

Thromboembolic Events During Weightbearing vs Nonweightbearing Accelerated Rehabilitation Protocols for Complete Achilles Tendon Ruptures

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Abstract

Background: Achilles tendon rupture can be treated nonoperatively with functional rehabilitation. However, prolonged immobilization has associated risk of venous thromboembolism (VTE). Early weightbearing may reduce VTE risk, and this was introduced to our rehabilitation protocol. We investigated the prevalence of symptomatic VTE events before and after the introduction of the early weightbearing protocol.

Methods: Adults with ultrasonography-confirmed complete tendo-Achilles ruptures between January 2017 and June 2020 were included. Preprotocol, patients were instructed to not weightbear for 4 weeks. In 2018, immediate weightbearing was introduced to the treatment protocol. All patients in both cohorts were given low-molecular-weight heparin for 4 weeks. Patients with symptomatic VTE events were investigated with duplex ultrasonographic scan or chest computed tomography. Two independent anonymized examiners collected data from electronic records. Rates of symptomatic VTEs were compared.

Results: A total of 296 patients were included. Sixty-nine patients were managed with the nonweightbearing protocol, and 227 patients were managed with the early-weightbearing protocol. Two patients in each group developed deep vein thrombosis and 1 developed pulmonary embolism in the early-weightbearing group. Rates of VTEs were lower in the early-weightbearing group (1.3% vs 2.9%) but did not reach statistical significance ($P = .33$).

Conclusion: In this cohort we found that symptomatic VTE after nonoperatively treated Achilles tendon rupture was uncommon. We did not demonstrate a reduction in symptomatic VTE between our early weightbearing and nonweightbearing rehabilitation protocols. We believe a larger study may help clarify whether early weightbearing is beneficial in VTE reduction.

Level of Evidence: Level III, retrospective cohort study.

Keywords: Achilles tendon rupture, venous thromboembolism, VTE, functional rehabilitation, immobilization

Background

The treatment of acute tendo-Achilles rupture has been widely discussed over the past decade, with a shift toward functional nonoperative rehabilitation to mitigate the risks of serious complications such as deep infections associated with surgical treatment in the United Kingdom. Functional rehabilitation protocols involve immobilization in a wedged

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Non-operative management of acute complete Achilles tendon rupture	
Week 1	<ul style="list-style-type: none"> • Aircast boot with 5 wedges • Weightbearing status <ul style="list-style-type: none"> ○ Non-weight bearing for 4 weeks (2017 protocol) ○ Full weight bearing (2018 protocol) • Venous thromboembolism prophylaxis based on patient weight (Tinzaparin) for 28 days <ul style="list-style-type: none"> ○ Under 50 Kg – 3500 units once a day ○ 50-100 Kg – 4500 units once a day ○ Over 101 Kg – 4500 units twice a day
Week 4	<ul style="list-style-type: none"> • Foot and ankle clinic follow up • Remove one heel wedge per week
Week 9	<ul style="list-style-type: none"> • All heel wedges removed • Commence physiotherapy

Figure 1. Showing rehabilitation protocol for complete Achilles tendon rupture. Note the difference in weightbearing status between the 2017 and 2018 protocols.

walking boot allowing early weightbearing with or without gradual controlled ankle range of movement.⁴

Nonoperative management with plaster cast immobilization requires nonweightbearing, with reducing degree of equinus over an 8- to 10-week period. Venous thromboembolism (VTE) including deep vein thrombosis (DVT) and pulmonary embolism (PE), as well as post thrombotic syndrome remain serious complications from lower limb immobilization. Symptomatic VTE rate of 1.36% was reported in a large nationwide study of 28 546 patients with acute tendo-Achilles rupture in Denmark.¹¹

The use of pharmacologic thromboprophylaxis such as low-molecular-weight heparin (LMWH) has been shown to reduce the rate of VTE events following temporary lower limb immobilization.^{6,7} A recent Cochrane review on LMWH for prevention of VTE in patients with lower-limb immobilization reported symptomatic VTE rate of 0.8% in patients given LMWH vs 2.1% in the control group.¹³ In the United Kingdom, the National Institute for Health and Care Excellence (NICE) recommends that all patients with temporary lower limb immobilization undergo VTE risk assessment and prescribed individualized pharmacologic prophylaxis accordingly.⁹

In addition to pharmacologic thromboprophylaxis, permitting early full weightbearing during lower limb immobilization may have a role in reducing VTE event due to increased venous return.^{3,6} Clinically, however, it remains unclear whether early weightbearing in addition to pharmacologic VTE prophylaxis would provide added benefits to reduce VTE rates. Our aim is to review the prevalence of symptomatic VTE events during our study period comparing the rates before and after introduction of the early weightbearing functional rehabilitation protocol. Our hypothesis is that the VTE rate would be reduced with an early weightbearing protocol.

Methods

Patient Recruitment

All consecutive adult patients aged ≥ 18 years with acute complete Achilles tendon rupture, who presented to our hospital from January 2017 to June 2020 were included in the study. Patients with incomplete Achilles tendon rupture or incomplete data were excluded from the study. Patients out of area who transferred their care to their local hospital were excluded as well.

Treatment Protocol

All patients following suspected acute traumatic tendo-Achilles injuries were assessed in our hospital's accident and emergency department. These patients were discharged home with aircast boots with 5 heel wedges, and referred to our virtual fracture clinic. Outpatient Achilles tendon ultrasonographic scans were performed within 72 hours of presentation. If a complete tendo-Achilles rupture was confirmed on ultrasonographic scan and deemed suitable for nonoperative management at the virtual fracture clinic, the patient would be instructed to remove 1 wedge per week from week 4 post-injury. Rehabilitation with physiotherapy would commence at week 9 if there are clinical signs of tendon healing. In our 2017 protocol, patients were instructed to nonweightbear with crutches for the initial 4 weeks. This protocol was later modified in 2018 to allow patients to fully weightbear immediately in wedged aircast boots with or without crutches. In both protocols, VTE prophylaxis in the form of LMWH was prescribed for patients to self-administer for 28 days. Our protocol for nonoperative management of acute traumatic complete tendo-Achilles injuries is shown in Figure 1.

Table 1. Trend of Venous Thromboembolic Events in Nonweightbearing Cohort vs Weightbearing Cohort.

	Nonweightbearing, n (%) (n=69)	Weightbearing, n (%) (n=227)	P Value
Deep vein thrombosis			.23
Yes	2 (2.9)	2 (0.9)	
No	67 (97.1)	225 (99.1)	
Pulmonary embolism			.76
Yes	0 (0)	1 (0.4)	
No	69 (100)	226 (99.6)	
Venous thromboembolic event			.33
Yes	2 (2.9)	3 (1.3)	
No	67 (97.1)	224 (98.7)	

Our practice does not routinely screen for asymptomatic VTE using duplex ultrasonographic scans; however, if a patient presents with symptoms of VTE, then duplex ultrasonography or computed tomography pulmonary angiogram would be obtained. In this study, symptomatic VTEs were considered related to the tendo-Achilles rupture event if diagnosed within 3 months from the injury.

Data Analysis

The different weightbearing protocols defined the 2 cohorts of patients (weightbearing vs nonweightbearing) in this retrospective study. Primary outcome investigated was the incidence of symptomatic VTE. Two independent anonymized examiners collected data from the electronic medical record and imaging systems of our hospital. Data were amalgamated and reviewed for inconsistencies. Time of ultrasonographic scan and chest CT if performed for suspected clinical VTE event were noted.

SPSS, version 23.0 (IBM Corp, Armonk, NY), was used for the statistical analysis. Fisher exact, chi-square, and independent samples *t* test were used considering 0.05 the threshold for statistical significance.

Results

Data from a total of 305 patients with complete traumatic tendo-Achilles ruptures were examined. After exclusions, a total of 296 patients were included in the study. The mean age of the cohort was 53.7 ± 15.4 years; 209 were male and 96 were female. Fifty-three percent of the patients had a left-side tendo-Achilles rupture. The diagnostic ultrasonographic scan of the tendo-Achilles was performed 5.2 ± 13.4 days after the injury.

A total of 227 patients were treated with the full-weightbearing protocol (76.7%) and 69 patients with the nonweightbearing protocol (23.3%). The 2 groups were comparable in terms of age ($P=.66$) and injury side ($P=.8$).

Thirteen patients (4.4%) developed symptoms of calf swelling and persistent pain and were clinically and radiologically assessed for potential lower limb DVT using an ultrasound Doppler scan. Among them, DVTs were confirmed only in 4 (1.4%) patients. Specifically, the symptomatic DVTs were diagnosed at 3, 5, 50 and 85 days post-diagnosis of Achilles tendon rupture. Three patients (1%) developed clinical signs of PE and were investigated with computed tomography pulmonary angiogram. Only 1 patient (0.3%) was confirmed to have bilateral pulmonary nonfatal emboli diagnosed at 56 days post Achilles tendon rupture. Table 1 summarizes the results.

Two patients in each group developed DVT and 1 patient in the weightbearing group developed PE. There was no statistically significant difference between the 2 groups regarding the incidence of the DVT or PE (Fisher exact test 0.23 and 0.76, respectively). There was no statistical difference of the total thromboembolic events between the 2 groups and the incidence of tendo-Achilles rerupture ($P=.33$ and $.58$, respectively).

Discussion

In our cohort of 296 patients, a total of 5 symptomatic VTE events (1.7%) were found. Although not statistically significant, we found a lower symptomatic VTE rate in the early weightbearing group compared to the nonweightbearing group (1.3% vs 2.9% respectively), which is similar to other studies. A large study conducted in Denmark of 28 546 patients over an 18-year period found an overall symptomatic VTE rate of 1.36%. This study showed that high-risk groups were those who had a previous VTE event, male patients aged >50 years who were managed conservatively and in women aged <50 years who had used hormone medications for contraception. In this study, routine thromboprophylaxis was not used. The authors also believed that cast immobilization was a contributing factor to VTE, and functional rehabilitation is an important part of VTE prophylaxis but not on its own. They therefore concluded that

patients should be risk stratified and be given anticoagulation if at risk.¹¹ On the other hand, a retrospective review of 1172 patients with tendo-Achilles rupture found the rate of DVT to be 0.43% of PE to be 0.34% and could not find patient identifiable predictive factors for VTE-related events. Specifically, the rate of VTE events in nonoperatively managed tendo-Achilles ruptures was 0.43%. The authors therefore conclude with such low rates that anticoagulation is not needed.¹⁰ Despite the continued debates over the use of VTE prophylaxis, the potentially preventable nature of VTE events has driven recommendations for routine individualized assessments and prophylaxis prescribing in patients with lower limb immobilization in the United Kingdom.⁶

From previous studies, we understand that the risk of complications from pharmacologic VTE prophylaxis is low. A recent systematic review showed little evidence of harm, with only 4 events of major bleeding in 7000 patients. Minor bleeding rates were variable at 0% to 10.5% with patients treated with LMWH. No cases of heparin-induced thrombocytopenia rates were identified in trials monitoring this complication.⁶ A meta-analysis by Hickey et al⁵ showed a major bleeding risk of 0.11%. The number needed to prevent 1 symptomatic DVT was 86, and that 10 symptomatic DVTs could be prevented for every major bleed.

Nonoperative management for acute tendo-Achilles rupture involves cast immobilization with prolonged non-weightbearing. Moreover, early functional rehabilitation can include early weightbearing with or without early controlled ankle range of movement.⁴ Partial or full weightbearing has been observed to increase lower limb venous return in comparison to nonweightbearing.³ Interestingly, the authors found less venous return when the ankle is in equinus position during full weightbearing as opposed to being in neutral. They suggest that the calf muscle “pump” may be less effective when the ankle is in equinus although it is unknown how much venous return is sufficient to eliminate DVT risk.

In a recent randomized controlled trial, Maempel et al⁸ compared the outcomes of patients treated in cast immobilization with functional rehabilitation in walking boot allowing immediate weightbearing. Better early functional outcomes were found in those treated in walking boot. VTE was found in 2 patients treated with walking boot and in 3 patients in the nonweightbearing cast group ($P=.67$). Similar to our findings, the incidence of VTE was lower in patients who were allowed to weightbear immediately. On the contrary, a randomized controlled trial of 130 patients comparing early weightbearing and controlled ankle motion to nonweightbearing immobilization following surgical repair showed little difference in VTE rates between both groups (38% and 35%, respectively). This high incidence of DVT was due to routine postoperative screening for DVT at

2 and 6 weeks using compression Doppler ultrasonography, as a result, included asymptomatic DVTs. In addition, no patients were prescribed pharmacologic VTE prophylaxis, making a comparison to our study difficult.¹ Another randomized controlled trial by Barfod et al² investigating early controlled motion of the ankle for nonoperatively treated tendo-Achilles rupture also showed no significant benefits compared with immobilization. Rivaroxaban 10 mg were used as prophylaxis if patients were deemed high risk. Again, although the DVT rates were high (47.7%), all apart from 1 case were asymptomatic. Fifty-nine of 62 DVTs detected with routine ultrasonography were isolated distal DVTs, and none developed PE.²

Early functional rehabilitation in the treatment of tendo-Achilles ruptures has demonstrated noninferior outcomes to operative treatments. However, a robust protocol involving good patient education, close supervision, and communication between the doctor and physiotherapist is important to improve patient compliance, which in turn mitigates the risk of rerupture and tendon elongation.⁴ In a recent meta-analysis, Reda et al¹² found a significantly reduced rerupture rate with surgical treatment vs functional rehabilitation for acute tendo-Achilles rupture. However, differences in VTE rates in both surgical and functional rehabilitation were nonsignificant.¹²

Limitations and Further Studies

The retrospective nature of our study limits our ability to capture rare outcomes such as symptomatic VTEs and is subject to confounding factors. The uneven total number of each cohort was attributed to the availability of routine data collected during each treatment protocol. The low rate of symptomatic VTE after Achilles tendon rupture is likely to reflect its rare nature as well as the routine use of VTE prophylaxis in our institute. Although including asymptomatic VTEs may increase our incidence rates, it would be difficult logistically in our current practice to screen all patients during treatment. In addition, the clinical relevance of asymptomatic VTE remains unknown. We did not specifically review for side effects from pharmacologic VTE prophylaxis in this study; however, we understand that the absolute risk of significant complications is low according to current literature.^{5,6} Although our observed reduced VTE rates in the early weightbearing group did not reach statistical significance, this trend may be supported by future studies with larger cohorts.

Conclusions

Although rare, symptomatic VTE remains a concerning complication from lower limb immobilization. Nonweightbearing immobilization for conservatively managed acute Achilles tendon rupture has been superseded by functional

rehabilitation, which allows early weightbearing. Although our study did not demonstrate statistically significant reduction in symptomatic VTE events in patients with early weightbearing compared with nonweightbearing protocol, based on our setting of alpha level at $P < .05$, we believe further larger studies are required to explore the benefits of early weightbearing on VTE events.

Ethics Approval

The study was approved and registered with the local research and audit department. As we used routinely collected clinical data retrospectively, formal research ethics approval was not required. This was confirmed using the online National Research Ethics Service decision tool.

Declaration of Conflicting Interests

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