Achilles Tendon Repair and Rehabilitation

Surgical Indications and Considerations

Anatomical Considerations: The poorest blood supply to the Achilles tendon is in the central part of the tendon – approximately 2 to 6 cm proximal to the calcaneal insertion – which may account for the fact that most of the ruptures occur in this area.

Pathogenesis: Tendons rupture when the mechanical loads exceed the physiologic capacity of the tendon. The physiologic capacity of the Achilles tendon may be compromised by intrinsic factors such as hypovascularity, repetitive microtrauma and the associated inflammation and degeneration, endocrine function and nutrition. Extrinsic, mechanical forces may also exceed the physiologic capacity of the Achilles tendon, such as when 1) an individual forcefully pushes off the forefoot while extending the knee (e.g., when cutting, sprinting or jumping), 2) an individual experiences a sudden dorsiflexion with full weightbearing (e.g., a slip, fall, or sudden deceleration), or 3) an individual experiences violent dorsiflexion when jumping from a height and landing on a plantar-flexed foot.

Epidemiology: Achilles tendon ruptures are one of the most frequently ruptured tendons – about 40% or all tendon ruptures are of the Achilles. Most Achilles tendon ruptures occur in male, recreational athletes between the ages of 30 and 40 years. Athletic activities that require sudden acceleration or deceleration are most likely to cause a rupture. Ruptures not attributed to athletic activity are usually caused by falls or stumbles that also produce sudden acceleration and deceleration movements.

Diagnosis

- Most patients describe a “pop” as though someone has shot them in the back of the ankle
- Palpable defect in the tendon between 2 to 6 cm proximal to the calcaneus
- Positive Thompson’s test
- Radiograph’s rule out bony injury
- MRI can be helpful in demonstrating the presence, location, and severity of the tear(s)

Nonoperative Versus Operative Management: Surgical repair is typically recommended for patients who expect to return to relatively high functional activities required of recreational athletics. Surgical repairs allow quicker mobilization and return to activity – thus lessening the deleterious effects on prolonged cast immobilization with the ankle in a plantarflexed position. The main surgical risk is wound infection and breakdown, which can be a distrastrous complication because soft tissue coverage can only be resolved with vascularized flaps and a reconstructive tendon procedure will likely be required. Indications for nonoperative management include patients with poor wound healing potential (e.g., those with moderately severe diabetes), concomitant illnesses, a sedentary lifestyle or lower functional/athletic goals. The prolonged cast immobilization required of nonoperative management promotes the
following common problems associated with immobilization: muscle atrophy, joint stiffness, cartilage atrophy, degenerative arthritis, adhesion formation, and deep venous thrombosis. The average re-rupture rate is about 18% in nonoperative patients compared with approximately 2% in operatively treated patients.

*Surgical Procedure:* Surgery is usually performed about one week after rupture. This delay allows consolidation of the tendon ends, making the repair technically easier. Various suture techniques have been described to approximate the ruptured ends of the tendon. Augmentations using either the plantaris tendon or gastrocnemius fascia flaps have also been described. Mandelbaum et al promotes the use of a Krackow modified suture technique to provide a stronger fixation – thus, allowing an accelerated rehabilitation emphasizing early motion, weight bearing and conditioning in motivated, higher-level athletes. Neglected acute ruptures or re-ruptures may require reconstruction using endogenous materials (e.g., fascia lata, peroneus brevis transfer) or exogenous materials (e.g., carbon fiber, Marlex mesh, Dacron vascular grafts, polypropylene braid).

*Preoperative Rehabilitation*

- Further injury protection using a splint or cast – with the ankle in about 20° or plantarflexion
- Instruction in use of crutches to maintain the desired non-weight bearing or partial weight bearing status
- Instructions/review post-operative rehabilitation plan

**POSTOPERATIVE REHABILITATION**

*Note:* The following rehabilitation progression is a summary of the guidelines provided by Mandelbaum, Gruber, and Zachazewski. Refer to their publication to obtain further information regarding criteria to progress from one phase to the next, anticipated impairments and functional limitations, interventions, goals, and rationales.

**Phase I for Traditional Immobilization and Rehabilitation:** Weeks 1-4

*Goals:* Control edema and pain
  - Protect repair
  - Minimize deconditioning

*Intervention:*

- Cast with ankle in plantarflexion
- Elevation and ice
- Instruct and monitor non-weight-bearing crutch ambulation
- General cardiovascular and muscular conditioning program
Phase II for Traditional Immobilization and Rehabilitation: Weeks 5-8

Goals: Control any residual symptoms of edema and pain
 Continue to protect repair
 Progressive weightbearing status
 Minimize deconditioning

Intervention:

• Re-casted with ankle in neutral dorsiflexion
• Elevation and ice
• Instruct in progressive weight-bearing, as allowed, using the appropriate assistive devices and encouraging normal gait mechanics
• Modify/progress cardiovascular and muscular conditioning program

Phase III for Traditional Immobilization and Rehabilitation: Weeks 9-16

Goals: Normal gait mechanics
 Limit scar tissue adhesions
 Full range of motion (ROM)
 Improve strength of all ankle and foot musculature
 Modify/progress cardiovascular and muscular conditioning program

Intervention:

• Gait training – use a the appropriate height heel lift, if necessary, to attain normal loading response and stance phase mechanics
• Soft tissue mobilization to hypomobile tissue in superficial fascia near surgery site and to shortened posterior calf myofascial
• Joint mobilization to hypomobile accessory motions of the talocrural, talocalcaneal, and mid-tarsal articulations
• Progressive passive stretching to painfree tolerance
• Active range of motion (AROM) exercises, isometric exercises, progressing to resisted exercises using tubing or manual resistance – to all weakened ankle and foot musculature
• Modify/progress cardiovascular and muscular conditioning
**Phase IV** for *Traditional* Immobilization and Rehabilitation: Weeks 17-20

Goals: Normal gait mechanics for walking and running on level surfaces
Symmetric ankle mobility and single-leg proprioception
Improved ability to perform repeated single leg heel raises
Initiate sport-specific or job-specific skill development

Intervention:

- Continue intervention strategies listed in Phase III as indicated by remaining impairments
- Progress stretching exercises to initiate body weight stretching over incline or wedge
- Progress resistive exercises to body weight exercises such as repeated heel raises (if no increase in symptoms occurs with previous exercises)
- Progress proprioceptive and balance training to include pertabative surfaces (such as a wobble board) or advanced single-leg balance activities
- Near the end of phase IV, begin running progression and/or sport-specific or job-specific skill development

**Phase I** for *Early Motion* and Rehabilitation: Day 1-7

Goals: Prevent wound complications
Control edema and pain
Active dorsiflexion to –5°
50% of active plantar flexion (compared to opposite side)

Intervention:

- Instruct in surgical site protection
- Elevation and ice
- Toe curls, ankle pumping (full active dorsiflexion and plantar flexion – out of splint - by day 3)
- Instruct and monitor non-weight-bearing crutch ambulation
**Phase II** for *Early Motion* and Rehabilitation:  Weeks 2-8

Goals:  
Active dorsiflexion to 0° by week 4  
Active dorsiflexion to +5° by week 8  
Full weight bearing beginning on day 14  
Normal gait mechanics on level surfaces without brace by end of week 8  
Initiate progressive resistive training program for the gastrocnemius-soleus complex

Intervention:

- Pool therapy – walk or run under full buoyancy conditions (non-weight bearing only), heel raises in chest deep water after Week 5  
- Ankle AROM (out of splint) exercises  
- Initiate gentle passive dorsiflexion stretching with towel or strap after Week 3  
- Initiate gentle, painfree, weight-bearing dorsiflexion starting at Week 5  
- Gait training wearing protective splint – with weight bearing to tolerance until Week 5  
- Gait training out of walking splint to painfree tolerance starting at Week 5  
- Painfree resistive ankle exercises using elastic tubing or band  
- Initiate double-leg heel raises at Week 5  
- Initiate single-leg heel raises in chest-deep water after Week 5  
- Initiate submaximal isokinetic dorsiflexion and plantarflexion – emphasizing endurance  
- Cardiovascular conditioning on stationary bicycle to painfree tolerance using walking splint until Week 5 – without splint to painfree tolerance starting at Week 5  
- Resistive exercises for unaffective muscle groups

**Phase III** for *Early Motion* and Rehabilitation:  Weeks 9-20

Goals:  
Normal gait mechanics for all activities of daily living  
Normal ankle and foot ROM  
Ability to perform repeated single-leg heel raises  
Fast walking, progressing to slow jogging, progressing to sport-specific or job specific skill development – all to painfree tolerance

Intervention:

- Continue intervention strategies listed in Phase II as indicated by remaining impairments  
- Pool therapy – walking, gentle hopping and jumping in waist deep water  
- Gait training – progress to treadmill walking on level surfaces and later on a slight incline, gradual progressing to jogging if symptom free – and – progress to skipping, hopping, and easy jumping after Week 17.  Careful not to progress gait or sport specific training too soon and accentuate the risk of re-rupture.  
- Progress submaximal isokinetic dorsiflexion and plantarflexion – emphasizing endurance  
- After Week 17, develop and individualized strength and flexibility program to address
remaining impairments on the involved and uninvolved lower extremities. Then, gradually initiate a functional training program – leading toward the ability to perform the desired sport-specific or job-specific skills.

Selected References:


