Surgical treatment of hamstring injuries  
‘When indicated, why and how’

@KerkhoffsG
Proximal HMC: Origins

Ischial tuberosity

3. Vertical ridge
Divides upper region into:

4. Lateral facet
   → Semimembranosus (SM)

5. Medial facet
   → Biceps Femoris (BF)
   → Semitendinosus (ST)
Proximal HMC: Ligaments

4. Lateral facet (SM)
5. Medial facet (BF/ST)
10. Sacrospinous ligament
11. Sacrotuberous ligament
12. Adductor longus (ischial origin)
Muscle-tendon unit

1. Semitendinosus
2. Raphe
3. Semitendinosus tendon

6. Biceps femoris (Long head)
7. Biceps femoris (Short head)
8. Biceps femoris tendon

9. Ischial tuberosity
10. Conjoint tendon
Proximal HMC: Topographical view

1. Semitendinosus
2. Semimembranosus
3. Biceps Femoris (Long head)
4. Ischial tuberosity
5. Sacrotuberous ligament
6. Sciatic nerve
Proximal HMC: Topographical view

1. Semitendinosus
2. Semimembranosus
3. Biceps Femoris (Long head)
4. Ischial tuberosity
5. Sacrotuberous ligament
6. Sciatic nerve
1. SM tendon
2. Conjoint (BF/ST) tendon
3. Ischial tuberosity
4. Sacrotuberous ligament
5. Sciatic nerve
6. Gluteus maximus
Hamstring surgery in literature

• Bone (i.e. avulsion fracture)

• Tendon
  • Free tendon (i.e. tendon avulsion/complete tear or tendinopathy)
  • Central tendon (i.e. complete tear)

• Tendon → Muscle
  • Musculotendinous Junction (MTJ) (i.e. partial tear)
Mechanism of injury – Complete tear

• Combination
  • Hip (hyper)flexion
  • Knee extension
  • Abduction...

• Often forced
  • Slip & fall
  • Sports participation
Mechanism of injury – Complete tear

- Combination
  - Hip (hyper)flexion
  - Knee extension
  - Abduction...

Case Report

Abduction in Proximal Hamstring Tendon Avulsion Injury Mechanism—A Report on 3 Athletes
Anne D. van der Made, MD, †‡ Rolf W. Peters, MD, †‡§ Claire Verheul, PhD, †‡ § Mario Maas, MD, PhD, †‡ and Gino M. Kerkhoffs, MD, PhD†‡

Abstract: Proximal hamstring tendon avulsions are typically sustained during forced hip hyperflexion combined with knee extension. Present 3 cases of athletes with a proximal hamstring tendon avulsion caused by an alternative injury mechanism that also involves a considerable hip abduction component (flexion-abduction injury mechanism). All cases had at least one concurrent injury of the medial thigh muscles, either on the ipsilateral or contralateral side. The 2 elite athletes with this injury mechanism returned to sport at preinjury level relatively quickly. A history of the flexion-abduction mechanism should raise suspicion of a hamstring tendon avulsion with concomitant injury of the medial thigh muscles. The magnetic resonance imaging (MRI) protocol should include both legs, and any concurrent injury may need to be addressed as well. In future studies, it would be interesting to investigate whether injury mechanism holds prognostic value in proximal hamstring tendon avulsions.

Key Words: Injury mechanism, proximal, avulsion, rupture, hamstring

(Clin J Sport Med 2017;001-4)
Mechanism of injury – Complete tear

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  • Hip (hyper)flexion
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  • Abduction...

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(Clin J Sport Med 2017;00:1–4)
Tendon injury: To operate or not?

• In theory:
  • Oxygen consumption in tendon is 7.5x less than skeletal muscle tissue, relatively low metabolic rate
  • Metabolic rate ↓ is thought to result in healing speed ↓

• In practice:
  • injuries involving free tendon or central tendon take significantly longer to heal compare to muscle injury
  • Supported by case series only

• Conservative treatment, or is intervention necessary?

Askling et al. (2007), Sharma et al. (2006)
Avulsion fracture - Proximal

- More common in the skeletally immature
- Literature limited to (small) case series

- Proximal insertion on ischial tuberosity (secondary ossification centre)

- Undisplaced:
  - Both non-operative and operative treatment reported with ‘good’ outcome

- Displaced:
  - Appears to lead to higher risk of (fibrous) non-union and chronic symptoms/disability
  - Viewed as surgical indication (open reduction & internal fixation)
    - Kocher-Langenbeck approach
    - Fixation with pelvic plate & screws

Gidwani et al. (Ann R Coll Surg Engl 2007), Shyamalan et al. (Injury 2010), Wood et al. (JBJS 2008), Wootton et al. (JBJS 1990)
Tendon avulsion: To operate or not?

→ Hamstring avulsion (proximal)
  • First case series (Sallay et al., 1996): debilitating outcome if untreated
  • 1st systematic review (Harris et al., 2011):
    • Surgery > Conservative
    • Acute (≤4 weeks) > Delayed (>4 weeks)
  • 2nd systematic review (van der Made et al., 2015):
    • All of low methodological quality
    • Acute ≈ Delayed

• NO studies comparing surgery vs conservative

Harris et al. (2011), Sallay et al. (1996), van der Made et al. (2015)
Surgical versus conservative

• Prospective case series from summer 2014
• Preliminary Update:
  • 13 conservative
  • 14 surgical
  • Follow-up of 1 year

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<th>Surgical group</th>
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<td>Sex</td>
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<td>Age, median (IQ-range)</td>
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<td>Side of injury</td>
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<td>0.168</td>
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<td>Pre injury level of sports</td>
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<td>2 professional, 6 competitive, 5 recreational and 1 unknown</td>
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<td>Ruptured tendons</td>
<td>7 (SM,ST and BF) / 2 (SM) / 2 (BF and ST)</td>
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<td>Level of retraction, median (IQ-range), cm</td>
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* Significant difference with level of significance P < 0.05
1. SM = M. Semimembranosus, ST = M. Semitendinosus, BF = M. Biceps Femoris
2. Time between injury and consult or surgical treatment in days
Surgical versus conservative

• MRI at 1 year
  • Conservative: 12/13 show discontinuity of hamstring muscle complex with moderate to severe muscle atrophy
  • Surgical: All show continuity of hamstring muscle complex with mild muscle atrophy

• Isokinetic hamstring strength peak torque deficit (con 60 deg/s) at 1 year
  • Conservative: 30%±28 (95% CI = 12-48%)
  • Surgical: 26%±23 (95% CI = 6-45%)
Limitations & Future perspective

- Small sample size
- Selection bias
  - Not randomized
  - Level of retraction
- Follow-up of 1 year
  - Relatively short-term
  - Possible recovery after 1 year

GO controlled!

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² Time between injury and consult or surgical treatment in days
Tendon avulsion - Distal

- Uncommon injury (2% of all hamstring injuries)
- Mainly case reports & 1 Retrospective series
  - Lempainen et al. (Br J Sports Med 2007)
    - N=18, 5 out of 18 were complete ruptures, all treated surgically
    - 5/5 ‘excellent’ results, 100% return to sport at former level
    - Surgery beneficial in selected cases

- No studies with a control group

- Case reports show inconsistent results on conservative vs surgical treatment

Koulouris et al. (Skeletal Radiol 2003), Lempainen et al. (Br J Sports Med 2007)
Tendinopathy - Proximal

• Key to tendinopathy management is progressive loading
  • No clear guidelines on rehabilitation program

• Surgery considered when conservative management fails
  • Proximal Semimembranosus (SM) tenotomy, SM sutured to Biceps Femoris
  • Sciatic nerve free of adhesions (if applicable)

• 89% (80/90) patients returned to sports at former level
• Results rated ‘excellent’ in 60% (62/103), ‘good’ in 29% (30/103), ‘fair’ in 5% (5/103) and ‘poor’ in 6% (6/103) cases

Goom et al. (J Orthop Sports Phys Ther 2016), Lempainen et al. (Muscles Ligaments Tendons J 2015), Lempainen et al. (Am J Sports Med 2009)
MTJ injury

• Vast majority of hamstring injuries are
  • Partial tears (also called ‘strain injury’)
  • Proximal > distal
  • Located at/near MTJ
  • Managed conservatively with good outcome

• However
  • Some cases seem to be ‘therapy-resistant’
  • Surgery has been suggested in recurrent/persistent hamstring injury
MTJ injury

• Sonnery-Cottet et al. (Orthop J sports Med) 2015):
  • Persistent/Recurrent injury (N=10, 6 proximal & 4 distal)
    • Proximal: Excision of scar tissue (incl. torn tendon) & sutured muscle to adjacent hamstring
    • Distal (ST): Stripping of distal tendon
    • All returned to pre-injury level after surgical intervention

• Lempainen et al. (Br J Sports Med 2007)
  • N=18 (all distal), 12 out of 18 were partial tears located at MTJ
    • Excision of scar tissue & suturing
    • Results 7/12 (58%) ‘excellent’, 1/12 (8%) ‘good’, 3/12 (25%) ‘fair’ & 1/12 (8%) ‘poor’
    • 67% return to sport at former level, 2/4 that did not showed sings of severe denervation
    • Surgery might be beneficial as a final resort in selected cases

Summary

• Surgery in hamstring injuries now mainly reserved for avulsions

• Currently no evidence-based criteria/indications for surgery

• Athletes seem to have advantage after surgical repair for avulsions

• Need for high-level controlled trials/registry