Proximal Hamstring Injury
Dr. Joseph C. McCormick III, MD
AMG Orthopedic Surgeon
Objectives

- Describe anatomy of the hamstring muscle group
- Identify the differences in management of proximal hamstring injuries versus other more common hamstring injuries
- Appropriately identify proximal hamstring injury
- Discuss the indications for operative intervention and the associated risks and benefits of surgical management of proximal hamstring injury
- Recognize implications of early versus late recognition of proximal hamstring injury
Hamstring Muscle group

- Biceps Femoris
  - Long Head
  - Short Head
- Semimembranosus
- Semitendinosus

Spans 2 joints (hip and knee)

- Flexion of the knee
- Extension of the hip
- Antagonist of quadriceps, leg control and deceleration walking
- Also rotation of lower leg when knee flexed
Proximal Origin
- Ischial tuberosity of the pelvis
- *Exception: Linea aspera of femur
  - Short Head biceps femoris

Distal
- Pes anserine (Anteromedial Tibia)
  - Semitendinosus, Gracilis, Sartorius
- Posteromedial Tibia
  - Semimembranosus
- Fibular Head
  - Biceps femoris
Innervation

- Biceps Femoris
  - Long Head: Sciatic Nerve
  - Short Head: * Common Peroneal N.
- Semimembranosus: Sciatic N.
- Semitendinosus: Sciatic N.

Blood supply

- Inferior gluteal artery
- Profunda femoris artery
Hamstring Injury

- **Proximal**
  - Focus of this talk
  - Relatively rare injury
  - Overall little research due to small numbers
  - Increasing research recent years

- **Mid**

- **Distal**
Risk factors

- Inadequate warm up
- Strength imbalance
- Lower extremity flexibility
- Core stability
- Muscle weakness
- Fatigue
- Dehydration
- Timing of season
- History of prior hamstring injury
Mechanism for Injury

- Most common with eccentric muscle contraction
- Most common for proximal avulsion is eccentric contraction with hip flexed and knee extended
- Hamstring injury among the most common lower extremity injuries in athletes accounting for up to 29% of all injuries in various sports.
- May produce prolonged impairment
- Reinjury risk high 12-31%
- Sports requiring rapid acceleration and ballistic movements
# Activity at injury

<table>
<thead>
<tr>
<th>Sport/Recreation</th>
<th># Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>water skiing</td>
<td>69</td>
</tr>
<tr>
<td>low energy fall</td>
<td>21</td>
</tr>
<tr>
<td>soccer</td>
<td>19</td>
</tr>
<tr>
<td>running/sprinting</td>
<td>9</td>
</tr>
<tr>
<td>gymnastics</td>
<td>12</td>
</tr>
<tr>
<td>rugby</td>
<td>11</td>
</tr>
<tr>
<td>martial arts</td>
<td>12</td>
</tr>
<tr>
<td>cross-country skiing</td>
<td>9</td>
</tr>
<tr>
<td>downhill skiing</td>
<td>7</td>
</tr>
<tr>
<td>tennis</td>
<td>5</td>
</tr>
<tr>
<td>power-lifting</td>
<td>5</td>
</tr>
<tr>
<td>basketball</td>
<td>4</td>
</tr>
<tr>
<td>ice hockey/skating</td>
<td>4</td>
</tr>
<tr>
<td>football</td>
<td>4</td>
</tr>
<tr>
<td>motorcycle/dirtbike</td>
<td>3</td>
</tr>
<tr>
<td>surfing</td>
<td>3</td>
</tr>
<tr>
<td>softball</td>
<td>2</td>
</tr>
<tr>
<td>rollerblading</td>
<td>2</td>
</tr>
<tr>
<td>bull-riding</td>
<td>2</td>
</tr>
<tr>
<td>cycling</td>
<td>1</td>
</tr>
<tr>
<td>horseback riding</td>
<td>1</td>
</tr>
<tr>
<td>volleyball</td>
<td>1</td>
</tr>
<tr>
<td>other</td>
<td>94</td>
</tr>
</tbody>
</table>

Feel a pull/pop
Stiff legged gait pattern
Ecchymosis posterior thigh
Palpable defect
Pain/weakness with resisted knee flexion/hip extension
Sitting pain ischial tuberosity
Xrays not helpful
  *exception: bony avulsion
MRI
  Level, # tendons, degree retraction
Symptoms

- Thigh pain
- Weakness
- Loss of leg control
  - Antagonist of quadriceps
- Pain with sitting
- Paresthesias
  - Due to proximity of sciatic nerve
Management

- Localize level of injury
- Early recognition for proximal injury
- Patient factors: age, activity level, medical comorbidities
- Physical Therapist or Athletic Trainer
- Referral to orthopedic specialist if suspect complete proximal rupture
- Non-operative versus operative intervention
Non-operative Management

- Incomplete proximal rupture
- Complete rupture, < 2 cm retraction (consideration for non-op)
- Ice
- NSAIDs
- Rest
- Therapy
  - Gentle stretching
  - Gradual strengthening
- Modalities
  - Ultrasound, estim, edema control
- Injection
  - PRP
Operative Management

- Surgical Indications
  - Proximal Avulsion
  - More than 2 tendon involvement
  - Retraction > 2cm
  - Active patient
  - Medical co-morbidities
  - Compliance with post-op rehabilitation
Outpatient surgery
Requires retrieving retracted tendons and re-insertion to the ischial tuberosity.
Utilize suture anchors to reattach and repair tendons back to the ischial tuberosity.
Post-op restrictions
- Brace
- Crutches
Acute vs Chronic

- Has implications for surgical management

- Acute
  - Less than 4 weeks
  - Trend towards improved function, outcomes

- Chronic
  - Greater than 4 weeks
Treatment of Proximal Hamstring Ruptures – A Systematic Review

J. D. Harris¹, M. J. Grieser¹, T. M. Best², T. J. Ellis¹

Surgical repair resulted in significantly (p < 0.05) better subjective outcomes, greater rate of return to pre-injury level of sport, and greater strength/endurance than non-surgical management. Similarly, acute surgical repair had significantly better patient satisfaction, subjective outcomes, pain relief, strength/endurance, and higher rate of return to pre-injury level of sport than chronic repair (p < 0.001) with reduced risk of complications and re-rupture (p < 0.05). Chronic surgical repair also improves outcomes, strength and endurance, and return-to-sport, but not as well as acute repair. Non-operative treatment results in reduced patient satisfaction, with significantly lower rates of return to pre-injury level of sport and reduced hamstring muscle strength.
Systematic Review

<table>
<thead>
<tr>
<th>Study</th>
<th># Surgical/ Non-surgical</th>
<th>Mean subject age (y)</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Konan 2010</td>
<td>10/0</td>
<td>29</td>
<td>Based on RTS. Excellent in all 10 cases.</td>
</tr>
<tr>
<td>Floor 2010</td>
<td>2/0</td>
<td>45</td>
<td>Both subjects satisfied. No pain with daily activities.</td>
</tr>
<tr>
<td>Mica 2009</td>
<td>6/0</td>
<td>59</td>
<td>Mean Harris Hip Score 97. Equivalent to contralateral side. No pain with daily activities.</td>
</tr>
<tr>
<td>Marx 2009</td>
<td>2/0</td>
<td>30</td>
<td>Both subjects “much improved”. No pain with daily activities or sports.</td>
</tr>
<tr>
<td>Sallay 2008</td>
<td>25/0</td>
<td>44</td>
<td>All subjects satisfied. 92% minimal to no daily pain. Equivalent isokinetic hamstring strength (vs. contralateral).</td>
</tr>
<tr>
<td>Wood 2008</td>
<td>72/0</td>
<td>40</td>
<td>All subjects improved. Significantly better strength/endurance if surgery within 3 months of injury.</td>
</tr>
<tr>
<td>Sarimo 2008</td>
<td>41/0</td>
<td>46</td>
<td>71% excellent or good outcome. Good/excellent delay to surgery 2.4 months (moderate/poor 12 months).</td>
</tr>
<tr>
<td>Folsom 2008</td>
<td>26/0</td>
<td>44</td>
<td>96% subjects satisfied. 80% subjects no daily pain. Equivalent isokinetic hamstring strength (vs. contralateral).</td>
</tr>
<tr>
<td>Gidwani 2007</td>
<td>9/3</td>
<td>nr</td>
<td>4/4 excellent outcomes if surgery within 5 months. Good outcomes even with delay in diagnosis.</td>
</tr>
<tr>
<td>Lempainen 2006</td>
<td>48/0</td>
<td>33</td>
<td>69% excellent, 19% good, 8% fair, 4% poor.</td>
</tr>
<tr>
<td>Brucker 2005</td>
<td>8/0</td>
<td>40</td>
<td>All subjects satisfied. 88% torque vs. contralateral side.</td>
</tr>
<tr>
<td>Chakravarthy 2005</td>
<td>4/0</td>
<td>nr</td>
<td>No pain with daily activities in all subjects.</td>
</tr>
<tr>
<td>Klingele 2002</td>
<td>11/0</td>
<td>42</td>
<td>91% subjects satisfied. 91% isokinetic hamstring strength vs. contralateral side.</td>
</tr>
<tr>
<td>Cross 1998</td>
<td>9/0</td>
<td>34</td>
<td>All subjects satisfied. All had “good clinical result”.</td>
</tr>
<tr>
<td>Kurosawa 1996</td>
<td>1/1</td>
<td>27</td>
<td>No difference in strength vs. contralateral side in operative case (vs. 30% strength in nonoperative).</td>
</tr>
<tr>
<td>Sallay 1996</td>
<td>2/10</td>
<td>40</td>
<td>5 subjects never RTS. 7 RTS at lower level. Very poor non-operative clinical results.</td>
</tr>
<tr>
<td>Orava 1995</td>
<td>8/0</td>
<td>40</td>
<td>63% good, 25% moderate, 12% poor. Significantly better pain relief if surgery within 2 months of injury.</td>
</tr>
<tr>
<td>Ishikawa 1988</td>
<td>2/0</td>
<td>20</td>
<td>Both subjects returned to full strength.</td>
</tr>
</tbody>
</table>

RTS (return to sport); y (years); nr (not reported)
Sports associated with increased risk of proximal hamstring injury

- Novice and expert water skiing
- Cross country skiing
- Dance/gymnastics
- Soccer
- Judo/martial arts

<table>
<thead>
<tr>
<th>Sport/Recreation</th>
<th># Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>water skiing</td>
<td>69</td>
</tr>
<tr>
<td>low energy fall</td>
<td>21</td>
</tr>
<tr>
<td>soccer</td>
<td>19</td>
</tr>
<tr>
<td>running/sprinting</td>
<td>9</td>
</tr>
<tr>
<td>gymnastics</td>
<td>12</td>
</tr>
<tr>
<td>rugby</td>
<td>11</td>
</tr>
<tr>
<td>martial arts</td>
<td>12</td>
</tr>
<tr>
<td>cross-country skiing</td>
<td>9</td>
</tr>
<tr>
<td>downhill skiing</td>
<td>7</td>
</tr>
<tr>
<td>tennis</td>
<td>5</td>
</tr>
<tr>
<td>power-lifting</td>
<td>5</td>
</tr>
<tr>
<td>basketball</td>
<td>4</td>
</tr>
<tr>
<td>ice hockey/skating</td>
<td>4</td>
</tr>
<tr>
<td>football</td>
<td>4</td>
</tr>
<tr>
<td>motorcycle/dirtbike</td>
<td>3</td>
</tr>
<tr>
<td>surfing</td>
<td>3</td>
</tr>
<tr>
<td>softball</td>
<td>2</td>
</tr>
<tr>
<td>rollerblading</td>
<td>2</td>
</tr>
<tr>
<td>bull-riding</td>
<td>2</td>
</tr>
<tr>
<td>cycling</td>
<td>1</td>
</tr>
<tr>
<td>horseback riding</td>
<td>1</td>
</tr>
<tr>
<td>volleyball</td>
<td>1</td>
</tr>
<tr>
<td>other</td>
<td>94</td>
</tr>
</tbody>
</table>
There was higher return to pre-injury sports for surgical treatment (82%) vs non-op (14%).

Rate of return to sport was higher for acute repair (96%) over chronic repair (75%).
Complete Proximal Hamstring Avulsions

A Series of 41 Patients With Operative Treatment

Janne Sarimo,*† MD, PhD, Lasse Lempainen,*‡§ MD, Kimmo Mattila,†‖ MD, PhD, and Sakari Orava,*† MD, PhD

From the *Mehiläinen Sports Trauma Research Center, Mehiläinen Hospital and Sports Clinic, Turku, Finland, †Paavo Nurmi Center, Sports and Exercise Medicine Unit, Department of Physiology, University of Turku, Turku, Finland, ‡Department of Surgery, Satakunta Central Hospital, Pori, Finland, and ‖Medical Imaging Centre of Southwest Finland, University Hospital of Turku, Turku, Finland

Background: Complete proximal hamstring avulsions can cause considerable morbidity and are often associated with significant functional loss.

Hypothesis: Early surgical treatment leads to better results than does surgery in the chronic phase.

Study Design: Case series; Level of evidence, 4.

Methods: Forty-one patients (21 men and 20 women) with a complete proximal hamstring avulsion were included. The cases were retrospectively analyzed, and a 4-category rating system was used to evaluate the overall result of the surgical treatment.

Results: The mean follow-up was 37 months (range, 12-72 months). Nineteen patients were rated as having an excellent result and 10 patients a good result. In 5 patients, the result was classified as moderate and in 7 patients poor. In the patients with an excellent or good result, the delay from the injury to surgery averaged 2.4 months, whereas in patients with a moderate or poor result, the delay averaged 11.7 months. The difference was statistically significant (P < .001).

Conclusion: Excellent or good results can often be expected with surgery, and considerable improvement of symptoms may be achieved even in chronic cases. According to the results, early operative treatment in complete proximal avulsions of the hamstring muscles gives better results than does late surgery and is therefore recommended.
Functional Outcomes and Return to Sports After Acute Repair, Chronic Repair, and Allograft Reconstruction for Proximal Hamstring Ruptures

David A. Rust,* MD, M. Russell Giveans,* PhD, Rebecca M. Stone,* MS, ATC, Kathryn M. Samuelson,* BS, and Christopher M. Larson,*† MD

Investigation performed at the Minnesota Orthopedic Sports Medicine Institute at Twin Cities Orthopedics, Edina, Minnesota, USA

Background: There are limited data regarding outcomes and return to sports after surgery for acute versus chronic proximal hamstring ruptures.

Hypothesis: Surgery for chronic proximal hamstring ruptures leads to improved outcomes and return to sports but at a lower level than with acute repair. Proximal hamstring reconstruction with an Achilles allograft for chronic ruptures is successful when direct repair is not possible.

Study Design: Cohort study; Level of evidence, 3.

Methods: Between 2002 and 2012, a total of 72 patients with a traumatic proximal hamstring rupture (51 acute, 21 chronic) underwent either direct tendon repair with suture anchors (n = 58) or Achilles allograft tendon reconstruction (n = 14). Results from the Single Assessment Numeric Evaluation (SANE) for activities of daily living (ADL) and sports-related activities, Short Form–12 (SF-12), visual analog scale (VAS), and a patient satisfaction questionnaire were obtained.

Results: The mean time to surgery in the chronic group was 441.4 days versus 17.8 days in the acute group. At a mean follow-up of 45 months, patients with chronic tears had inferior sports activity scores (70.2% vs 80.3%, respectively; \( P = .026 \)) and a trend for decreased ADL scores (86.5% vs 93.3%, respectively; \( P = .085 \)) compared with those with acute tears. Patients with chronic tears, however, reported significant improvements postoperatively for both sports activity scores (30.3% to 70.2%; \( P < .01 \)) and ADL scores (56.1% to 86.5%; \( P < .01 \)). Greater than 5 to 6 cm of retraction in the chronic group was predictive of the need for allograft reconstruction (\( P = .015 \)) and resulted in ADL and sports activity scores equal to those of chronic repair (\( P = .507 \) and \( P = .904 \), respectively). There were no significant differences between groups in SF-12, VAS, or patient satisfaction outcomes (mean, 85.2% satisfaction overall).

Conclusion: Acute repair was superior to chronic surgery with regard to return to sports. Acute and chronic proximal hamstring repair and allograft reconstruction had favorable results for ADL. For low-demand patients or those with medical comorbidities, delayed repair or reconstruction might be considered with an expected 87% return to normal ADL. For patients who desire to return to sports, acute repair is recommended.
- 37/72 (51%) water skiing injuries
- Again trend towards improved outcomes, patient satisfaction, and sports related activity with acute repair, though still significant benefit provided in ADLs and patient satisfaction with chronic repairs/allograft reconstruction.
Return to sports range 67-100% across various recent studies

<table>
<thead>
<tr>
<th>Study (Year)</th>
<th>No. of Patients</th>
<th>Satisfaction, %</th>
<th>ADL, %</th>
<th>Sports, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mansour et al(15) (2013)</td>
<td>10</td>
<td></td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>Acute surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lefevre et al(13) (2013)</td>
<td>34</td>
<td>88</td>
<td></td>
<td>79.40</td>
</tr>
<tr>
<td>Acute surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cohen et al(5) (2012)</td>
<td>40</td>
<td>98 (overall)</td>
<td></td>
<td>67 (overall)</td>
</tr>
<tr>
<td>Acute surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic surgery</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chahal et al(3) (2012)</td>
<td>12</td>
<td>100 (overall)</td>
<td></td>
<td>100 (overall; 45% lower level)</td>
</tr>
<tr>
<td>Acute surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic surgery</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birmingham et al(1) (2011)</td>
<td>9</td>
<td>95 (overall)</td>
<td></td>
<td>95 (overall)</td>
</tr>
<tr>
<td>Acute surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic surgery</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rust et al. AJSM 2014
More complex than acute
Increased risk of complications
Increased surgical time
Often requires allograft tissue to supplement native hamstrings and bridge the gap
Less favorable outcomes compared to acute repair
Chronic Repair Surgery
Complications of Surgery

- Nerve Injury
  - Incisional numbness: 12-61%
  - Posterior thigh, leg, or foot numbness: 10-39%

- Pain

- Infection
  - 4-6%
- Sciatic Nerve
  - During identification and mobilization of retracted torn tendon
  - Also during exposure
- Inferior Gluteal Nerve
  - At risk during gluteal muscle retraction during repair
  - Also with surgical approach
- Posterior Femoral Cutaneous Nerve
  - At risk with surgical approach
Rehab

- Varies depending on surgeon, repair tension, tendon quality, timing of repair.
- Brace (up to six weeks)
- Crutches, Non-weightbearing (2 weeks)
- Partial weightbearing (up to 6 weeks)
- Passive motion at 2 weeks
- Active motion begins 4 weeks
- Gradual progression of motion
- Isometric strengthening starting 8-10 weeks
- Typical return to sport between 6-10 months
Proximal hamstring rupture a rare injury
Not every hamstring strain needs an MRI
Sports at increased risk: WATER SKIING, hurdlers, dance, gymnastics, martial arts, soccer
Surgical intervention recommended for active patient wishing to return to sports
Acute repair outperforms chronic repair, and is technically easier to perform with less risk of complications than chronic repair.
Chronic repair still provides improved patient function and satisfaction


J Chakravorty, N Ramisetty, A Pimpalnerkar, N Mohtadi


Functional Outcomes and Return to Sports After Acute Repair, Chronic Repair, and Allograft Reconstruction for Proximal Hamstring Ruptures

David A. Rust, M. Russell Gieves, Rebecca M. Stone, Kathryn M. Samuelson and Christopher M. Larson


Evaluation and Management of Hamstring Injuries

Christopher S. Ahmad, Lauren H. Redler, Michael G. Ciccotti, Nicola Maffulli, Umile Giuseppe Longo and James Bradley


"I think I pulled a hamstring."
Thank you

Questions?