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Surgical Treatment of Insertional Achilles Tendinopathy Augmented With Human Acellular Dermal Matrix: A Retrospective Case Series

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Abstract

Background: Insertional Achilles tendinopathy (IAT) is often surgically treated with Achilles tendon partial or total detachment, debridement and repair of the Achilles tendon, excision of retrocalcaneal exostosis, and suture anchor reattachment. To date, there is no report that examines the use of acellular dermal matrix (ADM) augmentation in this procedure without the use of suture anchor reattachment.

Methods: Thirty-two female and 10 male patients (mean age 52 years) with IAT underwent surgical treatment including partial detachment of the Achilles tendon, excision of the retrocalcaneal exostosis, debridement and repair of the Achilles tendon, and augmentation with human acellular dermal matrix allograft. Outcomes measured were the visual analog scale (VAS) score, time to weightbearing, major and minor complications.

Results: Forty-two patients were followed for a mean of 20.8 months. The VAS score improved from a mean of 5.1 to 1.9 at final follow-up. The mean time to weightbearing was 4.4 weeks. Eleven patients (26.2%) experienced complications. One patient (2.4%) suffered a rupture of the Achilles in the early postoperative period. Three patients (7.1%) had delayed wound healing, with 1 (2.4%) requiring surgical debridement. Two (4.8%) experienced continued pain requiring further surgical treatment.

Conclusion: This protocol for surgical treatment of IAT with the use of human ADM allograft augmentation resulted in improved VAS scores and was associated with a low risk of postoperative infection without a prolonged nonweightbearing period.

Level of Evidence: Level IV, retrospective case series.

Keywords: insertional Achilles tendinopathy, human acellular dermal matrix, allograft, suture anchors, Achilles tendon repair, tendon disorders

Introduction

Insertional Achilles tendinopathy (IAT) presents as pain and swelling at the insertion of the Achilles tendon.[4] This pathology commonly affects runners and athletes as well as patients with hypertension, diabetes mellitus, and obesity.[5,14] Additionally, the presence of these comorbidities has been associated with acute tendon ruptures and decreased healing potential.[14] Symptoms of IAT are often worsened because of

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the mechanical load placed on the Achilles tendon insertion with activity. IAT is marked by the presence of degenerative changes within the insertion.[4] This degenerative process is associated with a loss of parallel collagen fiber orientation and integrity, fatty infiltration of the tendon, and an increase in tendon thickness.[15]

Surgical management of IAT is used when conservative measures fail to ameliorate symptoms. Approaches have used multiple different incisions including the linear longitudinal medial or lateral incision, vertical J-shaped medial or lateral incision, central tendon splitting incision, or transverse incision. Central tendon splitting approaches have recently gained popularity because of improved visualization of the retrocalcaneal exostosis and the intrasubstance of the Achilles tendon.[7] However, Watson et al[18] reported that the rate of postoperative avulsion may be less when the lateral insertion of the Achilles tendon is detached given the more expansive medial attachment. These surgical treatments include partial or total detachment of the Achilles tendon, excision of calcifications and degenerative tissue within the tendon and excision of the retrocalcaneal exostosis. This has historically been followed by reattachment of the Achilles tendon with 1 or multiple suture anchors. Partial and total detachment of the Achilles tendon increases the risk for rupture at the insertion site in the postoperative period. It has been reported that 50% of the Achilles insertion can safely be detached without reattachment using a suture anchor.[7] Generally, a detachment greater than 50% requires single or double-row suture anchor repair.[3]

Various graft materials have been used to bolster the repair of the Achilles tendon; these include autografts, allografts, and xenografts. Xenografts have been linked to cellular rejection whereas harvesting autografts has been linked to increased surgical time and donor site morbidity. Human acellular dermal matrix allografts avoid the complexity and morbidity associated with autografts and hypersensitivity reactions because of the proprietary cleansing processes used in production. Additionally, acellular dermal matrixes (ADM) provide mechanical support to the tendon in the healing process.[2] In 2015, Greaves et al demonstrated that the ADM had a distinct advantage in promoting angiogenesis in vivo. Compared with the autograft, xenograft, and collagen groups, the ADM showed a significantly elevated presence of pro-angiogenic PROK2 and MT6-MMP, which may account for the observed increase in angiogenesis.[9] The use of ADM to augment an Achilles tendon tear repair has been reported by Cole et al[6] to improve functional outcomes without an increased risk of rerupture. The augmentation of Achilles midsubstance tendon rupture repair has been reported to decrease the return to activity time.[12]

To our knowledge, there exists no report within the literature examining the use of ADMs to provide supplemental support and augmentation of the repair in IAT without the use of suture anchors following partial detachment of the Achilles tendon for surgical treatment of IAT. The purpose of this case series was to evaluate the efficacy of IAT surgical treatment with the use of ADM and without the use of suture anchors.

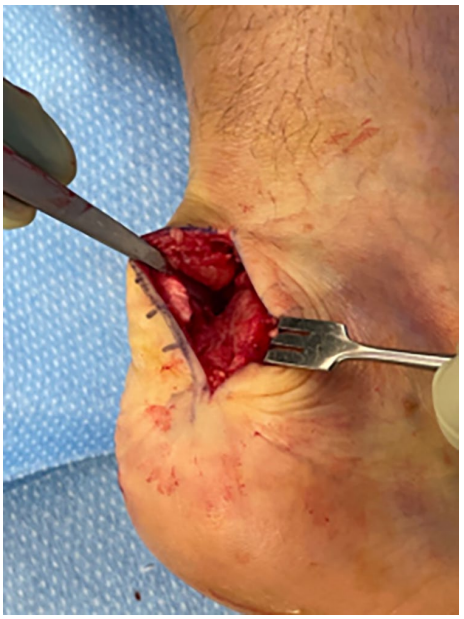

Figure 1. Intraoperative view of lateral incision placement and reflection of the lateral Achilles tendon attachment.

Materials and Methods

After institutional review board waiver and informed consent was obtained, data were retrospectively collected on patients seen by the senior author from September 2018 to October 2022. Thirty-two women and 10 men with a mean age of 51.5 ± 2.5 years who underwent surgical treatment for IAT with ADM augmentation were included. Patients who underwent concomitant procedures were excluded.

All patients were taken to the operating room and placed on the operating table in a prone position. General anesthesia and a popliteal nerve block were administered by the anesthesia provider. A well-padded thigh tourniquet was applied to the operative extremity and inflated to 300 mm Hg following exsanguination. The operative extremity was prepped with a chlorhexidine gluconate antiseptic solution and sterilely draped. A linear longitudinal incision was made in a full-thickness fashion parallel to the lateral border of the Achilles tendon at the insertion site. Bleeding vessels were electrocauterized as required. The Achilles tendon was then identified and retracted posteromedially. Approximately 50% to 75% of the Achilles tendon insertion was then detached from the lateral aspect of the posterior calcaneus (Figure 1). The remaining medial portion of the insertion

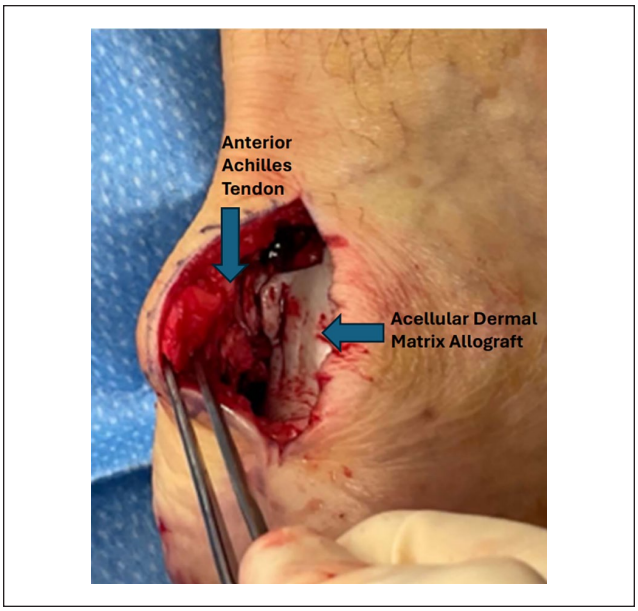

Figure 2. Intraoperative view of the interposition of the acellular dermal matrix (ADM) anterior to the Achilles tendon and posterior to the cut surface of the calcaneus.

was left intact. Thorough debridement of all intratendinous calcification and degenerative tissues was performed to reduce the thickness of the tendon. Any longitudinal tears identified were repaired with No. 0 Vicryl absorbable suture.

The retrocalcaneal exostosis was then resected with the sagittal saw approximately 1 cm anterior to the Achilles tendon in an orientation that parallels the tendon. The cut surface was then smoothed with a rasp. The patient group received a 2 × 3 cm ADM graft (DermaPure; TRX BioSurgery) interposed between the Achilles tendon and the calcaneus and sutured in place with No. 0 Vicryl (Figure 2). The deep tissues along the incision were then reapproximated with No. 0 Vicryl absorbable suture. A Thompson test was performed to demonstrate plantarflexion of the ankle, which was always present following the repair. The subcutaneous tissues were reapproximated with No. 2-0 Vicryl, and the skin was reapproximated with No. 3-0 Nylon suture. On inspection, there was no increase in bulk at the surgical site following the resection of the retrocalcaneal exostosis and debridement of the Achilles tendon. The surgical site was dressed with a nonadherent dressing, gauze, and cast padding. A 4 × 30-in. fiberglass posterior splint was then applied with the ankle in a gravity equinus position.

They remained nonweightbearing in the posterior splint for 2 weeks. Sutures were removed at the 2-week follow-up. The patients were then placed in a short leg cast for 2 additional weeks of nonweightbearing. At 4 weeks, they were then transitioned to a removable cast boot with a heel wedge and allowed full weightbearing as tolerated. They began physical therapy at 4 weeks postoperatively and transitioned to regular shoe wear as tolerated. Patients were followed clinically before and after surgical treatment by the senior surgeon. Outcomes were measured by the senior surgeon and include the VAS score, time to weightbearing, and major and minor complications.

Statistical analysis in the intragroup *P* value was calculated using Wilcoxon signed-rank test for nonindependent difference in medians.

Table 1. Patient Demographics in the ADM Group.[a]

Characteristic	ADM Group (N = 42)
Age, y	51.5 ± 2.5
BMI	35.6 ± 8.3
Male	10 (23)
Comorbidities	
Hypertension	20 (47.6)
Diabetes mellitus	4 (9.1)
Tobacco use	6 (14.3)

Abbreviations: ADM, acellular dermal matrix; BMI, body mass index.
[a]Data are presented as mean ± SD or n (%).

Table 2. VAS, Time to Weightbearing and Follow-up Period in the ADM Group.[a]

Characteristic	ADM Group (N = 42)
VAS score	
Preoperative	5.1 ± 2.5
Postoperative	1.9 ± 1.9
Change in VAS score	3.2 ± 2.6
P value (difference within group)	<.001
Time to weightbearing, wk	4.4 ± 0.8
Follow-up time, mo	20.8 ± 18.8

Abbreviations: ADM, acellular dermal matrix; VAS, visual analog scale.
[a]Data are presented as mean ± SD or n (%).

Results

There were 32 female (76%) and 10 male (23%) patients in the case series. The age of the patients ranged from 21 to 71 years, with a mean of 51.5 ± 2.5 years. Their mean body mass index was 35.6 ± 8.3. Twenty patients (47.6%) were previously diagnosed with hypertension, 4 (9.5%) with diabetes mellitus, and 6 patients (14%) endorsed tobacco use at the time of the procedure (Table 1). The mean follow-up period was 20.8 ± 18.8 months. Their mean time to weightbearing was 4.4 ± 0.8 weeks. The VAS score improved from a mean of 5.1 ± 2.5 to 1.9 ± 1.9 at final follow-up (Table 2). One patient (2.4%) suffered Achilles rupture after a fall in the early postoperative period, which required reoperation.

Table 3. Observed Complications in the ADM Group.[a]

Characteristic	ADM Group (N = 42)
Complications	11 (26.2)
Rupture	1 (2.4)
Reoperation	4 (9.5)
Delayed wound healing	3 (7.1)
Infection	0 (0)

Abbreviations: ADM, acellular dermal matrix.
[a]Data are presented as n (%).

Three patients (7.1%) had delayed wound healing. Two healed with local wound care whereas 1 required surgical debridement. Two patients (4.8%) had continued pain and underwent a reoperation with posterior ankle arthroscopy, which resolved the pain. Of these 2 patients, 1 was diagnosed with Diabetes Mellitus. Overall, 4 patients (9.5%) required reoperation with 1 experiencing an Achilles tendon rupture secondary to a fall. No postoperative infections were observed (Table 3).

Discussion

In this series, 42 patients successfully underwent surgical treatment for IAT using an ADM for augmentation, without suture anchor reattachment of the Achilles tendon. They were followed for a mean of 20.8 ± 18.8 months. These patients began weightbearing on average at 4.4 ± 0.8 weeks postoperatively. Eleven of these patients (26.2%) had complications including postoperative Achilles tendon rupture after a fall (1), delayed wound healing (3), and continued pain (2). Of these, 4 required reoperation. See Table 3.

In a 1999 cadaveric, biomechanical study by Kolodziej et al, the Achilles tendon was shown to be stable at its insertion when less than 50% is detached. The risk of complete rupture in their study was shown to be minimal. They suggested suture anchor reattachment when more than 50% of the Achilles tendon is detached.[11] In our series, the data suggest that 50% to 75% of the Achilles tendon can be safely detached when using the ADM for supplemental support and augmentation without increasing the risk of postoperative rupture.

In a 2014 Lin et al study, 44 patients underwent calcaneoplasty with detachment and reattachment of the Achilles tendon using a suture anchor and lateral linear incision approach. They reported a 6.8% delayed wound healing rate. This is similar to the results observed in this study in which 3 (7.1%) patients had delayed wound healing.[13] In this study, no increase in bulk at the surgical site was observed despite ADM placement. Patients in this study were removed from their plantarflexed weightbearing cast at 6 weeks and also allowed to begin physical therapy. In our study, patients were allowed to bear weight in a controlled ankle motion (CAM) boot and begin physical therapy as early as 4 weeks.

In a 2018 Cole et al study, 9 patients underwent Achilles tendon rupture repair with ADM augmentation. This study used suture anchors for Achilles tendon reattachment. Their study did not demonstrate adverse reactions to the ADM nor postoperative infections. These results were similar to our study in that the use of an ADM was not associated with adverse reactions or postoperative infections.[6] One possible benefit of this technique over others is a decreased suture load in the operative site. In a 2018 article by Vega et al,[17] 2 of the 12 patients had prominent suture knots deep to the skin that required surgical excision. A 2015 study by Greaves et al[8] demonstrated a reduction in fibrosis in acute cutaneous wounds when ADM is used when compared to healing by secondary intention. It is possible that the purported improvement in angiogenesis would reduce deposition of fibrotic tissue at the Achilles tendon insertion site while further strengthening the reattachment of Achilles tendon, thereby reducing the risk of postoperative rupture as observed in our study. We hypothesize that the increase in angiogenesis observed with the use of ADM allograft may also facilitate earlier healing at the bone-tendon interface. As noted by Greaves et al in their 2015 study, the decellularized vascular channels within the ADM allowed for earlier influx of endothelial and inflammatory cells and more organized granulation tissue, and it ultimately resulted in earlier formation of organized vascular networks within 21 days of initial wounding. We hypothesize that this earlier increase in organized vascular channels within the ADM may also result in rapid and increased organized infiltration of bone into the native Achilles tendon facilitating an earlier time to weightbearing when performed in combination with the postoperative weightbearing and physical therapy protocol used in this study. Another theoretical benefit of the technique used by the senior author includes potential maintenance of a patient's native ankle kinematics secondary to maintaining a portion of the Achilles tendon attachment to the calcaneus. With the medial portion of the Achilles left intact, the native tension of the Achilles tendon would be preserved.

In a 2013 study by Rigby et al, 43 patients underwent surgical treatment for IAT that included reattachment of the Achilles tendon with a suture bridge technique. The study reported a mean time to weightbearing of 10 days (range 0-28) postoperatively, which is considerably sooner than the results in our study.[16] They reported no postoperative ruptures of the Achilles tendon and reported wound dehiscence requiring surgical debridement in 5% of the patients. This is comparable to our reported surgical debridement rate of 2.4%.

In a 2013 study, Greenhagen et al[10] reported a time to full weightbearing in a CAM boot with a heel lift of 3-6 weeks following reattachment using a double-row suture bridge

technique. No ruptures or wound complications were reported. Zhuang et al reported 6-8 weeks until full weightbearing in a CAM boot in their 2019 study, which used a modified double-row suture bridge technique. No postoperative complications were reported.[19] Finally, Arunakul et al[1] in 2021 reported on an accelerated rehabilitation protocol that saw their patients full weightbearing in a CAM boot with a heel lift as early as 2 weeks. In their study a modified double-row suture bridge technique was used. They reported an improvement in functional outcomes when compared to their conventional protocol, which allowed full weightbearing at 8-10 weeks. No difference was noted in the rate of postoperative complications between the 2 groups.

The results of the present study demonstrate that the use of ADM in the surgical treatment of IAT appears to allow a time to weightbearing that is comparable to and in some cases quicker than surgical treatments that use suture anchors to reattach the Achilles tendon with no observed increase in postoperative complications. The reason for this is likely multifactorial and could include the ADM's role in improving angiogenesis and decreasing fibrous deposition at the tendon-bone interface. Additionally, the early time to weightbearing in this study may result from leaving 25% to 50% of the Achilles tendon insertion intact with the senior author's technique.

The limitations of this study include those inherent to retrospective studies and limited follow-up period. Additionally, there is no comparison group to determine if the outcomes observed are related to the use of the ADM or the surgical technique alone. Future studies may compare this technique to other methods in a randomized controlled fashion. Longer-term follow-up could elucidate other reactions or complications; MRI at later time points would also help assess graft incorporation.

In conclusion, the senior author's protocol using human ADM allograft was successful in the surgical treatment of IAT. There were no postoperative infections or reactions to the ADM graft tissue. There was 1 postoperative rupture following a fall in the early postoperative period. The time to weightbearing was similar too and in some cases sooner than that reported in the literature.

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Ethical Approval

Ethical approval for this study was waived by the WCG Clinical IRB (20234581).

Declaration of Conflicting Interests

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