


Review Article

Conservative management of ruptured Achilles tendon: A physiotherapist's perspective

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Abstract

Ruptured Achilles tendons are a common injury, often occurring among athletes and middle-aged individuals involved in recreational activities. In patients, such as those with partial ruptures, small tendon gaps, or medical comorbidities, conservative management without surgical intervention is an effective alternative option. This approach requires immobilization through a below knee cast holding ankle in plantarflexed position or walking boot, followed by rehabilitation through gradual weight-bearing and structured physiotherapy sessions. Rehabilitation focuses on pain management through mobility restoration, calf muscle strengthening, and balance improvement. Physiotherapy aided by early mobilization and progressive weight bearing helps in improving active tendon healing, muscle strength, and functional recovery. Physiotherapists play a crucial role in guiding the rehabilitation process, as they educate and motivate patients on adherence, monitoring their progress, guiding and modifying rehabilitation to prevent complications like re-rupture or tendon elongation. Studies have shown that properly implemented conservative treatment, especially in low demand patients, can provide outcome results similar to surgical treatment. Advancements in recovery support technology like wearable devices and platelet-rich plasma (PRP) are expected to boost restoration efforts and enhance recovery in future.

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1. Introduction

The Achilles tendon, the largest and strongest tendon in the human body, connects the calf muscles (gastrocnemius and soleus) to the calcaneus (heel bone). It is crucial for walking, running, and jumping as it transmits forces from the calf to the foot. Achilles tendon ruptures are not rare, especially in athletes and middle-aged men participating in recreational activities. The injury typically results from acute accelerations or decelerations, e.g., sprinting or pivoting, and is described by a sudden "snapping" sensation, pain, and impaired function.¹

Achilles tendon ruptures may be treated conservatively or surgically. Operative treatment is usually advised for young, active patients or those with total ruptures, but older,

less active patients or those with partial ruptures are often treated conservatively. Conservative treatment bypasses the risk of surgical complications, including infection and wound problems, but patient selection is crucial and adherence to rehabilitation is necessary.²

This review aims to provide an overview of conservative management of Achilles tendon rupture with emphasis on evidence-based care, challenges, and outcomes of non-surgical intervention, with special reference to the role of physiotherapy in enhancing recovery.

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2. Pathophysiology of Achilles Tendon Rupture

2.1. Mechanism of injury

Achilles tendon ruptures most commonly result from a combination of intrinsic and extrinsic factors (**Table 1**). The most frequent mechanism is sudden, forceful dorsiflexion of the ankle or eccentric calf muscle loading, such as when pushing off with the foot in sprinting or jumping. This sudden stress may exceed the ability of the tendon to resist tension and cause a complete or partial rupture.³

Table 1: Risk factors and mechanisms of Achilles tendon injury

Category	Cause	Description
Intrinsic Factors	Degenerative Changes	Tendon degeneration (tendinopathy) is a significant risk factor associated with ageing, decreased blood supply, and chronic overuse.
	Reduced Elasticity	Achilles tendon loses elasticity with age due to changes in collagen composition, Increasing susceptibility to injury.
	Genetic Predisposition	Some individuals may have genetic predisposition to tendon weakness or collagen abnormalities, Increasing risk of rupture.
Extrinsic Factors	Repetitive Stress	Activities involving repetitive loading (e.g., running, jumping) leading to microtrauma and eventual rupture of tendon.
	Sudden Increase in Activity	Rapid increase in training intensity or duration overloads the tendon without adequate conditioning.
	Medications	Corticosteroids and fluoroquinolone have detrimental effects on collagen synthesis and tendon strength.
Common Scenarios	Sports Injuries	Higher risk for athletes in sports requiring brisk and repetitive movements like in basketball, tennis, and soccer.
	Recreational Activities	Middle-aged "weekend warriors" prone to ruptures due to inadequate conditioning and poor warm-up practices.

2.2. Healing process

Healing of a Ruptured Achilles tendon involves a series of cellular, biochemical, and biomechanical changes. Knowledge of these stages is very important for proper designing and modelling of rehabilitation protocols.^{4,5}

1. Inflammatory phase (0–7 days):

- Key events:** Immediately after the injury, the ruptured tendon ends retract, and a hematoma (blood clot) is formed at the site of injury, often disguised as black-blue discoloration. Inflammatory cells, including neutrophils and macrophages, start infiltrating the area to remove debris and initiate the healing process.
- Clinical implications:** During this phase, the tendon is highly vulnerable, and further stress can disrupt the healing process. The critical intervention for avoiding re-ruptures consists of protection and immobilization.
- Physiotherapist's role:** Focus on pain management, edema control (e.g., ice, compression), and gentle passive range of motion (ROM) exercises to avert stiffness.

2. Proliferative phase (2–6 weeks):

- Key events:** Fibroblasts migrate to the site of injury to synthesize collagen, primarily type III collagen, which is weaker and less organized than natural type I collagen. This results in the formation of granulation leading to early scar tissue.
- Clinical implications:** Although, the tendon begins to regain some structural integrity, it still remains weak and prone to re-injury. Controlled tension is essential to stimulate collagen synthesis while preventing overstress at the site of healing.
- Physiotherapist's role:** Introduce gentle exercises with active range of motion, isometric strengthening, and partial weight-bearing. Eccentric tension exercises can be added cautiously to help further collagen alignment.

3. Remodeling phase (6 weeks–12 months):

- Key events:** Tensile strength gradually increases with the gradual reorganization and alignment of collagen fibers along the tendon's longitudinal axis. Over time, the weaker type III collagen is replaced by stronger type I collagen, improving the tendon's overall mechanical potential.
- Clinical implications:** As the tendon heals, it becomes stronger and more functional, but full recovery of function can take up to a year. Progressive weight bearing exercises and functional training are important for best results.

- c. Physiotherapist's role: The physiotherapist's Role is to increase the level of eccentric strengthening exercises, balance training, and sport-specific drills. They should also monitor signs of overloading, like pain or swelling, and adjust the rehabilitation program accordingly.

4. Challenges in tendon healing:

- a. Scar tissue formation: The healing tendon may form scar tissue, which is less flexible and weaker than the original tendon. This leads to decreased functional capacity and a higher risk of re-rupture.
- b. Tendon elongation: In some cases, the healed tendon may elongate, causing reduced strength and power.
- c. Delayed healing: Factors like advanced age, poor nutrition, smoking, and associated comorbidities (e.g., diabetes) can impair the healing process.

3. Conservative Management: An Overview

Conservative management of Achilles tendon rupture is a well-accepted approach that avoids the risks associated with surgery, such as infection, wound complications, and anesthesia-related issues. This approach is suitable for a specific group of patients who willing to comply the structured and phased approach of rehabilitation process.^{6,7}

3.1. Indications for conservative treatment

Conservative management is not a one-size-fits-all approach and is most effective when applied to carefully selected patients. The following are the primary indications for non-surgical treatment:

1. Partial ruptures:
 - a. Patients with partial tears of the Achilles tendon are ideal candidates for conservative management. These injuries often have a better prognosis because the remaining intact tendon fibres inside the tendon sheath provide structural support and facilitate healing.
2. Minimal tendon gap (<10 mm):
 - a. Imaging studies like ultrasound or MRI are used to measure the gap between the ruptured tendon ends. A gap smaller than 10 mm is often considered suitable for conservative treatment, as the tendon ends are more likely to approximate and heal without surgery.
3. Low functional demands:
 - a. Patients with lower physical activity levels, like older adults or sedentary individuals, may not

require the high tensile strength provided by surgical repair. Conservative management can sufficiently restore function for daily activities.

4. Contraindications to surgery:

- a. Certain medical conditions increase the risks associated with surgery, making conservative management a safer option. These include:
 - i. Diabetes: Poor wound healing and increased risk of infection.
 - ii. Peripheral Vascular Disease: decreased blood flow to the lower extremities and chances of necrosis at repaired site.
 - iii. Smoking: Impaired tissue healing and higher complication rates.
 - iv. Obesity: Increased surgical risks and delayed recovery.

5. Patient preference:

- a. Some patients may prefer to avoid surgery due to personal, financial, or logistical reasons. In such cases, conservative management can be followed with careful monitoring and adherence to rehabilitation protocols.

3.2. Key components of conservative management

Conservative management involves a structured, stepwise approach that includes immobilization, early weight-bearing, and progressive rehabilitation. Each component has a critical role in promoting tendon healing and restoring function.

1. Immobilization and bracing:^{8,9} Immobilization and bracing play a significant role during the early management of conservative Achilles tendon rupture. It protects the healing tendon, decreases rupture ends gap, and prevents re rupture. In the traditional approach, a below-knee cast down in plantarflexion (pointed downward) is employed within a time frame of 2-4 weeks. Modern approaches often use removable walking boots with adjustable wedges to gradually decrease plantarflexion over time, facilitating easier wound management and earlier rehabilitation. Immobilization period is normally 6-8 weeks with progressive movement of the ankle in the sagittal plane as healing progresses.
2. Early weight-bearing:^{10,11} Early weight-bearing in conservative management of Achilles tendon rupture helps stimulate tendon remodeling, reduce muscle atrophy, and improve patient mobility. In the beginning, patients bear the load with crutches during non-weight-bearing or partial weight-bearing phases for the first 2 weeks to reduce the loading on the

tendon in healing phase. Then, they sequentially move to full, more weight-bearing activity in a walking boot with heel wedges for the following 4 weeks. Eventually, they move from weight-bearing on their own and without assistive devices for 6 weeks at the maximum tolerated level. Evidence-based literature indicates that early weight-bearing should not lead to re-rupture of the tissues and may actually have a positive effect on functional outcomes in comparison with extended immobilization.

3. **Rehabilitation:**^{12,13} Rehabilitation is performed in three phases: early (0-6 weeks), intermediate (6-12 weeks), and late (12+ weeks). The initial period is characterized by pain and swelling control, soft tissue range of motion and isometric calf strengthening. The intermediate phase provides a dose-dependent, progressive stabilization process, including eccentric loading, balance training, and progressive, sequential step-by-step weight-bearing return. The late phase includes sport-specific and functional exercise training in which, through a process of progressive recovery, the body is brought back to performing analogous pre-injury activities. During rehabilitation, emphasis is placed on adherence to the rehabilitation program and teaching activities modification and injury prevention techniques.
4. **Adjunctive therapies:**^{11,13} Conservative treatment of Achilles tendon rupture may include adjunctive therapies to induce healing. Physical modalities, such as ultrasound, laser therapy or shockwave therapy, are occasionally delivered, but there is no clear evidence that they are effective. Biological therapies, including platelet-rich plasma (PRP) injections, are being researched as an alternative to potentially accelerate tendon healing, however, there is a need for further studies to determine their contribution to nonsurgical management.

3.3. Monitoring and follow-up:¹³

Regular follow-up is an essential part of being able to track healing and change the treatment plan. This requires pain, swelling and functional status assessments by clinical examinations, and periodic imaging techniques (e.g., ultrasound or MRI) for tendon healing and gap measurement. Maintaining effective communication with patients enables concern management and ensures compliance within the rehabilitation program.

3.4. Challenges and considerations:¹⁴

Conservative management, while effective for many patients, comes with challenges. It is associated with a slightly higher

re-rupture rate (5-10%) compared to surgery (2-5%). Some patients may experience elongation of the healed tendon, which can lead to reduced strength and power. Successful outcomes largely depend on strict patient compliance with immobilization, weight-bearing, and rehabilitation protocols.

4. Role of Physiotherapy in Conservative Management

The physiotherapist has a central role in the conservative treatment of Achilles tendon rupture, taking patients through every stage of rehabilitation to ensure optimal results. This requires a blend of clinical knowledge, evidence-based practice, and patient-focused care.¹⁵⁻¹⁷

4.1. Initial assessment

The initial assessment is critical for establishing a baseline, confirming the diagnosis, and developing an individualized treatment plan.

1. Clinical evaluation:

- a. **Thompson test:** This is a key diagnostic tool where the physiotherapist squeezes the calf muscle while the patient lies prone. The absence of plantarflexion (downward movement of the foot) indicates a complete Achilles tendon rupture.

2. Imaging:

Ultrasound or MRI can be employed to verify the diagnosis, evaluate the size of the rupture, and quantify the gap between the ends of the tendon. Imaging also serves to exclude other diagnoses, including partial tears or tendinopathy.

3. Functional assessment:

- a. **Gait analysis:** Observing the patient's walking pattern helps to identify mechanisms of compensation, such as limping or reduced push-off on the affected side.
- b. **Range of motion (ROM):** Assess active and passive ROM of the ankle joint, especially plantarflexion and dorsiflexion, to find out the degree of functional impairment.
- c. **Strength testing:** Manual muscle testing of gastrocnemius and soleus muscles gives information regarding the extent of weakness.
- d. **Pain and swelling:** Assess the severity of pain and swelling, which can guide the choice of initial interventions.

4. Patient history:

Gather information on the mechanism of injury, previous injuries, activity level, and medical history

(e.g., diabetes, smoking) to modify the treatment plan.

4.2. Rehabilitation

Rehabilitation is divided into three key stages: early, mid, and late. Each phase has specific goals and exercises aimed to protect the healing tendon, restore strength and mobility. Physiotherapists play a vital role in implementing the stages of rehabilitation, adjusting exercises based on progress, and ensuring patient understanding and adherence at every step. (Table 2)

4.3. Patient education and adherence

Patient education is crucial to the success of conservative management of Achilles tendon injuries. Physiotherapists need to educate patients with information and resources to become active participants in their rehabilitation. This involves highlighting the need to adhere to the rehabilitation program on a consistent basis, overcoming barriers to compliance, and offering advice on lifestyle changes. Important components are weight control to minimize tendon stress, advising on appropriate footwear with sufficient support, and counseling on activity modifications. Injury prevention techniques, including correct warm-up and stretching, are taught to patients, and they are encouraged to gradual progression of activity intensity and duration to avoid overuse injuries.

5. Evidence-Based Practices

5.1. Review of key studies

Evidence-based practice is the basis of successful conservative management of Achilles tendon rupture. Such practices are supported by high-quality research, clinical guidelines, and new trends that seek to maximize patient outcomes.

There have been a number of landmark studies that have compared surgical and conservative treatment of Achilles tendon rupture, and they have offered useful insights into their outcomes. These studies have significantly influenced the treatment of Achilles tendon ruptures, especially towards conservative treatment under specific circumstances.

A randomized controlled trial by Willits et al. in 2010 compared surgical repair with conservative treatment in 144 patients. There was not much significant difference between the two groups in terms of re-rupture rates, with 2.8% for surgical patients and 5.6% in the conservative group. A key finding was that conservative treatment had fewer complications in terms of infections and wound healing. Functional outcomes in terms of strength and return to activity were comparable for both groups. This research provided strong evidence for conservative management as a safe and effective alternative to surgery, especially in patients at increased risk of surgical complications.¹¹

Table 2: Phased rehabilitation protocol for conservative management of Achilles tendon rupture

Phase	Time Frame	Goals	Interventions	Patient Education/Monitoring
Early-Stage	0-6 weeks	Protect healing tendon Minimize pain and swelling Maintain joint mobility	Immobilization (cast/boot) Ice therapy and compression Gentle ROM exercises Non/partial weight-bearing	Explain adherence to restrictions Guide on pain/swelling management
Mid-Stage	6-12 weeks	Restore calf muscle strength Improve balance/proprioception Transition to full weight-bearing	Eccentric strengthening (heel drops) Balance/proprioceptive training Gradual return to full weight-bearing	Regularly assess pain, swelling, progress Adjust exercise intensity based on tolerance
Late-Stage	12+ weeks	Restore full strength/power Improve agility/sport-specific skills Ensure safe return to activity	Plyometric exercises Sport-specific drills Gradual return to activity	Perform functional tests (e.g., single-leg hop) Compare results to unaffected s

Zhao et al. performed a systematic review and meta-analysis in 2017 comparing early functional rehabilitation protocols with prolonged immobilization. Their observations identified that the commencement of functional rehabilitation early in 2-4 weeks resulted in quicker recovery, better functional scores, and better patient satisfaction compared to delayed immobilization. Weight-bearing and progressive loading at an early time was linked to minimal muscle atrophy and elongation of the tendon. The results highlighted the relevance of implementing early mobilization as a prime component of conservative protocols.¹⁸ Similarly, Liu X et al. in another metanalysis in 2021, concluded that early functional rehabilitation provides safe and better early function and the same functional outcome in the longer term than traditional immobilization.¹⁹

Other notable studies have further supported the efficacy of conservative management. Maffulli et al. in 2010 showed that eccentric loading exercises greatly enhance tendon healing and functional results with conservative management.¹ Suchak et al. in 2008 identified the advantage of early weight-bearing in the reduction of complications and recovery time.⁸

These studies collectively suggest that conservative management, when combined with early functional rehabilitation and appropriate patient selection, can be as effective as surgical treatment in re-rupture rates, range of motion, calf girth, and functional performance for acute Achilles tendon ruptures. This approach also offers the benefits of avoiding surgical complications while achieving similar functional outcomes. However, the decision between conservative and surgical management should still be made on a case-by-case basis, considering factors such as patient age, activity level, and the availability of functional rehabilitation programs.

5.2. Emerging trends

Current trends in Achilles tendon rupture treatment through conservative methods explore new ways to boost healing processes in addition to rehabilitation recovery. The clinical use of biologics has emerged as an important trend in medical care where Platelet-Rich Plasma (PRP) injections represent one such treatment modality. PRP is researched with the hope to speed up the healing process in tendons through the application of growth factors and cytokines at the affected site. Early studies indicate that PRP could enhance pain and functional results, but additional high-quality randomized controlled trials (RCTs) are required to determine its effectiveness.²⁰ Stem cell therapy, especially with mesenchymal stem cells (MSCs), is also being investigated for its regenerative properties, but studies in this field are yet in the experimental phase.²¹

Wearable technology is yet another source of innovation in rehabilitation. Wearable sensors and smart insoles can track gait, load distribution, and activity levels during rehabilitation, giving real-time feedback to inform patients and clinicians to optimize loading and avoid overuse. Devices such as the DorsaVi sensor system offer objective measurements of movement patterns and improvement, which can be a real asset in individualizing rehabilitation programs.²²

Tele-rehabilitation is also becoming popular as a way to promote accessibility and compliance with rehabilitation programs. Online platforms and mobile applications allow physiotherapists to teach patients physical therapy exercises remotely. This is especially useful for individuals who live in rural or underserved communities, where access to on-site physical therapy may be restricted.²³ Applications such as Physitrack provide exercise programs with video instructions and monitoring of progress, which helps patients remain on course with their rehabilitation.²⁴

Advanced imaging technologies are being applied to offer objective information regarding tendon healing and biomechanical function. Ultrasound elastography quantifies tendon stiffness and healing status, and 3D motion analysis systems break down movement patterns to detect biomechanical deficits and customize interventions.²⁵ These technologies enable clinicians to make more educated decisions regarding rehabilitation status and return to activity readiness.

6. Challenges and Considerations

Although conservative management of Achilles tendon rupture is a vital and effective method for most patients, it is not without its difficulties. It is crucial to understand these difficulties and address them proactively in order to maximize outcomes.

6.1. Potential complications

Conservative management, while avoiding surgical risks, has its own complications and challenges.

Conservative treatment of Achilles tendon rupture has some possible complications that need to be taken into consideration. Re-rupture is more common with conservative treatment (5-10%) than with surgical intervention (2-5%). Risk factors for re-rupture are early or excessive loading during the healing phase, non-compliance with rehabilitation protocol, and suboptimal immobilization or bracing. Strict adherence to weight bearing and activity restrictions during the early stages of healing along with regular monitoring and adjustment of the rehabilitation program are important in preventing re-rupture.^{14,26}

Tendon elongation is another potential complication, occurring when the healing tendon lengthens, resulting in reduced strength and power during plantar flexion. This may result in functional impairments, like impaired push-off when walking or running. Measures to prevent this are early commencement of controlled loading and eccentric strengthening exercises to promote correct collagen alignment and progressive rehabilitation to avoid overloading the healing tendon.²⁷

Residual weakness and stiffness in the injured ankle may occur in some patients despite following proper rehabilitation. This can restrict functional capacity and decrease quality of life. To avoid these complications, thorough rehabilitation programs involving strength, flexibility, and proprioceptive training are necessary, along with follow-up on a regular basis to treat any residual deficits.^{27,28}

Other complications are deep vein thrombosis (DVT) and muscle atrophy. Immobilization for extended periods increases the risk of DVT, which can be avoided by early mobilization and compression therapy. Immobilization can also cause calf muscle atrophy, which can be avoided by early weight-bearing and strengthening exercises.²⁹

6.2. Psychosocial factors

Patients often require effective mental and social support to achieve positive results from Achilles tendon rupture treatment through conservative approaches. Success in rehabilitation adherence depends on their motivation which becomes sometimes difficult to maintain throughout the long

recovery period. Psychological problems of anxiety, depression, and fear of re-injury are frequent, especially among sportsmen.³⁰ Physiotherapists should implement these practices to handle these factors which include creating attainable targets and providing praise as well as instructing patients regarding their healing progression with open dialogue. Family, friends, and social support can greatly impact rehabilitation compliance and outcomes.

6.3. Long-term outcomes

The functional recovery of ruptured Achilles generally leads to satisfactory outcomes during the 6-to-12-month period, although some may have residual weakness or decreased performance in high-demand activities. Athletes typically return to sport within this timeframe, facing challenges like fear of re-injury. Although the injury significantly impacts the quality of life in the acute phase, the majority of patients report progressive improvement during rehabilitation. Some may develop chronic tendinopathy, underlining the significance of proper rehabilitation and gradual return to activity.^{8,13}

7. Case Studies

Achilles tendon rupture management case studies illustrate that treatment strategies may differ from patient to patient. Various factors like age, activity level, injury severity, and comorbidities influence treatment decisions. Conservative treatment can be successful for a wide range of patient types, ranging from young active persons to elderly with comorbidities, if appropriately individualized. (Table 3)

Table 3: Case studies illustrating the treatment strategies

Aspect	Example 1: Young Athlete	Example 2: Middle-Aged Individual	Example 3: Elderly Patient
Patient Profile	25-year-old male soccer player	50-year-old female recreational runner	70-year-old male, sedentary
Injury Type	Partial rupture	Degenerative rupture	Complete rupture
Comorbidities	None	History of chronic tendinopathy	Diabetes, peripheral vascular disease
Initial Assessment	5 mm tendon gap on ultrasound	8 mm tendon gap on MRI	12 mm tendon gap on ultrasound
Immobilization	Walking boot with 20° plantarflexion for 4 weeks	Cast with 30° plantarflexion for 2 weeks, then walking boot	Walking boot with 30° plantarflexion for 8 weeks
Weight-Bearing	Partial immediately, full by week 6	Gradual from week 4	Partial with walker from week 2
Rehabilitation Duration	12+ weeks	12+ weeks	16+ weeks
Outcome	Returned to soccer at 6 months	Pain-free walking at 12 weeks, running at 9 months	Full mobility and independence at 6 months
Key Takeaway	Effective for partial ruptures in young, active individuals	Suitable for degenerative ruptures in middle-aged	Safe option for elderly with comorbidities

8. Conclusion

Achilles tendon rupture can be treated effectively and viably on conservative basis for patients with partial rupture, with minimal tendon gap, or with contraindications for surgery. Evidence based rehabilitation protocols including early mobilization, progressive loading and patient centered care, have an essential role in the physiotherapy to optimize the outcomes. Although re-rupture rates and tendon elongation are challenges, they can be handled by properly selecting patients, sticking to rehabilitation, and regular monitoring. Future research should involve refinements to rehabilitation protocols, examination into the use of biologics (platelet rich plasma), and integration of new technology (wearable devices and tele-rehabilitation). By improving our knowledge and use of appropriate conservative management, we can continue to enhance functional outcomes and quality of life for patients with Achilles tendon ruptures.

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10. Conflict of Interest

None.

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