Rehabilitation Guidelines for Hamstring Strains in Adults

About Hamstring Strains

Hip anatomy is complex, and 21 muscles cross the hip and pelvic region. The hamstrings muscles cross 2 joints and are commonly injured in athletics. In fact, hamstring injuries account for 12-26% of all sporting injuries. Return to sports is usually achieved within weeks of the injury. However, this common injury can lead to prolonged time away from activity. Furthermore, there is a high risk of reinjury when returning to sport. The hamstrings are comprised of three muscles (semimembranosus, semitendinosus, and biceps femoris). In sports the biceps femoris muscle is the most injured hamstring muscle. The hamstrings have several roles: 1) assist in extension of the hip; 2) produce knee flexion; 3) and decelerate the lower leg when running.

Image 1: Anatomy of the hamstrings

Mechanism of Injury

Hamstring injuries occur secondary to high muscle and tendon forces, lengthening beyond normal length, and high velocity motion. These mechanisms of injury will be at the forefront during the rehab process in efforts to prepare the hamstrings for these stresses when returning to sport. In sports the most common mechanism of injury is sprinting and kicking. Hamstring forces increase dramatically when going from jogging to sprinting. In fact eccentric hamstring load goes up fifty percent from 80% running speed to 100% running speed. Therefore, a deliberate progression needs to utilized when returning to sprinting. The biceps femoris muscle takes more of the stress at high speeds, making it prone to injury. Hamstring injuries are also common in explosive water sports like surfing and waterskiing.

Less commonly, the hamstrings can get injured from chronic repetitive trauma. These chronic hamstring injuries are common in dancers and gymnasts who slowly stretch the hamstrings with simultaneous extremes of hip flexion and knee extension. This population commonly injure the proximal tendon of the semimembranosus. They typically have insidious onset of pain, progressive hamstring weakness and eventual loss of function.

Diagnosing a Hamstring Strain

There are several methods used to diagnose a hamstring tear. Your healthcare provider will assess the posterior thigh through a physical exam. They will use evidence-based examination techniques to assess the performance of the hamstring muscles as well as the function of surrounding body regions and hip. They may also request diagnostic imaging be taken of the hip and posterior thigh.

Several diagnostic imaging procedures are also used to assess the hamstrings. Radiographic (x-ray) images may initially used to assess the bony integrity of the hamstring attachment, especially in a younger person. Magnetic resonance imaging (MRI) may often be ordered to visualize the soft tissue structures, (muscles, tendons, and ligaments) and is highly accurate in diagnosing and staging hamstring injuries. It may take longer to get back to sport if the injury occurs in the intramuscular tendon. Diagnostic Ultrasound also provides the opportunity to visualize the muscles dynamically.

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845 SW 30TH STREET, CORVALLIS, OR 97330

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Treatment Options for a Hamstring Strain

Treatment options are individualized to the patient with consideration for age, activity level, and degree of impairment to daily function. Hamstring injuries are graded based on their severity and location of injury. A progressive eccentric (lengthening of the muscle-see image 2) strengthening program is an important part of rehab. Eccentric strengthening should start as soon as possible and is okay to perform with pain <4/10. Eccentric strengthening is important because it changes the morphology of the muscle fascicle length and the aponeurosis. Eccentric hamstring training increases muscle fascicle length by 1-2 cm. The benefit of eccentric is lost in 7-10 days, so consistency is key. Research shows that conservative treatment may be effective in returning you to your previous level of activity, and may include activity modification, and functional exercise therapy prescription. One of the most important aspects for treating a hamstring injury is a progressive return to running program.

Surgery is rarely indicated for this injury. If surgery is warranted, repair of the hamstrings involves suturing the torn tendon back to the bone. This repair is performed by placing sutures through the involved muscle tendons and securing them with anchors placed to the ischial tuberosity. Factors that guide the decision for surgical repair include: 1) amount of retraction & dimensions of the tear; 2) length of time from original injury; 3) sport/work requirements; 4) age; 5) overall physical health.

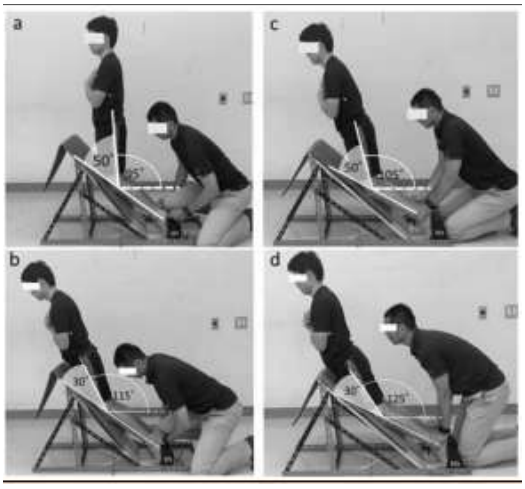

Image 2: Shallow angle eccentric exercise

Rehabilitation Following Hamstring Strain

All patients will undergo four to 12 weeks of rehabilitation, divided into phases, focusing on progressing you back to your daily activities, hobbies, and sports. The progression through these phases is dependent on factors related to the location of the strain and your response to rehab. Age, tear size/location, muscles involved, and tendon retraction (increased distance from the torn tendon to its attachment) will lengthen the progression of rehabilitation.

Tears that take longer to heal include: (tears at musculotendinous junction, larger area of pain, and injuries closer to the ischial tuberosity). This is usually because it delays when you can start performing eccentric strengthening exercises. Larger tears will also take longer to heal. Slowing the progression through rehabilitation phases will give these tissues time to heal without additional stress. Depending on the muscles involved, there may be additional restrictions in movement in the early phases of rehabilitation to protect them from being stretched too early.

Phase I of rehabilitation should begin immediately without delay. Initially rehab focuses on developing greater functional capacity through therapist-led activity. Therapy Phases II and III focus on developing full strength and return to running.

In order to safely return to sport-specific activities, a patient must first achieve certain functional goals: 1) full range of motion; 2) greater than 90% of the uninvolved side; 3) functional hip complex motor control; 4) progress through return to running program; and 5) physician and sports medicine team approval. Once these goals have been achieved, your sports medicine team will put you through criterion-based functional tests to determine the ability to safely return to sport. After satisfactory performance on these tests, you will progress

through a return-to-sport program specific to your sport & position of play in order to return

to pre-injury levels of performance. A referral to a strength and conditioning specialist may also be made to assist in returning you to pre-injury performance levels. Progression to pre-injury activity is time **and** criterion-based, and is dependent on soft tissue healing, patient demographics, and clinician evaluation.

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Rehabilitation Guideline

Eccentric strengthening at end range and appropriately progressing back into sprinting is crucial in preventing recurrent injuries. These both need to be performed in a progressive manner following hamstring injuries. The protocol outlined in this document is designed for the rehabilitation of general hamstring injuries. When there are additional structures involved, or poor tissue quality, rehabilitation following this injury will need to be adjusted.

Acute Phase: 0-1 weeks post-injury	
Appointments	Start Formal Rehab at: 1-5 days post-injury, visits 2-3 visits per week, rehab daily
Rehabilitation Goals	▪ Protect injured/healing muscle ▪ Control inflammation and pain ▪ Restore functional range of motion (ROM) ▪ Return to walking as soon as possible and minimize muscle atrophy
Precautions	Stretching: avoid passive stretching, but okay to do active motion • Avoid aggressive manual therapy/massage Mobility: avoid rapid hip flexion and rapid knee extension Running:
Range of Motion	Try to get hip range of motion through active motion • AROM with pain <4/10 • Knee extension and hip flexion with pain <4/10
Therapeutic Interventions	Education ▪ Education on hamstring strains – Comfortable gait and sitting positions – Avoiding jogging until walking pain is <4/10 Mobility: ▪ Address anterior chain immobility & Dorsiflexion limitations Strength: (Askling "L" protocol-Chart below) • "Eccentric knee flexor 1" • "Long Hip Extensor 1" • "Short Hip Extensor 1" Modalities: Ice: up to 3x/day or as needed for pain. Compression and elevation
Criteria for Progression to Next Rehabilitation Phase	• Walking pain <4/10 • Decreasing pain in isometrics and AROM • Improving passive hip flexion and passive knee extension
Special Considerations	Large Tear: Advance ROM as tolerated If surgical-follow hamstring repair guidelines from surgeon

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Sub-Acute Phase: 1+ weeks post injury	
Appointments	Rehab 2-3 visits week, rehab daily Surgeon follow-up at 12 weeks
Rehabilitation Goals	▪ Regain hamstring strength in hip neutral ▪ Progress NMC of hip and trunk ▪ Start increasing movement speed ▪ Return to light jogging with pain <4/10 ▪ Progress back into lower extremity strength training
Precautions	Mobility: no kicking, sprinting, passive stretching Strength: avoid aggressive rapid strength motions
Range of Motion	Active- ROM into stretch multiple times a day (3-4 x day) • All planes to full available ROM • Hip Flexion to full available ROM • Knee extension at 90 deg hip flexion to full available ROM
Therapeutic Exercises	Running: • Phase 1-2 running progression (chart below) ○ Hydroworx → Alter -G → land running (stage 1) Strength: (Chart below) • "Eccentric knee flexor 2" • "Long Hip Extensor 2" • "Short Hip Extensor 2" ▪ Balance progression ▪ PATS hamstring progression ▪ Supine sport cord triple threat eccentrics Mobility: ▪ Nerve flossing ▪ 90-90 knee extension standing with swiss ball with increasing speed as tol Modalities: As needed
Criteria for Progression to Next Rehabilitation Phase	• Jogging pain free • No reactive pain from flossing or eccentric training • Active ROM performed with minimal pain • Improving balance and trunk stability in upright moving positions • Equal Straight leg raise test
Special Considerations	Eccentric Training: keep pain < 4/10 Jogging: start light jogging when pain <4/10 and progress to stage 1(below) Musculo tendon injuries will progress slower Proximal injuries usually progress slower Larger areas of tenderness to palpation usually progress slower Re-injury rates: reinjury is common, so goals need to be achieved

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Remodeling Phase: 2+ weeks post-injury	
Appointments	**Formal Rehab:** 1-2 visit per week • Personal rehab daily
Rehabilitation Goals	▪ Progress into single leg eccentric strengthening at end ranges ▪ Progress through stage 2 and 3 of running progression (below) ▪ Initiate active ROM exercises
Precautions	• No sprinting until progressing through stages 1 & 2 pain free
Range of Motion	• Full pain free ROM against resistance in elongated position
Therapeutic Exercises	Strength: (Chart below) • "Eccentric knee flexor 3" • "Long Hip Extensor 3" • "Short Hip Extensor 3" • Shallow angle eccentrics Nordic Curls (figure 2) Running: • Phase 3 running progression (chart below)
Criteria for Progression to Practice or conditioning with team	Running: Progress into phase 3 of running without pain Strength: Equivocal strength and pain free in all 7 hamstring testing positions • Knee Flexion-Supine 90 deg hip & knee flexion (test at the heel) • Hip Extension-Supine knee extended (test at the heel) • Prone hip extension-knee flexed (test bottom of heel) • Prone knee flexion- (@ 90, 45 &20 degrees) • 'Tyler Test'-supine max hip flexion and max knee extension Range of Motion: • Equal knee extension at max hip flexion • 125 deg knee flexion in prone pelvic lock quad stretch
Special Considerations	Pass all RTS testing criteria: prior to returning to sprints and practice with team Continue with end range eccentric strengthening (ie shallow angle Nordic Curls) Continue with PATS interventions

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Rehabilitation Guidelines for Hamstring Strain

Return to Practice/Sport Phase: ongoing preventative control and strength exercises	
Appointments	**Formal Rehab:** 1 visit every 1-2 weeks • Personal rehab daily
Rehabilitation Goals	▪ Pass Hop Testing ▪ Pass 'Askling H-Test' ▪ LSI with single leg 'Bunkie Test' ▪ LSI within 10% in hamstrings, quads, and hips ▪ Incorporate some rehab exercises into routine strength and conditioning
Precautions	None-continue with eccentric training at end range
Range of Motion	Active- ROM into stretch multiple times a day • All planes to full available ROM • Hip Flexion to full available ROM • Knee extension at 90 deg hip flexion to full available ROM
Therapeutic Exercises	▪ Continue with Askling's exercises ▪ PATS exercises ▪ Shallow angle (figure 2) Nordic Curls ▪ **Eccentric training needs to be completed long term**

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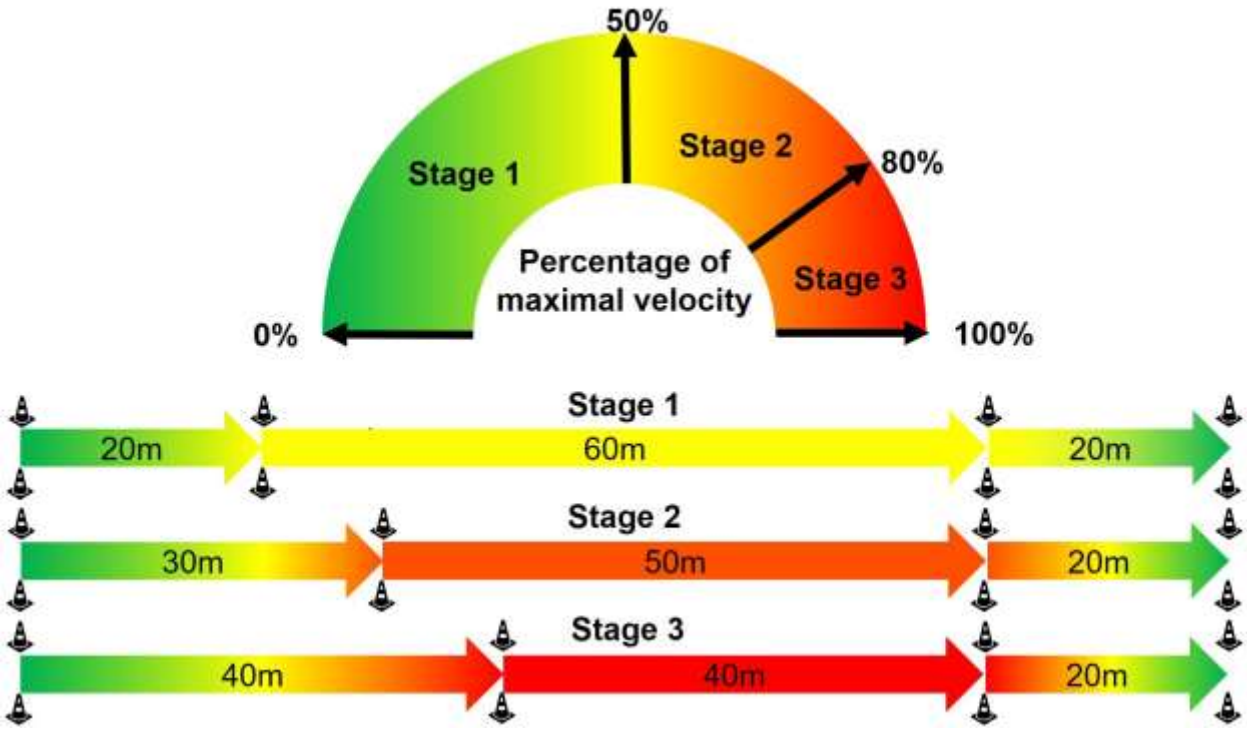
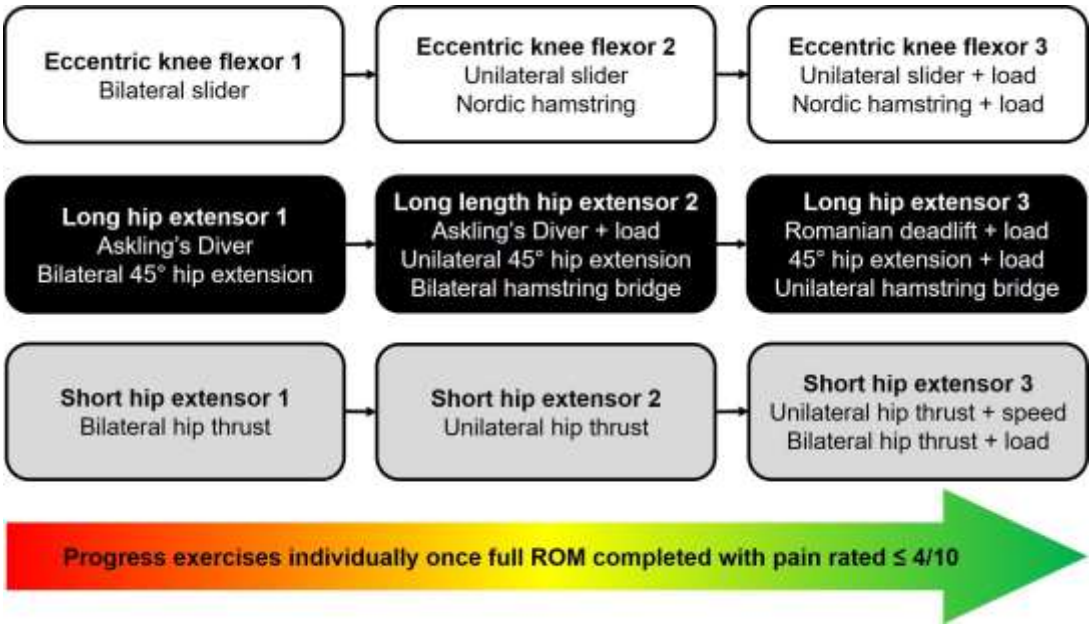
Return to Sprinting Stages

Important to note that from 80% speed to 100% sprinting speed, eccentric load increases by 50%. This non-linear increase highlights the importance of a deliberate progression back to top speed.



Hamstring Strengthening Progression



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Acute Hamstring Strain Examination DOI____

Athlete History	Yes	No
Sudden Onset of Pain?		
Did you feel a pop?		
Did you have to stop activity?		
Have strained hamstring before?		
Is walking pain < 4/10		

Previous hamstring injury = 2.7 x risk of re-injury

Athlete Examination	Right	Left
Side of Injury		
Pain Rating at time of injury?	/10	/10
Distance from Ischial Tuberosity of maximal pain (prone)	cm	cm
Total length of palpable pain	cm	cm
Previous LBP, groin, knee injury?		
Is there a palpable deformity?		
Is there a change in sensation?		
Is there Discoloration?		
Ischial Tuberosity		

Pain closer to ischial tuberosity or of greater total length, both have association with increased duration of rehabilitation

AROM: Hip: *=pain	Right	Left
Passive SLR	°	°
Knee ext at max hip flexion	°	°
Knee ext at 90° hip flexion	°	°
Hip ER	°	°
Hip abduction	°	°
Ankle DF	°	°
Thomas test (hip flexor ROM)	°	°

Between leg deficits in ROM & pain during active knee ext tests are useful in prognosis for RTS & running progression intensity

Strength & pain:	Right	Left
Supine 90° knee flexion at 90° hip flexion (test at heel)	lbs /10	lbs /10
Supine hip extension knee extended (test at heel)	lbs /10	lbs /10
Prone hip extension knee flexed (test at heel)	lbs /10	lbs /10
Prone knee flexion 90 deg	lbs /10	lbs /10
Prone knee flexion 45 deg	Lbs /10	Lbs /10
Prone knee flexion 20 deg	Lbs /10	Lbs /10

Special Tests:	Right	Left
Slump Test		
Patrick (FABER) Test		
Trendelenburg's Sign		
Thomas Test		
Ober's Test		
Coppenhagen adductor test	sec	sec
Leg Length in cm (ASIS to lateral malleolus)		

MRI Involvement & RTS	Yes	No
Full Thickness Intramuscular tendon disruption (31.6 ± 10.9 days)		
No tendon disruption (22.2 ± 7.4 days)		
Waviness of the intramuscular tendon (30.2 ± 10.8 days)		
No waviness in intramuscular tendon (22.6 ± 7.5 days)		

In blinded rehab providers, time to RTS and recurrence rates were not significantly different when comparing between HSIs with and without intramuscular tendon disruption

Evidence Based Treatment
PRP-Meta-analysis shows no significant reduction in RTS time or re-injury rates when added to normal rehab
Manual Therapy to SI, spine, and soft tissue-no clear evidence this has any benefit
Running Technique Drills-no clear evidence it helps
Progressive Agility and trunk stability (PATS)-moderate evidence this decreases time to RTS and re-injury
Hamstring Flexibility Exercises-moderate evidence you can accelerate knee extension ROM by stretching 4 x day compared to once daily, from 48 hours after HSI
Progressive Running-most important aspect of rehab and can be initiated once they can walk with pain <4/10
Eccentric Hamstring Exercises-Asklings 'L-protocol' is effective in reducing RTS time compared to normal rehab
Hip Extensor training-moderate evidence this helps

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