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DIAGNOSIS AND TREATMENT OF ACUTE ACHILLES TENDON RUPTURE: A COMPREHENSIVE SYSTEMATIC REVIEW

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ABSTRACT

Background: *Achilles tendon rupture is a common orthopaedic injury that results in substantial functional limitations throughout a lengthy recovery time. The increasing incidence of Achilles tendon ruptures has been well documented in population-based studies. The delayed treatment of AT ruptures is usually attributable to either poor diagnosis upon injury or patients disregarding their injuries and not presenting to healthcare facilities.*

The aim: *The aim of this study to show about diagnosis and treatment of acute achilles tendon rupture.*

Methods: *By the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. This search approach, publications that came out between 2014 and 2024 were taken into account. Several different online reference sources, like Pubmed, SagePub, and Google Scholar were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.*

Result: *In the PubMed database, the results of our search get 17 articles, whereas the results of our search on SagePub get 299 articles, on Google Scholar 6990 articles. Records remove before screening are 5317, so we get 1989 articles fos screening. After we screened based on record exclude, we compiled a total of 12 papers. We included five research that met the criteria.*

Conclusion: *Multiple evaluative techniques including the addition of diagnostic ultrasound imaging and continuous shear wave elastography (cSWE) to standard clinical tests and measures were used to assess patient-reported symptoms, tendon structure, and tendon functional performance. As treatment recommendations and strategies evolve, decisional conflict may arise when patients with Achilles tendon ruptures are faced with the need to choose a management option. There have been several reviews of management strategies, primarily focused on pairwise comparisons between individual operative and non-operative strategies.*

Keyword: *Achilles tendon rupture (ATR), diagnosis, treatment, operative, imaging.*

INTRODUCTION

The Achilles tendon is the strongest tendon in the human body. Achilles tendon rupture is a common injury seen in orthopaedic departments, and with an increase in sporting activities, incidence of Achilles tendon rupture is increasing, particularly in young people. There is no consensus regarding optimal treatment, however, with published studies covering conservative treatment, percutaneous or open repair, or minimally invasive repair techniques. Although repair procedures vary considerably, end-to-end suturing techniques to repair Achilles tendon without defects have achieved good success rates.[1,2]

There is still no consensus on whether acute Achilles tendon ruptures should be treated conservatively or operatively. Supporters of conservative treatment argue that there is no risk for surgery-related complications such as wound healing problems, scar tissue, adhesion of the tendon, infection or nerve damage. According to the current literature, two major indications for surgical treatment are: tendon gap formation of more than 1 cm in 20° plantar flexion or treatment initiation more than 24 h after injury, where haematoma formation is likely. In the latter case, elongation of the tendon is quite likely and might lead to a functionally unsatisfactory outcome in conservative treatment. The main reason for supporting operative treatment is based on lower rerupture rates. The aftercare protocols also differ considerably and range from early functional rehabilitation models to strict immobilisation for six to eight weeks. However, a current meta-analysis showed that early functional rehabilitation protocols reduce the rerupture rate in non-operatively treated patients to a level similar to that of patients treated by surgery.[3]

Surgical treatment significantly reduces the risk of re-rupture, but increases the risk of complications associated with surgery, such as wound infection and necrosis caused by excessive dissection, and Achilles tendon contracture. End-to-end suture techniques lead to reduced complication rates and more successful outcomes compared with tendon augmentation methods. In a study that compared the Krakow locking loop technique with triple bundle technique in terms of Achilles tendon tensile strength following repair, the triple bundle technique represented statistically significant superiority. In another study, Achilles tendon repair using the triple-bundle technique was shown to result in good functional restoration with a low complication rate.[1,4]

Contrast-enhanced ultrasound (CEUS) can be used to detect neovessels, angiogenesis and perfusion with greater sensitivity than duplex ultrasound (DU) following Achilles tendon rupture. The advantage of kinematic magnetic resonance imaging (MRI) is that it enables the visualisation of pathologies that depend on the position and/or load in the area of interest. This technique was performed mainly to detect pathologies related to joints regarding the musculoskeletal domain. Only a few studies have been published using kinematic MRI to clarify the involvement of tendons such as peroneal tendon subluxation or biceps tendon dislocation. To our knowledge, no other study has used kinematic MRI or CEUS to compare the outcome of operative and non-operative treatment after Achilles tendon rupture.[3,5]

METHODS

Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

Criteria for Eligibility

For the purpose of this literature review, we compare and contrast diagnosis and treatment of acute achilles tendon rupture. It is possible to accomplish this by researching or investigating diagnosis and treatment of acute achilles tendon rupture. As the primary purpose of this piece of writing, demonstrating the relevance of the difficulties that have been identified will take place throughout its entirety.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English, and it needs to determine about diagnosis and treatment of acute achilles tendon rupture. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2014, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

Search Strategy

We used "diagnosis and treatment of acute achilles tendon rupture." as keywords. The search for studies to be included in the systematic review was carried out using the PubMed and SagePub databases by inputting the words: *((*"Achilles tendon rupture*"[MeSH Subheading] OR* "Acute achilles tendon rupture*"[All Fields] OR* "Diagnosis acute achilles tendon rupture*" [All Fields]) AND (*"Treatment acute achilles tendon rupture*"[All Fields] OR* " Achilles tendon rupture management*"[All Fields]) AND (*"Acute achilles tendon rupture complications*"[All Fields]) OR (*"Diagnosed of acute achilles tendon rupture" *[All Fields]))* used in searching the literature.

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and cannot have been seen anywhere else.

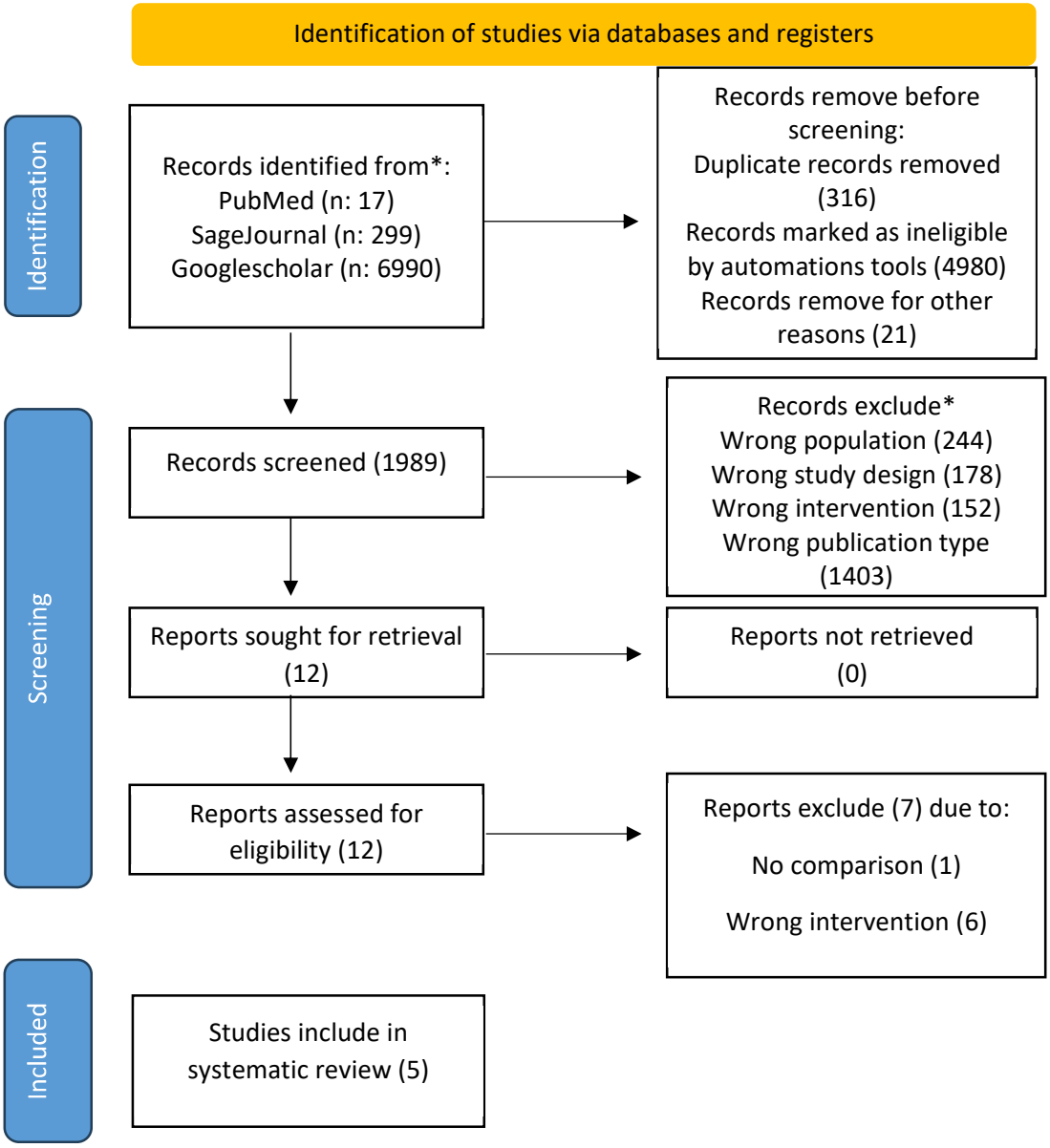

Figure 1. Article search flowchart

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

RESULT

From the PubMed database, the results of our search get 17 articles, whereas the results of our search on SagePub get 299 articles, on Google Scholar 6990 articles. Records remove before screening are 5317, so we get 1989 articles fos screening. After we screened based on record exclude, we compiled a total of 12 papers. We included five research that met the criteria.

Crook, BS *et al* (2023)[6] showed no differences between operative and nonoperative management of Achilles tendon ruptures in terms of the need for subsequent surgery in a large cohort of 17,996 patients. As hypothesized, we found that operative management was associated with an increased risk of complications with an NNH of 83 and higher costs of care at 9 months and 2 years. Management trends in the US have not matched the decrease in operative management described in European studies, despite increasing evidence of similar outcomes between treatments.

Tarczynska, M *et al* (2023)[7] showed the delayed treatment of a ruptured AT results in the lengthening of some gait phases and changes in the shape and size of plantar pressure areas, as well as affects the balance performance of the affected limb. Despite the differences in our US and pedobarographic findings indicating that delayed surgery had negative impacts on patient treatment outcomes, the mid- and long-term functional outcomes of AT ruptures were good in both acute and chronic rupture patients.

Table 1. The litelature include in this study

Author	Origin	Method	Sample Size	Result
Crook, BS *et al*., 2023[6]	USA	Cohort study	31515	The operative cohort experienced a significantly larger total number of complications within 30 days of injury (1026 vs 917; P = .0088). The absolute increase in cumulative risk was 1.2% with operative treatment, which resulted in an NNH of 83. Neither 1-year (1.1% [operative] vs 1.3% [nonoperative]; P = .1201) nor 2-year reoperation rates (1.9% [operative] vs 2% [nonoperative]; P = .2810) were significantly different. Operative care was more expensive than nonoperative care at 9 months and 2 years after injury; however, there was no difference in cost between treatments at 5 years. Before matching, the rate of surgical repair for Achilles tendon rupture remained stable, from 69.7% to 71.7% between 2007 and 2015, indicating little change in practice in the United States.
Tarczynska, M *et al*., 2023[7]	Poland	A pilot study	30	Our ultrasonographic and pedobarographic findings revealed differences between both patient groups, thus indicating that delayed surgery had negative impacts on

				treatment success, however, with good long-term functional score outcomes in both patient groups. Nevertheless, delayed treatment of AT ruptures did not leave individual gait phases unaffected, as it also affected the plantar surface and balance performance of the affected limb. As per the results, the Achilles tendon manifested decreased capacity following delayed treatment; however, its long-term functional outcomes were favourable, irrespective of whether it was for acute or chronic patients.
Geng, X *et al*., 2023[8]	China	From January 2016 to December 2019, patients with acute closed ATR who had undergone repair surgery were retrospectively enrolled.	47	This study included 47 consecutive patients with acute ATR, with an average age of 38.4 years. Among them, 40 were male, and seven were female. The intraoperative exploration demonstrated a total of 34 (72.3%), 10 (21.3%), and three (6.4%) patients with type I, II, and III ruptures, respectively. The average distance between the insertion site and the proximal broken end measured intraoperatively was 4.07 ± 1.57 cm. High or excellent consistencies were found for ATR classifications (kappa: 0.739–0.770, $p < 0.001$) and rupture sites (ICC: 0.962–0.979, $p < 0.001$) between two observers and between observers 1 and 2 and intraoperative findings. Tendinopathy was identified in 22 patients by MRI and confirmed during surgery.
Westin, O *et al*., 2020[9]	Sweden	Data was collected from five previous randomised controlled trials (RCTs)	422	A total of 422 patients (350 males and 72 females) aged between 18 and 71 years, with a mean age of 40.6 (standard deviation 8.6), were included. A total of 363 (86%) patients were treated surgically. The ATRS (difference (Δ) = − 0.253 [95% confidence interval (CI); − 5.673;5.785] $p = 0.36$) and LSI of heel-rise height (difference = 1.43 [95% CI; − 2.43;5.59] $p = 0.81$), total work (difference = 0.686 [95% CI; − 4.520;6.253] $p = 0.67$), concentric power (difference = 2.93 [95% CI; − 6.38;11.90] $p = 0.063$) and

				repetitions (difference = − 1.30 [95% CI; − 6.32;4.13] $p = 0.24$) resulted in non-inferiority within a Δ − 10% margin for patients treated non-surgically.
Westin, O *et al*., 2016[10]	Sweden	Cohort study	45	Patients with a diastasis of >10 mm treated nonsurgically had a higher degree of rerupture. In the nonsurgically treated group, 3 of 4 patients with a diastasis of >10 mm suffered from rerupture ($P <$ .001). Moreover, in the nonsurgical group, there was significantly worse outcomes in patients with a diastasis of >5 mm in terms of patient-reported outcomes using the Achilles tendon Total Rupture Score (ATRS) ($P =$ .004) and heel-rise height at 12 months ($P =$ .048) compared with the group with a lesser degree of tendon separation.

Geng, X *et al* (2023)[8] showed using MRI scanning combined with intraoperative exploration, it can be concluded that MRI scanning of acute closed ATR can help determine whether there is degeneration of the AT and the location and shape of the rupture. For cuff-like ruptures, ruptures with degeneration of the Achilles tendon, and avulsion ruptures at the insertion point, the surgical method should be carefully selected.

Westin, O *et al* (2020)[9] showed The non-surgical treatment of Achilles tendon ruptures is non-inferior compared with surgery at 1 year in terms of the ATRS and LSI for heel-rise height, total work, repetitions and concentric power.

Westin, O *et al* (2016)[10] showed Acute US measurement of the diastasis between the ruptured tendon ends may give the treating physician an indication of the risk of having a rerupture and poor outcome, hence providing guidance in the decision between surgical and nonsurgical management. Nonsurgical management of Achilles ruptures with a gap >10 mm had a significantly higher rate of rerupture than nonoperative treatment with a gap <10 mm. Nonsurgical management of ruptures with a gap >5 mm led to inferior outcomes for heel-rise height and heel-rise work compared with surgical treatment.

DISCUSSION

Acute Achilles' tendon rupture (AATR) is a common injury, with an annual incidence of 5 to 50 events per 100,000 people and may result in severe disability and prolonged absence from work and physical activity. With more than 10,000 references presently published on the topic, and more than 200 systematic reviews, debate still exists about the best treatment strategy and the rehabilitation protocol. Meta-analyses including different trials at different times, and focusing on different outcomes, further increased the confusion on the topic.[11,12]

Different treatment strategies have been proposed over the years, mainly categorized in open repair (OR), minimally invasive surgery (MIS) and nonoperative treatment (NOT). OR requires about 10 cm of vertical posteromedial incision and wide tendon exposure. The supposed advantages of OR are the lowest re-rupture rate and fastest return to sports activity while showing the highest rate of complications. MIS includes different techniques (Ma and Griffith's technique, Dresden technique, Tenolig and Achillon), all with a reduced incision length, minimizing the exposure of the Achilles tendon and, theoretically, lowering the complications while preserving the same efficacy on the prevention of re-ruptures. Eventually, the NOT has shown the lowest complications rate, but requires longer healing time and thus increased disability.[11]

Ultrasound (US) imaging has been used as an objective measure of tendon structural assessment post-rupture. Tendon elongation, in particular, has been found to relate to performance on functional heel-rise tests as well as changes in triceps surrae muscle activation during gait. Recently, a new ultrasound technique, continuous shear wave elastography (cSWE) has been developed and validated in a population of individuals with healthy Achilles tendons and in one case of an individual with tendinopathy. This technique uses an external actuator to send a low-level vibration along the tendon. Ultrasound imaging is used to track tissue displacement and is used to calculate the speed that the wave travels along the

tendon. The speed of the wave is then used in a biomechanical model to calculate the tendon's shear modulus and viscosity.[13]

The correct diagnosis of ATR may be missed in up to 25% of patients at initial presentation. The diagnosis relies on clinical examination, and imaging techniques can be useful in providing additional clinical information. Patients with an ATR usually report a history of pain in the affected leg and the feeling that, at the time of injury, they had been kicked in the posterior aspect of the lower leg or complain of a popping or giving way sensation in their heel after pushing off. On clinical examination, diffuse edema and bruising are usually present, and, unless the swelling is severe, a palpable gap may be felt along the course of the tendon, most frequently 2 to 6 cm proximal to the insertion of the tendon. Inspection and palpation should be followed by other tests to confirm the diagnosis, such as the Simmonds (or Thompson) and Matles test and the O'Brien and Copeland tests. Imaging, especially diagnostic ultrasound (that is generally considered the primary imaging method) and magnetic resonance imaging, plays only an adjunct role in the diagnosis and monitoring of ATRs, and it is recommended to rely primarily on clinical examination and evaluation, and to use imaging for ruling out other injuries.[14]

There is a dichotomy of therapeutic options: operative and conservative. Both are accepted forms of management for acute rupture and the optimal regimen remains contentious. The article discusses cases of acute tendoachilles rupture. In cases of delayed diagnosis the likely success of conservative management may be limited by a lack of apposition of the tendon ends due to scarring and retraction. Therefore, surgical repair is advocated. Cases of chronic rupture of the tendoachilles by their very nature will not respond to conservative treatment and therefore will require repair utilising graft.[15]

Historically, non-operative management has been associated with a higher risk of tendon re-rupture. For this reason, many surgeons have advocated for operative treatment. Unfortunately, due to a tenuous soft-tissue envelope over the Achilles tendon, surgery may result in devastating wound complications and infections. As such, alternative management strategies have been sought to minimize the risks that come with both operative and non-operative care. In many centers, non-operative care has evolved to include early mobilization and functional rehabilitation. This strategy has been shown to decrease the re-rupture rate to that similar to operative management.[16]

Functional rehabilitation programs, however, do require significant patient engagement and access to physiotherapy for optimal results, which may present a barrier to some patient populations. There is also concern that calf strength remains weaker with functional rehabilitation than with operative treatment, leading some to advise surgery for more active patients. Surgical care is evolving, with minimally invasive and percutaneous surgical techniques being developed to negate the risk of wound complications and infections found with open surgery. These techniques are more challenging than traditional open surgery, with a learning curve for surgeons, and are not yet widely used.[16]

CONCLUSION

Multiple evaluative techniques including the addition of diagnostic ultrasound imaging and continuous shear wave elastography (cSWE) to standard clinical tests and measures were used to assess patient-reported symptoms, tendon structure, and tendon functional performance. As treatment recommendations and strategies evolve, decisional conflict may arise when patients with Achilles tendon ruptures are faced with the need to choose a management option. There have been several reviews of management strategies, primarily focused on pairwise comparisons between individual operative and non-operative strategies.

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