

## Home Exercise Program Progression and Components of the LTP Intervention

### HEP Activities at Every Session

Vital signs monitoring	Warm-up
<p>Blood pressure, heart rate, Borg Rate of Perceived Exertion (RPE) and oxygen saturation are measured after the warm up and then initially every five minutes during the intervention to establish exercise tolerance to ensure that they remain within acceptable limits. (Gordon, 2004)</p>	<p>Gentle passive range of motion exercise and stretching, depending on participant specific needs:</p> <ol style="list-style-type: none"> <li>1. Upper extremity (UE) <ul style="list-style-type: none"> <li>• Scapular mobilization</li> <li>• Shoulder abduction</li> <li>• Shoulder flexion</li> <li>• Shoulder internal rotation</li> <li>• Shoulder external rotation</li> <li>• Shoulder shrugging (active, in sitting)</li> <li>• Elbow flexion/extension</li> <li>• Forearm pronation/supination</li> <li>• Wrist flexion/extension</li> <li>• Finger flexion/extension</li> </ul> </li> <li>2. Lower extremity (LE) range of motion, depending on participant specific needs (performed bilaterally, max 5 repetitions) <ul style="list-style-type: none"> <li>• Hamstring stretch (30 second hold, straight leg raise, supine)</li> <li>• Gastrocnemius stretch (30 second hold, in standing)</li> <li>• Soleus stretch (30 second hold) (in standing)</li> </ul> </li> <li>3. Trunk rotation (sitting, 5 repetitions each direction)</li> <li>4. Additional stretching as required</li> </ol>
<b>Walking encouragement</b>	At the end of every session, participants are encouraged to walk.

## HEP Strengthening Progression

LE Strengthening	UE strengthening
<p data-bbox="134 305 302 329"><u>Sessions 1-12</u></p> <ul data-bbox="134 370 919 618" style="list-style-type: none"><li data-bbox="134 370 919 488">• Progression when participant is able to perform the movement without substitutions. If the participant has no volitional movement, the limb is moved passively through the movement, encouraging participant to assist as able.</li><li data-bbox="134 558 919 618">• Exercises completed through AROM only (2 sets of 10 repetitions).</li></ul> <p data-bbox="134 743 317 768"><u>Sessions 13-24</u></p> <ul data-bbox="134 808 919 894" style="list-style-type: none"><li data-bbox="134 808 919 894">• LE strengthening progresses as above, but with additional progression to include increased resistance via Theraband (up to level green)</li></ul> <p data-bbox="134 930 317 954"><u>Sessions 25-36</u></p> <ul data-bbox="134 995 919 1052" style="list-style-type: none"><li data-bbox="134 995 919 1052">• Continue lower extremity exercise programs outlined for sessions 13-24.</li></ul>	<p data-bbox="961 305 1129 329"><u>Sessions 1-12</u></p> <ul data-bbox="961 370 1940 699" style="list-style-type: none"><li data-bbox="961 370 1940 581">• Progression when participant is able to perform the movement without substitutions. If the participant has no volitional movement, the limb is moved passively through the movement, encouraging participant to assist as able. If participant is able to perform movement against gravity without substitution, progress to Theraband®. Once the participant can perform 2 sets of 10 exercises (all repetitions through available range of motion), the resistance of the Theraband® is increased. All exercises conducted within a pain-free range.</li><li data-bbox="961 613 1940 699">• UE movements: shoulder flexion (to 90), shoulder extension, shoulder ER, shoulder abduction, elbow flexion and extension, wrist flexion and extension, mass finger flexion (squeezing tennis ball for resistance) and extension</li></ul> <p data-bbox="961 735 1144 760"><u>Sessions 13-24</u></p> <ul data-bbox="961 800 1583 824" style="list-style-type: none"><li data-bbox="961 800 1583 824">• UE strengthening progressed as in sessions 1-12</li></ul> <p data-bbox="961 922 1144 946"><u>Sessions 25-36</u></p> <ul data-bbox="961 987 1835 1011" style="list-style-type: none"><li data-bbox="961 987 1835 1011">• Continue lower extremity exercise programs outlined in Phase 1 and 2.</li></ul>

**Balance and Coordination Progression**

<b>Coordination</b>	<b>Sitting/Standing Balance</b>	<b>Dynamic Standing Balance</b>	<b>Sit to Stand</b>
<p><u>Sessions 13-24</u></p> <ul style="list-style-type: none"> <li>• Addition of UE/LE coordination.</li> </ul>	<p><u>Sessions 13-36</u></p> <ul style="list-style-type: none"> <li>• If the participant has not yet progressed through the entire range of sitting balance exercises commenced in sessions 1-12, continue throughout sessions 13-36.</li> <li>• If they have, progress to standing balance exercises up to 5 repetitions each.</li> <li>• At each session, begin at one level below highest level participant achieved at previous visit. Complete that level one time, then progress to level at which participant is not able to maintain position for 30 seconds.</li> </ul> <p><u>Session 25-36</u></p> <ul style="list-style-type: none"> <li>• Use 6-inch step for #9- #12.</li> </ul>	<p><u>Sessions 25-36</u></p> <ul style="list-style-type: none"> <li>• At each session, begin at one level below highest level participant achieved at previous visit (able to perform without loss of balance).</li> <li>• Complete that level 5 times, then progress to level at which participant is able to complete safely without loss of balance. Record that level. Repeat up to 10 repetitions. Ball to be used for #1 - #3 is standard lightweight playground ball.</li> </ul>	<p><u>Sessions 25-36</u></p> <ul style="list-style-type: none"> <li>• Sit to stand with equal LE weight distribution.</li> <li>• Complete 3 sets of 5 repetitions before progressing to the next level.</li> </ul>

**Session 1-12 Home Exercise Program Progression**

Sitting balance	LE strengthening	UE strengthening
<p>1) Sitting with equal weight bearing, 30s, 5 reps                  2) Sitting with upright posture, shift weight laterally to nonparetic hip, lift paretic leg from chair by flexing paretic hip. Hold 5 seconds. Then shift weight laterally to paretic hip, lift nonparetic leg from chair by flexing nonparetic hip. Hold 5 seconds. Can alternate up to 10X</p> <p>Reaching with paretic and nonparetic UE:                  Place object just beyond arm's length, reach for object (can pick up or touch, depending on ability, return to upright posture)                  Repeat up to 5X each direction</p> <p>3) Ipsilateral anterior diagonal reaching/nonparetic UE                  4) Ipsilateral posterior diagonal reaching/nonparetic UE                  5) Contralateral anterior diagonal reaching/paretic UE                  6) Contralateral posterior diagonal reaching/paretic UE                  7) Contralateral anterior diagonal reaching/nonparetic UE                  8) Contralateral posterior diagonal reaching/nonparetic UE                  9) Ipsilateral anterior diagonal reaching/paretic UE                  10) Ipsilateral posterior diagonal reaching/paretic UE</p>	<p>Hip abductors</p> <ul style="list-style-type: none"> <li>Progress from supine, to standing to sidelying for AROM.</li> </ul> <p>Hip flexors</p> <ul style="list-style-type: none"> <li>Progress from supine knee to chest to standing hip flexion to supine straight leg raise (SLR).</li> </ul> <p>Hip extensors</p> <ul style="list-style-type: none"> <li>Progress bilateral bridge to unilateral bridge.</li> </ul> <p>Knee Flexors</p> <ul style="list-style-type: none"> <li>Progress supine heel slide to supine knee over bolster to sitting knee extension Supine heel slide, active.</li> </ul> <p>Ankle DF and PF done in sitting.</p>	<p>Progression:</p> <ol style="list-style-type: none"> <li>Gravity eliminated, active assistive</li> <li>Gravity eliminated, active</li> <li>Against gravity, no Theraband</li> <li>Theraband, yellow</li> <li>Theraband, red</li> <li>Theraband, green</li> <li>Theraband, blue</li> <li>Theraband, black</li> <li>Theraband, silver</li> </ol>

**Session 13-24 Home Exercise Program Progression**

Sitting/ Standing balance	UE/ LE strengthening	Coordination
<p>Standing balance progression</p> <ol style="list-style-type: none"> <li>1) Shoulder-width stance for 30 seconds, weight evenly distributed with eyes open</li> <li>2) Shoulder-width stance for 30 seconds, weight evenly distributed with eyes closed</li> <li>3) Feet together for 30 seconds, weight evenly distributed with eyes open</li> <li>4) Feet together for 30 seconds, weight evenly distributed with eyes closed</li> </ol>	<p>Hip abductors: Progress to standing with Theraband</p> <p>Hip flexors: Progress to supine SLR with Theraband.</p> <p>Hip extensors: Progress to standing hip extension with Theraband</p> <p>Knee flexors: Progress to sitting with Theraband</p> <p>Ankle DF: Progress to sitting with Theraband</p> <p>Ankle PF Progression (repeated for max 10 reps):</p> <ol style="list-style-type: none"> <li>1) Standing: Hold on with both UE's, raise up on toes of both feet, hold position for 3 seconds</li> <li>2) Standing: Hold on with one UE, raise up on toes of both feet, hold position for 3 seconds</li> <li>3) Standing: Without holding on, raise up on toes of both feet, hold position for 3 seconds</li> </ol>	<p>Lower extremity:</p> <ul style="list-style-type: none"> <li>• Supine, ask the participant to slide the affected heel on the shin of the opposite leg, from ankle to knee and return. Continue as fast as possible for 20 seconds.</li> <li>• Progression: number of repetitions completed in 20 seconds</li> </ul> <p>Upper extremity:</p> <ul style="list-style-type: none"> <li>• Sitting, ask the participant to reach with their affected arm to touch the therapist's finger held out in front of them and then touch their nose. Repeat as fast as possible for 20 seconds.</li> <li>• Progression: number of repetitions completed in 20 seconds</li> </ul>

**Session 25-36 Home Exercise Program Progression**

Static Standing balance	Dynamic Standing Balance	UE/ LE Strengthening	Sit to Stand
<p>Progression:</p> <ol style="list-style-type: none"> <li>1) Shoulder-width stance for 30s, weight evenly distributed with eyes open</li> <li>2) Shoulder-width stance for 30s, weight evenly distributed with eyes closed</li> <li>3) Feet together for 30 s, weight evenly distributed with eyes open</li> <li>4) Staggered stance for 30 s, paretic leg in front, weight evenly distributed with eyes open</li> <li>5) Staggered stance for 30 s, paretic leg in front, weight evenly distributed with eyes closed</li> <li>6) Feet together for 30 s, weight evenly distributed with eyes close</li> <li>7) Staggered stance for 30 s, paretic leg behind, weight evenly distributed with eyes open</li> <li>8) Staggered stance for 30 s, paretic leg behind, weight evenly distributed with eyes closed</li> <li>9) Staggered stance for 30 s, paretic leg in front on step, weight evenly distributed with eyes open</li> <li>10) Staggered stance for 30 s, paretic leg in front on step, weight evenly distributed with eyes closed</li> <li>11) Staggered stance for 30 s, nonparetic leg in front on step, weight evenly distributed with eyes open</li> <li>12) Staggered stance for 30 s, nonparetic leg in front on step, weight evenly distributed with eyes closed</li> </ol>	<p>Progression:</p> <ol style="list-style-type: none"> <li>1) Catching ball straight on</li> <li>2) Catching ball thrown towards nonparetic side</li> <li>3) Catching ball thrown towards paretic side.</li> <li>4) Turning towards paretic side.</li> <li>5) Turning towards nonparetic side</li> </ol>	<p>Ankle plantarflexion progressed with the addition of these more difficult exercises:</p> <ol style="list-style-type: none"> <li>1) Standing: Hold on with both upper extremities, raise up on toes of involved LE (single toe raise), hold position for 3 seconds</li> <li>2) Standing: Hold on with one UE, raise up on toes of involved LE (single toe raise), hold position for 3 seconds.</li> <li>3) Standing: Without holding on, raise up on toes of involved LE (single toe raise), hold position for 3 seconds</li> </ol>	<ol style="list-style-type: none"> <li>1) Move to edge of chair, lean forward, push up with arms, stand up.</li> <li>2) Move to edge of chair, lean forward, put arms out, stand up.</li> <li>3) Move to edge of chair, lean forward, fold arms across chest, stand up.</li> <li>4) Sit back in chair, push with arms, stand up.</li> <li>5) Sit back in chair, put arms out, stand up.</li> <li>6) Sit back in chair, fold arms across chest, stand up.</li> </ol>

## Components of the LTP Intervention

### LTP Activities at Every Session

#### **Vital signs monitoring**

Blood pressure, heart rate, Borg Rate of Perceived Exertion (RPE) and oxygen saturation are measured after the warm up and then initially every five minutes during the intervention to establish exercise tolerance to ensure that they remain within acceptable limits. (Gordon, 2004)

#### **Warm-up**

Stretching, depending on participant specific needs, weight bearing LE stretches emphasized

1. Lower extremity (LE) range of motion, depending on participant specific needs (performed bilaterally, as needed)
  - Hip flexor stretch
  - Quadriceps stretch
  - Hamstring stretch
  - Gastrocnemius stretch
  - Soleus stretch
  - Hip rotation
2. Trunk/ postural stretching as needed
3. Additional stretching of UE done if pain and/or ROM limited walking

#### **Home Activity**

Incorporate locomotor training principles or new skill to work on in home environment safely.

#### **Initiating stepping:**

- Practice step initiation from stride stance position with paretic leg in pre-swing position.
- Assist only when necessary.
- Steps
  1. Maintain upright posture and stabilize pelvis throughout.
  2. Shift weight to non-paretic leg.
  3. Flex hip and knee of paretic leg slightly to lift.
  4. Move leg backward by extending hip and knee.
  5. Place foot on ground and shift weight onto back leg.

#### **Initiating weight shift:**

- In stride position: rapidly shift weight forward onto front (paretic) leg and unload back leg
- Assist only when necessary.
- Steps
  1. Maintain upright posture and stabilize pelvis throughout.
  2. Rapidly shift weight forward to front leg and flex hip of back leg (unload).
  3. Flex hip and knee of swing leg as it moves forward.
  4. Swing arms in reciprocal coordination with legs.

**Session 1-12 Locomotor Training Program (LTP) Progression**

**Sessions 1-12 Priority:** Retraining capacity to step (and co-requisite balance)

**Goal and 1<sup>st</sup> priority:** Achieve 20 min intensity of step training on the treadmill. If participant is able to achieve 20 minutes with good kinematics, then increase speed to 2.0 mph. Once step for 20 minutes at 2.0 mph with good kinematics, then decrease BWS.

<b>Progress Areas</b>	<b>Step Training Component</b>	<b>Overground/ Community Training</b>
Weight bearing	Provide body weight support at a level to achieve good stepping. Decrease BWS by 5%, then 5%, to 0% (if good kinematics).	Bear even weight much as possible outside of training sessions. When standing from a seated position, emphasize use of the legs versus the arms. Weight bear on legs during all activities.
Speed	Achieve stepping at normal, pre stroke walking speeds with less manual assist as needed, aim minimal 0.8 m/s (2.0 mph)	Walk at speeds approximating training speed if kinematics remain good. If breakdown, decrease speed. Use balance from trainers or poles to advance speed.
Kinematics	Achieve a good stepping pattern focusing on loading and unloading, symmetrical stride length and coordination between the legs.	Establish and maintain proper upright posture during step initiation. Have assistance at home for proper weight shift and kinematics. Emphasize ankle/hip ROM and loading during stance, as well as foot position.
Endurance	Achieve 20 minutes total stepping of 4-5 min bouts with rests as necessary.	Stand at home for everyday living tasks; washing face, brushing teeth, washing hands. Transfer locomotor skills to walking in the home.
Independence	Establish and maintain proper upright posture and execute effective weight shift (this has a direct influence on success or failure in step training). Independence in non-paretic leg.	When standing, focus on an extended head, retracted shoulders, and aligned head, shoulders, trunk, hips and legs. When walking, allow uninvolved limb to adjust to new pattern of walking.
Adaptability	Respond to start and stopping of the treadmill and adjusting the training speed with the assist of the trainers.	Transfer skills from the treadmill to over ground for initiating stepping and taking several steps.



**Session 13-24 LTP Progression**

**Session 13-24 Priority:** Retraining capacity to step (and co-requisite balance) and Progress Independence Training.

**Session 13-24 Goals and Priorities:** Achieve 20 min intensity of step training on the TM at 2.0 mph, continue to decrease BWS Progress Independence (add 1-3 min bouts of independent step training).

<b>Progress Areas</b>	<b>Step Training Component</b>	<b>Over ground/ Community Training</b>
Weight bearing	Bear increasing level of body weight load and re-establish good stepping at each level.	Stand evenly. Begin gait initiation and stepping with greater symmetry and speed. Minimize weight bearing on arms.
Speed	Achieve stepping at normal, pre stroke walking speeds with less manual assistance.	Walk at normal, pre-injury speeds in the community using the least restrictive assistive device to promote speed of walking.
Kinematics	Achieve a good stepping pattern focusing on proper extension and flexion during stance and swing. Focus on specific gait deviations.	Begin or advance to ambulation at home and in the community using the least restrictive device/brace that promotes proper kinematics.
Endurance	Increase duration of bouts and decrease rests for minimum of 20 minutes. Achieve 30 mins of stepping with assistance.	Increase walking time and add adaptability training as independence improves. Increase standing and walking duration or time at home and in the community with proper kinematics and independence.
Independence	<ol style="list-style-type: none"> <li>1) Remove any assist with non-paretic LE</li> <li>2) Remove trunk/pelvic assist Short bout length (1-3 mins) Slow (decrease) speed Increase BWS, if needed Then, increase endurance (bout length)</li> <li>3) Establish and maintain proper upright posture and leg extension in response to increasing body weight load. Achieve full weight bearing while maintaining “good stepping” (e.g., upright posture, hip movement and proper kinematics)  And weight shift without bungees.</li> <li>4) Repeat for paretic LE</li> </ol>	When standing and stepping, focus on upright, midline posture, balance, and even weight distribution. Achieve normal walking speeds with least restrictive assistive device. Increase walking time and add adaptability training as independence improves.
Adaptability	Respond to starts and stops and adjusting treadmill speed with more independence.	Self-initiate stops, starts, turns, and uneven surface negotiation. Introduce obstacle negotiation.

**Session 25-36 Locomotor Training Program (LTP) Progression**

**Session 25-36 Priority:** Retraining capacity to step (and co-requisite balance), Progress Independence, AND add Adaptability Training.

**Session 25-36 Goals and Priorities:** Achieve 30 minutes of treadmill-based training: maintain 10-15 minutes training independently. (3 independent 5-min bouts: decrease BWS, increase speed) add Adaptability training.

<b>Progress Areas</b>	<b>Step Training Component</b>	<b>Over-ground/ Community Training</b>
Weight bearing	Bear full body weight load and maintain a good stepping pattern.	Stand and walk while bearing full, even body weight; eliminate weight bearing on arms.
Speed	Maintain independent stepping when challenged with different speeds.	Walk at normal, pre-injury speeds in the community. Achieve improved gait speed with independence and least restrictive device and brace.
Kinematics	Achieve an independent, good stepping pattern with full weight bearing at normal speeds. Correct deviations in stepping pattern without assistance.	Walk at home and in the community with proper hip extension/rotation and leg movements.
Endurance	Increase duration of stepping bouts, with decreased assistance and BWS. Achieve 30 mins stepping.	Increase frequency and duration of standing and walking at home and in the community.
Independence	Establish and maintain proper upright posture, leg extension and balance with more challenges such as standing on one leg or carrying objects. Achieve independent leg movement with increasing frequency and duration of stepping.	Achieve independent hip and leg movements, balance, and stepping coordination at home and in the community at speeds approximating normal. Add independence in negotiation of the environment and planning for changes in terrain.
Adaptability	<ol style="list-style-type: none"> <li>1) While walking, vary speed by changing 20% increments above and below self-selected speed, then increase range.</li> <li>2) Stop and start abruptly (pause and begin at SS, then faster and slower speeds)</li> <li>3) Remove or cover mirror.</li> <li>4) Walk and talk, turn head.</li> <li>5) Inclines</li> <li>6) Step over 2" foam obstacle, 4" foam obstacle. Respond to start, stops, speed variability</li> </ol>	Achieve adaptability to self-initiate changes in gait speed, turns, obstacle negotiation, curbs/stairs, step lengths, and to adjust to changes in the environment.