

Global Trends in Achilles Tendon Rupture Incidence and Surgical Versus Non-Surgical Treatment Rates

1. Introduction

The Achilles tendon, the strongest and largest tendon in the human body, plays a critical role in locomotion by connecting the calf muscles to the heel bone¹. This robust structure is essential for activities such as walking, running, and jumping, bearing loads up to 12 times body weight during running¹. Despite its strength, the Achilles tendon is susceptible to rupture, a common musculoskeletal injury that can result in significant morbidity¹. Achilles tendon rupture typically occurs due to sudden, forceful plantarflexion or dorsiflexion of the foot, often during sports participation involving rapid acceleration, deceleration, or changes in direction¹. However, these ruptures can also occur in non-athletic contexts, such as falls or sudden unexpected stresses on the tendon¹. The injury leads to considerable pain, weakness, and functional limitations, impacting patients' daily lives, sports participation, and overall quality of life, often requiring prolonged periods of recovery¹. The management of Achilles tendon rupture has evolved over time, with primary treatment options including surgical repair, using open, minimally invasive, or percutaneous techniques, and non-surgical management, which typically involves immobilization with casts or braces, often combined with early functional rehabilitation protocols¹, S_SS81¹.

This report aims to analyze the global trends in the incidence of Achilles tendon ruptures and the corresponding shifts in treatment approaches, specifically examining the proportion of cases managed surgically versus non-surgically across various countries. Understanding these trends is crucial for informing clinical decision-making, guiding future research directions, and potentially influencing healthcare policy and resource allocation related to this common injury. A bibliometric analysis of global research on Achilles tendon injuries and ruptures between 2000 and 2021 indicates a significant increase in the number of publications, highlighting a growing interest in this topic within the medical and research communities². Key journals such as Foot Ankle International, the American Journal of Sports Medicine, and Knee Surgery Sports Traumatology Arthroscopy have been central to disseminating this research². The substantial increase in research output suggests an ongoing evolution in our understanding and management of Achilles tendon ruptures, driven by factors such as changing incidence rates, advancements in treatment techniques, and a continuous debate regarding the optimal approach to care. Therefore, a comprehensive analysis of these trends is timely and essential for stakeholders in the field.

2. Global Trends in Achilles Tendon Rupture Incidence

Epidemiological studies from various parts of the world have consistently reported an increasing trend in the incidence of Achilles tendon ruptures over the past few decades ¹². For instance, a nationwide study in Sweden spanning from 2002 to 2021 demonstrated a 45% increase in the long-term incidence rate, with a notable acceleration of this rise after 2017 ¹⁶. The incidence in Sweden climbed from 28.8 to 41.7 cases per 100,000 person-years ¹⁶. Similarly, Denmark experienced a significant increase in incidence between 1994 and 2013, with rates ranging from 26.95 to 31.17 per 100,000 people annually ³⁹. By 2013, the incidence in Denmark had reached 31.17 per 100,000 ⁴⁰. In Finland, the incidence rose from 17.3 to 32.3 per 100,000 person-years between 1997 and 2019 ³⁰. Studies in the United Kingdom also indicate an increasing incidence trend from 1995 to 2019, with one cohort reporting a rate of 8 cases per 100,000 people per year ¹⁰. South Korea witnessed an upward trend in both overall and sex-specific incidence rates between 2009 and 2017, reaching 26.53 cases per 100,000 person-years in 2017 ³³. Furthermore, New Zealand experienced a substantial increase in incidence from 4.7 to 10.3 per 100,000 between 1998 and 2003 ³¹. This consistent pattern of rising incidence across geographically diverse locations strongly suggests a global phenomenon, likely influenced by shared societal and lifestyle factors rather than isolated local occurrences.

While the overall trend points towards an increase, the rate of this increase and the absolute incidence can vary considerably between countries and even within different regions of the same country ³⁶. For example, in Finland, the increase in incidence appeared to slow down during the latter part of the study period from 1997 to 2019 ⁴¹. Notably, regional variations in the average incidence were also observed within Finland ³⁶. The observed regional differences suggest that local factors, such as the popularity of specific sports, demographic nuances, and healthcare access, can influence the overall global trend. The potential plateauing of the increase in some regions might indicate the impact of local interventions or a saturation effect.

Several potential factors have been identified as contributing to the observed rise in Achilles tendon rupture incidence. An aging population that remains more physically active is a frequently cited reason ⁶. Increased participation in both recreational and competitive sports, including the "weekend warrior" phenomenon, is also considered a major contributing factor ⁴. The rising prevalence of obesity is another factor that has been linked to an increased risk of Achilles tendon rupture ⁴. Additionally, the use of certain medications, such as fluoroquinolone antibiotics and corticosteroids, has been associated with an elevated risk of tendon rupture ⁴. Finally, improvements and increased utilization of diagnostic methods, such as ultrasound and MRI, might lead to

better detection and consequently, higher reported rates of Achilles tendon ruptures²³. The multifactorial nature of this increasing trend underscores the complexity of addressing it, suggesting that effective prevention strategies will likely require a comprehensive approach targeting various risk factors at both individual and population levels.

3. Evolution of Treatment Approaches: Surgical vs. Non-Surgical Rates

Historically, while non-surgical treatment was initially the primary approach for managing Achilles tendon ruptures, the latter part of the 20th and the early 21st centuries saw a growing trend towards surgical intervention¹⁶. This shift was largely motivated by the belief that surgery resulted in lower rates of re-rupture compared to non-operative management. However, more recent years have witnessed a significant change in clinical practice in many countries, with a noticeable increase in the adoption of non-operative management for Achilles tendon ruptures¹¹.

In Canada, a substantial decline in surgical repair rates has been observed after 2009. Similarly, the United Kingdom has seen a trend towards non-operative management, with a recent study indicating that the majority of cases are now managed non-surgically. Sweden has experienced a significant decrease in surgical incidence rates from 13.4 to 6.0 per 100,000 person-years between 2002 and 2021, with the proportion of surgically treated cases stabilizing at around 14-15% since 2017¹⁶. Denmark has also reported a statistically significant decrease in the incidence of surgically treated patients from 1994 to 2013, with rates dropping from 16.9 to 6.3 per 100,000³⁹. Finland has shown a decrease in the incidence of operative treatment from 13.6 to 4.9 per 100,000 person-years between 1997 and 2019, with this decline becoming evident from 2008 onwards³⁰. In Australia, a declining rate of acute Achilles tendon surgery has been noted since a key randomized controlled trial in 2010, with a significant 68% decrease in surgical repairs reported within the Victorian Orthopaedic Trauma Outcomes Registry between 2009 and 2014¹⁹.

However, this trend towards non-operative management is not universal. Japan, in contrast to Scandinavian countries, has shown a significant increase in the annual proportion of surgical treatment for Achilles tendon rupture from 67% in 2010 to 72% in 2017, with an overall surgical rate of 70%⁴². France also reported a high proportion of patients (92%) with acute Achilles tendon ruptures being treated surgically between 2018 and 2019²¹. In the United States, despite increasing evidence supporting non-operative management, the rate of surgical repair for Achilles tendon rupture remained relatively stable at around 70% between 2007 and 2015²². Italy has seen an increasing number of hospitalizations for Achilles tendon repair between

2001 and 2015, suggesting a consistent role for surgical intervention, although the exact proportion relative to non-surgical management is not detailed in the provided information ⁴⁹.

The increasing adoption of non-operative management in many regions is largely attributed to the publication of numerous high-quality randomized controlled trials and meta-analyses. These studies have demonstrated that functional outcomes and re-rupture rates in well-managed non-operative treatment protocols, which include early functional rehabilitation, can be comparable to those achieved with surgical repair. Furthermore, there is a growing recognition of the higher risk of complications associated with surgical treatment, such as wound infections, nerve damage, and thromboembolic events, compared to non-operative management. The evolution of non-operative protocols to incorporate early weight-bearing and range of motion exercises has further improved outcomes and potentially reduced the risk of re-rupture previously associated with traditional immobilization methods ¹⁶. Finally, a greater emphasis on shared decision-making between patients and clinicians, considering individual risk factors, activity levels, and preferences, has likely contributed to the increased acceptance of non-operative management.

The continued preference for or increase in surgical rates in some regions might be explained by several factors. Surgeon preferences and variations in clinical practice, potentially influenced by training and experience, can play a significant role ¹⁶. Some surgeons might still believe that surgery offers advantages in terms of faster recovery, stronger tendons, and lower re-rupture rates, especially for highly active individuals or elite athletes ¹⁹. However, recent research is challenging the claim of a faster return to full capacity with surgery in elite athletes ²⁸. Additionally, there might be a time lag in the widespread adoption of the latest research findings into clinical practice, with some regions potentially being in earlier stages of this transition. The global landscape of Achilles tendon rupture treatment is clearly evolving, with a significant trend towards non-operative management in many parts of the world, driven by a growing body of evidence. However, the persistence of higher surgical rates in certain regions highlights the complexity of translating research into uniform clinical practice and the influence of factors beyond scientific findings alone.

4. Country-Specific Study Summaries

5. Demographic Characteristics of Achilles Tendon Rupture Patients

Across the studies reviewed, the median or average age of individuals experiencing an Achilles tendon rupture typically falls within the range of 30 to 50 years. Notably, research conducted in Sweden indicated an increase in the median age at rupture from 44 years in 2002 to 50 years in 2021¹⁶. Some literature suggests a bimodal distribution in the incidence of ATR, with peaks observed in younger, active individuals as well as in older adults⁷. The peak age for sports-related injuries is often in the fourth decade of life, while non-sporting injuries tend to occur more frequently in the sixth decade³¹. This trend towards an older average age in some populations may reflect the increasing participation of older individuals in sports and physical activities, alongside the general aging of the population. This shift could have implications for recovery timelines and the suitability of different treatment options, as older patients might present with more comorbidities and potentially slower healing capacities.

A consistent finding across the majority of studies is the higher incidence of Achilles tendon rupture in males compared to females. While the reported male-to-female ratios vary across different studies, men are generally found to be 2 to 12 times more likely to sustain an ATR⁴⁴. In Sweden, males accounted for 78% of all Achilles tendon ruptures between 2002 and 2021¹⁶. However, the Swedish study also noted an increasing incidence rate for women, with a 58% increase over the study period, compared to a 40% increase for men¹⁶. The strong male predominance suggests potential biological or behavioral factors that might make men more susceptible to ATR. Nevertheless, the observed increase in incidence among women in some regions warrants further investigation to understand the underlying causes and potential implications for prevention and treatment strategies.

Several studies have identified specific groups at higher risk of experiencing an Achilles tendon rupture. For instance, men aged 40–49 years are often cited as being particularly vulnerable. The concept of the "weekend warrior"—middle-aged men who participate in occasional athletic activities—is frequently mentioned as a high-risk group⁴. Achilles tendon rupture is commonly associated with sporting activities, accounting for a significant proportion of reported cases¹¹. The specific sports implicated can vary by region; for example, basketball is commonly associated with ATR in the United States, while soccer and badminton are frequently mentioned in European studies⁵¹. Additionally, the increasing incidence observed in older populations, particularly those over 50 years of age, is a notable trend in several

countries³⁹. Identifying these high-risk groups is crucial for developing targeted prevention programs and providing appropriate counseling to individuals at an increased risk of ATR. The evolving demographics, with a rising incidence in older adults and potentially women, suggest that risk profiles might be changing over time and require ongoing monitoring and research.

6. Outcomes Associated with Surgical and Non-Surgical Treatment

Systematic reviews and meta-analyses generally indicate that surgical treatment is associated with a statistically significant but often small reduction in the risk of re-rupture compared to non-operative management. The reported risk differences are often in the range of 1-2%. Importantly, numerous studies have demonstrated that with the implementation of accelerated functional rehabilitation protocols in non-operative management, the rates of re-rupture can become comparable to those observed with surgical treatment. This evolving understanding of re-rupture risk, particularly the positive impact of functional rehabilitation in non-operative management, has been a key factor driving the shift towards non-surgical approaches. The historical emphasis on surgery for its perceived superiority in preventing re-ruptures is now being balanced against the potential benefits of non-operative management.

A consistent finding across the literature is that surgical treatment is associated with a significantly higher risk of complications compared to non-operative management. These complications primarily include surgical site infections, wound healing problems, sural nerve injury, and venous thromboembolism (DVT). Infection rates in the surgical groups have been reported to be around 2.8% in some studies. In contrast, non-operative treatment, while avoiding these surgical complications, might be associated with a higher risk of tendon lengthening or calf muscle weakness if rehabilitation is not managed appropriately⁷. The higher risk of complications with surgery presents a significant trade-off against the potentially small reduction in re-rupture risk. This balance of risks and benefits is a crucial consideration in treatment selection and likely contributes to the increasing preference for non-operative management in many cases.

Numerous recent studies and meta-analyses have demonstrated that functional outcomes, including return to sports, strength, range of motion, and patient-reported outcome scores (e.g., ATRS), are often comparable between surgical and non-surgical treatment groups, particularly when non-operative management includes early functional rehabilitation¹. While some studies suggest that surgery might lead to a slightly faster return to sports in elite athletes, this is not consistently supported by

the latest research ²⁸. The growing evidence of equivalent functional outcomes between surgical and non-surgical treatment has been a pivotal factor in the changing treatment landscape. It challenges the traditional view that surgery is always necessary to achieve the best possible functional recovery after an ATR.

7. Conclusion

The incidence of Achilles tendon rupture has shown a significant increase globally over recent decades, likely attributable to a combination of factors such as an aging and more active population, rising obesity rates, and the use of certain medications. Concurrently, there has been a notable shift in treatment approaches in many countries, with a growing trend towards non-operative management. This change is largely driven by robust evidence from high-quality research demonstrating comparable functional outcomes and lower complication risks associated with non-operative treatment, especially when it includes early functional rehabilitation, compared to surgical repair. However, surgical rates have remained stable or even increased in some regions, highlighting the influence of factors beyond purely scientific evidence, including surgeon preferences and perceived benefits in specific patient groups.

The evolution of Achilles tendon rupture treatment exemplifies how high-quality clinical research can significantly impact and reshape medical practice. The increasing body of evidence supporting non-operative management has directly contributed to its greater acceptance worldwide. Ultimately, the optimal management strategy for an Achilles tendon rupture should be individualized, taking into account each patient's unique circumstances, including their age, activity level, overall health, risk factors, and personal preferences. A thorough discussion of the potential benefits and risks associated with both surgical and non-surgical treatment options, facilitated by shared decision-making between the patient and the clinician, is essential to ensure that the chosen approach aligns with the patient's specific needs and goals, leading to the best possible outcomes.

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