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*Literature Review*

# Current Update in Achilles Tendon Rupture Management: Operative or Nonoperative?

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## Abstract

The Achilles tendon is the most commonly ruptured tendon in the foot and ankle region. The peak incidence of Achilles tendon rupture occurs in the age range of 30-49 years, with a higher prevalence among males. Various risk factors, including aging, obesity, episodic athletic activity, engagement in high-impact sports, antibiotic use, and systemic factors, contribute to the occurrence of Achilles tendon rupture. Beyond the injury mechanism, it is crucial to assess any history of minor or repetitive trauma to the Achilles tendon and identify associated risk factors. Thorough examination and comparison of both the affected and unaffected sides are essential. While the diagnosis of Achilles Tendon Rupture is primarily clinical, radiological imaging can aid in visualizing the tendon gap. Treatment options for Achilles tendon rupture include conservative and surgical approaches. Despite a lower re-rupture rate associated with surgical treatment, recent evidence suggests that conservative treatment provides comparable results. However, return to activity was found to be better in surgical treatment with early rehabilitation

## Introduction

Achilles Tendon Rupture (ATR) is one of the most common injuries found in young athletes and those engaged in recreational sports. Most of the injuries are sustained in men aged 30-39 years old from high-impact sports.[1] Although the Achilles is one of the strongest tendons in the human body, it is also the most commonly ruptured tendon around the foot and ankle.[2] The incidence of ATR is approximately 40 per 100.000 person-years and seems to have increased over the last few decades.[3,4] Until now, there is still controversy regarding optimal management for ATR. In the past, surgical techniques were recommended over conservative management.[5] However, conservative treatment nowadays gives comparable results, therefore operative treatment is not the mainstay treatment anymore.[6] Nevertheless, other factors must be considered when deciding on treatment options, such as return to activity, particularly in athletes. The objective of this study is to investigate the current trend in Achilles tendon rupture management.

## Results

### ANATOMY

The Achilles tendon, also known as the calcaneal tendon, is the largest and strongest tendon in the human body, connecting the gastrocnemius and soleus muscles to the calcaneus.[7] In its course toward the calcaneus, this tendon rotates 90 degrees laterally, causing the gastrocnemius fibers to insert laterally onto the posterior calcaneus, while the soleus fibers insert medially. When the gastrocnemius and soleus muscles contract, a translational force is generated through the Achilles tendon, resulting in plantar flexion of the foot which facilitates movements such as walking, running, and jumping.[8,9] In this position, the Achilles tendon bears the heaviest load in the body, with a tensile load 10 times the body weight.[10] The Achilles tendon

consists of type II fast twitch fibers, type I collagen, and elastin, making its structure strong and elastic to facilitate movement.[11] It is also surrounded by a loose connective tissue sheath, known as the paratenon, allowing it to stretch and withstand significant forces.[12]

The Achilles tendon is supplied by two main blood vessels: the posterior tibial artery and the peroneal artery. However, there is a hypovascular area approximately 2-6 cm above the calcaneus, making this region relatively prone to poor healing after trauma.[13] The sural nerve and tibial nerve mainly provide the innervation of this tendon. The sural nerve traverses from the posterior to the lateral aspect approximately 8-10 cm away from the calcaneal insertion point of the Achilles tendon.[14]

## CLASSIFICATION

The classification for Achilles tendon rupture is based on the onset, location, and type of the rupture. Acute Achilles tendon rupture is defined as when an Achilles tendon has been ruptured for less than 6 weeks. If the onset of the rupture has passed 6 weeks, then it is called chronic ATR.[1] For chronic ATR, some classification systems have been developed to access the type of defect, especially asses the gap between the ruptured tendon and the best management for it. Myerson's and Kuwada's classifications are the two main classifications used worldwide. In Myerson's classification, the type of tear is divided into three types. If the defect is 1-2 cm long, it is classified as type I and the best management is with end-to-end repair and posterior compartment fasciotomy. In type II, the defect is 2-5 cm long, and the best management is with V-Y lengthening with or without tendon transfer. When the defect is greater than 5 cm, it is classified as type III, and the recommended treatment is with area tendon transfer alone or combined with V-Y advancement and augmentation. Based on Kuwada's classification, chronic ATR is further classified into four types. Type I (Partial tear) can be treated with conservative management, Type II (Complete tear less than 3 cm defect) can be treated with end-to-end repair, Type III (3-6 cm defect) can be treated with debridement and tendon transfer with or without tendon transfer, and for type IV (defect greater than 6 cm) can be treated with debridement and tendon graft with or without augmentation.[15]

Achilles tendon rupture can also be further categorized depending on its anatomic location. The musculotendinous junction occurs in 12.1% of all ATR cases, the midportion of Achilles occurs in 83% of all ATR cases, and the insertion of the calcaneus bone occurs in 4.6% of all ATR cases.[15] Based on the type of rupture, ATR can be divided into partial and total rupture. Partial rupture is defined as when there is

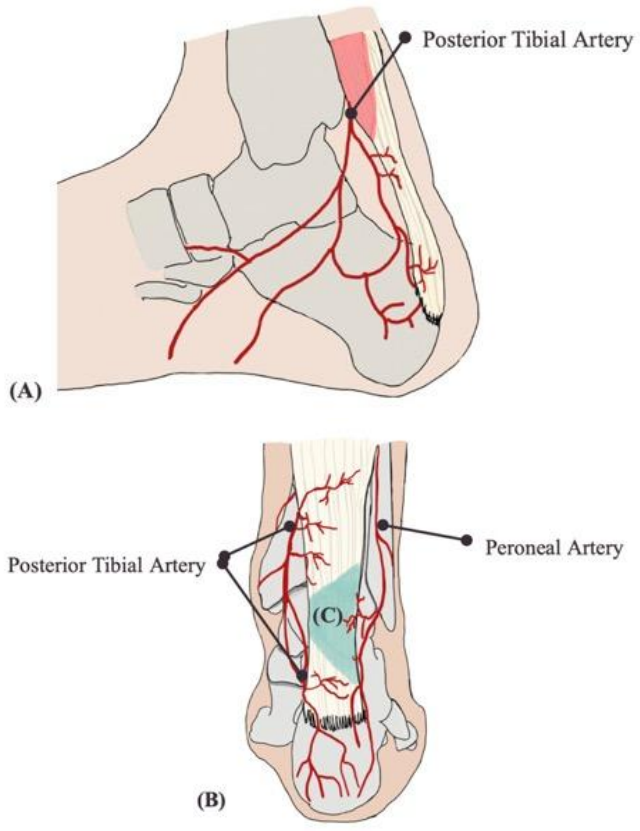


**Figure 1.** Vascularisation of the Achilles Tendon
A) Showing the posterior tibialis artery that supplies both the proximal, distal, and medial part of the Achilles Tendon; B) Showing the peroneal artery that supplies the middle and lateral part of the Achilles Tendon; C) Showing the "watershed zone" or area of hypovascularity approximately 2-6 cm above the Calcaneus Bone.[14]

**Table 1.** Myerson's Classification for Achilles Tendon rupture and Recommended Procedure

| Type | Size of Defect (cm) | Recommended Procedure |
|---|---|---|
| I | 1-2 | End-to-end repair and posterior compartment fasciotomy |
| II | 2-5 | V-Y lengthening with or without tendon transfer |
| III | >5 | Tendon transfer alone or combined with V-Y advancement and augmentation |

**Table 2.** Kuwada's Classification for Chronic Achilles Tendon Rupture

| Type | Defect | Recommended Procedure |
|---|---|---|
| I | Partial Tear | Conservative treatment |
| II | Complete tear (< 3 cm defect) | End-to-end repair |
| III | Complete tear (3-6 cm defect) | Debridement and tendon transfer with or without tendon graft |
| IV | Complete tear (> 6 cm defect) | Debridement and tendon graft with or without augmentation |

partial discontinuation of the Achilles structure integrity, meanwhile, complete rupture is when there is complete discontinuation and complete separation of the Achilles tendon.[2,15]

## EPIDEMIOLOGY

Based on recent studies, the peak age incidence of ATR is 30-49 years old and is dominated by males. The ratio of men and female rupture rates is 1:2 to 12:1. Besides that, sports activities caused 75% of all ATR cases, and the left Achilles was ruptured more commonly than the right, probably reflecting right-side dominance with the left leg pushing off.[15]

The average incidence of ATR varies between 7 and 40 per 100.000 person-years. Based on a recent population-based study in Finland with a range of data between 1997-2019, there is an increasing incidence of ATR from 17.3 to 32.3 incidence per 100.000 person-years.[15,20] Recent studies in the United States population show that sports activities were the most common cause of rupture, and the incidence was higher in people younger than 55 years. Based on the type of sports, basketball was the most involved sport followed by tennis and football.[21] There are no available studies about the incidence of Achilles Rupture in the Indonesian population.

## ETIOLOGY AND RISK FACTORS

Several risk factors such as aging, obesity, episodic athlete, high-impact sports, use of antibiotics, and systemic factors contribute to the occurrence of ATR. Aging is believed to reduce regeneration capacity and

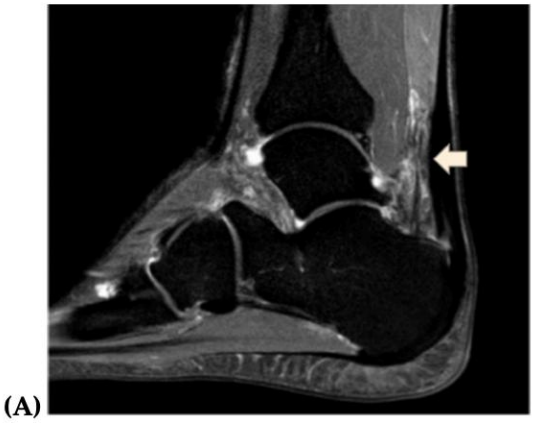


**Figure 2A.** MRI images of a case presented by Gatz., et al. showed a partial rupture Achilles tendon (Kuwada's classification type I) (White arrow).[16]


**Figure 2B.** MRI image of a case presented by Haghverdian., et al. Showed a chronic and complete right Achilles tendon rupture with a 2 cm gap. This case is included in Kuwada's classification type II (complete tear < 3 cm defect) and Myerson's classification type I (complete tear 1-2 cm defect).[17]

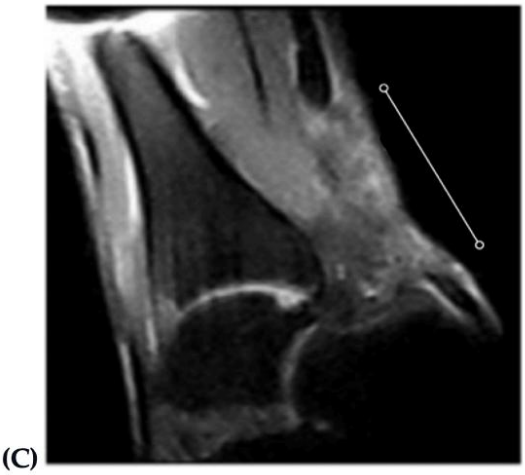


**Figure 2C.** MRI image of a case presented by Lin., et al. Showed a chronic and complete Achilles tendon rupture with a 9 cm gap. This case is included in Kuwada's classification type IV (complete tear with > 6 cm defect) and Myerson's classification type III (complete tear > 5 cm defect).[18]

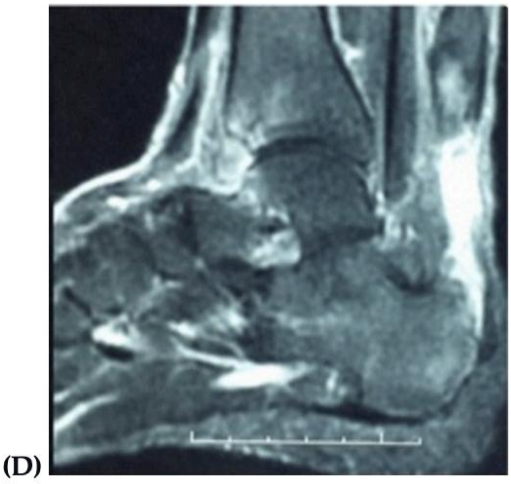


**Figure 2D.** MRI image of a case presented by Sadek., et al. Showed a chronic and complete right Achilles tendon rupture with a 2,4 cm gap. This case is included in Kuwada's classification type II (complete tear < 3 cm defect) and Myerson's classification type II (complete tear 2-5 cm defect).[19]

increase susceptibility to tendon injuries.[22] Tendons consist of Tendon Stem/Progenitor Cells (TSPCs) which play a crucial role in the maintenance, regeneration, and repair of tendons. As the aging process advances, TSPCs progressively lose their capacity for self-renewal and sustaining their population, resulting in depletion. Additionally, there is a reduction in collagen fibril size, accompanied by the fragmentation and disorganization of collagen fibers. This decline in collagen contributes to the disturbance in tendon tensile strength and viscoelasticity.[23]

There is still much debate regarding the relationship between obesity and ATR. A study states that obesity increases the risk of upper extremity tendon tear but does not have a correlation with lower extremity tendon rupture.[24] Despite this, fat accumulation within the tendon can lead to a disruption in its integrity. Fat deposition can also lead to muscle dysfunction, indirectly affecting tendon function.[25]

Achilles tendon injuries commonly occur in individuals who infrequently engage in physical activity, often referred to as "weekend warriors." This is caused by the sudden increase in intensity in the Achilles tendon when engaging in sports abruptly.[26] Furthermore, ATR commonly occurs in individuals involved in high-impact sports like badminton, volleyball, and football.[1] Despite the robustness of the Achilles tendon, repetitive exposure to high-energy loads during sports accelerates degenerative changes, leading to elongation and fatigue failure.[2]

Several studies indicate that the use of fluoroquinolone antibiotics can cause pathological lesions in tendons. In some cases, long-term use may even result in complete tendon rupture and significant subsequent disability. The exact mechanism is not yet precisely understood, but it is believed that fluoroquinolones can cause ischemia, degradation of tendon matrix, and degradation of the adverse alteration of tenocyte activity.[27] Other systemic conditions such as diabetes and chronic kidney disease, hyperthyroidism, rheumatoid arthritis, and systemic lupus erythematosus can also affect the structural integrity of tendons and increase the risk of rupture.[26]

## PATHOPHYSIOLOGY

The pathophysiology of Achilles tendon rupture involves mechanical, structural, and biomechanical factors. Essentially, the Achilles tendon is the strongest tendon and can twist 90 degrees in both medial and lateral directions. However, despite its strength, the tendon can rupture due to excessive tensile load. Structural changes, including collagen fiber degeneration, lead to a decrease in tensile strength, increasing the risk of rupture. Additionally, Achilles tendons exposed to chronic stress or repeated microtrauma may undergo degeneration, further elevating the likelihood of rupture.[28]

## CLINICAL EVALUATION

The most common patient profile for ATR is a male in his third or fourth decade of life who plays sports either occasionally or is an active athlete. The classical symptoms of a patient with ATR are a sudden painful blow with associated swelling in the posterior ankle. In some cases, the patient usually hears a "popping" or "snapping" sound when the injury occurs. The mechanism of injury is usually related to sudden or explosive movement related to sports activity with the ankle in a forced dorsoflexion position. After the injury, the patient also complained of an inability to bear weight and a weakness with push-off during gait or weakness when the ankle is forced to a plantarflexion position. Besides the mechanism of injury, it is important to assess if there is a history of minor or repetitive trauma to the Achilles tendon and if there are any risk factors associated with the rupture.[29]

On physical examination, the examiner usually finds external bruising and swelling in the posterior part of the ankle. It is important to thoroughly assess and compare both the affected and unaffected sides. It is also essential to perform a thorough neurovascular examination, with particular attention paid to the sural nerve.[29]

In assessing patients with suspected ATR, certain signs and tests can be helpful for an accurate diagnosis. The most common test is the Calf Squeeze Test (Thompson's Test or Simmond's Test). This test was performed with the patient in a prone position and both feet hanging over the edge of the bed. In normal or intact Achilles squeezing the calf will result in a plantar flexion of the ankle. If the Achilles is completely ruptured, there will be no apparent plantar flexion and this indicates a positive test.[29] The Matle's test, also called as knee-flexion test, was also one of the common tests performed. Matle's test is performed with the patient lying in a prone position and the patient is asked to flex the knee 90 degrees. The examiner will assess the neutral position of the ankle. Normally, the resting position of the ankle is slight plantarflexion. Dorsoflexion of the ankle at resting position suggests a torn tendon.[30] Apart from that, a single leg heel raise test can also be performed. In this test, the examiner will ask the patient to stand on the suspected leg with the heel raised. Unable to perform this test suggests a torn tendon.[31] Besides these tests, one of the most common and crucial clinical examinations that can be performed in ATR is a palpable gap. The examiner will palpate the Achilles tendon and try to feel the gap or discontinuation of the tendon. However, this method is less accurate in acute ATR when pain and swelling are present. Some literature suggests that performing this examination under anesthesia increases its sensitivity.[32]

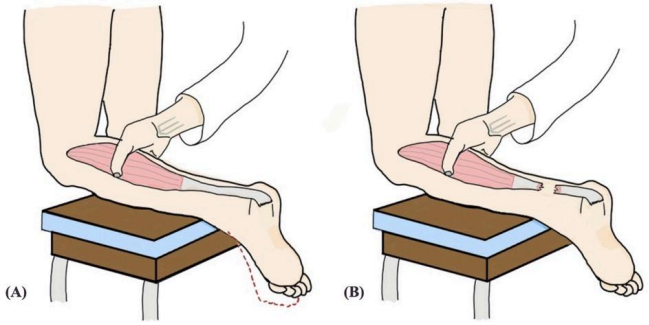


**Figure 3A,B:** Thompson Test - (A) Showing a normal or intact Achilles Tendon. As a result, squeezing the calf triggers ankle movements (plantar flexion). (B) The absence of ankle movement (plantar flexion) suggests a ruptured tendon.[29]

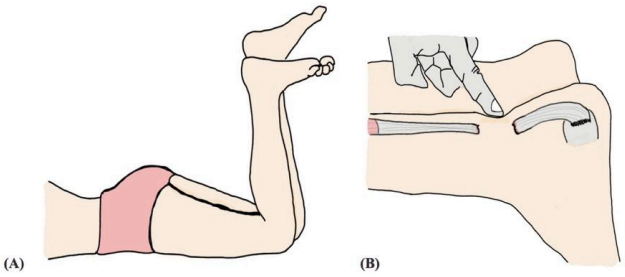


**Figure 4A,B:** (A) Matle's test, dorsoflexion of the left foot in a neutral position demonstrating a ruptured tendon when compared to the right side (slightly plantarflexion).[30]; (B) Showing a palpable gap or discontinuation of the tendon suggesting a torn Achilles tendon.[32]

## DIAGNOSTIC STUDIES

The diagnosis of Achilles Tendon Rupture is predominately clinical. There are no routine imaging modalities needed. Imaging is useful when there is either doubt within clinical examination or to assess the gap and reducibility of the torn tendon. One of the best and most clinically used imaging modalities is ultrasound. The use of X-rays in ATR may be useful to exclude other differential diagnoses such as fractures. However, in X-rays, some signs may be helpful in the diagnosis of ATR. Obliteration of Kager's Fat Pad is one of the signs that may indicate an Achilles rupture. Kager's Fat Pad was a triangle seen on X-ray and is formed by three main structures: the flexor hallucis longus tendon, the superior part of os calcaneus, and the Achilles tendon. Obliteration or loss of the posterior border of the Kager's Fat Pad in lateral ankle X-ray may indicate a torn Achilles Tendon. Another sign that indicated a torn Achilles tendon is the Toygar's Sign. This sign involves the measurement of the angle of the posterior skin surface seen on the lateral projection. The Toygar angle below 150 degrees suggests an Achilles tendon is torn.[33]

Ultrasound was the main imaging modality used in Achilles Rupture. Ultrasound is the preferred option as it is cheaper and widely available, but it is operator-dependent. Besides that, the main strength of ultrasound lies in its ability to assess the gap between torn tendons, fibrosis, and hematoma formation within the tendon gap, and to evaluate the reducibility of the torn tendon in various positions, mainly plantar flexion. If the gap between the tendon ends is more than 1 cm on passive plantar flexion, some studies recommend operative treatment.[33]

## TREATMENT

Achilles Tendon Rupture can be treated conservatively or surgically. Non-surgical or conservative management for ATR involves a short period of immobilization in a boot with early motion and progressive weight bearing. Patients typically undergo a cast placement in a plantarflexion position for the first 4 weeks, followed by a neutral position for the next 2-4 weeks. If surgical treatment is chosen, options include open repair, minimally invasive, and percutaneous repair techniques.[34] In open repair, a 6-8 cm incision is made in the posteromedial area, followed by dissections until the 2 ends of the ruptured tendon are identified. After that, debridement is performed, and stitching is done using vicryl sutures to secure the ends together. The paratenon layer is also stitched to reduce postoperative wound complications. Subsequently, layer-by-layer closure is performed, and the extremity is splinted in maximum plantar flexion.[35] Meanwhile, in minimally invasive repair, only an incision of 3-4 cm is made, and in percutaneous repair, mini-incisions are performed in the medial and lateral areas to insert instruments.[36] The commonly utilized open Achilles repair techniques comprise the Krackow and Bunnell suture techniques. Several minimally invasive approaches have been developed for the treatment of ATR. These include the Ma and Griffiths repair, the Webb and Bannister repair, the Achillon device, the Tenolig device, and the PARS repair, alongside other adapted percutaneous techniques.[37]

## OUTCOME COMPARISON BETWEEN OPERATIVE AND NONOPERATIVE METHODS

Recent studies have shown similar outcomes in terms of clinical scores and patient satisfaction between the two methods. Table 3 describes recent meta-analyses regarding the comparison of operative and nonoperative treatment of ATR. Overall, studies have found that the likelihood of re-rupture is lower in those who underwent surgical treatment.[6,38–40] However, in the meta-analysis conducted by Yassie et al., it was found that the obtained risk difference is relatively small, specifically at 1.6%.[6] Dexter Seow et al. analyzed multiple meta-analyses comparing re-rupture rates in groups undergoing open surgery versus those opting for minimally invasive surgery or percutaneous repair. Their findings revealed no significant differences in the incidence of re-rupture among these three groups.[38]

Despite the lower re-rupture rate, it has been found that complication rates other than re-ruptures

are significantly higher in those undergoing surgical intervention. Complications that typically occur following ATR interventions include infection, scar adhesion to the underlying tendon, sural nerve injury, and deep vein thrombosis (DVT). Across all four meta-analyses, it was observed that the overall complication rate was lower in the conservative group. However, most studies primarily compare surgical and conservative treatments broadly, without delving into the specific subtypes of surgical interventions, which can lead to misinterpretation. Various surgical procedures come with distinct risks and complications; for instance, open surgical interventions have a higher risk of infection, while minimally invasive surgery may have a lower infection rate but a higher risk of iatrogenic injuries, and after conservative treatment, DVT may be more prominent due to longer immobilization.[6,38–40]

Currently, the most interesting aspect for decision making is the patient's postoperative functional ability. Functional ability can be assessed through the patient's ability to return to activity/work/sports, ankle range of motion, and by utilizing the ATRS (Achilles Tendon Total Rupture Score) functional scoring system. In several meta-analyses, similar functional ability recovery was observed between the surgical and conservative treatment groups, whether in return to activity/work/sports, ankle range of motion, and ATRS scoring.[6,38–40]

In particular, return to activity (RTA) is a critical matter in treating ATR. On average, only around 72.5% of athletes can return to play after rehabilitation following ATR, with an average duration of 10.6 months.[41,42] This is concerning given that such a return is highly anticipated by nearly all individuals, particularly athletes. Interestingly, RTA outcomes may differ depending on the patient's lifestyle. When treating the athletic or active community, operative and functional rehabilitation may be preferred to enhance and expedite the outcomes. Whereas a sedentary person with limited functional outcome expectations may prefer nonoperative treatment. Some studies suggest that operative treatment and functional rehabilitation had a significant difference in plantar flexion strength at a higher or faster velocity than non-operative treatment. High-speed isokinetic strength may be of substantial importance for jumping and sprinting athletes.[43] Another study suggests that surgical fixation and early functional rehabilitation may be beneficial in expediting patients' return to work in active or athlete communities. A study conducted by Renninger et.al, investigating active-duty military members with ATR, showed that patients that undergo operative treatment returned to duty on average 1,5 months earlier than non-operative patients. These findings were sustained by a meta-analysis study conducted by Grassi et.al, which showed that patients that undergo surgical treatment returned to work on average 19 days earlier compared to conservative treatment.[44]

## REHABILITATION

Rehabilitation plays a crucial role in the treatment of ATR, whether following conservative or surgical treatment. In the past, patients who underwent conservative treatment were not allowed to engage in movements and weight-bearing as early as those who underwent surgical treatment. However, recent studies indicate that early rehabilitation can lead to better outcomes, as it can reduce re-rupture rates.[5] Weightbearing can allow fibroblasts and collagen fibers to fill the tendon gaps, enhancing tendon strength. It can also increase plantar flexor activity which helps the healing process.[45]

The reported rates of re-rupture and complications after conservative treatments were not significantly different between earlier and later rehabilitation.[6,38–40] However, one particular meta-analysis strongly supported early rehabilitation, especially in the comparison between cast with orthosis and cast alone.[38] Another study also indicates that although early weightbearing did not show significant differences in terms of endurance and strength as assessed by the heel-rise work test, re-rupture rate, or return to activity/sport, there were significant differences observed in health-related quality of life. Meanwhile, early rehabilitation post-surgery has shown better outcomes. A systematic review of 12 studies categorized early rehabilitation into three categories: full weightbearing, early ankle mobilization, and a combination of both, and found that all categories demonstrated a higher satisfaction level.[42] This is further supported by a meta-analysis which found that early weightbearing could reduce both minor and major complication rates. Early rehabilitation also provides advantages in terms of patients' functional ability.[38] Various meta-analyses examining the clinical outcomes of ATR treatments indicated that early rehabilitation enhanced functionality to a greater extent and facilitated an earlier return to work and sports compared to late rehabilitation involving prolonged immobilization.[46]

## REGENERATIVE THERAPY

In recent years, regenerative therapy using biological materials in orthopedic sports medicine, notably platelet-rich plasma (PRP), has surged. PRP offers advantages such as easy preparation, minimal patient burden, and relative safety.[46] Platelet-Rich Plasma therapy in the treatment of achilles tendon rupture primarily involves its potential to enhance and accelerate the healing process and is often used in conjunction with other treatments such as physical therapy, immobilization, or surgery. Rich in growth

**Table 3.** Recent Meta-analyses Comparing Surgical and Conservative Treatments for Achilles Tendon Rupture

| Author | Year | Type of Study | Sample | Type of Interventions | Conclusion |
|---|---|---|---|---|---|
| Dexter Seow, et al.[38] | 2023 | Systematic review of overlapping meta-analyses. There were 16 meta-analyses that discussed the comparison of surgical versus conservative treatment. | There was a total of 27.240 participants with possible overlap. | Non-surgical treatment: Cast or/and orthosis<br><br>Surgical treatment: Open repair or minimally invasive surgery | Significantly lower re-rupture rates were reported with surgical treatment compared to conservative treatment. However, conservative treatment was preferred due to lower complication rates. |
| Guorong She, et al.[40] | 2021 | Meta-analysis, 13 RCTs were included | There was a total of 1.164 participants (79,98% male) with an age range of 18-63 years. Participants were divided into two major groups: those who received non-surgical treatment (48,2%) and those who underwent surgery (51,8%). | Non-surgical treatment: Cast immobilization or functional bracing<br>Surgical treatment: Open or minimally invasive surgery | Surgical treatment showed a significant reduction in re-rupture rate. However, the complication rates other than re-rupture (DVT, adhesion of scars, sural nerve injury, superficial, and deep infection) were significantly lower in conservative treatment. There was no significant difference between surgical and conservative treatment in returning to sports and ATRS functional score. |
| Yasser Reda et al.[39] | 2020 | Systematic review and meta-analysis, 9 RCTs were included | There was a total of 822 participants (76,76% male) aged over 18 years. The participants were categorized into two major groups: those who received conservative treatment (49.6%) and those who underwent surgical intervention (50.4%). | Non-surgical treatment: Cast immobilization and/or functional bracing.<br><br>Surgical interventions: Open repair, minimally invasive techniques, or percutaneous methods. | Surgical intervention has a lower significant re-rupture rate compared to non-surgical treatment; however, surgical treatment carries a higher risk of experiencing wound complications. |
| Yassine Ochen, et al.[6] | 2019 | Systematic review and meta-analysis, 29 studies (10 RCTs and 19 observational studies) were included | There was a total of 15.862 participants (74% male) with an age range of 17-86 years. Participants were divided into two major groups: those who received non-operative treatment (40,9%) and those who underwent surgery (59,1%). | Non-operative treatments: Cast immobilization or functional bracing.<br><br>Operative treatment: Open repair or minimally invasive surgery | Operative treatment of ATR reduces the risks of re-rupture compared with nonoperative treatment, however, it has a higher risk of complications. |

factors like TGF-b, VEGF, PDGF, IGF, and bFGF, PRP aids tissue repair and accelerates healing. The use of PRP can be considered to expedite healing by promoting tissue regeneration and reducing inflammation during the early stages following an acute Achilles tendon rupture. Post-surgical application of PRP at the repair site may enhance healing outcomes, potentially decreasing recovery time and increasing tissue strength. In cases where there is poor healing in chronic Achilles tendon rupture, PRP can be used to stimulate healing in the damaged tissue. Additionally, when PRP is used in conjunction with conservative treatments such as immobilization or physical therapy, it can enhance the overall efficacy of the rehabilitation program. However, there is currently no standardized protocol for PRP preparation and application, which results in inconsistent clinical outcomes. Therefore, PRP indications and uses for Achilles tendon healing remain to be fully explored.[47] While some clinical studies have explored its effectiveness in treating ATRs, conclusive evidence remains limited. Shota Morimoto et al. reported a case study where a patient was able to return to sport only 3 months after receiving an intra-tissue injection of freeze-dried platelet-derived factor concentrate along with early rehabilitation following operative treatment. Considering this case, it is important to evaluate the potential of early rehabilitation, specifically mechanical loading, in aiding and speeding up tendon tissue healing when combined with growth factors like an intra-tissue injection of FD-PFC.[46]

## Conclusion

Achilles tendon rupture is an emerging problem due to young populations increasing awareness of regular exercise. The operative treatment is also modified to be as minimally invasive as possible. Despite the lower re-rupture rate with surgical treatment, recent evidence showed that conservative treatment yields comparable patient's satisfaction. Current studies are primarily focused on re-rupture rates, while other outcomes such as complication rate, functional ability recovery, and patient's satisfaction should be taken into consideration when deciding on treatment. Consideration of the patient and the types of activity in everyday life is also crucial in treating ATR. In athletes or active communities, the surgical and functional rehabilitation option may be wise due to an earlier return to work rate and stronger plantar flexion ability. Moreover, it is also essential to conduct research that can compare outcomes based on other considerations such as comorbidities and systemic conditions that may influence the results.

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