

Rehabilitation Guidelines Following Proximal Hamstring Primary Repair

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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.

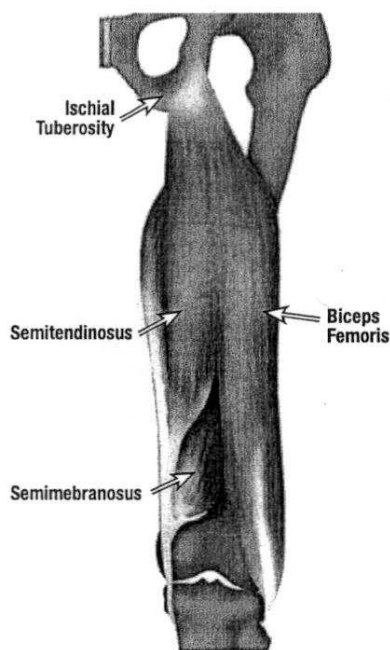


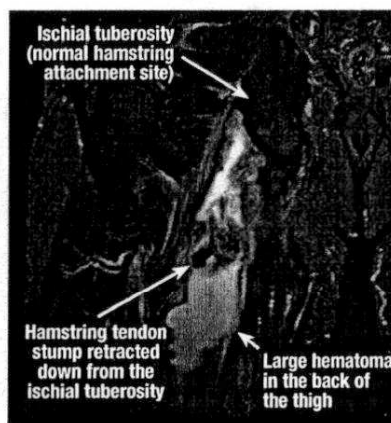
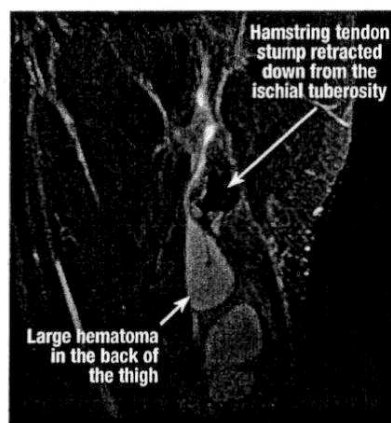
Figure 1 Normal hamstring anatomy. Three muscles (semimembranosus, semitendinosus and biceps femoris) originate from the pelvis (ischial tuberosity).

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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 1998-2007.¹ Hamstring strains were the second most common injury, only surpassed by "knee sprains".¹ Numerous studies have shown that hamstring strains are one of the most common injuries in sprinting sports, soccer, rugby and Australian rules football.¹⁻¹² Hamstring strains primarily occur at the proximal musculotendon junction.¹³ Proximal musculotendon strain injuries have been shown to be treated effectively with rehabilitation.^{1,8}

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.¹⁴⁻¹⁵ 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.

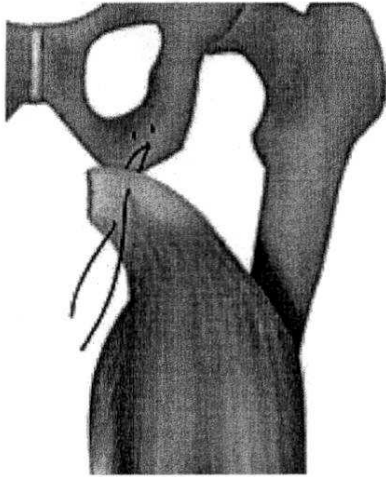


Figure 4: Sutures extending out to the torn tendon stump from anchors placed in the ischial tuberosity (pelvic bone).



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

The 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).¹⁶⁻¹⁷

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.

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. Phases II and III include progressions with the speed and amplitude of movement, as well as force distribution. 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.^{14, 18} Sports requiring longer bouts of sprinting seem to be the most difficult sports to which an athlete may return.

The rehabilitation guidelines below are presented in a criterion based progression. 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

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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).

Appointments	Rehabilitation appointments begin 7-10 days after surgery and are once every 7-10 days
Rehabilitation Goals	- Protection of the repaired tendon(s) - Pain control
Weight Bearing	- Use axillary crutches for up to 6 weeks - Post-operative weeks 0-2: Touch down weight bearing - Post-operative weeks 3-4: 15% - 40% weight bearing progression - Post-operative weeks 5-6: Weight bearing as tolerated with weaning from crutches
Brace	The use of a brace is determined by the surgeon at the time of surgery, which is based on time of year, timing of surgery and associated injuries
Precautions	- Avoid hip flexion coupled with knee extension - Avoid unsafe surfaces and environments
Suggested Therapeutic Exercise	- Quad sets - Ankle pumps - Abdominal isometrics - Passive knee range of motion (ROM) with no hip flexion during knee extension - Post-operative weeks 3-4: Begin pool walking drills (without hip flexion coupled with knee extension), hip abduction, hip extension, and balance exercises - Scar mobilizations
Cardiovascular Exercise	Upper body circuit training or upper body ergometer (UBE)
Progression Criteria	6 weeks post-operative

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PHASE II (begin after meeting Phase I criteria, usually 6 weeks after surgery)

Appointments	• Rehabilitation appointments are once every 1-2 weeks
Rehabilitation Goals	• Normalize gait • Good control and no pain with functional movements, including step up/down, squat, partial lunge (do not exceed 60° of knee flexion)
Precautions	• Avoid dynamic stretching • Avoid loading the hip at deep flexion angles • No impact or running
Suggested Therapeutic Exercise	• Non-impact balance and proprioceptive drills – beginning with double leg and gradually progressing to single leg • Stationary bike • Gait training • 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 • Hip and core strengthening
Cardiovascular Exercise	• Upper body circuit training or UBE
Progression Criteria	• Normal gait on all surfaces • Ability to carry out functional movements without unloading the affected leg or pain while demonstrating good control • Single leg balance greater than 15 seconds • Normal (5/5) hamstring strength in prone with the knee in a position of at least 90° knee flexion

PHASE III (begin after meeting phase II criteria, usually three months after surgery)

Appointments	• Rehabilitation appointments are once every 1-2 weeks
Rehabilitation Goals	• Good control and no pain with sport and work specific movements, including impact
Precautions	• No pain during strength training • Post-activity soreness should resolve within 24 hours

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Suggested Therapeutic Exercise	- 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 - Hip and core strengthening - Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to the other and then 1 foot to same foot - Movement control exercise beginning with low velocity, single plane activities and progressing to higher velocity, multi-plane activities - Initiate running drills, but no sprinting until Phase IV
Cardiovascular Exercise	Biking, elliptical machine, Stairmaster, swimming, and deep water running
Progression Criteria	- Dynamic neuromuscular control with multi-plane activities at low to medium velocity without pain or swelling - Less than 25% deficit for side to side hamstring comparison on Biodex testing at 60° and 240° per second

PHASE IV (begin after meeting phase III criteria, usually 4-5 months after surgery)

Appointments	Rehabilitation appointments are once every 1-2 weeks
Rehabilitation Goals	Good control and no pain with sport and work specific movements, including impact
Precautions	- No pain during the strength training - Post-activity soreness should resolve within 24 hours
Suggested Therapeutic Exercise	- 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 - Running and sprinting mechanics and drills - Hip and core strengthening - Impact control exercises beginning 2 feet to 2 feet, progressing from 1 foot to other and then 1 foot to same foot - Movement control exercise beginning with low velocity, single plane activities and progressing to higher velocity, multi-plane activities - Sport/work specific balance and proprioceptive drills - Stretching for patient specific muscle imbalances

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Cardiovascular Exercise	Replicate sport or work specific energy demands
Return to Sport/Work Criteria	- Dynamic neuromuscular control with multi-plane activities at high velocity without pain or swelling - Less than 10% deficit for side to side hamstring comparison on Biodex testing at 60° and 240° per second - Less than 10% deficit on functional testing profile

These rehabilitation guidelines were developed collaboratively between Marc Sherry, PT, DPT, LAT, CSCS (msherry@uwhealth.org) and the UW Health Sports Medicine physician group.

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