > proximal)
- Joint & muscle pain due to side effect of AZT
- Pain that worsens from stimuli not normally considered painful or noxious

## **Posture**

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with advanced HIV/AIDS may stand with pronated feet & a wide base of support due to distal lower limb muscle weakness

## Range of Motion

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with advanced HIV/AIDS may have limited active ROM of fingers, wrists, ankles, & possibly knees due to weakness

## Reflex Integrity

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with advanced HIV/AIDS & peripheral neuropathy may have decreased DTRs at Achilles tendon, patellar tendon, hamstrings, & brachioradialis due to PNS involvement

## Self-Care and Home Management

*Assessment*

- Administer Bowel & Bladder Control Checklist (Tab 2)

*Potential findings*

- Patients with advanced HIV/AIDS & ANS dysfunction may have bowel & bladder problems

## Sensory Integrity

*Assessment*

- Assess cortical sensory function, kinesthesia, vibration, & proprioception

*Potential findings*

- Impaired vibration & proprioception in lower & upper limbs due to PNS involvement (not necessarily cortical problem)

## Ventilation and Respiration

*Assessment* (Refer to Tab 2)

*Potential findings*

- Limited pulmonary capacity due to opportunistic infections

## Work, Community, and Leisure

*Assessment (Refer to Tab 2)*

*Potential findings*

- Patients with advanced HIV/AIDS may be ADL-dependent due to weakness, poor endurance, & impaired cardiac & pulmonary responses to exercise

### Medications<sup>2</sup>

Indications	Generic Name	Brand Name	Common Side Effects
HIV/AIDS: Highly Active Anti-Retroviral Therapy (HAART) <sup>2</sup>	Refer to Medications table for HIV in Tab 5	Refer to Medications table for HIV in Tab 5	Refer to Medications table for HIV in Tab 5
HIV/AIDS	zidovudine	AZT, Retrovir	Headache, fever, nausea, myopathy, neutropenia
Pain & numbness	amitriptyline mexiletine	Elavil, Endep Mexitil	GI problems, drowsiness Nausea, dizziness, confusion
Progressive weakness	intravenous immunoglobulin	Gammagard	Headache, fever, fatigue, chills
Peripheral neuropathy	lamotrigine	Lamictal	Balance or coordination loss, vision problems, concentration difficulty

## Peripheral Nerve Injuries of Lower Limbs

### Sciatica

#### Overview/Description

Emerging from the lumbosacral plexus & branching into the common peroneal nerves (L4, L5, S1, S2) & tibial nerves (L4, L5, S1, S2, S3), the sciatic nerve may experience pressure leading to pain radiating down the

lower back & into the back of the lower limbs.<sup>3</sup> Patients with sciatica may also experience motor problems, including weakened hip extensors & adductors, knee flexors, ankle dorsiflexors, plantar flexors, evertors, invertors & big toe extensors; sensory problems such as lower limb & buttock paresthesia or numbness; & bowel & bladder control problems.<sup>4</sup>

## Physical Therapy Examination

### History (Refer to Tab 2)

- Does any position or activity aggravate pain?

### Vital Signs

- Assess BP, HR, RR, & body temperature

## Tests and Measures

### Cranial and Peripheral Nerve Integrity

#### Assessment

- Assess peripheral motor & sensory nerve integrity
- Follow peripheral nerve innervation (Tab 2)

#### Potential findings

- Pain, numbness, or paresthesia along lower back, buttocks, or back of lower limbs
- Weakened
  - Hip extensors & adductors
  - Knee flexors
  - Ankle dorsiflexors, plantar flexors, evertors, & invertors
  - Big toe extensors

### Gait, Locomotion, and Balance

#### Assessment

- Observe gait at varied speeds on level surfaces, ramps, & stairs

#### Potential findings

Patients with sciatica

- Often walk asymmetrically with a shorter stance phase, weak push-off on the involved side, & an inability to bear full weight due to muscle weakness

- May have difficulty
  - Clearing involved foot from the floor
  - Performing one-legged stance on involved leg
  - Walking fast or ascending & descending stairs

## Muscle Performance

### Assessment

- Assess muscle strength in pain-free range rather than standard position
- Focus on lower limb muscles

### Potential findings

Patients with sciatica may demonstrate weakened

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>■ Hip extensors &amp; adductors</li> <li>■ Ankle dorsiflexors, plantar flexors, evertors, &amp; invertors</li> </ul> | <ul style="list-style-type: none"> <li>■ Big toe extensors</li> <li>■ Knee flexors</li> </ul> |
|---|---|

## Orthotic, Protective, and Supportive Devices

### Considerations

- Patients with sciatica may need ankle-foot orthoses due to ankle muscle weakness

### Assessment (Refer to Tab 2)

## Pain

### Assessment

- Administer Universal Pain Assessment Tool (Tab 2) & Ransford Pain Drawing (Tab 2)

### Potential findings

Patients with sciatica

- Often report that prolonged sitting or any movement involving the lumbar spine triggers pain
- Often experience pain on one side
- May have more pain sitting & bending compared to standing if disc herniation causes sciatica

## Posture

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with sciatica often stand asymmetrically to shift weight laterally to the uninvolved side

## Range of Motion

*Assessment* (Refer to Tab 2)

*Potential findings*

- Limited active knee flexion, ankle dorsiflexion, ankle plantar flexion, eversion, inversion, & big toe extension due to muscle weakness
- Limited positive straight leg raise on the involved or opposite side

## Reflex Integrity

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with sciatica may have decreased DTR in Achilles tendon

## Self-Care and Home Management

*Assessment*

- Administer Bowel & Bladder Control Checklist (Tab 2)

*Potential findings*

- Patients with sciatica may experience incontinence due to sacral nerve compression

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Pain	NSAID – aspirin	Aspirin	Stomach ulcer, nausea
	NSAID – ibuprofen	Motrin, Nuprin, Advil	GI problems, dizziness, fluid retention
Muscle tightness & cramps	cyclobenzaprine	Fexmid, Flexeril	Arrhythmia, chest pain, sudden weakness
	diazepam	Valium	Hypotension, muscle weakness, tachycardia, respiratory depression
Pain & inflammation	steroids	Meticorten	Headache, dizziness, sleep disorders

## Carpal Tunnel Syndrome



### Description/Overview

Carpal tunnel syndrome (CTS) occurs when the median nerve (C5–8, T1) becomes compressed at the wrist.<sup>5</sup> Sensory problems (tingling or numbness of thumb, 2nd, & 3rd fingers, radial half of 4th finger, & radial half of palm) normally are the first indicators of CTS with motor problems

(weak grip or pinch & weak or no thumb flexion & opposition) appearing later.

## Physical Therapy Examination

### History (Refer to Tab 2)

- Ask about onset of sensory symptoms versus motor symptoms
- Did the symptoms occur during pregnancy?
- Ask about recent activities with tools & computer keyboard

### Potential findings

- Sensory symptoms generally occur before motor symptoms

### Vital Signs

- Assess BP, HR, RR, & body temperature

## Tests and Measures

### Cranial and Peripheral Nerve Integrity

#### Assessment

Administer

- Tinel's Test
  - Examiner taps or presses median nerve at the affected wrist
  - Tingling or shock-like sensation in the fingers indicates CTS



- Phalen (wrist flexion) Test
  - Patient holds forearms upright by pointing fingers downward & pressing backs of hands together
  - Tingling or increased numbness in the fingers within 1 minute indicates CTS
- Examine light touch (using monofilament test kit) & pinprick sensation of hands (palm & dorsum) & fingers



### Potential findings

- Positive Tinel's sign
- Tingling or numbness on the palmar side of the
  - Radial half of palm
  - Thumb
  - 2nd & 3rd fingers
  - Radial half of 4th finger
- Tingling or numbness in the tips of the 2nd & 3rd fingers on the dorsum side
- Impaired light touch and pinprick sensation

## Ergonomics and Body Mechanics

### Assessment

- Assess shoulder, elbow, & wrist movements at work & during leisure activities (e.g., tool-handling & computer keyboard tasks)

### Potential findings

Patients with CTS may

- Habitually keep wrist in flexion (causing compression of median nerve at the carpal tunnel) or in extension (stretching median nerve) while using tools during work & leisure activities
- Use vibration hand tools for long duration

## Motor Function

### Assessment (Refer to Tab 2)

### Potential findings

- Hand muscle weakness may affect hand functions & dexterity in patients with CTS

## Muscle Performance

### Assessment

- Assess finger & hand intrinsic muscles
- Focus on thenar muscles (opposition & abduction) & finger flexors (grip strength)

### Potential findings

- Thenar muscle weakness & atrophy (ape hand)
- Finger flexor weakness (limp grip causing dropping of objects)
- Thumb abductor weakness

## Orthotic, Protective, and Supportive Devices

### Considerations

- Some patients with CTS may need to wear a night splint to keep wrist neutrally positioned

*Assessment (Refer to Tab 2)*

## Pain

### Assessment

- Administer Ransford Pain Drawing (Tab 2)

### Potential findings

- Paresthesia or numbness of the radial half of the palm, thumb, 2nd & 3rd fingers, & radial half of 4th finger
- Pain that worsens at night & upon awakening
- Pain that worsens when using affected hand

## Sensory Integrity

### Assessment

- Assess 2-point discrimination
- Assess stereognosis

### Potential findings

- Impaired 2-point discrimination
- Impaired stereognosis

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Inflammation	corticosteroids (prednisone)	Meticorten	Headache, dizziness, sleep disorders
Pain	lidocaine	Xylocaine	Nausea, drowsiness, tinnitus
	NSAID – aspirin	Aspirin	Stomach ulcer, nausea, tinnitus
	NSAID – ibuprofen	Motrin, Nuprin, Advil	GI problems, dizziness, fluid retention

## Radial Nerve Injury

### Radial Nerve Sensory Distribution (Dorsum)



### Description/Overview

Radial nerve (C5–8, T1) compression in the spiral groove of the humerus is the most common cause of radial nerve injury (RNI).

Forearm RNI can lead to grasping, finger extension & thumb abduction problems as well as sensory loss at the radial 2/3 dorsum of the hand, dorsum, & lateral half aspect of the thumb, proximal 1/3 dorsum of the 2nd & 3rd fingers, & radial half of the 4th finger.<sup>3</sup>

### Physical Therapy Examination

#### History (Refer to Tab 2)

#### Vital Signs

- Assess BP, HR, RR, & body temperature

### Tests and Measures

#### Cranial and Peripheral Nerve Integrity

##### Assessment (Refer to Tab 2)

##### Potential findings

- Intact cranial nerves
- Numbness or paresthesia on the
  - Radial 2/3 dorsum of the hand

- Dorsum & lateral half aspect of the thumb
- Proximal 1/3 dorsum of the 2nd & 3rd fingers
- Radial half of the proximal 1/3 dorsum of the 4th finger
- Weakness of wrist & finger extensors, thumb abductor, forearm supinators, & elbow extensors

## Muscle Performance

### Assessment

- Focus on wrist (extensor carpi radialis longus & brevis) & finger extensors
- Assess forearm supinators and elbow extensors

### Potential findings

- A wrist drop
- Grasping weakness or inability
- Weakness or paralysis of wrist & finger extensors, thumb abductor, forearm supinator, & elbow extensors

## Orthotic, Protective, and Supportive Devices

### Considerations

- Patients with RNI may need hand/wrist splints to address wrist drop problems

### Assessment (Refer to Tab 2)

## Reflex Integrity

### Assessment (Refer to Tab 2)

### Potential findings

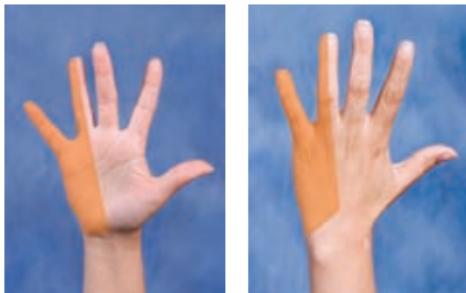
- Decreased DTR at affected brachioradialis and triceps due to PNS involvement

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Pain	NSAID – aspirin	Aspirin	Stomach ulcer, nausea
	NSAID – ibuprofen	Motrin, Nuprin, Advil	GI problems, dizziness, fluid retention

## Ulnar Nerve Injury (Entrapment)

### Ulnar Sensory Nerve Distribution



### Description/Overview

Ulnar nerve (C7–8, T1) injury (UNI) at wrist level can lead to inability to: flex the 5th finger; abduct & adduct fingers; extend the proximal & distal interphalangeal joints of the 4th & 5th fingers; sense light touch, pain, & temperature on the ulnar half of palm and dorsum of hand, dorsal & palmar side of the 5th finger, & the ulnar half of the 4th finger.<sup>3</sup>

Elbow UNI can lead to wrist flexor weakness & ulnar deviation loss in addition to the aforementioned functional impairments.<sup>3</sup>

### Physical Therapy Examination

#### History (Refer to Tab 2)

- Assess any elbow or wrist trauma

#### Vital Signs

- Assess BP, HR, RR, & body temperature

### Tests and Measures

#### Cranial and Peripheral Nerve Integrity

##### Assessment

- Follow peripheral nerve innervation pattern to assess peripheral nerve integrity (see Tab 2)

- Focus on hand muscle strength & sensation
- Administer the elbow flexion test
  - Patient fully flexes elbows with wrists in extension & shoulders in abduction and external rotation and holds the position for 3–5 minutes

#### *Potential findings*

- Paresthesias or numbness over the ulnar half of both palm and dorsum of hand, both palmar & dorsal sides of the 5th finger, & ulnar half of the 4th finger
- Weakened:
  - Wrist flexors
  - 5th finger distal flexors
  - 4th & 5th finger extensors (proximal & distal interphalangeal joints)
  - Finger abductors & adductors
- Loss of wrist ulnar deviation
- Positive elbow flexion test (feeling tingling or paresthesia along ulnar nerve distribution of the forearm and hand) indicates cubital tunnel (ulnar nerve) compression

## Ergonomics and Biomechanics

### *Assessment*

- Assess hand functions in tool-handling for work & ADLs

#### *Potential findings*

Patients with UNI may

- Have difficulty handling tools due to wrist or finger muscle weakness
- Demonstrate posture that causing compression on the medial side of elbow
- Use hand in an awkward position to manipulate computer mouse, keyboard, or hand tools

## Muscle Performance

### *Considerations*

- Ulnar nerve innervates the flexor carpi ulnaris, flexor digitorum profundus (4th & 5th fingers), palmaris brevis, interossei, medial two lumbricals, & hypothenar muscles

**Assessment**

- Wrist flexion & extension
- Ulnar & radial deviation
- Finger flexion, abduction, & adduction

**Potential findings**

- Weakened
  - Wrist flexion
  - 5th finger distal interphalangeal joint flexion
  - 4th & 5th finger extension
  - Finger abduction & adduction
- Loss of wrist ulnar deviation
- Hypotenar muscle atrophy

**Pain****Assessment**

- Administer Ransford Pain Drawing (Tab 2)
- Assess Tinel's sign
  - Lightly tap over elbow along course of ulnar nerve

**Potential findings**

- Paresthesias or numbness over both ulnar half of palm and dorsum of hand, palmar & dorsal sides of the 5th finger & ulnar side of the 4th finger
- Positive Tinel's sign at or below elbow along course of ulnar nerve
- Positive elbow flexion test

**Range of Motion****Assessment (Refer to Tab 2)****Potential findings**

- When bending MCP joints, patients with UNI may keep 4th & 5th MCP joints straight & both proximal & distal interphalangeal joints flexed (benediction hand deformity)

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
Pain	NSAID – aspirin	Aspirin	Stomach ulcer, nausea, tinnitus
	NSAID – ibuprofen	Motrin, Nuprin, Advil	GI problems, dizziness, fluid retention
	amitriptyline	Elavil, Endep	Dry mouth, drowsiness, nausea, weakness
	nortriptyline	Aventyl HCl, Pamelor	Upset stomach, drowsiness, weakness

## Peripheral Vestibular Diseases

### Benign Paroxysmal Positional Vertigo (BPPV)

#### Description/Overview

Benign paroxysmal positional vertigo (BPPV), a peripheral vestibular disorder, is thought to be caused by debris (otoconia) floating in semicircular canals.<sup>6</sup> Head position changes (e.g., getting out of or rolling over in bed & bending down or looking up) often precipitate BPPV symptoms such as vertigo & dizziness.<sup>6</sup>

#### Physical Therapy Examination

##### History (Refer to Tab 2)

##### Vital Signs

- Assess BP, HR, RR, & body temperature

##### Potential findings

- Patients with BPPV often report vertigo associated with certain head movements & positions

## Tests and Measures

### Circulation

#### Assessment

- Administer Vertebral Artery Test to rule out vertebral artery problems
  - With patient in supine, examiner holds patient's head, extends & laterally flexes patient's neck, rotates patient's neck to the same side & holds position for 30 seconds
  - Consider performing Vertebral Artery Test in sitting if patient cannot tolerate supine

#### Potential findings

- Positive finding (dizziness, diplopia, nausea, nystagmus, & slurred speech) indicates vertebral artery compression

### Cranial and Peripheral Nerve Integrity

#### Considerations

- Posterior semicircular canal is most frequently affected

#### Assessment

- Examine visual acuity (II)
- Examine eye movements (III, IV, and VI)
- Examine auditory acuity (VIII, cochlear component)
- Perform Dix-Hallpike Maneuver to assess semicircular canals



- Examiner positions patient in long-sitting on treatment table, turns patient's head to one side ( $45^\circ$ ) and extends the neck, then lowers patient with neck extended to supine on table & watches patient's eyes for nystagmus
- Patient returns to long-sitting
- Positive – If patient becomes dizzy & exhibits nystagmus, the ear pointed toward the floor is implicated
- Examiner repeats the test on other side to check other ear
- Perform head thrust test to assess vestibular-ocular reflex
  - Patient sits with eyes fixed on a distant visual target with the head flex  $30^\circ$  forward
  - Examiner quickly rotates patient's head to one side
  - A healthy person's eyes should move opposite to head movement while gaze remains on the target
  - A patient with unilateral peripheral vestibular lesion or central vestibular neuron disorder will be unable to maintain gaze when head quickly rotates toward lesion side
  - A patient with bilateral loss of vestibular function will make corrective saccades after head thrust to either side
- Perform head-shaking test to assess labyrinthine function
  - While seated wearing Frenzel lenses, patient flexes head down  $30^\circ$  & quickly shakes head horizontally 20 times at rate of 2 repetitions per sec
  - Examiner checks for nystagmus
  - A patient with unilateral labyrinthine problems should have horizontal head-shaking-induced nystagmus with the quick phase toward the healthy ear & the slow phase toward the affected ear
  - A patient with central (cerebellar) problems may exhibit vertical nystagmus

#### *Potential findings*

- Positive Dix-Hallpike Maneuver (ear pointing toward floor is affected)
- Negative head thrust test
- Negative head shaking test (negative for nystagmus)
- Normal auditory function (unlike Meniere's disease)
- Impaired visual acuity due to vestibular hypo-function

## Gait, Locomotion, and Balance

*Assessment* (Refer to Tab 2)

- Administer Dynamic Gait Index (see Tab 2)

*Potential findings*

- Patients with BPPV tend to keep head fixed when walking or performing other functional tasks to avoid vertigo

## Range of Motion

*Assessment*

- Examine cervical ROM to rule out cervical spine problems

*Potential findings*

- Patients with BPPV should have normal cervical ROM

## Self-Care and Home Management

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with BPPV may have impaired self-care and home management skills

## Disease-Specific Tests and Measures

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## Meniere's Disease

### Description/Overview

Meniere's disease (MD), a vestibular disorder with an unknown cause, is associated with a recurring symptom set that includes sudden onset of severe vertigo, tinnitus, hearing loss, & pain & pressure in the affected ear. Progressive, fluctuating hearing loss is the most significant symptom.

### Physical Therapy Examination

#### History (Refer to Tab 2)

- Does any movement provoke an attack?

#### Potential findings

- Response should be negative for patients with MD

#### Vital Signs

- Assess BP, HR, RR, & body temperature

## Tests and Measures

### Aerobic Capacity/Endurance

*Assessment* (Refer to Tab 2)

*Potential findings*

- Patients with MD may experience extreme fatigue & exhaustion following an attack

### Cranial and Peripheral Nerve Integrity

*Assessment*

- Assess all cranial nerves
- Focus on auditory functions (VIII, cochlear component) of each ear
- Administer Rinne Test (Tab 2) & Weber Test (Tab 2)

*Potential findings*

- Progressive, fluctuating hearing loss (low frequency loss first)
- Normal response to Rinne Test (air conduction remains better than bone conduction)
- Lateralized response to Weber Test (away from the affected ear)
- Tinnitus
- Ear fullness
- Vision problem

### Gait, Locomotion, and Balance

*Assessment* (Refer to Tab 2)

- Administer Dynamic Gait Index (Tab 2)

*Potential findings*

- Patients with late-stage MD may demonstrate:
  - Balance problems such as Tumarkin's otolithic crisis (sudden falls while standing or walking)
  - Difficulty walking in the dark

### Pain

*Assessment*

- Administer Ransford Pain Drawing (Tab 2)

*Potential findings*

- Some patients with MD may experience earache, & headache

**Self-Care and Home Management**

*Assessment (Refer to Tab 2)*

*Potential findings*

- Patients with MD may have impaired self-care & home management skills during or right after an attack

**Medications**

Indications	Generic Name	Brand Name	Common Side Effects
Vertigo, nausea & vomiting	diazepam	Valium	Hypotension, muscle weakness, tachycardia, respiratory problems, depression
	promethazine	Phenergan	Drowsiness, confusion, disorientation
	dimenhydrinate	Dramamine	Drowsiness, restlessness, blurred vision
Vestibular system activity	prochlorperazine	Compazine	Blurred vision, irregular heartbeat, confusion
Inner ear fluid	diuretics	Lasix	Blurred vision, GI problems
	antihistamine drugs	Claritin, Allegra	Dizziness, drowsiness, headache, nausea

## Trigeminal Neuralgia (Tic Douloureux)

### Description/Overview

Trigeminal neuralgia (TN), also known as *tic douloureux* due to associated facial tics, is a chronic pain condition causing severe, sudden burning episodes or shock-like facial pain lasting between seconds & minutes.

#### Pain

See the photo for Trigeminal Nerves in the Cranial/Peripheral Nerve Integrity section of Tab 2.

### Physical Therapy Examination

#### History (Refer to Tab 2)

#### Vital Signs

- Assess BP, HR, RR, & body temperature

### Tests and Measures

#### Cranial and Peripheral Nerve Integrity

##### Assessment

- Assess cranial and peripheral nerves
- Assess muscles for facial expression to rule out cranial nerve VII problem
- Focus on trigeminal nerve (V)

##### Potential findings

- During attacks, patients with TN may experience unilateral stabbing pains along one or more branches of the trigeminal nerve
- After an attack, patients with TN should have normal facial sensations (because sensory loss does not occur), mastication muscle strength, & intact corneal reflexes

#### Muscle Performance

##### Assessment

- Ask patient with TN to bite down to feel masseter contraction & temporalis size & strength on both sides of the face

*Potential findings*

- Patients with TN should demonstrate normal masseter & temporalis strength

**Pain***Assessment*

- Administer Universal Pain Assessment Tool (Tab 2) & Ransford Pain Drawing (Tab 2)

*Potential findings*

Patients with TN often

- Report that stimuli, particularly light touch & vibration, triggers severe pain
- Experience pain on one side of the face along one or more branches of trigeminal nerve
- Report that pain provokes brief facial muscle spasms & tics

**Reflex Integrity***Assessment*

- DTR of biceps and patellar tendon
- Jaw jerk reflex (Tab 2)

*Potential findings*

- Normal DTR, including jaw jerk reflexes

**Medications**

Indications	Generic Name	Brand Name	Common Side Effects
Pain & convulsions	carbamazepine	Tegretol, Carbatol	Skin rash, fever, sore throat, easy bruising or bleeding
	oxcarbazepine	Trileptal	Dizziness, drowsiness, blurred vision, GI problems
	gabapentin	Neurontin	Drowsiness, tremor, headache, weakness
Pain	amitriptyline	Elavil, Endep	Dry mouth, drowsiness, nausea, weakness
	nortriptyline	Aventyl HCl, Pamelor	Upset stomach, drowsiness, weakness
	baclofen	Lioresal, Kemstro	Confusion, nausea, drowsiness

## Acute or Chronic Polyneuropathies

### Axonal Polyneuropathy

#### Description/Overview

Polyneuropathy (PN) occurs when multiple peripheral nerves are damaged resulting in sensory and/or motor deficits. The damage may be to the axon or myelin and can be caused by diabetes, alcoholism, renal disease, toxic agents, or infections, such as leprosy. Chronic idiopathic axonal PN is seen in the elderly and manifests itself as a progressive numbness of the feet, lower limbs, and at times, the hands.

#### *Medical Red Flags*

### Autonomic Polyneuropathy

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Changes in BP and HR; orthostatic hypotension; nausea; vomiting; dyspnea; and/or dizziness are red flags because autonomic neuropathy may mask heart attack signs such as chest tightness and pain in chest, arms, jaw, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Heart attack</li> </ul>	<ul style="list-style-type: none"> <li>Cease treatment</li> <li>Seek immediate medical attention</li> </ul>

### Precautions

- Peripheral neuropathy may result in unnoticed lower limb injury; any injury or open wound should receive medical attention
- The patient may not appreciate the importance of sensory loss when some elements of sensation remain intact
- Charcot foot, or neuropathic arthropathy, develops from longstanding elevated blood glucose levels; it can result in softening of the bone, which may fracture and collapse; it most frequently involves the tarsal bones of the foot and calcaneus

## Physical Therapy Examination

### History

Refer to Tab 2 for full history. Include

- Date of onset
- Description of progression of symptoms

### Tests and Measures

#### Aerobic Capacity/Endurance

*Considerations*

- Aerobic exercise must be carefully monitored in the presence of autonomic neuropathy as patients may not notice typical signs of a heart attack
- Diminished thermoregulatory function occurs with autonomic neuropathy so patients should avoid exercising in hot or cold environments

#### Anthropometric Characteristics

*Considerations*

- Fluid retention can occur in diabetes and can result in tight-fitting footwear, which can cause blisters and skin breakdown

*Assessment*

- Track weight and girth measurement

#### Assistive and Adaptive Devices

*Considerations*

- The importance of protecting the hands and feet must be stressed
- Patient should be advised about safety options including the need to always wear foot wear, use gloves for washing dishes, gardening, etc.

*Assessment*

- Determine the need for special footwear, walking casts, splints, and ambulatory assistive devices to protect areas prone to breakdown
- Footwear needs to be inspected for fit

**Circulation***Considerations*

- Autonomic neuropathy may mask the perception of orthostatic hypotension and painful symptoms of a heart attack

*Assessment*

- Perform ongoing monitoring of vital signs
- Take femoral, popliteal, dorsalis pedis, and posterior tibial pulses

*Potential findings*

- Decrease in skin temperature may be indicative of poor arterial perfusion; an increase may result from infection
- Use the Edema Rating Scale to measure fluid retention of hands and lower limbs (Refer to Tab 2)

**Cranial and Peripheral Nerve Integrity (Refer to Tab 2)***Assessment*

- Test cranial nerves II, III, IV, and VI
- Assess sensory distribution of the peripheral nerves
- Assess temperature sensation

*Potential findings*

- Temperature sensation is often lost

**Environmental, Home, and Work Barriers (Refer to Tab 2)***Considerations*

- All rooms should have adequate lighting, including night lights
- Stairs, bathtub, and shower should have non-skid surfaces
- Water temperature should be adjusted to avoid burns

**Gait, Locomotion, and Balance***Considerations*

- Balance and gait problems arise from sensory loss and weakened interosseous musculature

*Assessment (Refer to Tab 2 for testing procedures)*

- Complete static and dynamic balance tests, including the Clinical Test for Sensory Integration in Balance (Refer to Tab 2)

- Complete Tinetti's Falls Efficacy Scale
- Assess safety during gait and locomotion

#### *Potential findings*

- Sensory loss and weakened interosseous musculature can result in:
  - An increased risk of falls
  - Foot drop
  - High-steppage gait
- Weakness in the hip musculature, particularly the hip abductors, can result in a positive Trendelenburg sign or a compensated Trendelenburg (use of excessive lateral weight shifting)

## **Integumentary Integrity**

#### *Considerations*

- The protection and care of the feet must be stressed
- Patient may have loss of visual acuity or diabetic retinopathy, which may interfere with adequate skin inspection

#### *Assessment*

- Inspect skin for open wounds, callous formation, and discoloration especially on weight-bearing surfaces
- Assess skin temperature
- Inspect feet, hands, and limbs for symmetry and color
- Describe any wounds in terms of location and staging

#### *Potential findings*

- Bunions, hammer-toe, and claw-toe deformities can put pressure on shoes, resulting in skin breakdown
- Decreased skin temperature may indicate poor arterial perfusion
- Increased skin temperature is evidence of impending inflammation or ulceration
- Limbs should be protected from extreme temperatures
- Trophic changes include callus formation, skin ulceration, painless fractures, and neuropathic osteoarthropathy
- Autonomic neuropathy can result in decreased or absent sweat and oil production. This can lead to dry, inelastic skin, which is susceptible to breakdown, injury, and heavy callus formation
- Ulcerations of the foot can lead to infection and gangrene and warrant prompt medical attention

## Muscle Performance

### *Potential findings*

- Muscle wasting most often occurs in the lower limbs, although it can also occur in the hands
- Lumbrosacral plexus neuropathy and femoral neuropathy can result in lower limb weakness, including a foot drop
- PN is associated with weakness, which occurs in a distal to proximal pattern

## Orthotic, Protective, and Supportive Devices

### *Assessment – Assess for*

- The fit and need for extra-depth, wide toe-box shoes, padded socks, and orthotics
- The need to reduce stress at wound sites through reduction in weight-bearing activities and use of customized footwear, or total contact casts
- The need for ankle-foot orthotics and cock-up splints in the presence of muscle weakness

### *Potential findings*

- Hammer and claw toes are common and need protection

## Pain

### *Assessment*

- Assess with the Universal Pain Assessment Tool (Refer to Tab 2)
- Note areas and type of pain on the Ransford Pain Drawing (Refer to Tab 2)

### *Potential findings*

- Polyneuropathies may result in significant peripheral neuropathic pain
- Pain may be described as burning, “pins and needles,” aching, tingling, stabbing, and/or shooting
- Allodynia, or pain from normal touch, may be present

## Range of Motion

- Active and passive range of motion to assess muscle length and flexibility

### Potential findings

- Hammer-toe and claw-toe deformities may be present

### Reflex Integrity

Assess the following DTRs

- Chin reflex; trigeminal nerve
- Biceps C5–6
- Triceps C6–8
- Patellar reflex (Quadriceps) L2–4
- Plantar flexors (Achilles) S1–2

### Potential findings

- DTRs are typically diminished or absent in the presence of sensory (PN)

### Sensory Integrity

#### Considerations

- Self-reporting measures may not be effective because patient may not have awareness of sensory deficits

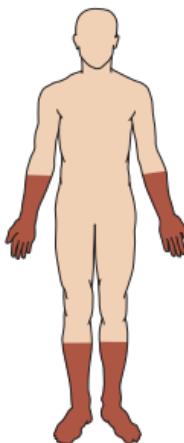
#### Assessment

- Have the patient describe abnormal sensations such as dysesthesia, paresthesia, tingling, etc.
- Assess proprioception, vibratory sense, and position sense
- Use the Subjective Peripheral Neuropathy Screen (refer to later Disease-Specific Tests and Measures)
- Sensory testing of several areas should be done by using a monofilament (Refer to Tab 2)



*Potential findings*

- There may be impaired sensation of pain, vibratory sense, and position sense
- Being able to sense a 4.17 monofilament is considered normal sensation; feeling a 5.07 monofilament is considered protective sensation; a lack of protective sensation indicates significant loss of feeling and an increased risk of developing foot ulceration
- Sensory impairment usually occurs in a stocking/glove pattern

**Disease-Specific Tests and Measures****Subjective Peripheral Neuropathy Screen**

Recorded severity for each symptom

1. Never, always been normal
2. Currently absent
3. If currently present, assigned a score from 1 (mild) to 10 (most severe)

Symptoms	Severity
(1) pain, aching, or burning in hands, arms	
(2) pain, aching, or burning in feet, legs	
(3) "pins and needles" in hands, arms	
(4) "pins and needles" in feet, legs	
(5) numbness (lack of feeling) in hands, arms	
(6) numbness (lack of feeling) in feet, legs	

Maximum Severity Score	Grade of Neuropathy
never or currently absent	0
1–3	1
4–6	2
7–10	3

Source: McArthur JH. The reliability and validity of the Subjective Peripheral Neuropathy Screen. *J Assoc Nurses AIDS Care.* 1998; 9(4): 84–94, with permission.

## Medications

Many medications used to treat peripheral neuropathies are not approved by the FDA for this purpose. These include drugs typically used as anticonvulsants and antidepressants and are listed according to their approved usage.

Indications	Generic Name	Brand Name	Common Side Effects
Mild pain	duloxetine hydrochloride also an anti-depressant	Cymbalta	Constipation, diarrhea, dry mouth, and nausea
Moderate to severe pain	oxycodone fentanyl	OxyContin Percocet Duragesic	Bradycardia, confusion, dizziness, confusion, drowsiness, and nausea
Peripheral neuropathy	Antidepressants including: imipramine amitriptyline nortriptyline	Tofranil Elavil Pamelor Aventyl	Drowsiness, dizziness, low blood pressure, and fatigue

## Guillain-Barré Syndrome

### Description/Overview

Guillain-Barré Syndrome (GBS) is an acute inflammatory disease that results in demyelination and/or axonal degeneration in peripheral nerves, spinal sensory and motor nerve roots, and at times in cranial nerves.

Criteria used in the diagnosis of GBS include:

- A history of flu-like symptoms preceding the GBS symptoms
- Progressive motor weakness in more than one limb
- Symmetric, bilateral pattern of weakness
- Cranial nerve involvement
- Diminished or absent deep tendon reflexes
- Progression of symptoms stabilizes after 2 to 4 weeks

### *Medical Red Flags*

All assessment and intervention should cease; medical attention should be obtained.

### Deep Vein Thrombosis

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Swelling, heat and erythema in the involved area</li> <li>• Positive Homans' sign</li> </ul>	<ul style="list-style-type: none"> <li>• Due to immobilization, thrombus may form in deep veins in legs and/or arms</li> </ul>	<ul style="list-style-type: none"> <li>• Cease treatment and seek immediate medical attention</li> <li>• Avoid any exercise of the lower extremities</li> </ul>

## Autonomic Disturbances

<b>Symptoms</b>	<b>Possible Causes</b>	<b>Management</b>
<ul style="list-style-type: none"> <li>• Tachycardia</li> <li>• Bradycardia</li> <li>• Paroxysmal hypertension</li> <li>• Anhidrosis or diaphoresis</li> <li>• Orthostatic hypotension</li> </ul>	<ul style="list-style-type: none"> <li>• Dysfunction in parasympathetic and sympathetic systems</li> </ul>	<ul style="list-style-type: none"> <li>• Cease treatment and seek immediate medical attention</li> </ul>

## Respiratory Distress

May occur in first few weeks of disease

<b>Symptoms</b>	<b>Possible Causes</b>	<b>Management</b>
<ul style="list-style-type: none"> <li>• Change in cardiopulmonary function including dyspnea and tachypnea</li> </ul>	<ul style="list-style-type: none"> <li>• Severe weakening of respiratory muscles</li> </ul>	<ul style="list-style-type: none"> <li>• Cease treatment and seek immediate medical attention</li> </ul>

## Dysphagia

<b>Symptoms</b>	<b>Possible Causes</b>	<b>Management</b>
<ul style="list-style-type: none"> <li>• Pain on swallowing</li> <li>• Choking</li> <li>• Aspiration</li> <li>• Airway obstruction</li> <li>• Pneumonia</li> </ul>	<ul style="list-style-type: none"> <li>• Decreased coordination of swallowing muscles</li> <li>• Diminished swallow reflex</li> <li>• Reduced lingual and pharyngeal control</li> <li>• Cranial nerve deficits</li> </ul>	<ul style="list-style-type: none"> <li>• For aspiration, seek immediate medical attention</li> <li>• Administer the Heimlich maneuver or CPR, if warranted</li> <li>• Speech-language feeding program</li> </ul>

## Precautions

- Overuse of painful muscles may result in prolonged recovery period or lack of recovery; frequent rest periods are recommended
- Overstretching can occur due to the denervation and weakened muscle

## Physical Therapy Examination

### History

Refer to Tab 2 for full history. Include:

- Date of onset
- Description of progression of symptoms

## Tests and Measures

### Aerobic Capacity/Endurance

- Assess BP, RR, and HR at rest and during and after exercise
- Use the Borg Rating of Perceived Exertion (Refer to Tab 2)

### Potential findings

- The respiratory status may be impaired in the initial stages of GBS
- Initially endurance is poor and overexertion should be avoided

### Assistive and Adaptive Devices

#### Assessment

- Assess the need for assistive or adaptive devices and equipment for functional activities

### Findings

- A WC is usually required during the initial few months; selection should consider avoidance of muscle fatigue, existing strength, need for positioning, and ease of maneuvering in patient's home/work environment

### Circulation

#### Potential findings

- Decreased cardiac output and cardiac arrhythmia
- Fluctuations in blood pressure between hypotension and hypertension

## Cranial and Peripheral Nerve Integrity

### Assessment

- Assess cranial nerves (CN) (Refer to Tab 2)

### Potential findings

- CN involvement may cause weakness of the ocular muscles and reflex responses (CN III, VI, and X), facial (CN VII), and oropharyngeal (CN IX and XII) muscles
- Resultant dysphagia, dysarthria, ophthalmoparesis, and ptosis may occur

Assess peripheral nerves for sharp/dull discrimination and light touch.

### Potential findings

- Deficits in sharp/dull discrimination and light touch are often long standing

## Environmental, Home, and Work Barriers (Refer to Tab 2)

### Gait, Locomotion, and Balance

#### Balance assessment using (Refer to Tab 2)

- Romberg and Timed Up and Go
- Berg Balance Scale
- Performance-Oriented Mobility Assessment

#### Gait and locomotion assessment

- Observational Gait Analysis (Refer to Tab 2)

### Potential findings

- Gait and balance will be affected by pain, diminished endurance, and muscular weakness
- Common findings include a drop foot and diminished heel strike

### Motor Function

#### Assessment

- Use the Rivermead Mobility Index (refer to Tab 2)

## Muscle Performance

### *Considerations*

- Caution should be taken to avoid overexertion so manual muscle testing should be done over several sessions
- Avoid substitutions for weakened muscles

### *Assessment*

- Manual muscle testing of individual muscles (as opposed to testing muscle groups) should be performed for monitoring progression
- Facial and respiratory muscles should be tested
- Use dynamometry to improve sensitivity to change in strength over time

### *Potential findings*

- Muscular weakness generally proceeds in a symmetric manner from proximal to distal, first in the lower, then the upper limbs
- Facial and respiratory muscles are often involved

## Orthotic, Protective, and Supportive Devices

### *Considerations*

- The need for devices is usually short-term so consideration should be given to cost
- An ankle-foot orthotic is often required due to residual weakness of the anterior tibialis and intrinsic muscles of the foot
- Resting splints may be needed to prevent contractures of the hands and ankles

### *Assessment*

Assess the need for:

- Orthotic devices
- Positioning devices to reduce or eliminate pressure (e.g., specialty pressure reducing mattresses, cushions, multipodus boots, etc.)
- Walkers, crutches, and canes

## Pain

### *Assessment*

- Universal Pain Assessment Tool (Refer to Tab 2)
- Note areas and type of pain on the Ransford Pain Drawing (Refer to Tab 2)

### *Potential findings*

- Pain, which may be severe, often occurs in the back and legs
- Pain often worsens at night
- Pain may be described as feelings of dysesthesia, such as burning, tingling or shock-like

## Reflex Integrity

### *Assessment*

- Assess deep tendon reflexes

### *Potential findings*

- Deep tendon reflexes are diminished or absent in the early stages of the illness

## Self-Care and Home Management

### *Assessment*

- Assess with the Functional Independence Measure (FIM)
- Administer the Katz Index of Activities of Daily Living (Refer to Tab 2)

## Sensory Integrity

### *Assessment*

- Establish sensory system functional status (somatosensory, vision, hearing) before completing cognitive/perceptual testing
- Assess superficial (pain, temp, touch), deep (proprioception, vibration) and combined cortical sensations

### *Potential findings*

- Initially there is paresthesia or anesthesia beginning in the feet, although this may also occur in the hands
- Decreased vibratory and position sense may be present

## Ventilation and Respiration

### Assessment

Assess respiratory status including:

- Auscultation of lungs for breath sounds
- Pulse oximetry
- Signs of dyspnea and tachypnea
- Tidal volume and vital capacity with spirometry
- Strength of cough
- Ability to clear airway
- Chest expansion
- Use the Medical Research Council Dyspnea Scale during and after exercise (Tab 2)

### Potential findings

- Impaired respiratory muscle strength can result in a weak cough, decreased vital capacity, tidal volume, and oxygen saturation
- Aspiration may occur when there is cranial nerve involvement resulting in oromotor weakness

## Work, Community, and Leisure

### Assessment

- Assess mobility skills with WC, orthotics, and/or assistive devices within the community and work environments

## Medications/Treatment

- Plasmapheresis has been found to shorten the course of GBS and to lessen symptoms

## Medications

Indications	Generic Name	Brand Name	Common Side Effects
GBS symptoms	IV immunoglobulin	Gammagard S/D, Gamma-IV, IVEEGAM	Headache, skin rash, back pain, wheezing, tachycardia, nausea, and hypotension
Neuropathic pain	acetaminophen with codeine	Tylenol with codeine	Lightheadedness, dizziness, drowsiness, and nausea
Hypersensitivity and neuropathic pain	gabapentin carbamazepine	Neurontin Tegretol	Low white blood cell counts, nausea, vomiting, and dizziness
Muscle spasms	diazepam	Valium	Drowsiness, dizziness, blurred vision, impaired coordination and balance, short-term memory loss

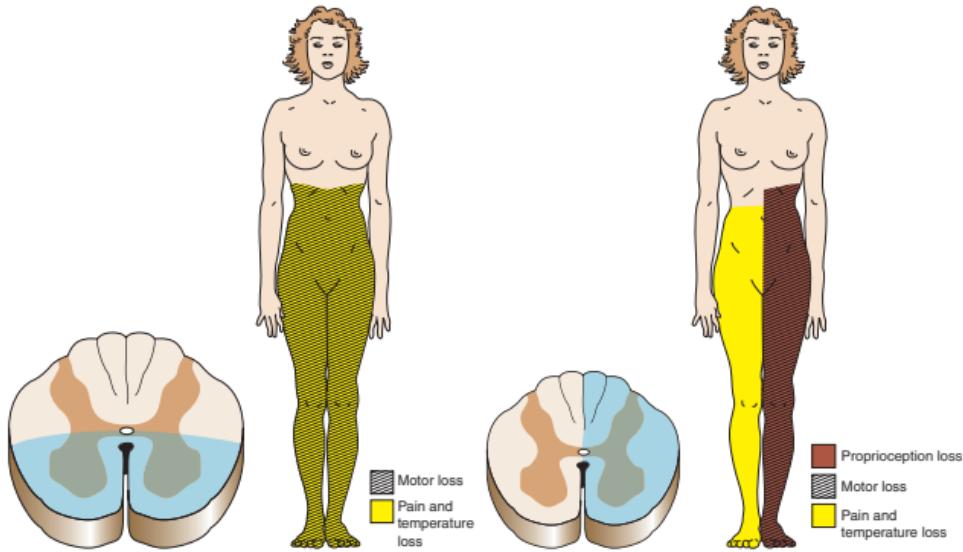
## Nonprogressive Disorders of the Spinal Cord (Spinal Cord Injury [SCI])

### Description/Overview

#### Neurological Involvement Types (in Alphabetical Order)

**Anterior cord syndrome** – motor function, pain, & temperature loss below lesion level

**Brown-Séquard syndrome** – spinal cord hemisection showing ipsilateral side motor involvement & proprioception loss, & contralateral side pain & temperature loss

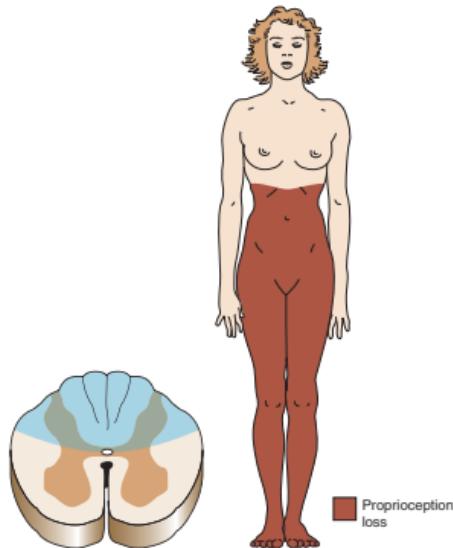


**Cauda equina injury** – similar symptoms to peripheral nerve injury (with specific spinal nerve root involvement)

**Central cord syndrome** – more severe motor involvement than sensory involvement; upper limbs more involved than lower limbs; common in the elderly & individuals with narrow spinal canals

**Conus medullaris syndrome** – may present with both UMN & LMN symptoms, including lower limb paralysis & areflexic bowel & bladder; some patients may retain sacral reflexes

**Posterior cord syndrome** (very rare today) – loss of proprioception & 2-point discrimination below lesion level



**Sacral sparing** – the most centrally-located sacral tract is spared; perianal sensation & external anal sphincter remain intact (often observed in incomplete cervical lesions)

### Medical Red Flags

### Autonomic Dysreflexia

Occurs most often in patients with injuries above T6

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Flushed face</li> <li>Headache</li> <li>Profuse sweating above lesion level</li> <li>Very high blood pressure</li> <li>Bradycardia</li> <li>Skin rash</li> </ul>	<ul style="list-style-type: none"> <li>Impacted bowel</li> <li>Full urinary bladder</li> <li>Blocked urinary catheter</li> <li>Urinary tract infection</li> <li>Noxious stimulus below lesion level (e.g., ingrown toenail)</li> </ul>	<ul style="list-style-type: none"> <li>Identify &amp; remove cause</li> <li>Monitor blood pressure &amp; heart rate</li> <li>Keep patient sitting up</li> <li>Notify physician (may need blood pressure medication)</li> <li>If unresolved in 10 minutes, call for emergency medical help</li> </ul>

## Orthostatic Hypotension (Postural Hypotension)

Occurs most often in patients with tetraplegia

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Sudden blood pressure drop due to position changes (e.g., from supine to sitting)</li> </ul>	<ul style="list-style-type: none"> <li>Poor distal &amp; lower limb venous return</li> <li>Unable to regulate blood pressure</li> </ul>	<ul style="list-style-type: none"> <li>Recline patient &amp; elevate lower limbs</li> <li>Constantly monitor blood pressure during position changes</li> <li>Have patient wear pressure stockings &amp; abdominal binder</li> </ul>

## Deep Vein Thrombosis (DVT)

Occurs most often in lower limbs

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Swelling, heat, erythema in involved area</li> <li>May not feel pain when testing for Homans' sign (calf muscle pain when passively dorsi-flexing ankle with knee extended)</li> </ul>	<ul style="list-style-type: none"> <li>Thrombus formed in deep leg veins due to immobilization</li> <li>Sensory impairment regarding negative Homans' sign</li> </ul>	<ul style="list-style-type: none"> <li>Rest &amp; no lower limb exercises</li> <li>Refer to physician</li> </ul>

## Precautions

### Heterotopic Ossification

Osteogenesis of soft tissue below injury level

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Pain, local swelling/warmth, or sometimes blockage of movements during passive range of motion (ROM) exercises (usually bony end feel)</li> </ul>	<ul style="list-style-type: none"> <li>Spur formation in intra-articular space or soft tissue around joint</li> </ul>	<ul style="list-style-type: none"> <li>Perform gentle ROM exercises</li> <li>Refer to physician</li> </ul>

### Shoulder Pain

Often occurs in patients with tetraplegia

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>Shoulder pain exacerbated by movement</li> </ul>	<ul style="list-style-type: none"> <li>Rotator cuff tear or injury due to overuse</li> <li>ROM loss due to immobilization during acute phase</li> </ul>	<ul style="list-style-type: none"> <li>Assess causes of shoulder pain</li> <li>Provide appropriate exercise and positioning management</li> <li>Refer to physician</li> </ul>

## Urinary Tract Infection

Patients with SCI are more susceptible to urinary tract infection

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Fever</li> <li>• Chills</li> <li>• Nausea</li> <li>• Headache</li> <li>• Increased spasticity</li> <li>• Extraordinary pain or burning during urination</li> <li>• Autonomic dysreflexia</li> <li>• Dark or bloody urine</li> </ul>	<ul style="list-style-type: none"> <li>• Urinary tract infection</li> </ul>	<ul style="list-style-type: none"> <li>• Refer to physician</li> </ul>

## Vertebral Compression Fracture

More common among patients with chronic SCI

Symptoms	Possible Causes	Management
<ul style="list-style-type: none"> <li>• Extreme back pain in upright positions</li> <li>• Pain lessens in supine</li> </ul>	<ul style="list-style-type: none"> <li>• Osteoporosis of spine</li> </ul>	<ul style="list-style-type: none"> <li>• Bed rest</li> <li>• Refer to physician</li> </ul>

## Physical Therapy Examination

### General Considerations

Examiner should

- Inquire if patient is allowed to perform any neck & trunk movements during examination if patient has had fracture stabilization surgery (spinal orthoses & halo devices often restrict neck & trunk movements)
- Assess medically cleared weight-bearing status & ROM limitations (patients with tetraplegia may need finger flexor tightness for tenodesis grasp)
- Monitor initial sitting tolerance (may be limited)
- For patients with traumatic brain injury, carefully assess cortical & cerebellar function (Tab 4)

## History (Refer to Tab 2)

- Assess pre-injury functional status & activity level
- Assess home, work, school, & play environments (wheelchair accessibility) & support system
- Assess injury mechanism
- Assess date of occurrence
- Review medical chart for medical & surgical history

## Vital Signs

### Considerations

- Patients with SCI & autonomic nervous system (ANS) involvement may experience body temperature regulation problems because they are unable to sweat below lesion level

### Assessment

- Measure BP, HR, RR, & body temperature

### Potential findings

- See following sections on Aerobic Capacity/Endurance; Circulation; and Ventilation & Respiration

## Tests and Measures

## Aerobic Capacity/Endurance

### Considerations

- Phrenic nerve (C3–5) innervates diaphragm
- T1–12 innervates intercostal muscles

### Assessment

- Measure BP, RR, & HR (wrist, carotid, pedal) in supine, sitting, standing, at rest, & during post-exercise
- If available, review pulse oximetry, blood gas, tidal volume, & vital capacity
- If possible, conduct upper limb ergometer test

**Potential findings**

- Decreased cardiovascular & pulmonary responses to position changes & exercise (supine < sitting)
- Decreased exercise endurance
- Profuse sweating above lesion level

**Anthropometric Characteristics***Considerations*

- Arm length versus torso length is important for mat & transfer activities (patients with short arms & long torso may need blocks to perform push-ups in long-sitting)

*Assessment*

- Measure height, weight, BMI, & arm versus trunk length

**Arousal, Attention, and Cognition***Considerations*

- Patients with SCI & sustained head injury may have affected mental status, memory, & attention span

*Assessment*

- Perform Mini-Mental State Examination (Tab 2) or Rancho Levels of Cognitive Functioning (for patients with traumatic brain injury) (Tab 4)
- Assess
  - Orientation to time, place, & person
  - Short- & long-term memory
  - Attention
  - Mood
  - Expressive & receptive language

**Potential findings**

- Depression
- Low frustration tolerance

**Assistive and Adaptive Devices***Considerations*

- Patients with SCI may need assistive or adaptive devices for ADLs (e.g., wheelchair, transfer board, hair/tooth brush, feeding utensils with built-up handles)

## Assessment

- Assess assistive & adaptive device fit, alignment, & safety
- Assess ability to use assistive & adaptive devices
- Administer Wheelchair Checklist (see <http://davisplus.fadavis.com>) for fitting
- Assess ability to maintain assistive & adaptive devices (including wheelchair)

## Circulation

### Assessment

- Measure wrist & pedal pulse
- Differentiate proximal versus distal (toe & finger) circulation & edema
- Examine lower limbs for deep vein thrombosis
- Assess blood pressure in supine, sitting, & standing
- Measure body temperature
- Assess pulse, blood pressure, & body temperature in response to exercise

### Potential findings

- Area below lesion level may be colder than area above lesion level
- Movement from supine to sitting & standing may lead to quick blood pressure drop
- Patients with tetraplegia may have lower baseline blood pressure
- Patients with SCI may demonstrate poor sitting endurance (prolonged sitting may lead to blood pressure drop)
- Patients with SCI may demonstrate decreased cardiovascular responses to exercise

## Cranial and Peripheral Nerve Integrity

### Considerations

- Perform comprehensive motor & sensory assessment for patients with SCI to determine the extent of injury & recovery
- Assess sacral area to determine sacral sparing
- Key sensory areas (see the following American Spinal Injury Association [ASIA] sensory form)<sup>1</sup>

**Assessment**

- Grossly check all cranial nerves especially if one suspects traumatic head injury
- Follow myotomes to assess muscle strength (see the following ASIA motor form)<sup>1</sup> listed under **Muscle Performance**
- Follow dermatomes to assess sensation
- Differentiate proprioception & vibration (dorsal column) versus sharp or dull & temperature (lateral spino-thalamic tract) versus light touch (anterior spinothalamic tract)

**ASIA Sensory Form**

<b>Level</b>	<b>Key Sensory Area</b>	<b>Findings (R)</b>	<b>Findings (L)</b>
C2	Occipital protuberance		
C3	Supraclavicular fossa		
C4	Top of acromioclavicular joint		
C5	Lateral side of antecubital fossa		
C6	Thumb		
C7	Middle finger		
C8	Little finger		
T4	Nipple line		
T10	Umbilicus		
T12	Inguinal ligament at midpoint		
L2	Mid anterior thigh		
L3	Medial femoral epicondyle		
L4	Medial malleolus		
L5	Dorsum of foot at 3rd MT joint		
S1	Lateral heel		
S2	Popliteal fossa		
S3	Ischial tuberosity		
S4–5	Perianal area		

Source: American Spinal Injury Association: International Standards for Neurological Classification of Spinal Cord Injury, revised 2002; Chicago, IL, with permission.

## Environmental, Home, and Work Barriers

### Assessment

- Environment, Home, Work Recommendations Chart (Tab 2)
- Driver rehabilitation specialists should evaluate patients with SCI for motor vehicle modifications & driving capabilities (for more information, see Association for Drivers Rehabilitation Specialists Web site at [www.driver-ed.org](http://www.driver-ed.org))

## Ergonomics and Body Mechanics

### Considerations

- Patients with SCI are more susceptible to upper limb overuse injuries, especially shoulders, when manually propelling a wheelchair & performing transfers

### Assessment

- Assess wheelchair propulsion on level & uneven surfaces & ramps, through open & closed doors, during transfers, & in community
- Assess bed level mobility skills (rolling, coming up to sit, long-sitting, & moving from side-to-side in long-sitting)

### Potential findings

- Patients with SCI may have shoulder overuse problems or injuries

## Gait, Locomotion, and Balance

### Considerations

- Evaluate location of center of mass in reference to the body (e.g., center of mass is posterior to the hips in long-sitting with shoulders in extension & external rotation & elbows in extension)

### Assessment

- Assess balance with & without perturbation (long-sitting on mat, short-sitting over mat edge, short-sitting in chair & standing)
- Conduct modified Functional Reach Test to assess balance: patient short-sits over a mat table (hip, knee, & ankle at 90°) & reaches forward; patient can use non-reaching hand for balance & should be guarded carefully during the test<sup>2</sup>
- Examine gait with orthotics & ambulatory assistive devices

- Assess self-propelled & motorized wheelchair mobility (i.e., level surfaces, turns, wheelies, open & closed doors, & up & down ramps & stairs)
- Assess pressure relief skills in wheelchair (push-up & forward & lateral lean)
- If mobility-dependent, check if patient can independently direct care-giver

## Integumentary Integrity

### *Considerations*

- Up to 80% of patients with SCI will experience pressure sores at some point
- Lingering redness or breakdown within 30 minutes of pressure relief indicates pressure sore onset

### *Assessment (Refer to Tab 2 for Classification of Pressure Sores)*

- Pressure relief techniques
- Skin twice daily
- Seating system adequacy to avoid sacral sitting posture
- Need of patient with SCI for long-handled mirror to check back & buttocks

## Joint Integrity and Mobility

### *Assessment*

- Determine passive ROM of upper & lower limb joints

### *Potential findings*

- In a patient with SCI, examiner may notice a click or block in joint when performing passive ROM exercises if patient has heterotopic ossification; hips and knees are the most common sites
- Patients with tetraplegia may demonstrate shoulder impingement syndrome

## Motor Function

### *Assessment*

- Hand function (dexterity, coordination, & agility) in ADLs
- Hand function in donning & doffing orthotic & protective devices
- Hand function for wheelchair mobility & ambulation skills

## Potential findings

- Patients with tetraplegia may use tenodesis in ADLs

## Muscle Performance

### Considerations

- Stabilize joints of patient with SCI while assessing muscle strength to prevent substitution
- Depending on the level of lesion, patients with SCI may substitute
  - Shoulder external rotation for elbow extension
  - Wrist extension with tenodesis grasp for finger flexion
  - Hip flexion for knee flexion

### Assessment

- Follow myotomes to assess muscle strength for bed level activities, wheelchair mobility skills, ADLs, & ambulation
- Determine muscle strength at key motor levels (see the following ASIA motor form)<sup>2</sup>

**ASIA Motor Form**

Level	Key Muscles	Findings (L)	Findings (R)
C5	Elbow flexors		
C6	Wrist extensors		
C7	Elbow extensors		
C8	Finger flexors (distal phalanx of middle finger)		
T1	Little finger abductor		
L2	Hip flexors		
L3	Knee extensors		
L4	Ankle dorsi-flexors		
L5	Long toe extensors		
S1	Ankle plantar-flexors		

American Spinal Injury Association: International Standards for Neurological Classification of Spinal Cord Injury, revised 2002; Chicago, IL, with permission.

## Orthotic, Protective, and Supportive Devices

### *Assessment*

- Assess orthotic, protective, & supportive device & equipment fit & alignment (e.g., ankle or foot orthosis)
- Determine safety during orthotic, protective, & supportive device & equipment use
- Examine ability to maintain orthotic, protective, & supportive device & equipment

## Pain

### *Assessment*

- Administer Universal Pain Assessment Tool & Ransford Pain Drawing (see Tab 2)
- Assess pain according to dermatomes (see Tab 2)

### *Potential findings*

- Pain or paresthesia
- Traumatic pain during acute phase due to bone or soft tissue injury
- Pain due to nerve root compression (dermatome distribution)
- Spinal cord dysesthesias (burning, numbness, pins & needles, or tingling sensation below lesion level)
- Sharp back pain resulting from renal calculi

## Posture

### *Assessment*

- Examine posture alignment & symmetry in long- & short-sitting (in wheelchair) & standing

### *Potential findings*

- Patients with high-level paraplegia or tetraplegia often long-sit with back rounded to keep center of mass within support base

## Range of Motion

### *Assessment*

- Assess passive & active ROM
- With hip at 90°, assess hamstring length in supine & then gradually extend knee

### Potential findings

- Patients with SCI must have sufficient range in
  - Shoulder extension, external rotation, & scapular adduction for weight-bearing in long-sitting
  - Elbow & wrist extension & forearm supination for support in long-sitting
  - Hip flexion (greater than 90°) for sitting
  - Hip extension (at least 10°) for ambulation
  - Ankle dorsiflexion (at least neutral or better than 10°) for standing & ambulation
- Patients with tetraplegia need tenodesis for functional grasping & gripping



- Patients with SCI need sufficient hamstring length (hip 90°, knee at least 110°) for dressing & transfer activities

**Range of Motion Form**

Joint	ROM Needed	Findings (R)	Findings (L)
Shoulder extension	> 50°		
Hip extension	> 10°		
Hip flexion	> 90°		
Knee flexion	> 110°		
Ankle dorsiflexion	> neutral		

## Reflex Integrity

### *Considerations*

- Spinal shock – patients with SCI may demonstrate areflexia (no DTR below involvement level including no response to digital anal stimulation) for a few days or weeks, post-injury
- Examiner must differentiate between flaccidity & spasticity

### *Assessment*

- Muscle tone
- DTRs
- Clonus

### *Potential findings*

- Patients with cervical, thoracic, or lumbar neurological level injury may demonstrate spasticity, clonus, & increased DTR below the level of lesion
- Patients with cauda equina injury may demonstrate flaccidity

## Self-Care and Home Management

### *Assessment*

- Assess bed level mobility (rolling, moving up & down in supine, coming to sit, & moving sideways in long-sitting)
- Assess transfer, including head & trunk & hips relationship, dependency, sliding board, modified stand pivot, stand pivot, forward & sit-to-stand. PT must note transfer surface level, including transfer in & out of driver's seat if patient drives independently
- Assess ADLs & IADLs performance abilities with & without assistive, adaptive, orthotic, protective, & supportive devices & equipment
- Assess self-care & home management safety
- Administer Functional Independence Measure (accessed at: <http://www.tbims.org>)
- Assess bowel & bladder control (Tab 2)

### *Potential findings*

Patients with SCI may:

- Have a reflexive bladder during spinal shock or when the sacral reflex arc (S2-4) is damaged; overflowing bladder leads to urine dripping

- Reflexively empty bladder following recovery from spinal shock or if sacral reflex arc is intact; bladder may empty during strenuous physical activity (e.g., mat exercise or transfer)

## Sensory Integrity

### Considerations

- Assess combined & cortical sensation if the patient has traumatic head injury

### Assessment

- Determine tactile discriminatory, vibration, & joint position sense

### Potential findings

- Patients with posterior cord syndrome may demonstrate joint position sense & tactile discriminatory sensation deficits

## Ventilation and Respiration

### Considerations

- Phrenic nerve (C3–5) innervates diaphragm
- T1–12 innervate intercostal muscles
- T6–12 innervate abdominal muscles

### Assessment (Refer to Tab 2)

- Perform auscultation to check breath sounds of each lobe
- Use spirometer to assess tidal volume, vital capacity in supine, sitting, & standing
- Assess respiratory muscle strength & breathing pattern
- Assess coughing ability
- Review blood gases from chart
- Use pulse oximeter to assess blood oxygen level

### Potential findings

- Low voice volume due to decreased pulmonary capacity
- Decreased tidal volume & vital capacity
- Decreased respiratory muscle strength
- Accessory muscle use to aid breathing
- Decreased coughing ability

## Work, Community, and Leisure

### Assessment

- Assess ability to resume work, school, community, & leisure activities with & without wheelchair, modified car, & orthotics
- Assess ability to gain access to work, school, community, & leisure environments
- Assess work & school, community, & leisure environment safety
- Administer Craig Handicap Assessment Reporting Technique (CHART, accessed at: <http://www.tbims.org/combi/chart/index.html>)
- Consider U.S. Department of Labor-provided guidelines for job accommodations (accessed at: <http://www.dol.gov/dol/topic/disability/ada.htm>) & to assess work reintegration

### Disease-Specific Tests and Measures

#### ASIA Impairment Scale

Classification	Type	Impairment
A	Complete	No motor or sensory function is preserved in the sacral segments S4 to S5
B	Incomplete	Sensory but not motor function is preserved below the neurological level & includes the sacral segments S4 to S5
C	Incomplete	Motor function is preserved below the neurological level & more than half of key muscles below the neurological level have a muscle grade less than 3
D	Incomplete	Motor function is preserved below the neurological level & at least half of key muscles below the neurological level have a muscle grade of 3 or more
E	Normal	Motor & sensory function are normal

Source: American Spinal Injury Association: International Standards for Neurological Classification of Spinal Cord Injury, revised 2002; Chicago, IL, with permission.

To find ASIA forms go to <http://davisplus.fadavis.com>.

### **Zone of Partial Preservation**

If a patient has motor & sensory function below the neurological level but does not have function at S4–S5, the area of intact motor & sensory function below the neurological level is termed a “zone of preservation.”

### **Medications**

<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
Immediate post-injury secondary damage	methylprednisolone	Medrol, Solu-medrol	Very rare with short-term use
Spasticity	baclofen either orally or intrathecal	Lioresal	Drowsiness, weakness, dizziness
	dantrolene sodium	Dantrium	Drowsiness, weakness, dizziness
	tizanidine	Zanaflex	Dizziness, GI problems
	botulinum toxin-A (injected locally)	BTX	Hypotonia, weakness
Deep vein thrombosis	warfarin	Coumadin, Jantoven, Marevan, Waran	Abnormal bleeding, gas, tiredness
	heparin	Heparin	Abnormal bleeding, heavy menstrual bleeding, easy bruising
Flaccid bladder	bethanechol	Urecholine	Upset stomach, dizziness, excessive sweating

**Medications—*Cont'd***

<b>Indications</b>	<b>Generic Name</b>	<b>Brand Name</b>	<b>Common Side Effects</b>
Spastic bladder	propantheline	Pro-Banthine	Dry mouth, dizziness, drowsiness
	oxybutynin	Ditropan, Ditropan XL	Dry mouth, dizziness, constipation
	tolterodine	Detrol	Dry mouth, abdominal pain, constipation
Urinary system infection	antibiotics (ciprofloxacin)	Cipro	Stomach/intestinal irritation
Heterotopic ossification	etidronate disodium	Didronel	Nausea, upset stomach, painful joints

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