complications

MDPI

Article

Haglund's Deformity with Preoperative Achilles Tendon Rupture: A Retrospective Comparative Study

Kevin A. Wu *, Alexandra N. Krez, Katherine M. Kutzer, Albert T. Anastasio, Zoe W. Hinton, Kali J. Morrissette, Andrew E. Hanselman, Karl M. Schweitzer, Samuel B. Adams, Mark E. Easley, James A. Nunley and Annunziato Amendola *

Department of Orthopaedic Surgery, Duke University School of Medicine, Durham, NC 27710, USA; alexandra.krez@duke.edu (A.N.K.); katherine.kutzer@duke.edu (K.M.K.); albert.anastasio@duke.edu (A.T.A.); zoe.hinton@duke.edu (Z.W.H.); kali.morrissette@duke.edu (K.J.M.); andrew.hanselman@duke.edu (A.E.H.); karl.schweitzer@duke.edu (K.M.S.); samuel.adams@duke.edu (S.B.A.); mark.e.easley@duke.edu (M.E.E.); james.nunley@duke.edu (J.A.N.)

* Correspondence: kevin.a.wu@duke.edu (K.A.W.); ned.amendola@duke.edu (A.A.)

Abstract

Introduction: Haglund's deformity, characterized by bony enlargement at the back of the heel, often coincides with Achilles tendon pathology due to impingement on the retrocalcaneal bursa and tendon insertion. Surgical management of Haglund's deformity with a preexisting Achilles tendon rupture is complex, and understanding the outcomes of this subset of patients is essential for optimizing treatment strategies. Methods: This retrospective study reviewed patients undergoing open surgical management for Haglund's syndrome between January 2015 and December 2023. Patients with chronic degenerative changes secondary to Haglund's deformity and a preoperative Achilles tendon rupture were compared to those without. Data on demographics, surgical techniques, weightbearing protocols, and complications were collected. Univariate analysis was performed using χ^2 or Fisher's exact test for categorical variables, and the T-test or Wilcoxon rank-sum test for continuous and ordinal variables, with normality assessed via the Shapiro–Wilk test. Results: Four hundred and three patients were included, with 13 having a preoperative Achilles tendon rupture. There was a higher incidence of preoperative ruptures among males. Surgical repair techniques and postoperative weightbearing protocols varied, though were not randomized. Complications included persistent pain, wound breakdown, infection, plantar flexion weakness, and revision surgery. While patients with Haglund's deformity and a preoperative Achilles tendon rupture demonstrated a trend toward higher complication rates, including postoperative rupture and wound breakdown, these differences were not statistically significant in our analysis. Conclusions: A cautious approach is warranted in managing these patients, with careful consideration of surgical planning and postoperative rehabilitation. While our findings provide valuable insights into managing patients with Haglund's deformity and preoperative Achilles tendon rupture, the retrospective design, limited sample size of the rupture group, and short duration of follow-up restrict generalizability and the strength of the conclusions by limiting the power of the analysis and underestimating the incidence of long-term complications. Therefore, the results of this study should be interpreted with caution. Further studies with larger patient cohorts, validated functional outcome measures, and comparable follow-up durations between groups are needed to confirm these results and optimize treatment approaches.

Keywords: Haglund's deformity; Achilles tendon; Achilles rupture; Achilles repair; Haglund's tendinopathy

check for updates

Academic Editor: Giovanni E. Cacciamani

Received: 17 April 2025
Revised: 20 July 2025
Accepted: 29 July 2025
Published: 1 August 2025

Citation: Wu, K.A.; Krez, A.N.; Kutzer, K.M.; Anastasio, A.T.; Hinton, Z.W.; Morrissette, K.J.; Hanselman, A.E.; Schweitzer, K.M.; Adams, S.B.; Easley, M.E.; et al. Haglund's Deformity with Preoperative Achilles Tendon Rupture: A Retrospective Comparative Study. *Complications* **2025**, 2, 19. https://doi.org/10.3390/complications2030019

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Haglund's deformity is a common cause of posterior heel pain, characterized by a bony enlargement at the back of the calcaneus [1,2]. Epidemiological data suggest that its prevalence ranges from 2% to 6% in the general population, with higher incidence among physically active individuals and those with specific biomechanical predispositions such as a high-arched foot or tight Achilles tendon [3–6]. Notably, Haglund's deformity frequently coexists with Achilles tendon pathology, including insertional tendinopathy and, in severe cases, partial or complete tendon rupture [7]. Studies estimate that up to 20–30% of patients presenting with Haglund's deformity have concomitant Achilles tendon abnormalities, highlighting the clinical significance of this combined pathology [8–10].

The presence of both Haglund's deformity and Achilles tendon rupture creates a unique clinical challenge [11]. The bony prominence contributes to mechanical overload and chronic irritation of the retrocalcaneal bursa and Achilles insertion, leading to inflammation, tendon degeneration, and compromised biomechanical integrity. These pathological changes increase the risk of rupture and complicate surgical management due to the need to address both the bony deformity and compromised tendon tissue. Furthermore, altered biomechanics and the inflammatory milieu predispose these patients to higher postoperative complication rates [11].

Despite advances in imaging and surgical techniques, there remains a lack of standardized treatment protocols for patients presenting with concurrent Haglund's deformity and Achilles tendon rupture. Diagnosis typically relies on a combination of clinical examination and radiographic imaging guided by established criteria [8–10]. The pathophysiology involves a cycle of mechanical overload, chronic inflammation, and tendon degeneration, which underscore the importance of a comprehensive approach to management [12].

Various surgical techniques have been developed to manage insertional Achilles tendinopathy and Haglund's deformity, especially after failure of conservative treatment. For example, Maffulli et al. described a modified dorsal closing wedge calcaneal osteotomy that significantly improved pain and function with low complication rates and rapid return to activity at two years postoperatively [13]. Similarly, Conle and Saxena reported excellent outcomes using bioabsorbable suture anchors in Achilles tendon insertion repair, demonstrating high rates of return to full activity and minimal complications in a cohort of 60 patients [14]. However, outcome data specifically addressing patients with preoperative Achilles tendon rupture in the setting of Haglund's deformity remain limited and heterogeneous.

The primary objective of this retrospective study was to compare the outcomes of patients undergoing surgical management for Haglund's deformity with a preoperative Achilles tendon rupture to those without a preoperative Achilles tendon rupture using the largest cohort of Haglund's deformity patients to date. Specifically, the study aimed to evaluate differences in surgical techniques, postoperative protocols, and complication rates, including wound breakdown, postoperative Achilles tendon rupture, plantar flexion weakness, and infection between patients experiencing preoperative Achilles tendon rupture and those without. This study hypothesized that the presence of a preoperative Achilles tendon rupture may influence both the surgical technique and the prognosis, potentially leading to higher complication rates and necessitating alterations in surgical technique and postoperative care.

2. Materials and Methods

2.1. Cohort Selection

This was a retrospective review of patients who underwent open surgical management for Haglund's syndrome between January 2015 and December 2023. Surgical management included open central-splitting Achilles tendon debridement, Haglund's prominence resection, and subsequent Achilles tendon reattachment. All procedures were exclusively performed at a singular academic institution by one of six highly experienced foot and ankle surgeons, each with specialized fellowship training. Institutional Review Board approval was obtained prior to study conduction.

Inclusion criteria were: (1) age $\geq$ 18 years, (2) diagnosis of Haglund's deformity confirmed by both clinical assessment and preoperative lateral weightbearing radiographs (demonstrating a posterior superior calcaneal prominence with associated retrocalcaneal bursitis or Achilles insertional symptoms), and (3) treatment with open operative management as described.

Exclusion criteria included: (1) revision surgeries (n = 51), (2) procedures performed by a surgeon with fewer than 40 prior Haglund resections (n = 35), (3) active heel ulcers or soft tissue compromise precluding standard wound closure (n = 3), and (4) endoscopic Haglund's procedures (n = 1).

Patients were identified using the corresponding CPT codes for the open surgical management of Haglund's syndrome (27630, 27654, 27659, 27680, 27687, 28118, 28119, 28120, 28300). Haglund's syndrome was manually verified by provider notes and preoperative radiographs. Preoperative concomitant Achilles tendon rupture related to degenerative changes secondary to Haglund's deformity was identified via CPT codes 27652 and 27650 and manually verified by chart review.

No minimum follow-up duration was required for inclusion, but follow-up length was recorded for outcome analysis.

2.2. Data Collection

Patient demographics, including age, sex, presence of diabetes mellitus (DM), body mass index (BMI), smoking status, and American Society of Anesthesiology (ASA) classification, were recorded. Various surgical repair techniques were employed, including the SutureBridge, suture anchor, and corkscrew methods.

After surgery, patients were instructed to adhere to specific weightbearing protocols, such as non-weightbearing (NWB), touchdown weightbearing (TDWB), partial weightbearing (PWB), or weightbearing as tolerated (WBAT). The determination of weightbearing status was based on the recommendations documented in the operative report. Any discrepancies between the initially reported and actual postoperative weightbearing statuses per patient description at follow-up appointments were promptly updated in the medical records.

Postoperative complications were documented and categorized, encompassing persistent pain, plantar flexion weakness, wound breakdown, Achilles tendon rupture, infection, and revision surgery. Persistent pain was characterized as any persistent and incapacitating physical discomfort noted during the most recent follow-up appointment beyond 6 months. Weakness was characterized by a sustained inability to execute plantarflexion movements against body weight, persisting beyond six months following the removal of the walking boot.

The presence of calcific insertional tendinopathy was identified intraoperatively and managed at the surgeon's discretion; however, it was not systematically assessed on preoperative imaging.

2.3. Surgical Techniques

Three primary techniques were employed in the surgical management of Haglund's deformity:

- Central-Splitting Achilles Tendon Debridement: A longitudinal incision is made through the Achilles tendon, allowing access to Haglund's prominence for resection. Any degenerative tendon tissue is also debrided.
- Haglund's Prominence Resection: The bony enlargement at the posterior aspect of the calcaneus is excised to alleviate the mechanical impingement on the Achilles tendon and retrocalcaneal bursa.
- Achilles Tendon Reattachment: The Achilles tendon is reattached post-resection using methods such as:
    - SutureBridge system: Suture anchors providing strong fixation.
    - Suture anchors: Traditional anchor fixation into the calcaneus.
    - Corkscrew method: A specialized technique using screws and sutures for robust tendon attachment.

In cases where calcific insertional tendinopathy was identified intraoperatively, surgeons typically performed thorough debridement of the calcified tissue along with resection of the Haglund's prominence and tendon reattachment. The decision to repair the distal stump versus using a graft was made intraoperatively based on the surgeon's judgment. The choice of repair technique was left to surgeon discretion based on preference and patient circumstances, and was therefore not randomized.

2.4. Postoperative Management

Postoperative rehabilitation was based on intraoperative findings and stratified by rupture status.

- Patients with preoperative Achilles rupture: All were placed in a non-weightbearing (NWB) short leg cast in 20–30° plantarflexion for 4 weeks, followed by transition to a controlled ankle motion (CAM) boot with progressive dorsiflexion and weightbearing initiated at 6 weeks postoperatively.
- Patients without rupture: Typically began in NWB or touchdown weightbearing (TDWB) for 2–4 weeks, then progressed to partial weightbearing (PWB) by week 4 and weightbearing as tolerated (WBAT) by weeks 6–8 based on clinical assessment.

Physical therapy was initiated between 6 and 8 weeks postoperatively depending on wound healing and patient tolerance, focusing on ankle range of motion, proprioception, and gradual strengthening. Return to full activity typically occurred between 4 and 6 months postoperatively. Any discrepancies between planned and actual rehabilitation were identified through follow-up records and corrected in the dataset.

2.5. Statistical Analysis

Demographic and clinical data were summarized for all subjects with descriptive data presented as mean ± standard deviation (SD) for continuous measures and count (% of total) for categorical variables. Categorical variables included sex, smoking status, presence of DM, ASA classification, surgical technique (Corkscrew, SutureBridge, Suture anchor), postoperative weightbearing protocol (NWB, TDWB, PWB, WBAT), and complications (persistent pain, wound breakdown, Achilles tendon rupture, infection, revision surgery). Continuous variables included age, BMI, and follow-up duration. Univariate analysis was implemented to compare patient demographics, perioperative characteristics, and postoperative complications between patients with preoperative Achilles tendon rupture and those who do not. This was performed using χ^2 test or Fisher's exact test as appropriate for categorical variables. Normality was assessed quantitatively using the Shapiro–Wilk

normality testing. T-test or Wilcoxon rank-sum test was performed when appropriate for continuous and ordinal variables. All statistical analysis was performed with RStudio (R version 4.2.2), and p values < 0.05 were considered statistically significant.

3. Results

3.1. Patient Demographics

Four hundred and three patients underwent open surgical management for Haglund's syndrome. The mean age was 55.1 ± 11.7 years, and the average BMI was 34.8 ± 7.0 kg/m^2. The average age for the rupture group was 55.3 years ± 14.6 years compared to 55.1 years ± 11.7 years for the non-rupture group. The majority of patients did not have a smoking history (n = 279; 69.2%). The predominant ASA scores observed within the cohort were III (n = 193; 47.9%) and II (n = 177; 43.9%). The ASA classification was included as a measure of baseline physical status and surgical risk, providing context for assessing post-operative outcomes and complication rates. While not directly linked to tendon pathology, the ASA score helps to stratify patients' general health, which may indirectly influence healing and recovery. Demographic characteristics are summarized in Table 1. Thirteen patients had an Achilles tendon rupture preoperatively. There was a statistically significant difference in the distribution of sex between the two groups with a higher incidence of preoperative Achilles tendon rupture among males compared to females (p = 0.014). There was no significant difference in age, ASA score, DM, or smoking status between patients with or without preoperative rupture.

Table 1. A Comparison of Preoperative Demographics Between Patients with and without Achilles Tendon Rupture.

	Total (n = 403)	**No Rupture (n = 390)**	**Rupture (n = 13)**	**p Value**
Patients, n (%)	403 (100)	390 (79.1)	13 (2.6)	
Age; Mean (SD)	55.1 (11.7)	55.1 (11.7)	55.3 (14.6)	0.97
Sex, n (%)				0.01
Male	140 (34.7)	131 (33.6)	9 (69.2)	
Female	263 (65.3)	259 (66.4)	4 (30.8)	
DM, n (%)	13 (3.2)	10 (2.6)	3 (23.1)	0.71
BMI (kg/m^2), Mean (SD)	34.8 (7.0)	34.8 (7.0)	35.0 (6.51)	0.92
Smoking status, n (%)				0.91
Never	279 (69.2)	270 (69.2)	9 (69.2)	
Former	111 (27.5)	108 (27.7)	3 (23.1)	
Current	13 (3.2)	12 (3.1)	1 (7.7)	
ASA class, n (%)				0.79
I	29 (7.2)	28 (7.2)	1 (7.7)	
II	177 (43.9)	172 (44.1)	5 (38.5)	
III	193 (47.9)	186 (47.7)	7 (53.8)	
IV	4 (1.0)	4 (1.0)	0 (0.0)	

Abbreviations: ASA, American Society of Anesthesiology Physical Classification; BMI, body mass index; DM, diabetes mellitus; n, number; SD, standard deviation.

3.2. Intraoperative Characteristics and Postoperative Weightbearing Protocols

Surgeons had varied preferences concerning both the surgical repair techniques and the postoperative weightbearing protocols (Table 2). SutureBridge was the most common, accounting for 59.8% of cases, followed by Corkscrew (n = 84; 20.8%) and Suture anchors (n = 82; 20.3%). There were no significant differences in repair type or weightbearing protocol between rupture and no rupture groups. Most patients were non-weight bearing postoperatively (n = 281; 69.7%), followed by touch down weight bearing (n = 56; 13.9%), weight bearing as tolerated (n= 54; 13.4%), and partial weight bearing (n = 9; 2.2%). All patients who had a preoperative Achilles tendon rupture were NWB following surgery.

Table 2. A Comparison of Intraoperative and Postoperative Characteristics Between Patients with and without Achilles Tendon Rupture.

	Total (*n* = 403)	No Rupture (*n* = 390)	Rupture (*n* = 13)	*p* Value
Repair type, *n* (%)				0.24
Corkscrew	84 (20.8)	83 (21.3)	1 (7.7)	
Suture anchors	82 (20.3)	81 (20.8)	1 (7.7)	
SutureBridge	237 (58.8)	226 (57.9)	11 (84.6)	
Postoperative weight bearing, *n* (%)				0.15
Non weight bearing	281 (69.7)	268 (68.7)	13 (100)	
Touch down weight bearing	56 (13.9)	56 (14.4)	0 (0.0)	
Partial weight bearing	9 (2.2)	9 (2.3)	0 (0.0)	
Weight bearing as tolerated	54 (13.4)	54 (13.8)	0 (0.0)	
Follow-up duration; Mean (SD)	9.9 (12.7)	10.1 (12.9)	5.93 (3.19)	<0.001

3.3. Postoperative Complications

The average follow-up duration was 9.9 ± 12.7 months. At least one postoperative complication was observed in 15.4% of patients who had a perioperative Achilles tendon rupture, compared to 20.0% of patients who did not have perioperative Achilles tendon rupture. The most common complication in the cohort at large was persistent pain (*n* = 40; 9.9%), followed by wound breakdown (*n* = 34, 8.4%). Less frequent complications included infection (*n* = 7; 1.7%) and plantar flexion weakness (*n* = 6; 1.5%). One patient in each group experienced a postoperative Achilles tendon rupture. Additionally, 8 patients (2.0%) underwent revision surgery. While complication types and revision rates did not show significant differences between groups, of the two patients who had a preoperative Achilles tendon rupture and experienced complications, both sustained either a re-rupture or wound breakdown (Table 3). The mechanisms underlying Achilles tendon rupture were recorded, with the majority of cases identified as spontaneous rather than trauma-induced. Patient activity levels were also reviewed, with physical activity history indicating a mix of sedentary and low-intensity activity among those with ruptures. One patient in the preoperative Achilles tendon rupture group developed postoperative heterotopic calcification during follow-up; however, this was not associated with tendon rupture.

Table 3. A Comparison of Complications and Reoperations Between Patients with and without Achilles Tendon Rupture.

	Total (*n* = 403)	No Rupture (*n* = 390)	Rupture (*n* = 13)	*p* Value
Any Complication, *n* (%)	80 (19.6)	78 (20.0)	2 (15.4)	>0.99
Pain, *n* (%)	40 (9.9)	40 (10.3)	0 (0.0)	0.63
Plantar flexion weakness, *n* (%)	6 (1.5)	6 (1.5)	0 (0.0)	>0.99
Rupture, *n* (%)	2 (0.5)	1 (0.3)	1 (7.7)	0.06
Wound breakdown, *n* (%)	34 (8.4)	32 (8.2)	2 (15.4)	0.30
Infection, *n* (%)	7 (1.7)	7 (1.8)	0 (0.0)	>0.99
Other, *n* (%)	4 (1.0)	4 (1.0)	0 (0.0)	>0.99
Revision, *n* (%)	8 (2.0)	7 (1.8)	1 (7.7)	0.23

3.4. Multivariable Regression

In the multivariable regression analysis, preoperative rupture was not a significant predictor of complications following Haglund's resection (Table 4). The only variable significantly associated with postoperative complications was increased BMI ($p = 0.011$). Due to the low number of postoperative re-rupture events, a separate variable analysis for re-rupture was not performed.

Table 4. Multivariable Regression Analysis of Postoperative Complications Following Haglund's Deformity Resection.

Variable	Coef.	Std.Err.	*p*-Value	95% CI (Lower)	95% CI (Upper)
Male	−0.1	0.29	0.743	−0.67	0.48
Preoperative Achilles Rupture	−1.17	1.06	0.27	−3.26	0.91
Never smoker (Compared to Current Smoker)	−1.17	0.64	0.065	−2.42	0.07
Quit Smoking (Compared to Current smoker)	−1.21	0.68	0.073	−2.54	0.11
Diabetes	0.3	0.34	0.382	−0.37	0.97
Repair Type (Speed Bridge)	0.11	0.33	0.736	−0.54	0.76
Repair Type (Suture Anchor)	−0.29	0.43	0.502	−1.12	0.55
BMI	0.06	0.02	0.011	0.01	0.1
Age	0	0.01	0.874	−0.02	0.03
ASA	−0.1	0.25	0.687	−0.6	0.4

4. Discussion

This retrospective comparative study aimed to evaluate the surgical management and outcomes of patients with Haglund's deformity with concomitant preoperative Achilles tendon rupture compared to cases without tendon rupture. The results provide valuable insights into the challenges and outcomes associated with these complex cases. There was a significant difference in the incidence of preoperative Achilles tendon rupture between males and females, with a higher prevalence in males. There were higher rates of postoperative rupture and wound break down in patients with a preoperative rupture, although this difference did not reach statistical significance.

Previous studies have demonstrated higher rates of Achilles tendon rupture in men between the ages of 30 and 50 relative to women and other age cohorts [15–17]. These injuries often occur during intense physical activities, notably in sports such as basketball, tennis, football, and softball [18]. However, spontaneous ruptures can also occur in the elderly population. Our study similarly shows a higher percentage of men among Haglund's deformity patients presenting with a preoperative Achilles rupture compared to those without. It is important to note that certain demographic features may increase the risk of rupture during the preoperative phase. In the context of Haglund's deformity, this demographic pattern may signal a unique at-risk subpopulation that warrants more aggressive surveillance. Conservative management may delay surgical intervention, allowing progressive tendon degeneration, which may increase the likelihood of rupture. Therefore, earlier surgical consideration may be warranted in high-risk individuals to preempt progression to rupture.

The high BMI observed in our cohort, particularly among those with preoperative Achilles ruptures, warrants consideration. Obesity has been shown not only to increase mechanical load on the tendon but also to negatively affect collagen composition and healing potential via systemic low-grade inflammation [19]. These biological effects may impair surgical outcomes and delay wound healing. Prophylactic weight management and metabolic optimization may serve as a useful strategy to mitigate these risks preoperatively. Elevated BMI is known to place additional mechanical stress on the Achilles tendon, potentially accelerating degenerative processes that lead to rupture [20,21]. Previous studies have identified a correlation between high BMI and an increased risk of both Achilles tendinopathy and rupture [5,20]. This relationship suggests that patients with a higher BMI may require more tailored counseling regarding potential tendon complications.

There were no significant differences in complication types between the two groups. However, our study revealed a significantly longer follow-up period in patients without preoperative ruptures, which might explain the lack of statistical significance seen for certain complications, such as re-rupture, which may take longer to manifest. Despite the

differences in follow-up duration, there were higher rates of postoperative rupture and wound breakdown in patients with a preoperative rupture, although this difference did not reach statistical significance. These findings align with prior concerns that degenerative changes associated with chronic tendinopathy or prior rupture may compromise tendon integrity and healing capacity [22,23]. Anatomical alterations, such as chronic inflammation and calcific insertional tendinopathy often seen in Haglund's deformity, may further impair tendon resilience and predispose to complications [3–6].

One possible explanation for the higher—but not statistically significant—rate of re-rupture in our cohort is the inherent biological weakness of previously ruptured tendons, compounded by mechanical stress at the deformity site. Additionally, these patients may require more extensive dissection or augmentation during surgery, thereby increasing the risk of wound complications.

To reduce complications, early identification of patients at high risk—such as those with elevated BMI, insertional calcifications, or metabolic disorders—may allow for tailored surgical planning. Strategies might include minimizing dissection, using biologic augmentation, or employing staged protocols with prolonged immobilization. Further, standardized postoperative protocols balancing protection and early mobilization may improve tendon healing and reduce wound stress.

The incidence of postoperative Achilles tendon rupture may be higher in individuals with a preexisting rupture compared to those without rupture in patients undergoing surgical correction of Haglund's deformity. Although there has been limited case series surrounding these patients, a case report indicated re-rupture in a patient who had presented with Haglund deformity and a preexisting Achilles tendon rupture [11].

Providing evidence to support the logical conclusion that preoperative rupture may portend postoperative rupture has proven difficult. Aside from the present study, there is limited research on the outcomes of patients with both a preoperative Achilles rupture and Haglund's deformity. The majority of studies on Haglund's deformity have excluded patients with a previous Achilles rupture, focusing instead on those with an intact Achilles [24–26]. Understanding the outcomes of these typically excluded patients is crucial for their management. In a case report by Madi et al., a patient with Haglund deformity experienced an Achilles tendon rupture requiring surgical repair, and then re-ruptured their Achilles 11 years later [11]. They reported that the patient was able to return to light sports at the one year follow up. In our series of 13 patients with a preoperative Achilles tendon rupture, there were generally good outcomes, with only one case of re-rupture and two cases of wound breakdown at an average follow-up of 5.93 years, suggesting that these patients can achieve acceptable outcomes. Additionally, the current literature has yet to demonstrate a superior rehabilitation protocol when it comes to managing Achilles tendon rupture. A meta-analysis found that re-rupture and complication rates did not vary based on different weight bearing protocols, indicating the need for additional research [27]. Similarly, weight-bearing protocols for Haglund's deformity remain unstandardized and do not appear to influence complication rates [28].

At our institution, we use a cautious approach to dealing with patients with a preoperative Achilles tendon rupture undergoing surgical management of Haglund's deformity. All patients with preoperative Achilles tendon rupture were non-weightbearing postoperatively. Postoperatively, patients are typically placed in a molded short leg cast on the affected leg with the ankle in resting plantarflexion, leaving adequate space for the toes. Despite emphasis on non-weightbearing to allow for tendon healing, balancing postoperative stabilization to protect the repaired Achilles with mobility is important, as early mobilization has been shown to help with gastrocnemius muscle function and reduce the extent of weakness in the plantar flexor muscles [29]. While delayed weightbearing was

used for all rupture cases, previous research has demonstrated that early weight-bearing after surgical repair of an acute Achilles tendon rupture can have positive impacts on patient experience without increased risk of postoperative complications [30]. However, Haglund's deformity often induces inflammation around the tendon, a characteristic not typically seen in acute ruptures in patients without the deformity [3,7,31]. This distinction underscores the rationale for a cautious approach in managing patients with Haglund's deformity and a concurrent Achilles tendon rupture. Further research studying Haglund's deformity patients with Achilles rupture can help elucidate best practices for this specific patient population.

In our cohort, the SutureBridge technique emerged as the predominant choice for surgical repair in patients with preoperative Achilles tendon ruptures. This was guided by the technique's potential for augmentation and its specific benefits in addressing the complexities associated with Achilles tendon injuries, particularly in the context of concurrent Haglund's deformity. The technique allowed for augmentation of the tendon repair, which was beneficial in cases of preoperative Achilles tendon ruptures by providing a more extensive footprint on the bone. Beitzel et al. performed a study using 18 cadaver Achilles tendons that were reattached to the calcaneus using either a single-row (2 anchors) or double-row (4 anchors—Suturebidge technique) construct [32]. They found that the double-row repair demonstrated significantly larger initial footprint area and higher biomechanical strength, including greater peak load to failure and load at yield. Similarly, Kar et al. performed a prospective study involving 13 patients (16 feet) who underwent open Haglund deformity excision with complete detachment of the Achilles tendon, followed by reconstruction using the Suturebridge technique [33]. They found that at 24 months, the mean AOFAS Hindfoot Score improved from 53.07 preoperatively to 87.61, demonstrating excellent clinical outcomes with the technique. Similarly, a cadaveric study by Lakey and colleagues compared the biomechanical advantages of suture anchors vs. Suturebridge, demonstrating that the Suturebridge group was independently associated with an approximately 50-N increase in the load to clinical failure [34]. While this technique offers promising biomechanical advantages, its widespread adoption in our cohort may reflect a selection bias, particularly for complex cases with preoperative rupture. Future studies should stratify outcomes by technique and rupture status to determine whether double-row constructs confer tangible clinical benefits in compromised tendons. A more standardized approach to technique selection may reduce variability in outcomes. The choice of surgical technique was recorded to understand if the presence of a preoperative rupture influenced this selection process among surgeons. As such, while our data includes variations in techniques and postoperative protocols, the analysis does not aim to correlate these variations with differential outcomes, leaving this question open for future research.

The selection of surgical technique presents a potential bias in this study. The use of the SutureBridge repair may reflect individual surgeon preference rather than a systematic assessment of its effectiveness compared to other methods. Such preferences can introduce confounding variables, potentially skewing results and complicating the accurate interpretation of surgical outcomes. Additionally, the retrospective nature of this study further exacerbates this issue, as data were derived from existing patient records rather than randomized controlled trials. This design limits the ability to control for confounding factors, thereby reducing the generalizability of the findings. Future research should emphasize a prospective, randomized design to evaluate various surgical options while minimizing the impact of surgeon preference on outcomes.

The present study has several limitations that should be considered. First, its retrospective design introduces the possibility of selection bias, as the data were collected from

patient records after the events occurred. This can limit the generalizability of the findings, as the patient population may not be representative of all individuals with Haglund's deformity and preoperative Achilles tendon rupture. The retrospective design of this study inherently limits the strength of evidence it can provide. Second, the study was conducted at a single academic institution, which may limit the external validity of the results. The patient population and surgical practices at this institution may not reflect those at other centers, potentially reducing the generalizability of the findings. Third, the sample size, particularly of patients with preoperative Achilles tendon rupture, was relatively small. This may have affected the statistical power of the analysis, making it difficult to detect significant differences between groups. Although baseline demographics were similar between the rupture and non-rupture groups, the significantly shorter follow-up duration in the rupture group introduces a potential source of bias. This limited follow-up may have led to underreporting of complications, restricting the ability to make fully balanced comparisons between cohorts. Future studies should aim to standardize and extend follow-up duration to improve outcome assessment. Additionally, patient athletic status was not reliably documented in clinical notes and could not be assessed, though this may influence rupture risk and recovery; future studies should systematically capture this data. Other dysmetabolic conditions such as hyperlipidemia or thyroid dysfunction were not consistently recorded in the chart review and thus were not included in the analysis. Although BMI and ASA classification were used as proxies for overall metabolic and systemic health, they do not fully represent the spectrum of dysmetabolic disorders. Fourth, the follow-up duration varied among the two groups, which could have influenced the detection and reporting of postoperative complications. While shorter follow-up periods allow for a comprehensive assessment of early postoperative outcomes, they may underrepresent long-term complications such as recurrent rupture or delayed wound healing. Patients with longer follow-up may have had more opportunities to report complications, potentially skewing the results. Future studies with standardized, extended follow-up periods are necessary to better capture these potential outcomes. Additionally, a key limitation of this study is the absence of standardized functional outcome measures or patient-reported outcome scores, which are valuable for capturing the patient perspective and overall recovery. Return to activity level was also inconsistently documented, and therefore not included. Future prospective studies should incorporate validated patient-reported outcomes and functional assessments to better evaluate the long-term success of surgical management in this population.

Finally, the observational design limits our ability to control for selection biases in surgical technique. The choice of surgical technique was left to surgeon discretion rather that employing a standardized protocol, which may have introduced bias due to selective use of augmented repair in more complex cases. This lack of standardization and randomization limits the ability to isolate the effect of rupture status on outcomes. Notably, this study was not intended to assess how different surgical techniques affect postoperative outcomes; instead, it focused on understanding whether preoperative rupture influenced technique selection. Future prospective studies with standardized techniques and postoperative protocols would be necessary to rigorously explore how these variables impact patient outcomes.

5. Conclusions

This study highlights important considerations in the surgical management of Haglund's deformity with preoperative Achilles tendon rupture. Although patients with preoperative rupture exhibited a trend toward increased postoperative complications, including re-rupture and wound breakdown, these differences were not statistically sig-

nificant. These findings suggest that such cases may warrant heightened intraoperative vigilance and potentially augmented repair techniques, particularly when insertional pathology is present. However, the small number of patients with preoperative Achilles tendon rupture limits the power of our analysis and may obscure true differences in complication rates. Therefore, the results of this study are not generalizable and should be interpreted with caution. Additionally, the shorter follow-up duration for the rupture group likely underestimates the incidence of long-term complications such as re-rupture or delayed wound healing. Combined with the retrospective design, these limitations restrict the strength of our conclusions. Further prospective research with larger patient cohorts, validated functional outcome measures, and longer-term as well as equivalent follow-up durations are necessary to establish evidence-based guidelines for treating this complex patient population.

Author Contributions: Conceptualization, K.A.W., A.T.A., Z.W.H., K.M.K. and A.A.; data curation, K.A.W., Z.W.H., K.M.K., K.J.M. and M.E.E.; formal analysis, K.A.W. and A.N.K.; funding acquisition, K.A.W. and A.A.; investigation, K.A.W., A.T.A., Z.W.H., K.M.K. and K.J.M.; methodology, K.A.W., A.N.K., A.T.A., Z.W.H. and K.J.M.; project administration, A.A.; resources, K.A.W., A.E.H., K.M.S., S.B.A., J.A.N. and A.A.; software, K.A.W. and A.N.K.; supervision, A.T.A., A.E.H., K.M.S., S.B.A., M.E.E., J.A.N. and A.A.; validation, K.A.W., A.N.K., Z.W.H. and K.J.M.; visualization, K.A.W.; writing—original draft, K.A.W., A.N.K. and A.T.A.; writing—review and editing, K.A.W., A.T.A., Z.W.H., K.M.K., A.E.H., K.M.S., S.B.A., M.E.E., J.A.N. and A.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Duke University Hospital on 24 September 2024 (protocol code: Pro00111665).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to patient privacy.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Schepsis, A.A.; Leach, R.E. Surgical management of Achilles tendinitis. *Am. J. Sports Med.* **1987**, *15*, 308–315. [CrossRef]
2. Kutzer, K.M.; Morrissette, K.J.; Wu, K.A.; Krez, A.N.; Hinton, Z.W.; Anastasio, A.T.; Nunley, J.A.; Amendola, A. Patient characteristics, postoperative protocols, and surgical outcomes in Haglund's resection: A single-institution retrospective cohort study. *Arch. Orthop. Trauma. Surg.* **2025**, *145*, 241. [CrossRef] [PubMed]
3. Bullock, M.J.; Mourelatos, J.; Mar, A. Achilles Impingement Tendinopathy on Magnetic Resonance Imaging. *J. Foot Ankle Surg.* **2017**, *56*, 555–563. [CrossRef]
4. Hardy, A.; Rousseau, R.; Issa, S.-P.; Gerometta, A.; Pascal-Moussellard, H.; Granger, B.; Khiami, F. Functional outcomes and return to sports after surgical treatment of insertional Achilles tendinopathy: Surgical approach tailored to the degree of tendon involvement. *Orthop. Traumatol. Surg. Res.* **2018**, *104*, 719–723. [CrossRef]
5. Morrissette, K.J.; Kutzer, K.M.; Krez, A.N.; Wu, K.A.; Hinton, Z.W.; Anastasio, A.T.; Hanselman, A.E.; Schweitzer, K.M.; Adams, S.B.; Easley, M.E.; et al. Higher BMI is Associated with Wound Breakdown Following Resection of Haglund's Deformity. *Foot Ankle Int.* **2024**, *46*, 64–70. [CrossRef] [PubMed]
6. Kujala, U.M.; Sarna, S.; Kaprio, J. Cumulative incidence of achilles tendon rupture and tendinopathy in male former elite athletes. *Clin. J. Sport Med.* **2005**, *15*, 133–135. [CrossRef]
7. Maffulli, N.; Denaro, V.; Loppini, M. Haglund's deformity. *Foot Ankle Int.* **2012**, *33*, 807–808. [CrossRef] [PubMed]
8. Miller, C.P.; McWilliam, J.R.; Michalski, M.P.; Acevedo, J. Endoscopic Haglund's Resection and Percutaneous Double-Row Insertional Achilles Repair. *Foot Ankle Spec.* **2021**, *14*, 534–543. [CrossRef]

9. Yuen, W.L.P.; Tan, P.T.; Kon, K.K.C. Surgical Treatment of Haglund's Deformity: A Systematic Review and Meta-Analysis. *Cureus* **2022**, *14*, e27500. [CrossRef]
10. Pi, Y.; Hu, Y.; Guo, Q.; Jiang, D.; Xie, X.; Zhao, F.; Chen, L.; Ao, Y.; Jiao, C. Calcaneoplasty coupled with an insertional Achilles tendon reattachment procedure for the prevention of secondary calcaneal impingement: A retrospective study. *Ther. Adv. Chronic Dis.* **2020**, *11*, 2040622320944793. [CrossRef]
11. Madi, S.; Hillrichs, B. Haglund's Deformity as a Cause of Acute Achilles Tendon Rupture: A Case Report. *J. Foot Ankle Surg.* **2022**, *61*, 410–413. [CrossRef]
12. Oliva, F.; Bernardi, G.; De Luna, V.; Farsetti, P.; Gasparini, M.; Marsilio, E.; Piccirilli, E.; Tarantino, U.; Rugiero, C.; De Carli, A. IS Mu. LT Achilles tendon ruptures guidelines. *MLTJ Muscles Ligaments Tendons J.* **2018**, *3*, 310–363.
13. Maffulli, N.; D'Addona, A.; Gougoulias, N.; Oliva, F.; Maffulli, G.D. Dorsally Based Closing Wedge Osteotomy of the Calcaneus for Insertional Achilles Tendinopathy. *Orthop. J. Sports Med.* **2020**, *8*, 2325967120907985. [CrossRef]
14. Saxena, A. Insertional Achilles Tendon Repair with Bioabsorbable Anchors and Suture. *Muscles Ligaments Tendons J. (MLTJ)* **2022**, *12*, 484.
15. Mazzone, M.F.; McCue, T. Common conditions of the achilles tendon. *Am. Fam. Physician* **2002**, *65*, 1805–1810.
16. Maempel, J.F.; White, T.O.; Mackenzie, S.P.; McCann, C.; Clement, N.D. The epidemiology of Achilles tendon re-rupture and associated risk factors: Male gender, younger age and traditional immobilising rehabilitation are risk factors. *Knee Surg. Sports Traumatol. Arthrosc.* **2022**, *30*, 2457–2469. [CrossRef]
17. Lemme, N.J.; Li, N.Y.; DeFroda, S.F.; Kleiner, J.; Owens, B.D. Epidemiology of Achilles Tendon Ruptures in the United States: Athletic and Nonathletic Injuries From 2012 to 2016. *Orthop. J. Sports Med.* **2018**, *6*, 2325967118808238. [CrossRef]
18. Tarantino, D.; Palermi, S.; Sirico, F.; Corrado, B. Achilles Tendon Rupture: Mechanisms of Injury, Principles of Rehabilitation and Return to Play. *J. Funct. Morphol. Kinesiol.* **2020**, *5*, 95. [CrossRef] [PubMed]
19. Abate, M. How obesity modifies tendons (implications for athletic activities). *Muscles Ligaments Tendons J.* **2014**, *4*, 298–302. [CrossRef]
20. Ahn, H.S.; Kim, H.J.; Suh, J.S.; Kazmi, S.Z.; Kang, T.U.; Choi, J.Y. The Association of Body Mass Index and Waist Circumference with the Risk of Achilles Tendon Problems: A Nationwide Population-Based Longitudinal Cohort Study. *Clin. Orthop. Surg.* **2023**, *15*, 488–498. [CrossRef] [PubMed]
21. Hillam, J.S.; Mohile, N.; Smyth, N.; Kaplan, J.; Aiyer, A. The Effect of Obesity on Achilles Rupture Repair. *Foot Ankle Spec.* **2019**, *12*, 503–512. [CrossRef]
22. Abate, M.; Silbernagel, K.G.; Siljeholm, C.; Di Iorio, A.; De Amicis, D.; Salini, V.; Werner, S.; Paganelli, R. Pathogenesis of tendinopathies: Inflammation or degeneration? *Arthritis Res. Ther.* **2009**, *11*, 235. [CrossRef]
23. Yang, G.; Rothrauff, B.B.; Tuan, R.S. Tendon and ligament regeneration and repair: Clinical relevance and developmental paradigm. *Birth Defects Res. C Embryo Today* **2013**, *99*, 203–222. [CrossRef]
24. Xia, Z.; Yew, A.K.S.; Zhang, T.K.; Su, H.C.D.; Ng, Y.C.S.; Rikhraj, I.S. Surgical Correction of Haglund's Triad Using a Central Tendon-Splitting Approach: A Retrospective Outcomes Study. *J. Foot Ankle Surg.* **2017**, *56*, 1132–1138. [CrossRef] [PubMed]
25. Kang, S.; Thordarson, D.B.; Charlton, T.P. Insertional Achilles Tendinitis and Haglund's Deformity. *Foot Ankle Int.* **2012**, *33*, 487–491. [CrossRef]
26. Anastasio, A.T.; Krez, A.N.; Kutzer, K.M.; Wu, K.A.; Morrissette, K.J.; Hinton, Z.W.; Hanselman, A.E.; Schweitzer, K.M.; Adams, S.B.; Easley, M.E. Complications Following Surgical Treatment of Haglund's Syndrome With and Without Flexor Hallucis Longus Tendon Transfer. *JAAOS Glob. Res. Rev.* **2024**, *8*, e24. [CrossRef]
27. Massen, F.K.; Shoap, S.; Vosseller, J.T.; Fan, W.; Usseglio, J.; Boecker, W.; Baumbach, S.F.; Polzer, H. Rehabilitation following operative treatment of acute Achilles tendon ruptures: A systematic review and meta-analysis. *EFORT Open Rev.* **2022**, *7*, 680–691. [CrossRef]
28. Hinton, Z.W.; Kutzer, K.M.; Morrissette, K.J.; Wu, K.A.; Krez, A.N.; Anastasio, A.T.; Hanselman, A.E.; Schweitzer, K.M.; Adams, S.B.; Easley, M.E.; et al. Weightbearing Protocols and Outcomes in Open Surgical Management of Haglund Syndrome: A Large Retrospective Analysis. *Foot Ankle Orthop.* **2025**, *10*, 24730114251316554. [CrossRef]
29. Jiang, Y.; Li, Y.; Tao, T.; Li, W.; Zhang, K.; Gui, J.; Ma, Y. The Double-Row Suture Technique: A Better Option for the Treatment of Haglund Syndrome. *Biomed. Res. Int.* **2016**, *2016*, 1895948. [CrossRef] [PubMed]
30. Suchak, A.A.; Bostick, G.P.; Beaupré, L.A.; Durand, D.C.; Jomha, N.M. The influence of early weight-bearing compared with non-weight-bearing after surgical repair of the Achilles tendon. *J. Bone Jt. Surg. Am.* **2008**, *90*, 1876–1883. [CrossRef] [PubMed]
31. Doral, M.N.; Alam, M.; Bozkurt, M.; Turhan, E.; Atay, O.A.; Dönmez, G.; Maffulli, N. Functional anatomy of the Achilles tendon. *Knee Surg. Sports Traumatol. Arthrosc.* **2010**, *18*, 638–643. [CrossRef] [PubMed]
32. Beitzel, K.; Mazzocca, A.D.; Obopilwe, E.; Boyle, J.W.; McWilliam, J.; Rincon, L.; Dhar, Y.; Arciero, R.A.; Amendola, A. Biomechanical Properties of Double- and Single-Row Suture Anchor Repair for Surgical Treatment of Insertional Achilles Tendinopathy. *Am. J. Sports Med.* **2013**, *41*, 1642–1648. [CrossRef] [PubMed]

33. Kar, S.; Sauarbh, S.; Digge, V.K. Double row reconstruction of achilles tendon (speedbridge technique) for haglund syndrome results in early weight bearing. *J. Orthop.* **2023**, *39*, 70–74. [CrossRef] [PubMed]
34. Lakey, E.; Kumparatana, P.; Moon, D.K.; Morales, J.; Anderson, S.E.; Baldini, T.; Pereira, H.; Hunt, K.J. Biomechanical Comparison of All-Soft Suture Anchor Single-Row vs Double-Row Bridging Construct for Insertional Achilles Tendinopathy. *Foot Ankle Int.* **2021**, *42*, 215–223. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.