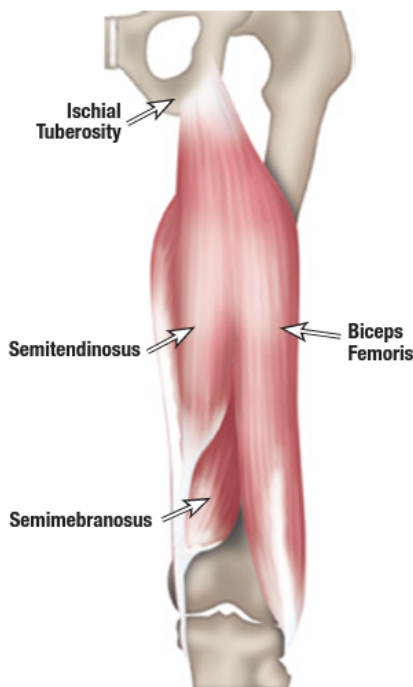


## Rehabilitation Guidelines Following Proximal Hamstring Primary Repair

The hamstring muscle group consists of three muscles: the biceps femoris, semitendinosus and semimembranosus. All three of these muscles originate from the ischial tuberosity of the pelvis and then insert below the knee with the biceps femoris attaching on the fibula and the semimembranosus and semitendinosus attaching on the tibia (Figure 1). These muscles cross the hip and the knee, and therefore can affect both hip and knee motion.



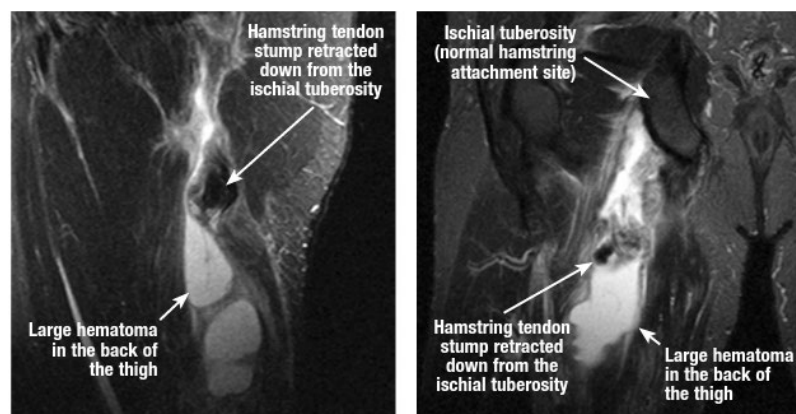
**Figure 1** Normal hamstring anatomy. Three muscles (semimebranosus, semitendinosus and biceps femoris) originate from the pelvis (ischial tuberosity).

Image Copyright 2010 UW Health Sports Medicine Center.

Acute hamstring strains are common in sports that involve sprinting, kicking and high-speed skilled movements. A National Football League team published injury data for their team during pre-season training camp from 1998-2007.<sup>1</sup> Hamstring strains were the second most common injury, only surpassed by “knee sprains”.<sup>1</sup> Numerous studies have shown that hamstring strains are one of the most common injuries in sprinting sports, soccer, rugby and Australian rules football.<sup>1-12</sup> Hamstring strains primarily occur at the proximal musculotendon junction.<sup>13</sup> Proximal musculotendon strain injuries have been shown to be treated effectively with rehabilitation.<sup>1, 8</sup>

Much less common, but most often much more severe, are the hamstring injuries involving complete avulsion of the hamstring complex off the ischial tuberosity.

When this occurs a large amount of bleeding (hematoma) will form in the back of the thigh and the tendon will move down the thigh, retracting away from the ischial tuberosity (Figures 2 and 3). Almost all injuries occur from a slip or a fall that creates forceful hip flexion with simultaneous knee extension, many of these during sporting activities. In addition to falls this injury can occur with waterskiing starts and bull riding.<sup>14-15</sup> These complete avulsions result in significant or complete loss of hamstring function depending on how many of the tendons are avulsed. This can lead to poor leg control and difficulty even walking. Because of the significant structural damage and resultant disability, these injuries are often treated with open surgical repair.

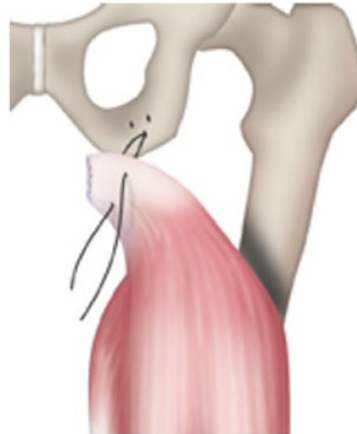


**Figures 2 and 3** MRI demonstrating a complete avulsion of the hamstring tendon from the ischial tuberosity.

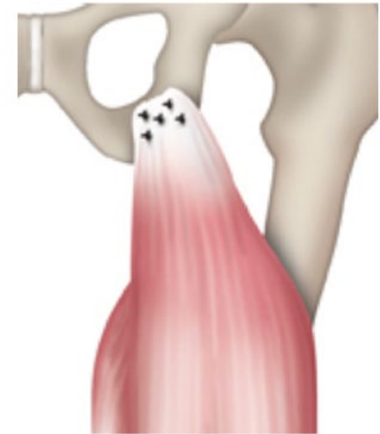
## Rehabilitation Guidelines Following Proximal Hamstring Primary Repair

The clinical indications for surgical repair are complete hamstring avulsion of all 3 tendons or significant retraction with less than 3 tendons avulsed. Outcome studies indicate that if surgery is performed shortly after injury, the outcome is superior to those whose surgery was delayed several months. Acute surgical repair is performed by suturing the torn tendons to suture anchors placed in the bone at the anatomical origin. This usually requires 2-4 suture anchors and Panacryl or Ethibond sutures (Figures 4 and 5)

Post-operatively crutches are used to assist in walking for the first few weeks. A brace or protective device also may be used to protect the hamstring. One factor in this decision is the time of year (snow / ice), as most reported episodes of early failure are related to slipping and falling. Another factor, which is assessed during surgery, is the ease with which the torn tendon can reach its original insertion on the pelvis. If the tendon was significantly retracted there is a greater likelihood of longer post-operative protection.



*Figure 4: Sutures extending out to the torn tendon stump from anchors placed in the ischial tuberosity (pelvic bone).*



*Figure 5: Sutures tied off to approximate the torn tendon to the ischial tuberosity (pelvic bone).*

The University of Wisconsin Sports Medicine and Rehabilitation post-operative rehabilitation guidelines consist of 4 phases. Phase I consists of range of motion and gait training exercises. This phase focuses on protecting the repair to allow adequate healing and usually lasts 6 weeks. This is followed by a progressive, supervised strengthening program. Early in the strengthening phase most exercises are done with both legs simultaneously in a short arc of motion either at the hip or the knee. Late in Phase III, most exercises are done in a single leg fashion with movement and force occurring at both the hip and knee simultaneously. In the final phase of rehabilitation, the focus shifts to the control of high-speed movement and the development of power. This is the return to sport phase. Not all athletes will return to sport after this injury due to how significant these injuries can be. Return to sport depends on the nature of the sport, severity of initial injury, timeliness of surgical intervention and compliance with the post-operative rehabilitation program. Most studies state approximately 75% of athletes may return to their sport in some capacity.<sup>14, 18</sup> Sports requiring longer bouts of sprinting seem to be the most difficult sports to which an athlete may return.

Specific time frames, restrictions and precautions are given to protect healing tissues and the surgical repair/reconstruction. General time frames are also given for reference to the average, but individual patients will progress at different rates depending on their age, associated injuries, pre-injury health status, rehab compliance and injury severity. The number of tendons repaired, the time from injury and the retraction prior to repair may also affect the rate of post-operative progression.

## **Rehabilitation Guidelines Following Proximal Hamstring Primary Repair**

**Phase I (Surgery to 6 weeks after surgery)**

The timeframes for each phase may be extended if the repair is delayed or the injury included other associated injuries (such as a hip adductor tear).

<b>Appointments</b>	Rehabilitation appointments begin 2-5 days after surgery and are once every 6-10 days after
<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Protection of healing graft fixation</li> <li>• Pain control</li> <li>• Safety with walking, stairs and precautions</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• <u>Weightbearing:</u> <ul style="list-style-type: none"> <li>• Use axillary crutches for up to 6 weeks</li> <li>• Post-operative weeks 0-2: Touch down weight bearing</li> <li>• Post-operative weeks 3-4: 15% - 40% weight bearing progression</li> <li>• Post-operative weeks 5-6: Weight bearing as tolerated with weaning from crutches</li> <li>• Full weight bearing occurs at week 6</li> </ul> </li> <li>• <u>Brace:</u> <ul style="list-style-type: none"> <li>• A hinged knee brace will be used after surgery. The starting point of knee flexion for this brace will be determined at the time of surgery based on graft tension. Each week it will be assessed if the brace can be moved in to 10 more degrees of extension based on if the patient can ambulate without feeling a pull or tension at the repair site.</li> <li>• In chronic repairs the brace may remained flexed for a longer period of time. This will be based on surgeon referral.</li> </ul> </li> <li>• <u>Pain &amp; Swelling Control:</u> Use a large ACE wrap with a hip spica wrap to help reduce swelling.</li> <li>• <u>Protection:</u> <ul style="list-style-type: none"> <li>• Avoid hip flexion coupled with knee extension</li> <li>• Avoid unsafe surfaces and environments</li> </ul> </li> </ul>
<b>Suggested Therapeutic Exercise</b>	<ul style="list-style-type: none"> <li>• Quad sets</li> <li>• Ankle pumps and plantarflexion with bands</li> <li>• Abdominal isometrics</li> <li>• Passive knee range of motion (ROM) with no hip flexion during knee extension (Thomas position)</li> <li>• Post-operative weeks 3-4: May begin pool walking drills (without hip flexion coupled with knee extension), hip abduction, hip extension, and balance exercises</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• None at this time</li> </ul>
<b>Progression criteria</b>	6 weeks post op

## Rehabilitation Guidelines Following Proximal Hamstring Primary Repair

Phase II (begin 6 weeks after surgery)	
Appointments	<ul style="list-style-type: none"> <li>Rehabilitation appointments are 1-2 times per week</li> </ul>
Rehabilitation Goals	<ul style="list-style-type: none"> <li>Normalize gait</li> <li>Avoid overstressing or stretching the repair site</li> <li>Closed chain leg control for non-impact movement control in shallow depth</li> <li>Adherence to HEP</li> </ul>
Precautions	<ul style="list-style-type: none"> <li>Avoid dynamic stretching</li> <li>Avoid loading the hip at deep flexion angles</li> <li>No impact or running</li> </ul>
Suggested Therapeutic Exercise	<ul style="list-style-type: none"> <li>Non-impact balance and proprioceptive drills – beginning with double leg and gradually progressing to single leg</li> <li>Stationary bike</li> <li>Gait training</li> <li>Begin hamstring strengthening – start by avoidance of lengthened hamstring position (hip flexion combined with knee extension) by working hip extension and knee flexion moments separately; begin with isometric and concentric strengthening with hamstring sets, heel slides, double leg bridge, standing leg extensions, and physioball curls</li> <li>Hip and core strengthening</li> </ul>
Cardiovascular exercise	<ul style="list-style-type: none"> <li>Upper body circuit training</li> <li>Assault bike arms only</li> </ul>
Progression criteria	<ul style="list-style-type: none"> <li>Normal gait on all surfaces</li> <li>Ability to carry out functional movements without unloading the affected leg or pain while demonstrating good control</li> <li>Single leg balance greater than 15 seconds</li> <li>Normal (5/5) hamstring strength in prone with the knee in a position of at least 90°knee flexion</li> </ul>

## Rehabilitation Guidelines Following Proximal Hamstring Primary Repair

Phase III (begin after meeting Phase II criteria, usually 11-12 weeks after surgery)	
Appointments	<ul style="list-style-type: none"> <li>Rehabilitation appointments as needed. Usually every 1-2 weeks.</li> </ul>
Rehabilitation Goals	<ul style="list-style-type: none"> <li>Continued good control and no pain with sport and work specific movements, including impact</li> </ul>
Precautions	<ul style="list-style-type: none"> <li>Avoid large eccentric and ballistic forces. Closely monitor post activity pain and soreness.</li> </ul>
Suggested Therapeutic Exercise	<ul style="list-style-type: none"> <li>Continue hamstring strengthening – progress toward strengthening in lengthened hamstring positions; begin to incorporate eccentric strengthening with single leg forward leans, single leg bridge lowering, prone foot catches, and assisted Nordic curls</li> <li>Hip and core strengthening</li> <li>Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to the other and then 1 foot to same foot</li> <li>Movement control exercise beginning with low velocity, single plane activities and progressing to higher velocity, multi-plane activities</li> <li>Initiate running drills, but no sprinting until Phase IV. Start by restoring kinematics without excessive force. For example high knee running in place, stationary butt kickers, Alter-G running, etc.</li> </ul>
Cardiovascular exercise	<ul style="list-style-type: none"> <li>Biking</li> <li>Elliptical trainer, Stairmaster or water running at moderate intensity</li> <li>Short stride jogging (this better than fast long stride walking)</li> </ul>
Progression criteria	<ul style="list-style-type: none"> <li>Dynamic neuromuscular control with multi-plane activities at low to medium velocity without pain or swelling</li> <li>Less than 25% deficit for side-to-side hamstring comparison on Biodex testing at 60° and 240° per second</li> </ul>

## Rehabilitation Guidelines Following Proximal Hamstring Primary Repair

<b>Phase IV (begin after meeting phase III criteria, usually 16-20 weeks after surgery)</b>	
<b>Rehabilitation appointments</b>	<ul style="list-style-type: none"> <li>Rehabilitation appointments are once every 2-4 weeks</li> </ul>
<b>Rehabilitation goals</b>	<ul style="list-style-type: none"> <li>Normal multi-planar high velocity without side-to-side differences or compensations.</li> <li>Normal double leg and single leg landing control without side-to-side differences or compensations</li> <li>Running without a limp</li> <li>Adherence to HEP</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>No active reactive swelling or joint pain that lasts more than 12 hours.</li> </ul>
<b>Suggested therapeutic exercises</b>	<ul style="list-style-type: none"> <li>Progressive agility drills; forward and backward skipping, side shuffle, skater's quick stepping, carioca, cross overs, forward jog, backward jog – increase amplitude and velocity</li> <li>Landing mechanics – progressing from higher amplitude double leg to single leg landing drills. Start uni-planar and gradually progress to multi-planar. Start with vertical challenges and drills prior to horizontal challenges and drills.</li> <li>Continue hamstring strengthening – progress toward higher velocity strengthening and reaction in lengthened positions, including eccentric strengthening with single leg forward leans with medicine ball, single leg dead lifts with dumbbells, single leg bridge curls on physio ball, resisted running foot catches, and Nordic curls</li> <li>Running and sprinting mechanics and drills</li> <li>Hip and core strengthening</li> <li>Movement control exercise beginning with low velocity, single plane activities and progressing to higher velocity, multi-plane activities</li> <li>Sport/work specific balance and proprioceptive drills</li> <li>Stretching for patient specific muscle imbalances</li> </ul> <p><u>NOTE:</u> neurocognitive strategies and external focus of attention should be utilized with the therapeutic exercises. Examples:</p> <ul style="list-style-type: none"> <li>Dual task for cognitive distraction</li> </ul>



	<ul style="list-style-type: none"> <li>• Single step cues/reactions: verbal or visual to promote visual scanning of outside environment</li> <li>• Multi-step commands: using color or number patterns</li> <li>• Partner reaction and competition to increase speed and effort</li> <li>• Cognitive challenges during movement or stabilization, such as quick math problems, counting backward, word association games, etc</li> </ul>
<b>Cardiovascular exercise</b>	<ul style="list-style-type: none"> <li>• Progressive running program. Design to use sport specific energy systems</li> </ul>
<b>Progression criteria</b>	<ul style="list-style-type: none"> <li>• Progressive testing will be completed. The patient should have less than 20% difference in Biodex strength test</li> <li>• Normal multi-planar low to medium velocity without side-to-side differences or compensations.</li> <li>• Normal double leg landing control without side-to-side differences or compensations</li> <li>• Running without a limp</li> </ul>



### References:

1. Feeley BT, Kennelly S, Barnes RP, et al. Epidemiology of National Football League Training Camp Injuries From 1998 to 2007. *Am J Sports Med.* Apr 28 2008.
2. Gabbe BJ, Finch CF, Wajswelner H, Bennell KL. Predictors of lower extremity injuries at the community level of Australian football. *Clin J Sport Med.* Mar 2004;14(2):56-63.
3. Orchard J, Best TM, Verrall GM. Return to play following muscle strains. *Clin J Sport Med.* Nov 2005;15(6):436-441.
4. Orchard J, Marsden J, Lord S, Garlick D. Preseason hamstring muscle weakness associated with hamstring muscle injury in Australian footballers. *Am J Sports Med.* Jan-Feb 1997;25(1):81-85.
5. Orchard J, Steet E, Walker C, Ibrahim A, Rigney L, Houang M. Hamstring muscle strain injury caused by isokinetic testing. *Clin J Sport Med.* Oct 2001;11(4): 274- 276.
6. Orchard JW. Intrinsic and extrinsic risk factors for muscle strains in Australian football. *Am J Sports Med.* May-Jun 2001;29(3):300-303.
7. Orchard JW, Best TM. The management of muscle strain injuries: an early return versus the risk of recurrence. *Clin J Sport Med.* 2002;12(1):3-5.
23. Sherry MA, Best TM. A comparison of 2 rehabilitation programs in the treatment of acute hamstring strains. *J Orthop Sports Phys Ther.* Mar 2004;34(3):116-125.
24. Verrall GM, Kalairajah Y, Slavotinek JP, Spriggins AJ. Assessment of player performance following return to sport after hamstring muscle strain injury. *J Sci Med Sport.* May 2006;9(1-2):87-90.
25. Verrall GM, Slavotinek JP, Barnes PG. The effect of sports specific training on reducing the incidence of hamstring injuries in professional Australian Rules football players. *Br J Sports Med.* Jun 2005;39(6):363-368.
26. Verrall GM, Slavotinek JP, Barnes PG, Fon GT. Diagnostic and prognostic value of clinical findings in 83 athletes with posterior thigh injury: comparison of clinical findings with magnetic resonance imaging documentation of hamstring muscle strain. *Am J Sports Med.* Nov-Dec 2003;31(6):969-973.
27. Brooks JH, Fuller CW, Kemp SP, Reddin DB. Incidence, risk, and prevention of hamstring muscle injuries in professional rugby union. *Am J Sports Med.* Aug 2006;34(8):1297-1306.
28. Askling CM, Tengvar M, Saartok T, Thorstensson A. Acute First-Time
18. Chakravarthy J, Ramisetty N, Pimpalnerkar A, Mohtadi N. Surgical repair of complete proximal hamstring tendon ruptures in water skiers and bull riders: a report of four cases and review of the literature. *Br J Sports Med.* Aug 2005;39(8):569-572.
19. Sallay PI, Friedman RL, Coogan PG, Garrett WE. Hamstring muscle injuries among water skiers. Functional outcome and prevention. *Am J Sports Med.* Mar-Apr 1996;24(2):130-136.
20. Sarimo J, Lempainen L, Mattila K, Orava S. Complete proximal hamstring avulsions: a series of 41 patients with operative treatment. *Am J Sports Med.* Jun 2008;36(6):1110-1115.
21. Wood DG, Packham I, Trikha SP, Linklater J. Avulsion of the proximal hamstring origin. *J Bone Joint Surg Am.* Nov 2008;90(11):2365-2374.
22. Klingele KE, Sallay PI. Surgical repair of complete proximal hamstring tendon rupture. *Am J Sports Med.* Sep-Oct 2002;30(5):742-747.

These rehabilitation guidelines were developed collaboratively by UW Health Sports Rehabilitation and the UW Health Sports Medicine physician group.

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