

REHABILITATION AND EXERCISE PROGRESSION AFTER GRADE II HAMSTRING STRAIN

Notes:

- Muscle most commonly affected is long head of the biceps femoris, usually just proximal to the musculotendinous junction 6-16 cm proximal to the knee joint.
- Immobilisation if required should be in the lengthened position and should not last longer than one week.
- The use of NSAIDS is controversial in the first few days because of the potential for impeding healing; evidence suggests that NSAIDs have no additive effect on the healing rate.

Acute Phase (3 to 4 times a day)

- Rest (immobilisation in a lengthened position for no longer than one week, then relative rest):
 - No antalgia with gait: if antalgic, supplement with assistive device.
 - Gentle stretching (pain less than 3/10).
- Ice in lengthened position (in long sitting with as much active pain free knee flexion and extension as possible).
- Compression and elevation until thigh girth stabilises.
- NSAIDS no sooner than 2 to 4 days after injury.
- Retrograde massage may be implemented for swelling control. DTM may begin when girth is stabilised.
- Modalities-sensory Estim can be used.

Criteria for progression: No increase in thigh girth measured 8cm proximal to the patella; SLR to 80° with an estimation of 3 or less on a numeric rating scale.

Test: The foot is plantar flexed and the examiner slowly (about 30°/s) raises the leg.

Sub-acute Phase: day 3 to >3 weeks

- Stretching (3 to 4 times per day):
 - Progressively increase stretch to full ROM (stretched across hip and knee) exercises.

- Self stretching:
 - Begin with standing technique with anterior pelvic tilt.
 - Progress to aggressive self-stretching and partner stretches.
- Strengthening progression (daily):
 - Isometric knee flexion:
 - Begin with sub-maximal isometric holds at multiple joint angles (0°, 30°, 60°, 90°) and progress to maximal holds.



- Stool scoots:
 - Athlete sits on wheeled stool and plants heel into floor and uses hamstring to propel forward. Progress with distance and to single leg.



- Start with Seated concentric isokinetic exercises (CON / ECC 50° to 75°/s or isotonic).
- Move towards higher and lower speeds with more force.



- Seated hamstring curls:
 - Begin at 30% of 1RM (repetition maximum) of contralateral hamstring 3 to 4 sets of 10 repetitions – progress to 60%.
- Deep Tissue Massage (daily):
 - Depth and forcefulness may be increased as the need arises to reach the target tissue that may be deeper.
- Cardiovascular fitness (up to 2 sessions per day):
 - UBE.
 - Stationary biking.
 - Other controlled activities.
- Modalities.



Remodelling Phase: 1 to 6 weeks

- Stretching progression (3 to 4 times per day):
 - Maintain or increase muscle length using aggressive frequent stretching (passive, self and partner stretches) encourage exercise through the full ROM.
- Strengthening progression (daily to every other)

Criteria for progression within this phase: Complete the activity with estimation of 3 or less on a numeric rating scale. Complete concentric seated strengthening progression and achieve full ROM with estimation of 3 or less on a numeric rating scale.



- Begin more aggressive concentric strengthening:
 - Seated hamstring curls:
 - 60% to 80% of 1RM (repetition maximum) of contralateral leg.
 - Begin with strength volume (high weight, low reps) and move to power volume (faster speeds).
 - Standing hamstring curls:
 - Can be performed with machine or ankle weights.
 - Begin with strength volume (high weight, low reps) and move to power volume (faster speeds).
- Prone hamstring exercises (introduces eccentric component):
 - Start with prone curls with ankle weights at 30% of 1RM (repetition maximum) of contralateral hamstring 3 to 4 sets of 10 repetitions.
 - Progress to strength and power volumes.
 - Progress to eccentric contraction via ankle weights with concentric assistance or manual resistance.



- Manual prone eccentric / concentric hamstring curls.
 - Athlete lays prone while manual resistance is applied distally. He / she contracts the hamstrings concentrically against resistance and continues to contract as resistance increases to bring the foot down eccentrically.
 - This allows for the athlete to be strengthened in pain free range and more focus can be paid to weakness in certain ranges, especially closer to full extension.



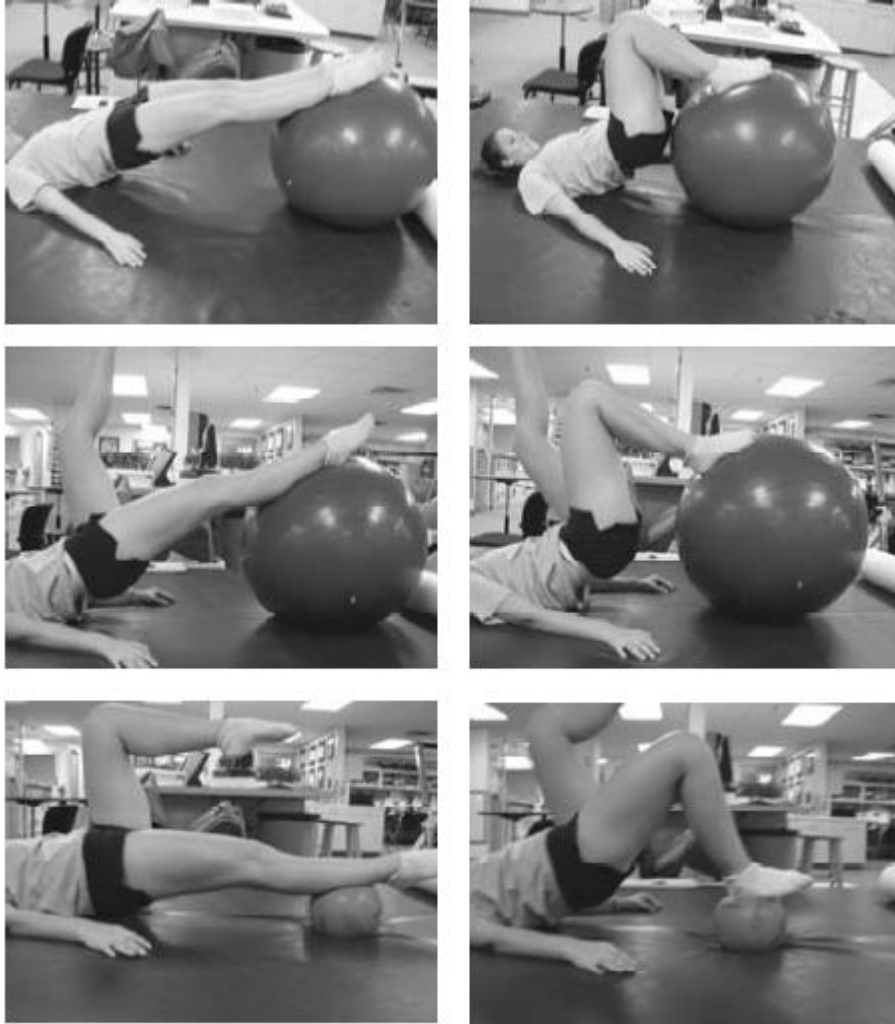
- Prone leg dropping:
 - Athlete lies prone with knee flexed and foot in air. Gently move foot back and forth to stimulate relaxation. Drop the foot suddenly and have athlete catch the foot as soon as they feel it released. Progress to 1kg and / or push leg instead of drop to increase loading.
 - This helps the athlete regain their proprioceptive sense that may have been lost secondary to weakness and immobilisation from injury. With a heightened proprioceptive sense the athlete may be able to better detect the position of the hamstring, which may decrease their risk of re-injury.



- Progress to seated eccentric hamstring curl:
 - Load weights at 120% of 1RM (repetition maximum) of single leg hamstring curl. Use two legs for concentric motion. Release one leg and allow single leg to release weight in a controlled fashion. Progress weights appropriately.
 - Progress to prone position.



- Progress to prone isokinetics (CON/ECC beginning at high speeds (240/240) and gradually decreasing the speed (193, 145, and 96), through pain free range.
 - Progress to strength and power volumes.
- Hamstring ball rolls:
 - The athlete lays supine with a ball under his / her leg(s).
 - Roll the ball towards the body by flexing the leg while maintaining trunk and hip stabilisation.
 - This exercise can be progressed from:
 - 0.6m using theraball.
 - 0.3m foot using theraball.
 - 0.3m using medball, other foot in air.



- Nordic hamstrings:
 - Athletes are kneeling with feet fixed. Instruct athlete to fall forward and use hamstring to control descent for as long as possible then catch themselves on the table with their hands. Athlete forcefully pushes with hands to return to starting position to decrease concentric load to the hamstrings. With two people begin with maximum assistance using a belt around the athlete's waist to assist them when they lean forward. With one person place theraball in front of patient to allow patient to push up and decrease the eccentric load.
 - Progress by decreasing assistance, and increasing range until fall.
 - Once patient can withstand whole range of motion, increase load by adding speed to the starting phase. The partner can also push on the patient's shoulder to increase difficulty. For variation person can hold down legs with different forces to load one side more than another.



Plyometric progression

In this case, plyometric exercise is used to strengthen the hamstrings while regaining the neuromuscular properties needed to effectively perform sport specific activities.

Plyometric exercise is based on the principle of utilising the muscle's stretch reflex with stores energy through its eccentric phase of contraction. If utilised quickly, the energy stored can produce more force output during the concentric event. This brief moment between the two phases is the amortisation phase. When performing plyometric exercise it is essential to perform a rapid eccentric phase to decrease the amortisation time. They should be progressed systematically for proper overload; typically low intensity with high volume up to high intensity with low volume. It is also important to warm up properly in a plyometric fashion, which can be incorporated in the dynamic warm up. An appropriate plyometric warm up for these particular exercises include:

- ❖ Marching;
- ❖ Jogging;
- ❖ Toe jogging to warm up a quick reaction time;
- ❖ Straight leg jogging to prepare for impact exercises;
- ❖ Butt kicks for stretching; and
- ❖ Exaggerated skipping.

These motions should also be progressed from 50% effort up to 100% effort to decrease the risk of re-injury.

This list is in order from easiest to hardest and should be progressed from one to another when completed with 100% effort while abiding by previously stated criteria for progression.

1. Cycle split jump

- a. Athlete stands in half lunge.
- b. Perform jump, switching feet in the air with emphasis on pulling backwards landing with feet opposite the starting position.
- c. Land and repeat jump with effort emphasised on decreasing the ground-contact time.



2. Running butt kicks

- a. Begin running by flexing your knee and bringing your heel back and around to your buttocks. Maintain a slight forward lean throughout the drill, and stay on the balls of your feet. Complete 20 kicks within 9 metres.
- b. Maintain a quick, yet shallow arm swing, keep your elbows at 90° and drive your hands from chest to front hip pocket.



3. Running high knees

- a. Execute proper running form; keep your elbows at 90° and drive your hands up to chin level and back to your rear pocket. Stay on the balls of your feet, and drive your knees up as high as possible, and then down as quickly as possible.

4. Pogo jumps with knees to butt

- a. Athlete stands erect, feet comfortably hips width apart.
- b. Perform straight jump and pulls heels towards the buttocks.
- c. Land and repeat jump with effort emphasised on decreasing the ground-contact time.



5. Rollerboard hamstring pulls

- a. Athlete lays supine with back on rollerboard.
- b. The athlete's legs are fixed either with a partner holding them or fixed to a stationary object.
- c. The athlete then flexes and pushes away from his / her feet with emphasis on decreasing the turn-around time between flexion and extension.



6. Leg swings (bent knee and straight knee)

- a. The athlete stands erect with one hand supported for balance.
- b. The athlete swings his / her leg forwards until he / she feels a slight stretch.
- c. Quickly and powerfully push the leg down into full hip extension and let the leg gently swing back into hip flexion with emphasis on decreasing the time between flexion and extension.



- d. This can also be done with the knee flexed to isolate the hamstrings. Start by flexing the knee up, then extending it forward, forcefully bend the knee downwards until almost straight, and then continue to forcefully drive the leg up towards the butt with the knee bent. Then flex the hip to the starting position and repeat (Claw).

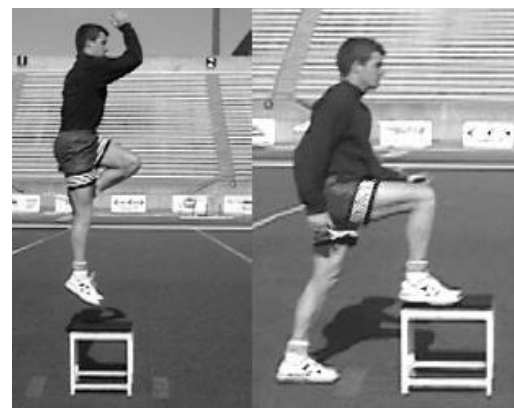
7. Heel toss with med ball

- a. Athlete is hanging from pull up bar with medball squeezed between his / her heels.
- b. From a stand still position, the athlete throws the ball backwards with forceful hip extension and knee flexion.
- c. A partner must retrieve the ball and replace it between the athlete's feet.
- d. This exercise can be progressed by using a heavier medball.



8. Box step up and jump

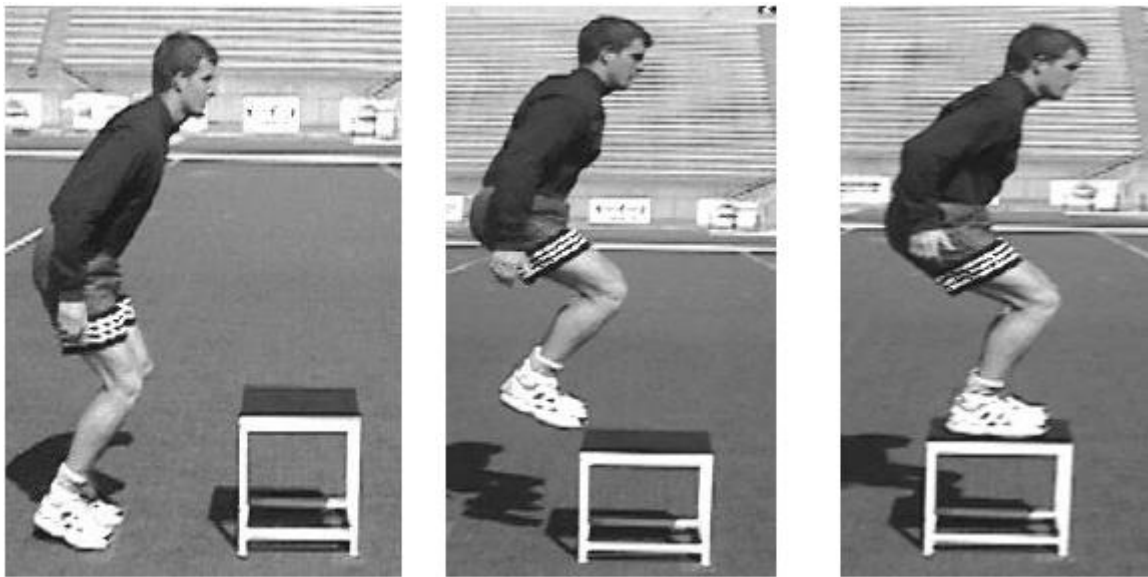
- a. Place an 18" box in front of you. Place your right foot on top of the box. Push off with your right foot and jump into the air. Land in the same position as you started. Perform the set then alternate legs.
- b. Emphasise the quick contraction and minimal ground contact time to get as high as possible. Use your arms to help you explode up.



- c. Variations: Perform with dumbbells or turn 180° in the air and land on opposite side of box.

9. Box jumps

- a. Stand facing a 12" to 18" box. Keeping your feet together, jump up onto the box. Immediately hop back down and then explode back up in one movement emphasising minimal ground contact time. Use your arms explosively to help propel you up and push off your toes.
- b. Variations: Move on to higher boxes of 24" to 48". On the higher boxes always step down, do not jump.



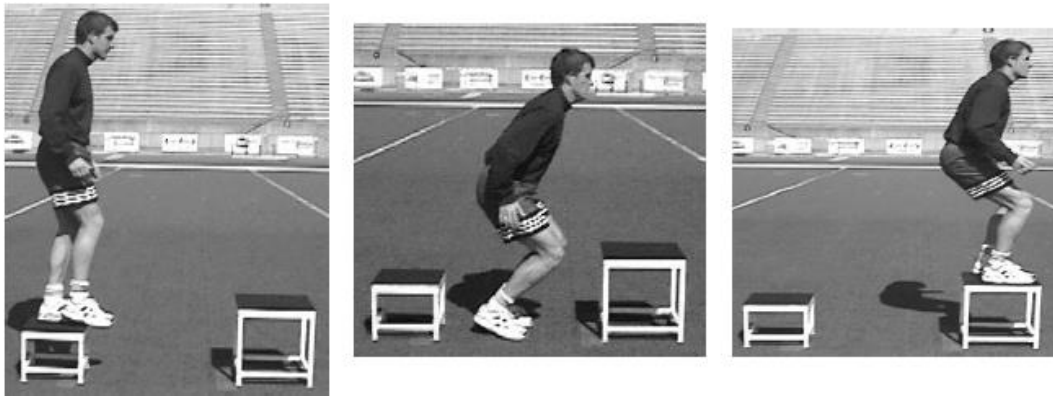
10. Depth jumps

- a. Stand on top of a 12" box. Place a 12" to 18" box about 1.8 metres in front. Drop down off the 12" box landing with your feet close together. Explode up onto the 12" to 18" box and stick your landing. Step down and repeat the jump emphasising rapid change in direction.
- b. Keep your feet close together when landing on the ground or on the box. Bend your knees when landing on the ground and use your arms to help you explode up. Variations: Progress to higher boxes. 18" box on to 24", then 48" boxes.

11. Forward depth jumps in series

- a. Set up a series of 6 to 8 boxes 12" to 18" high and 1 metre apart. Begin by standing atop the first box. Drop down to the ground and then explode up onto the second box. Continue through the series using your arms explosively decreasing ground contact time.

- b. Variations: Perform the depth jump series laterally. Perform the depth jump series on single leg.



12. Forward hurdle hops – over and back

- Stand facing a series of 6 to 8 hurdles at 12" to 18" high and 1 metre apart. Hop over the first hurdle then over the second. As you land over the second hurdle, immediately hop backwards over the second hurdle, then forwards again decreasing the ground contact time. Use your arms explosively and tuck your knees into your chest. Maintain your balance by keeping your torso upright and your body's centre of gravity over the hurdle.
- Hope over the third hurdle, then the fourth, now repeat over and back hop on the fourth hurdle. (Hop forwards over "odd" number hurdles; hop over and back over ("even" numbered ones).
- Variations: Explode into a 13.5 metre sprint, go up for a header over the last hurdle and explode into a 13.5 metre sprint.



- Jogging / running progression:
 - See attached for Field and Road Running Progression.

Criteria for progression within this phase: complete the activity with estimation of 3 or less on a numeric rating scale where 0 = no pain and 10 = maximal pain.

Criteria for progression to next phase: complete running progression. Able to perform 10 Nordic Hamstring exercises with minimum assist and no pain.

Return to activity: 2 weeks to 6 months

- Running activities are increased from jogging at low intensity to running and finally sprinting (please see attached running progression).
- High intensity plyometrics.
- Agility and sport / position specific drills (please see attached agility reference).

MAINTAIN FLEXIBILITY AND CONTINUE PROTECTIVE ECCENTRIC PROGRAMME

Field Sports Running Progression (Distances based on 91 x 45 metre field)		
Level 1	Walk	½ field then jog ½ field – repeat for 5 laps total
Level 2	Walk	½ field then jog full field – repeat for 6 laps total (~1.6kms)
Level 3	Walk	½ field then jog 2 full fields – repeat for 9 laps total (~2.4kms)
Level 4	Walk	½ field then jog 3 full fields – repeat for 9 laps total (~2.4kms)
Level 5	Jog	full 12 laps (~3.2kms)
Level 6	Jog	full 15 laps (~4kms)
Level 7	Jog	full 18 laps (~4.8kms)
** Levels 8 through 17 should be progressed to tolerance. Once at maximum level of time suggested continue to next level abiding by criteria for progression**		
Level 8	Alternate between running and jogging every field and a half	
Level 9	Alternate between running and jogging every 2 fields	
Level 10	Run full 18 laps (~4.8kms)	
Level 11	Jog ½ field, then run ½ field, then sprint for width of field, then run ½ field and repeat – 12 laps (~3.2kms)	
Level 12	Run ½ field then sprint a width of a field and repeat – 10 times	
Level 13	Run ½ field then sprint a length of a field and repeat – 10 times	
Level 14	Jog ½ field then sprint a width of a field and repeat – 10 times	
Level 15	Jog ½ field then sprint a length of a field and repeat – 10 times	
Level 16	Sprint width of a field then rest 2 minutes and repeat – 10 times	
Level 17	Sprint length of a field then rest 2 minutes and repeat – 10 times	

Soreness rule: (your pain)

- If sore during warm-up, take 2 days off and drop down 1 level.
- If sore during workout, take one off and drop down 1 level.
- If sore after workout, stay at same level.

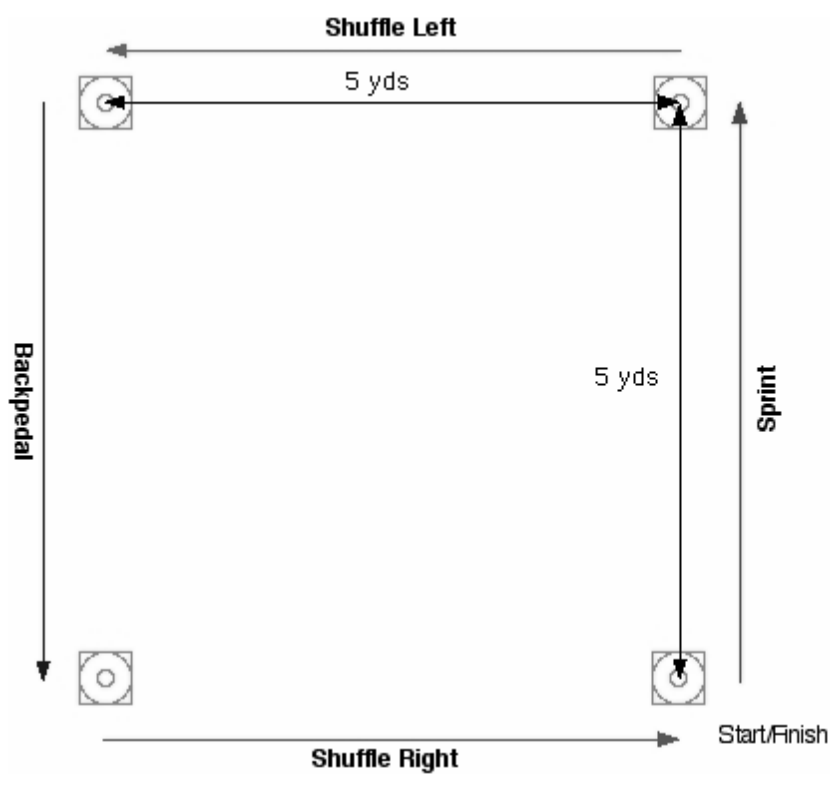
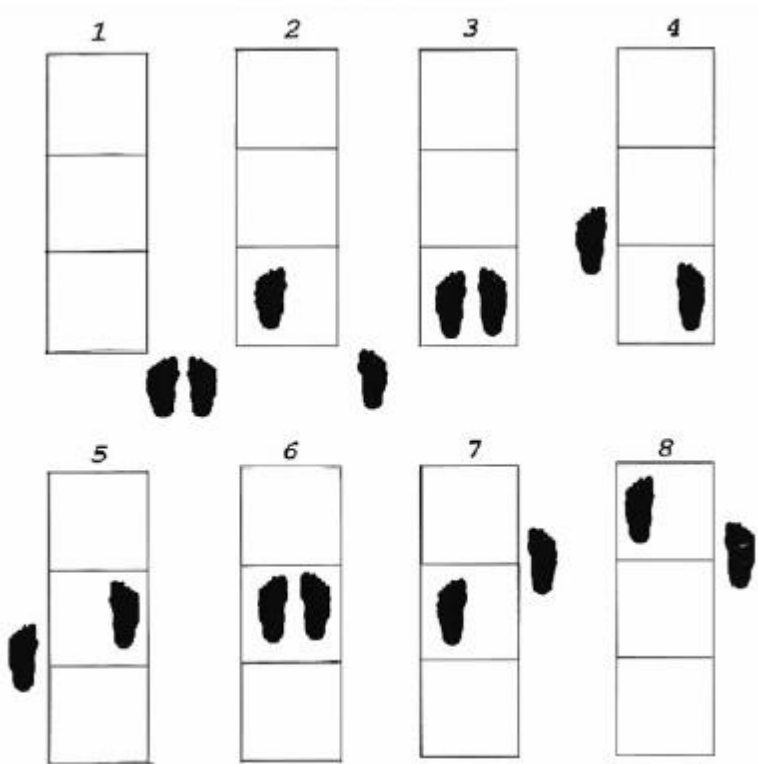
Road Running Progression	
(Based 12 minute jogging km / 8 minute running km)	
Level 1	Walk 2 minutes then jog 2 minutes – repeat for total of 35 minutes
Level 2	Walk 2 minutes then jog 3 minutes – repeat for 32 minutes
Level 3	Walk 2 minutes then jog 4 minutes – repeat for 30 minutes
Level 4	Walk 2 minutes then jog 5 minutes – repeat for 28 minutes
Level 5	Jog full 3.2kms – 24 minutes
Level 6	Jog full 4kms – 30 minutes
Level 7	Jog full 4.8kms – 36 minutes
** Levels 8 through 17 should be progressed to tolerance. Once at maximum level of time suggested continue to next level abiding by criteria for progression**	
Level 8	Alternate running for 2 minutes and jogging for 3 minutes – 30 minutes
Level 9	Alternate running for 5 minutes and jogging for 2 minutes – 28 minutes
Level 10	Run for 4.8kms – 24 minutes
Level 11	Jog 2 minutes then run for 2 minutes then sprint for 30 seconds, then run 2 minutes and repeat – 30 minutes
Level 12	Run 2 minutes sprint 15 seconds and repeat – 24 minutes
Level 13	Run 2 minutes sprint 30 seconds and repeat – 24 minutes
Level 14	Jog 2 minutes sprint 15 seconds and repeat – 24 minutes
Level 15	Jog 2 minutes sprint 30 second and repeat – 24 minutes
Level 16	Sprint 15 seconds then rest 2 minutes – 24 minutes
Level 17	Sprint 30 seconds then rest 3 minutes – 24 minutes

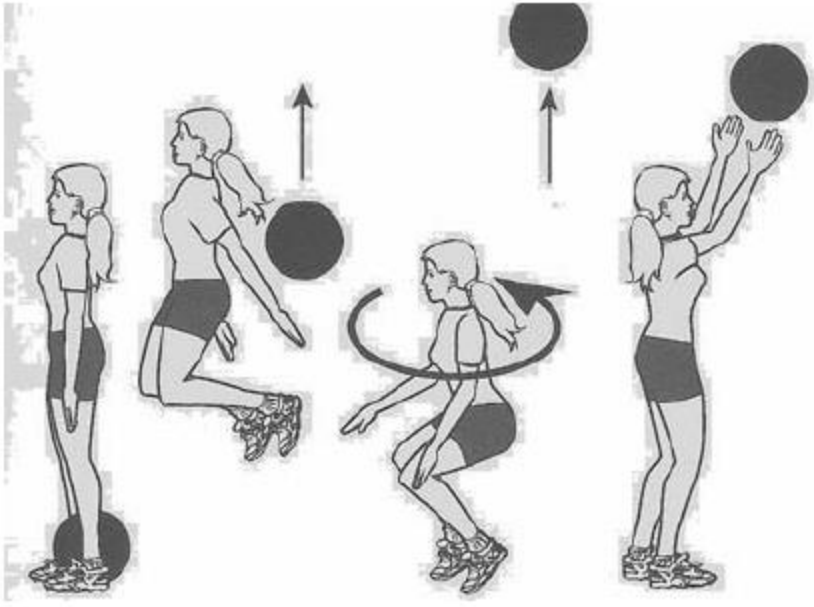
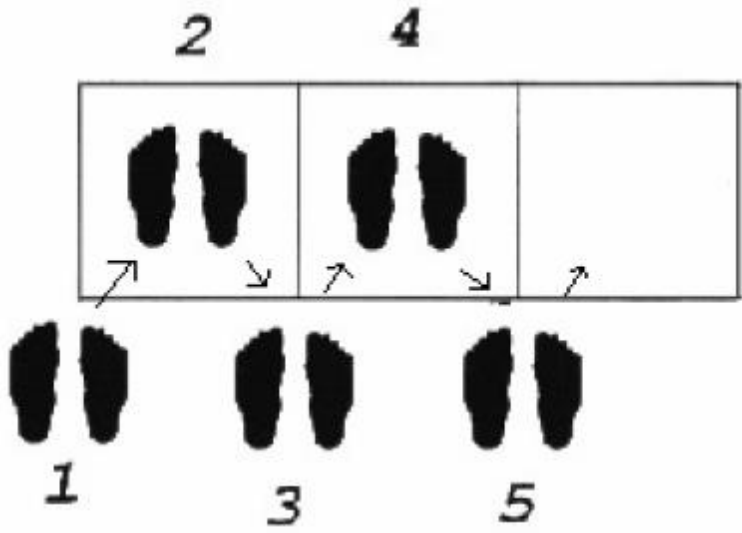
Soreness rules: (your pain)

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Agility Drills Progression

- Backward running:
 - Run backwards, progressing distance, speed and % effort.
- Ladder high knees:
 - Run through ladder with maximal hip and knee flexion increasing speed and % effort.
- Back ladder:
 - Run through ladder backwards increasing speed and % effort
- Cross ladder:
 - Start on left side of ladder, place right foot in ladder, followed by left, place right foot out of ladder followed by left.
 - Place left foot back into ladder, followed by right, place left foot out of ladder followed by right.
 - Repeat until end of ladder.
 - Progress by increasing speed and % effort.
- 18.2km square:
 - Start in 2pt stance, sprint 4.5 metres to first cone, make sharp right cut. Shuffle right 4.5 metres, make sharp cut back. Backpedal 4.5 metres to next cone, make sharp cut left. Left shuffle through finish.
- In and out shuffle:
 - Start in 2 pt. stance; stand on side of the ladder facing the first box. Jump with both feet into first box, then back to starting position, then jump to second box, and jump straight backwards, repeat pattern through ladder.
- Flip and catch:
 - Start in standing position, placing medicine ball tightly between both feet. Proceed to jump into the air, kicking the ball into the air behind you. After landing quickly turn and catch the ball before it hits the ground.





These exercises can be modified to meet sport and positions specific demands.