Achilles Tendon Rupture

Basic Science

- Achilles tendon is conjoint tendon of gastrocnemius, plantaris and soleus, which plantar flexes the foot at the ankle joint. Gastrocnemius is principal contributor when knee is straight, and soleus when the knee is flexed.
- Blood supply proximally is from muscle, and distally from the calcaneal insertion. A watershed area exists between 2-6 cm proximal to its insertion, where there is a zone of hypovascularity as blood supply depends solely on vessels from the paratenon.
- Composition:
  - Type 1 collagen (triple α-helix) forms primary bundle
  - Surrounded by the endotenon which is composed of type 3 collagen and contains neurovascular supply.
  - This is enveloped by the epitenon mainly composed of type 1 collagen.
  - The whole tendon is surrounded by the paratenon, which is a double-layer sheath without a synovial lining (= tenovagium) unlike most other tendon’s paratenon (= tenosynovium)
- Healing following acute injury:
  - Inflammatory phase: 4-7 days → invasion by inflammatory cells and fibroblasts
  - Proliferation phase: 7-14 days → random deposition of type 1 collagen
  - Maturation phase complete: 8-12 weeks (2-3 months) → re-alignment of fibrils along lines of tensile stress
  - NSAIDs can protect early soluble collagen from proteolytic enzymes, and cold therapy reduces chemotactic factors and oedema.
  - Controlled movement allowed early to prevent scar adhesions, but beware disruption of repair tissue if subjected to excessive tensile force.

Risks

- Gastrocnemius contracture can put increased stress on the tendon to maintain a plantargrade position – Achilles stretching an important part of rehab.
- Previous partial tears (common in athletes); this may represent an acute presentation of Achilles tendinosis (= thickening or degeneration of tendon in the absence of inflammatory cells)
- Steroid injections – intra-substance injections are contra-indicated, and peritendinous injections are also controversial.
  - Fluoroquinolones
  - Gout
  - Hyperthyroidism
  - Renal insufficiency

Scenarios

- Unexpected rapid dorsiflexion of the foot, while gastrocnemius and soleus contracting (stepping off curb or into hole)
- Forceful plantarflexion with a straight knee (playing tennis or badminton)
- Strong dorsiflexion force on a plantarflexed foot (deceleration during a fall or landing after a jump)
- Look for a palpable gap, history of a “snap” or “feeling as if hit in the back of the ankle”.
- Lack of tip-toe movement, and positive Simmond’s (or Thompson’s).
Management

- Non-operative in equinus cast for 4 weeks and NWB
  - Then 4 weeks in a semi-equinus cast and then a plantargrade cast.
  - Or use of weight bearing air-cast boots with reducing inserts every 2 weeks and PWB.
  - Risks of muscle atrophy, adhesion formation, stiffness and DVT
  - Re-rupture rates quoted between 5-20%, and higher in younger age group (more demand)
- Primary repair
  - Can be performed immediately or up to 6 weeks post injury; ideally within 2 weeks.
  - Open, mini-open or percutaneous.
- Percutaneous technique has increased risk of sural nerve injury, fewer wound complications but lower re-rupture rate (Haji 2004)
- Open technique using medial sided incision to avoid sural nerve, which lies subcutaneously on the lateral aspect of the Achilles tendon after perforating the crural fascia at the level of the musculo-tendinous junction (MTJ)
  - Avoid flaps and close paratenon separately to minimise adhesions between tendon and skin
  - Allows more accurate repair and greater chance of restoration of maximal strength
  - Higher risk of wound infections especially in the obese, diabetics, smokers and those with circulatory problems (venous or arterial).
- Rehabilitation involved 2 weeks of immobilisation in an equinus cast/slab and NWB to allow wound to heal.
  - Weight bearing is then allowed in an air-cast boot with active movements
  - Reducing inserts in the air-cast boot
  - Formal physiotherapy and strengthening at 6-8 weeks
  - Scar massage can be used to reduce adhesions
  - Continuous programme of stretching should be maintained for 1 year after surgery
- Chronic ruptures (> 6 weeks without treatment)
  - Non-operative management usually fails to restore push-off strength
  - V-Y lengthening of the gastrocnemius tendon at the MTJ or a tendon turndown can be performed to compensate for inevitable contracture
  - Often requires augmentation or transfer using FHL (a phasic muscle during gait cycle)
Literature Summary

- **Moller (JBJS, 2001)**
  multi-centre RCT with 112 patients treated either operatively with early mobilisation or 8 weeks in plaster.
  - 4 weeks equinus NWB, and 4 weeks neutral WB
  - Surgery involved an end-to-end modified Kessel suture with closure of paratenon, and a BK-POP in 30° equinus.
    - Replaced with Dom-Joy ROM-walker brace at 12 days, locked at 30° equinus.
    - FWB and 10° equinus at 4 weeks, with 10° dorsiflexion at 6 weeks
  - Excluded: prior injury, diabetes, immunosuppressed
  - 90% treated within 12 hours of injury (usually aim for < 72 hours)
  - Surgical complications:
    - 1 re-rupture
    - 1 superficial infection
  - Non-surgical complications:
    - 11 re-ruptures
    - 1 DVT
  - Outcomes:
    - Equal functional scores, and return to sporting activities
    - Surgical group returned to work 19 days earlier
    - No difference in ROM, isokinetic strength and endurance, but at 2 years 22% conservatively treated patients could not perform a single heel raise compared with 8% in surgical group.

- **Mafulli 1999 (JBJS)**
  percutaneous repair of a ruptured Achilles tendon provides approximately 50% of the initial strength afforded by open repair and places the sural nerve at risk for injury. *Mafulli’s opinion* was that non-operative treatment should be reserved for older patients who are unlikely to derive any major benefit from an operative procedure and for patients who view an operation as an unnecessary risk.

- **Nistor (1981)**
  recommended nonoperative management, as there were only minor functional differences between the two groups and the operation caused more complications

- **Carden (1987)**
  concluded that patients who are seen less than forty-eight hours after the injury should be managed nonoperatively, with eight weeks of immobilization in a cast, whereas patients who are seen one week or more after the injury should be managed operatively

- **Kellam (1985)**
  in a meta-analysis found a lower re-rupture rate (1% vs. 18%), better strength and ×1.5 better satisfaction in operative treatment groups

- **Suchak (JBJS Am 2008)**
  no difference in functional outcome or complications at 6 months with early weight-bearing at 2 weeks, compared with NWB for 6 weeks, after surgery.

- **Saxena (J Am Podiatr Med Assoc 2008)**
  n=219, wound complications can be as high as 10% after open surgical TA-repair, with greater risks in diabetics, smokers patients on steroid therapy.

- **Khan (Cochrane Database Syst Rev 2004) (JBJS Review 2005):**
  open operative treatment of acute Achilles tendon ruptures significantly reduces the risk of re-rupture compared to non-operative treatment (relative risk 0.27), but produces a significantly higher risk of other complications (relative risk 10), including wound infection. The latter may be reduced by performing surgery percutaneously. Post-operative splintage in a functional brace appears to reduce hospital stay, time off work and sports, and may lower the overall complication rate.
Wallace R et al (JBJS, 2011; 93-B; 1362-66)

*The non-operative functional management of patients with a rupture of the tendo Achillis leads to low rates of re-rupture*

Enrolled by clinical diagnosis based on classical history and examination findings (palpable gap, bruising and absent calf-squeeze test). 949 ruptures tendons treated non-operatively in patients with a mean age of 49, of whom 70 were delayed presentations. Minimum 2 year follow-up. Protocol: A&E referrals to Achilles rupture clinic, and placed immediately in an equinus cast. At 4 weeks changed to pneumatic walker with heel raises removed fortnightly. Walker removed at 8 weeks, and began physiotherapy (gait training, strength & mobility) for 6 weeks before discharge.

Good to excellent subjective assessments in 99.4%. All returned to work and pre-injury sporting level within 3 months of finishing physiotherapy. Re-rupture rate just 2.8% - all occurred within 3 months. Age, return to sport and delayed presentation did not influence re-rupture rate. Other complications: DVT 1%, heel pain 2%, reduced ROM 1%.

Willits K et al (JBJS 2010, 92-A; 2767-750)

*Operative vs. nonoperative treatment of acute Achilles tendon ruptures*

Multi-centre RCT with minimum 2 years follow-up for acute (less than 2 weeks) TA rupture. Excluded patients on fluoroquinolones or IDDM. Comparison of surgery plus accelerated rehab (n=58) with pure accelerated rehab alone (n=58), with primary outcome of re-rupture, and secondary outcomes of isokinetic strength, Leppilahti score, ankle ROM and calf circumference. Each group underpowered by 20, but initial power calculation based on much higher re-rupture rates seen with standard rehab as opposed to early weight bearing.

Reruptures: 2 in surgery group, and 3 in nonoperative group – not significant. Both groups achieved 80% plantarflexion and 100% dorsiflexion compared to uninjured side. But *operative group had 20% more strength* relative to uninjured side. No difference in calf circumference (both groups reduced by 1.3 cm). Total complications 18% vs. 8%, with *more complications related to surgery.*

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>Week 0</td>
<td>NWB equinus cast</td>
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<tr>
<td>Week 2</td>
<td>PWB in air cast boot with 2 cm heel insert, worn even when asleep.</td>
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<td>Passive ROM exercises up to plantargrade (neutral) position</td>
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<td>Week 4</td>
<td>Allow FWB in boot</td>
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<td>Week 6</td>
<td>Remove heel raise, and start dorsiflexion stretching</td>
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<td>Week 8</td>
<td>Wean off the boot</td>
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<tr>
<td>Week 12</td>
<td>Start strength training, and sport specific training with physiotherapist.</td>
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Healy et al (JBJS, 2010; 92B (5) 646-650)

*Venous thromboembolism following prolonged cast immobilisation for injury to the teno Achilles*

Retrospective case series of 208 patients, managed in cast for 6-8 weeks following surgical and conservative repair of the TA-injury (rupture or tendinitis). Symptomatic VTE rate proven on USS scan around 6.3% (comparable to rate following arthroplasty). No DVT prophylaxis given to any of the cases, despite 50% having risk factors for VTE.