

APPENDIX

Proposed guide for the rehabilitation of acute hamstring strain injuries. Suggested exercises, including sets and repetitions, should be individualized to the patient. Progression through the 3-phase program is estimated to require approximately 2 to 6 weeks but should be progressed on a patient-specific basis using criteria as indicated.

Phase 1

Goals

1. Protect scar development
2. Minimize atrophy

Protection

Avoid excessive active or passive lengthening of the hamstrings

Ice

2-3 times/d

Therapeutic exercise (performed daily)

1. Stationary bike \times 10 min
2. Side-step \times 10 m, 3×1 min, low to moderate intensity, pain-free speed and stride
3. Grapevine \times 10 m, 3×1 min, low to moderate intensity, pain-free speed and stride (**ONLINE VIDEO**)
4. Fast feet stepping in place, 2×1 min
5. Prone body bridge, 5×10 s
6. Side body bridge, 5×10 s
7. Supine bent knee bridge, 10×5 s
8. Single-limb balance progressing from eyes open to closed, 4×20 s

Criteria for progression to next phase

1. Normal walking stride without pain
2. Very low-speed jog without pain
3. Pain-free isometric contraction against submaximal (50%-70%) resistance during prone knee flexion (90°) manual strength test

Phase 2

Goals

1. Regain pain-free hamstring strength, beginning in mid-range and progressing to a longer hamstring length
2. Develop neuromuscular control of trunk and pelvis with progressive increase in movement speed

Protection

Avoid end-range lengthening of hamstrings while hamstring weakness is present

Ice

Postexercise, 10-15 min

Therapeutic exercise (performed 5-7 d/wk)

1. Stationary bike \times 10 min
2. Side-shuffle \times 10 m, 3×1 min, moderate to high intensity, pain-free speed and stride
3. Grapevine jog \times 10 m, 3×1 min, moderate to high intensity, pain-free speed and stride
4. Boxer shuffle \times 10 m, 2×1 min, low to moderate intensity, pain-free speed and stride (**ONLINE VIDEO**)
5. Rotating body bridge, 5-s hold each side, 2×10 reps (**ONLINE VIDEO**)
6. Supine bent knee bridge with walk-outs, 3×10 reps (**FIGURE 3**)
7. Single-limb balance windmill touches without weight, 4×8 reps per arm each limb (**ONLINE VIDEO**)
8. Lunge walk with trunk rotation, opposite hand-toe touch and T-lift, 2×10 steps per limb (**ONLINE VIDEO**)
9. Single-limb balance with forward trunk lean and opposite hip extension, 5×10 s per limb (**ONLINE VIDEO**)

Criteria for progression to next phase

1. Full strength (5/5) without pain during prone knee flexion (90°) manual strength test
2. Pain-free forward and backward jog, moderate intensity

Phase 3

Goals

1. Symptom-free (eg, pain and tightness) during all activities
2. Normal concentric and eccentric hamstring strength through full range of motion and speeds
3. Improve neuromuscular control of trunk and pelvis
4. Integrate postural control into sport-specific movements

Protection

Avoid full intensity if pain/tightness/stiffness is present

Ice

Postexercise, 10-15 min, as needed

Therapeutic exercise (performed 4-5 d/wk)

1. Stationary bike \times 10 min
2. Side-shuffle \times 30 m, 3×1 min, moderate to high intensity, pain-free speed and stride
3. Grapevine jog \times 30 m, 3×1 min, moderate to high intensity, pain-free speed and stride
4. Boxer shuffle \times 10 m, 2×1 min, moderate to high intensity, pain-free speed and stride
5. A and B skips, starting at low knee height and progressively increasing, pain-free
 - a. A skip is a hop-step forward movement that alternates from leg to leg and couples with arm opposition (similar to running). During the hop, the opposite knee is lifted in a flexed position and then the knee and hip extend together to make the next step (**ONLINE VIDEO**)
 - b. B skip is a progression of the A skip; however, the opposite knee extends prior to the hip extending recreating the terminal swing phase of running. The leg is then pulled backward in a pawing type action. The other components remain the same as the A skip (**ONLINE VIDEO**)
6. Forward-backward accelerations, 3×1 min; start at 5 m, progress to 10 m, then 20 m (**ONLINE VIDEO**)
7. Rotating body bridge with dumbbells, 5-s hold each side, 2×10 reps
8. Supine single-limb chair-bridge, 3×15 reps, slow to fast speed (**FIGURE 4**)
9. Single-limb balance windmill touches with dumbbells, 4×8 reps per arm each leg (**FIGURE 5**)
10. Lunge walk with trunk rotation, opposite hand dumbbell toe touch and T-lift, 2×10 steps per limb
11. Sport-specific drills that incorporate postural control and progressive speed

Criteria for return to sport

1. Full strength without pain
 - a. 4 consecutive repetitions of maximum effort manual strength test in each prone knee flexion position (90° and 15°)
 - b. Less than 5% bilateral deficit in eccentric hamstrings ($30^\circ/s$): concentric quadriceps ($240^\circ/s$) ratio during isokinetic testing
 - c. Bilateral symmetry in knee flexion angle of peak isokinetic concentric knee flexion torque at $60^\circ/s$
2. Full range of motion without pain
3. Replication of sport specific movements near maximal speed without pain (eg, incremental sprint test for running athletes)