The Reverse Fragility Index: A Systematic Review of Randomized Controlled Trials Comparing Rates of Re-rupture Following Open Achilles Tendon Repair versus Early Functional Rehabilitation

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INTRODUCTION: The non-operative treatment of Achilles tendon ruptures with periods of immobilization has historically demonstrated higher re-rupture rates than open operative repair. However, the advent of accelerated functional rehabilitation with early weight bearing and range of motion has resulted in decreased re-rupture rates that have often been reported as equivalent to those of surgical repair. The purpose of this study was to use the reverse fragility index (RFI) to evaluate the statistical reliability of randomized controlled trials (RCTs) reporting non-significant differences in re-rupture rates between treatment with open Achilles tendon repair and non-operative treatment with early functional rehabilitation.

METHODS:

All RCTs through May 2022 that compared re-rupture rates between open operative repair and early functional rehabilitation for treatment of Achilles tendon rupture were identified by systematic review. Studies that explicitly used early functional rehabilitation, defined as weight bearing and exercise-based interventions initiated within 2 weeks, and reported non-significant differences in re-rupture rates ($P \geq 0.05$) were included. The RFI, defined as the fewest number of event reversals needed to change the non-significant re-rupture outcome to statistically significant ($P < 0.05$), was calculated for each study. The number of studies in which the number lost to follow-up exceeded the RFI was also recorded.

RESULTS:

Among the 8 RCTs included in our analysis the overall median (interquartile range [IQR]) number of re-rupture events was 5 (3-6), while the overall median (IQR) re-rupture rate was 6.00% (4.62-7.06), with 2.95% (1.53-5.24) in the operative group and 7.17% (4.30-10.48) in the non-operative group. The median (IQR) RFI was 2.50 (1.75-4) which indicates that had the outcome of 3 patients in one treatment arm been reversed, the studies' non-significant result would change to statistically significant ($P < 0.05$). The median (IQR) number of patients lost to follow-up was 6 (4.75-8.25). Of the included studies, 7 out of the 8 (87.5%) had loss to follow-up greater than or equal to the studies' RFI.

DISCUSSION AND CONCLUSION: The results of clinical trials reporting non-significant differences in Achilles tendon re-rupture between open operative repair and nonoperative management with early functional rehabilitation would become significant if the outcomes of only a few patients were reversed. The number of patients needed to reverse the results of these studies was almost always less than the number lost to follow-up; thus, the neutrality of these studies is fragile. Routine reporting of RFI with statistically non-significant findings is encouraged to provide readers with an additional metric for interpreting the neutrality of study results.

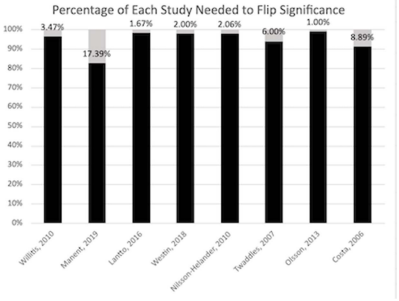

Table 1. Characteristics of Included Randomized Controlled Trials

Characteristic	No. of Studies (%)
Total No.	8
Sample size, median (IQR)	
Total	79 (49-100)
Operative	49 (28-49)
Non-operative	38 (23-51)
Year of publication	
2006-2012	4 (50.0)
2013-2021	4 (50.0)
Industry funding	
Yes	0
No/unclear	16 (100.0)
Journal	
American Journal of Sports Medicine	4 (50.0)
Knee Surgery, Sports Traumatology, Arthroscopy	1 (12.5)
Other	3 (37.5)

Other includes JBJS (n=1), JBJS British Volume (n=1), Journal of Foot and Ankle Surgery (n=1)

Table 2. Study Findings

Characteristic	Median (IQR)
Follow-up, mo.	12 (12-14)
No. of participants lost to follow-up	6 (5-9)
# of re-rupture events	5 (3-6)
Tendon re-rupture rate, %	
Total	6.00 (4.62-7.06)
Operative	2.95 (1.53-5.24)
Non-operative	7.17 (4.30-10.48)
Reverse fragility index (RFI)	2.5 (1.75-3.25)
Reverse fragility quotient (RFQ)	0.03 (0.02-0.07)