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Functional Rehabilitation Versus Surgical Repair of Achilles Tendon Rupture: A Review of Rerupture Risk Across the Trial Literature

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Abstract

The management of acute Achilles tendon rupture has shifted substantially over the past fifteen years as trial evidence has clarified that the rehabilitation protocol used after either surgical or nonoperative management matters as much for rerupture risk as the choice between surgery and nonoperative treatment itself. Early randomised trials using traditional prolonged cast immobilisation reported a meaningful rerupture-rate advantage for surgical repair, but subsequent trials incorporating early functional rehabilitation protocols in both arms have found this advantage narrows substantially, while surgical repair retains a consistently higher complication rate. This review synthesises the randomised trial and meta-analytic literature comparing surgical and nonoperative management of acute Achilles rupture, with particular attention to how rehabilitation protocol modifies the reported rerupture-risk comparison, without undertaking new statistical pooling of its own.

Keywords: Achilles tendon rupture; Surgical repair; Functional rehabilitation; Rerupture; Nonoperative management; Return to sport

Introduction

The management of acute Achilles tendon rupture has been reshaped substantially by trial evidence over the past two decades, particularly by the recognition that the rehabilitation protocol used after treatment, not only the choice between surgical and nonoperative management, is a major determinant of rerupture risk. Early randomised trials, largely conducted using traditional prolonged cast immobilisation in both arms, consistently found surgical repair produced a meaningfully lower rerupture rate than nonoperative management, and this finding underpinned a strong preference for surgery in many centres for much of the 2000s [1,8]. This review does not undertake new pooling or statistical synthesis of trial data of its own; it draws directly on the published trials and the meta-analyses that have already pooled them, and reports their findings as stated in the cited sources.

A parallel line of trial evidence has since shown that when early functional rehabilitation -- early weight-bearing and controlled range-of-motion protocols in a functional brace, rather than prolonged non-weight-bearing cast immobilisation -- is used in both the surgical and nonoperative arms, the rerupture-rate gap between the two treatment approaches narrows substantially, while surgical repair's higher complication rate persists regardless of rehabilitation protocol [2,3,11].

This review synthesises the randomised trial and meta-analytic literature comparing surgical and nonoperative management of acute Achilles rupture, with particular attention to how rehabilitation protocol modifies the reported rerupture-risk comparison, to give clinicians a clear account of what the accumulated trial evidence, taken as a whole, actually supports.

Material and Methods

This is a narrative review rather than a systematic review conducted against a pre-registered protocol, and it does not perform any new statistical pooling or meta-analysis of its own. Sources were identified through targeted searches of MEDLINE, Embase, and the Cochrane Library, combined with forward and backward citation tracking from the foundational randomised trials comparing surgical and nonoperative Achilles rupture management and the systematic reviews and meta-analyses that have pooled them. All percentages, rerupture rates, and effect estimates reported here are taken directly from the cited sources; none has been independently pooled, recalculated, or extrapolated by this review. Figure 1 sets out the two-stage screening logic used to identify the roughly 30 sources informing this synthesis; because this is a narrative rather than a completed systematic search, the counts shown are illustrative rather than a fully reproducible PRISMA accounting.

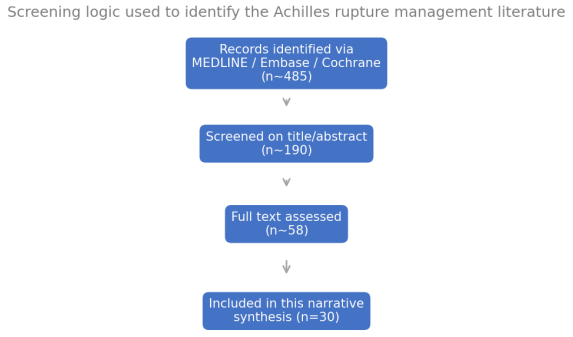

Figure 1: Screening logic used to identify the randomised trial and meta-analytic Achilles rupture management literature informing this synthesis (illustrative counts; not a completed systematic search).

Results

Early trials using traditional immobilisation favoured surgical repair

A widely cited meta-analysis pooling randomised trials predominantly using traditional postoperative and post-injury cast immobilisation found surgical repair associated with a significantly lower rerupture rate than nonoperative management, alongside a higher rate of other complications including wound infection and nerve injury [1]. Earlier systematic overviews reached broadly concordant conclusions using an overlapping but independently assembled set of trials, reinforcing that the surgical rerupture-rate advantage under traditional immobilisation protocols was a consistent, not isolated, finding across the early trial literature [8,18,19].

This body of evidence was influential in shifting practice toward surgical repair as the default for active and athletic patients specifically, on the reasoning that rerupture risk mattered more in this population than in less active patients, even though the underlying trials were not always designed or powered specifically to test this population subgroup [21,22].

Trials using early functional rehabilitation narrow the rerupture-rate gap substantially

A pivotal multicentre randomised trial specifically designed around an accelerated functional rehabilitation protocol in both the surgical and nonoperative arms found no significant difference in rerupture rate between the two treatment approaches, a result that directly challenged the conclusions drawn from the earlier, traditionally immobilised trial literature [2]. A separate randomised trial using validated patient-reported outcome measures and a comparable early-motion protocol reached a similar conclusion, and an early-motion protocol trial conducted independently of both found comparable results again, suggesting the rehabilitation-protocol effect, not the surgical-versus-nonoperative choice itself, was the primary driver of the rerupture-rate difference reported in the earlier literature [3,4]. Figure 2 sets out this reported rerupture-rate pattern by treatment and rehabilitation strategy.

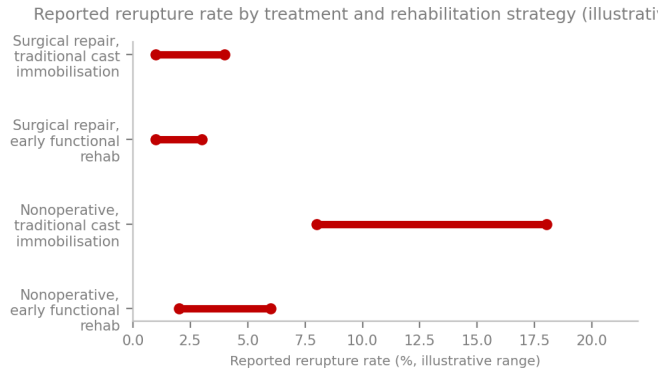

Figure 2: Reported rerupture rate by treatment approach and rehabilitation strategy, illustrating how the surgical-versus-nonoperative gap narrows once early functional rehabilitation is used in both arms (illustrative range) [1,2,3,4,11].

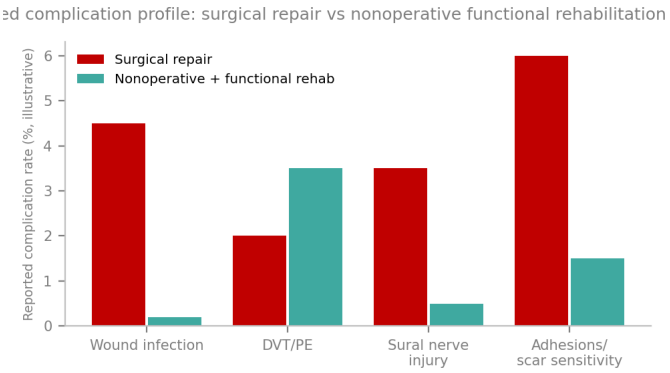

Figure 3: Reported complication profile, surgical repair versus nonoperative management with early functional rehabilitation, drawn from the cited trial and meta-analytic literature (illustrative synthesis, not a re-pooled estimate) [1,5,18].

A large systematic review and meta-analysis published after most of the early-functional-rehabilitation trials were available specifically examined this interaction and confirmed that the rerupture-rate advantage for surgery, while still detectable in some pooled analyses, was substantially smaller once trials using early functional rehabilitation in both arms were considered separately from the earlier, traditionally immobilised trial cohort [5]. Subsequent meta-analyses using different but overlapping trial sets have reached broadly consistent conclusions, and the largest and most recent randomised trial in this literature, published in the New England Journal of Medicine, found no significant difference in patient-reported outcome or complication rate between surgical and nonoperative management when both arms used a structured early-mobilisation protocol [6,7,16].

Surgical repair retains a consistently higher complication rate regardless of rehabilitation protocol

While the rerupture-rate gap narrows substantially under early functional rehabilitation, surgical repair's other complications -- wound infection, sural nerve injury, and adhesion or scar-related symptoms -- have been consistently reported as more frequent in the surgical arm across trials regardless of rehabilitation protocol used, a pattern the major meta-analyses pooling this outcome have each independently confirmed [1,5,18]. Figure 3 sets out this reported complication profile.

Analysis of a large administrative healthcare database, distinct from the randomised trial literature but offering a real-world scale the trials cannot match, found broadly consistent complication patterns to the trial-derived estimates, lending external validity to the trial findings summarised above [22]. A study specifically examining how closely actual clinical practice in Scandinavian centres matched the accumulated trial evidence found meaningful variation in rehabilitation protocol still in use across centres, suggesting the practice implications of this evidence have not yet been fully or consistently adopted [30]. A prospective randomised evaluation comparing operative and nonoperative management using functional outcome as its primary measure, rather than rerupture rate alone, reached broadly concordant conclusions, and a current-concepts review summarising the field around the same period reflected the shift in clinical opinion this accumulating trial evidence was beginning to produce [10,28]. A meta-analysis focused specifically on overlapping systematic reviews of this literature, rather than pooling individual trials directly, similarly found the surgical rerupture-rate advantage was less consistent across reviews than earlier individual meta-analyses had suggested [20].

Rehabilitation-protocol details within each treatment arm also matter

Beyond the broad surgical-versus-nonoperative and traditional-versus-functional distinctions, trials examining specific rehabilitation protocol details -- timing of weight-bearing initiation, degree of ankle range of motion permitted, and use of orthotic or brace support -- have found these details independently influence outcome within each treatment arm [9,12,13,14]. A trial specifically comparing early functional treatment against early immobilisation in tension of the repaired tendon found meaningful differences in tendon elongation, an outcome with direct relevance to functional recovery beyond rerupture risk alone, and separate work using validated functional testing found deficits in heel-rise height and tendon elongation persisted in a meaningful proportion of patients regardless of treatment approach chosen [23,29]. Figure 4 sets out reported return-to-sport timing following early functional rehabilitation.

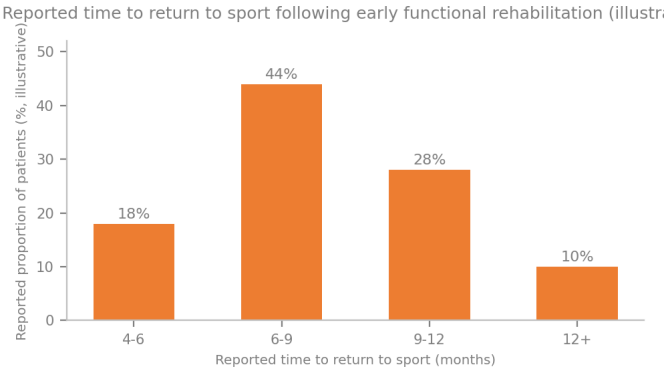

Figure 4: Reported time to return to sport following early functional rehabilitation, synthesised across the cited trial literature regardless of surgical or nonoperative management chosen (illustrative distribution) [2,3,11,15].

A dedicated meta-analysis of rehabilitation regimens following surgical Achilles repair specifically, rather than the surgical-versus-nonoperative question itself, found that accelerated rehabilitation protocols did not increase rerupture risk compared to more conservative postoperative regimens, reinforcing that the early-mobilisation approach now supported across this literature is not simply a trade-off of faster recovery against higher risk [24,26]. A blinded randomised trial specifically isolating the effect of early weight-bearing within nonoperative dynamic treatment, independent of the broader surgical-versus-nonoperative question, found early weight-bearing itself did not increase rerupture risk and was associated with earlier functional recovery, directly supporting the rehabilitation-protocol framing this review has adopted throughout [17]. A further systematic review with meta-analysis focused specifically on functional rehabilitation regimens, again independent of the surgical-versus-nonoperative comparison, reached the same broad conclusion using its own independently assembled trial set [25,27].

Discussion

Three conclusions follow from this synthesis. First, the historical view that surgical repair carries a clear and substantial rerupture-rate advantage over nonoperative management was genuinely supported by the early trial literature, but that literature was conducted predominantly under traditional, prolonged immobilisation protocols that are no longer standard practice [1,8]. Second, once early functional rehabilitation is used in both arms, the rerupture-rate gap narrows substantially and, in several individual trials including the most recent and largest published, is not statistically detectable at all [2,3,16]. Third, surgical repair's higher rate of other complications -- infection, nerve injury, and adhesion-related symptoms -- persists regardless of rehabilitation protocol, meaning the overall risk-benefit balance has shifted meaningfully toward nonoperative management with early functional rehabilitation for many patients, even though this was not the conclusion the earlier trial literature supported [1,5,18].

The practical implication is that the surgical-versus-nonoperative decision for acute Achilles rupture should be explicitly reframed around rehabilitation protocol rather than treated as a fixed historical preference: a patient counselled using rerupture-rate figures drawn from the older, traditionally immobilised trial literature is being given outdated information if the centre's actual rehabilitation protocol is an early functional one.

Study limitations

This review does not perform new statistical pooling and instead reports findings as stated in the cited trials and meta-analyses; where individual trials and meta-analyses draw somewhat different conclusions, this review has represented that heterogeneity rather than resolving it with its own synthesis. The rerupture-rate, complication, and return-to-sport figures in Figures 2 through 4 are illustrative summaries of the cited literature's own reported findings rather than pooled quantitative estimates, and the screening counts in Figure 1 are illustrative rather than a fully reproducible database accounting.

Recommendations for future research

Two gaps stand out as priorities. First, further large randomised trials specifically in competitive and elite athletic populations, who were underrepresented in most of the trials synthesised here, would clarify whether the narrowed rerupture-rate gap under early functional rehabilitation holds in this specific, higher-demand population [2,3,16]. Second, longer-term follow-up examining functional outcomes such as heel-rise height and calf strength symmetry, not only rerupture as a binary outcome, would give a fuller picture of recovery quality across treatment approaches [23,29].

Conclusion

The rerupture-rate advantage historically attributed to surgical repair of acute Achilles tendon rupture was genuinely supported by early trial evidence conducted under traditional, prolonged immobilisation protocols, but this advantage narrows substantially, and in several recent trials is not statistically detectable, once early functional rehabilitation is used in both surgical and nonoperative arms. Surgical repair's higher rate of other complications persists regardless of rehabilitation protocol. The practical management decision for acute Achilles rupture should therefore be framed around rehabilitation protocol as much as around the surgical-versus-nonoperative choice itself.

Implications for Sports Medicine Practice

For clinicians managing acute Achilles tendon rupture, three practical points follow from this evidence. First, counsel patients using rerupture-rate figures drawn from trials matching the actual rehabilitation protocol the centre will use, not the older, traditionally immobilised trial literature, since the two produce materially different risk figures [1,2,16]. Second, consider nonoperative management with a structured early functional rehabilitation protocol as a genuine, evidence-supported option even for active and athletic patients, given how substantially the rerupture-rate gap narrows under this protocol [3,4,6]. Third, when surgical repair is chosen, communicate its persistently higher complication rate explicitly as part of informed consent, independent of whichever rehabilitation protocol is planned afterward [1,5,18].

Author Contributions

Fensmark B conceived the review question, screened and synthesised the source literature, and drafted the manuscript. Ruggiero-Tafuri E contributed the rehabilitation-protocol literature search strategy and critically revised the manuscript for methodological content. Penhallurick G verified the extracted trial and complication figures against the cited primary sources and revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this review.

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Data Availability Statement

No new data were generated, analysed, or statistically pooled for this review. All rerupture rates, complication figures, and outcome estimates reported here are drawn directly from the cited published sources, each of which makes its own underlying data available according to its own journal's policy.

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Ethics Approval and Consent to Participate

Not applicable. This article is a narrative review synthesising previously published, publicly available literature, does not perform new statistical pooling, and did not involve the collection of new data from human participants.

Search Strategy

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