

Appendix: Balance Training Protocol

Single-Limb Hops to Stabilization (10 Repetitions per Direction)

Subject performed 10 hops in each direction. Each repetition consisted of a hop from the starting position to the target position (18, 27, or 36 inches). After stabilizing balance in a single-limb stance, participants hopped in the exact opposite direction back to the starting position and stabilized in the single-limb stance.

Four directions of hops (Fig. 1): 1) anterior/posterior, 2) medial/lateral, 3) anterolateral/posteromedial, and 4) anteromedial/posterolateral. Participants were not able to move to the next level in each category until they demonstrated 10 repetitions error-free. Errors were determined on the basis of the following:

- a. Touching down with opposite limb
- b. Excessive trunk motion ($>30^\circ$ lateral flexion)
- c. Removal of hands from hips during hands on hips activities

- d. Bracing the nonstance limb against the stance limb
- e. Missing the target

Hop to Stabilization and Reach (Five Repetitions)

Combined with the mentioned exercises, however, after stabilization in the single-limb stance, participants had to reach back to the starting position. Repetitions were counted in the same manner mentioned previously. Participants hopped, stabilized, and reached back to the starting position. Then they hopped back to the starting position and reached to the target position.

Participants were not able to advance to the next level in each direction until they demonstrated five repetitions error-free. Errors were determined on the basis of the following:

- a. All errors associated with hop to stabilization
- b. Using the reaching leg for a substantial amount of support during reaching component

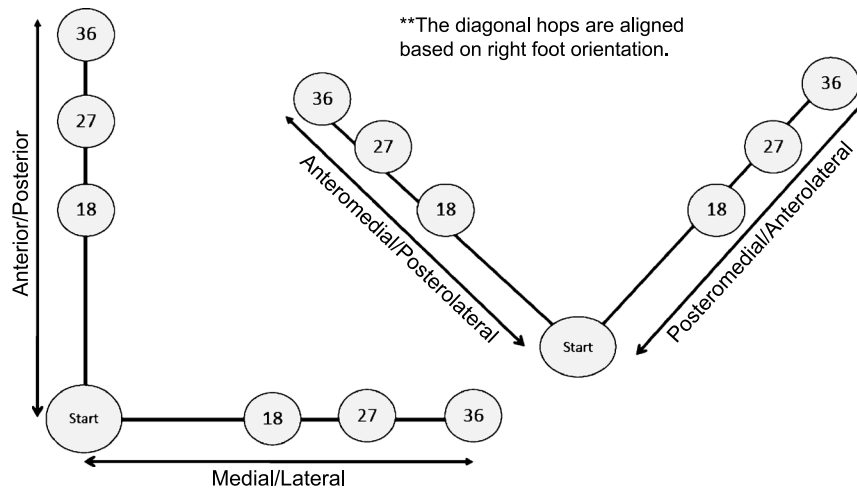


FIGURE 1—Directions and distances (in inches) for hop to stabilization activities.

All directions for Hop to Stabilization and Hop to Stabilization and Reach had seven levels of difficulty to progress:

1. 18-inch hop. Allowed to use arms to aid in stabilizing balance after landing.
2. 18-inch hop with hands on hips while stabilizing balance after landing.
3. 27-inch hop. Allowed to use arms to aid in stabilizing balance after landing.
4. 27-inch hop with hands on hips while stabilizing balance after landing.
5. 36-inch hop. Allowed to use arms to aid in stabilizing balance after landing.
6. 36-inch hop with hands on hips while stabilizing balance after landing.
7. 36-inch hop from a 6-inch platform.

Unanticipated Hop to Stabilization

Participants stood in the middle of a nine-marker grid (see Figure 2). A sequence of numbers was displayed on a computer screen in front of the participants. Each number corresponded to a target position to which they would hop. As the progression of numbers changed, participants would hop to the new target position. The hop to stabilization rules were applied for this activity; however, in this case, participants were allowed to use any combination of hops (AP, ML, AM/PL, or AL/PM) they desired to accomplish the goal of getting through the sequence error-free. As a participant developed proficiency, the amount of time per move was reduced. In each session, participants performed three sequences of numbers.

Levels of unanticipated hop to stabilization

- Level 1: 5 s per move.
- Level 2: 3 s per move.
- Level 3: 1 s per move.
- Level 4: If subject can progress to completion of all moves within 1 s without error, a foam pad will be placed

on one of the numbers during the sequence. The subject will then continue the progression at the same level of intensity. If he or she cannot complete the course error-free, the time constraint will be reduced to the level below.

Level 5: If subject can progress to completion of all moves at Level 3 with the foam pad error-free, a step will be added to an additional number.

Level 6: If a subject progresses error-free, an additional foam pad will be added to one of the numbers, resulting in two foam pads and one step.

Level 7: If a subject progresses error-free, an additional step will be included, resulting in two foam pads and two steps.

Errors were determined on the basis of the following:

- a. Touching down with opposite limb
- b. Excessive trunk motion ($>30^\circ$ lateral flexion)
- c. Removal of hands from hips during hands on hips activities
- d. Bracing the nonstance limb against the stance limb
- e. Missing the target

Each sequence of numbers was random such as 9, 7, 1, 6, 4, 5, 3, 8, 2.

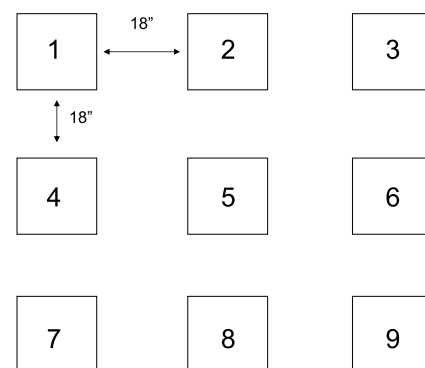


FIGURE 2—Nine marker grid for unanticipated hop to stabilization.

Single-Limb Stance Activities

Participants performed three repetitions of single-limb stance activities. Each activity (eyes open and eyes closed) had seven levels of difficulty.

Single-limb stance eyes open

1. Arms across chest on hard floor for 60 s
2. Arms across chest for 30 s on foam pad
3. Arms across chest for 60 s on foam pad
4. Arms across chest for 90 s on foam pad

Ball toss on foam

5. 30 s with arms across chest; 20 throws with a 6-lb medicine ball
6. 60 s with arms across chest; 20 throws with a 6-lb medicine ball
7. 90 s with arms across chest; 20 throws with a 6-lb medicine ball

Single-limb stance eyes closed

1. Arms out on hard floor for 30 s
2. Arms across chest on hard floor for 30 s
3. Arms across chest on hard floor for 60 s
4. Arms out on foam pad for 30 s
5. Arms across chest for 30 s on foam pad
6. Arms across chest for 60 s on foam pad
7. Arms across chest for 90 s on foam pad

Participants were not able to advance to the next level in each category until they demonstrated three repetitions

error-free. Errors were determined on the basis of the following:

- a. Subjects touching down with opposite limb
- b. Excessive trunk motion ($>30^\circ$ lateral flexion)
- c. Removal of arms from across chest during specified activities
- d. Bracing the nonstance limb against the stance limb

Example of a Typical Session

1. Hop to stabilization
 - Anterior/posterior—Level 2, 10 repetitions
 - Medial/lateral—Level 1, 10 repetitions
 - Anterolateral/posteromedial—Level 2, 10 repetitions
 - Anteromedial/posterolateral—Level 2, 10 repetitions
2. Unanticipated hop to stabilization—Level 1, Sequence 1
3. Hop to stabilization and reach
 - Anterior/posterior—Level 2, 5 repetitions
 - Medial/lateral—Level 1, 5 repetitions
 - Anterolateral/posteromedial—Level 2, 5 repetitions
 - Anteromedial/posterolateral—Level 2, 5 repetitions
4. Unanticipated hop to stabilization—Level 1, Sequence 2
5. Single-limb stance eyes open—Level 4, 3 repetitions
6. Single-limb stance eyes closed—Level 2, 3 repetitions