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Case Report
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ADIPOSE CELLULAR INJECTION IN THE TREATMENT OF AN INTRASUBSTANCE ACHILLES TENDON TEAR

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Abstract

Introduction: We describe a case report of a patient who presented with chronic right Achilles tendon pain and weakness. Without contrast, magnetic resonance imaging of the right Achilles tendon revealed significant expansion of the Achilles tendon in the traverse and anteroposterior dimension with extensive increased T2 signal consistent with large partial-thickness Achilles tendon tear. A musculoskeletal ultrasound using a linear transducer demonstrated an anechoic tendon defect measuring 0.97 cm in the longitudinal axis with a total tendon length measuring 1.53 cm, as well as a 0.9 cm defect in the transverse axis surrounded by homogenous tendon fibers consistent with a large defect involving the distal Achilles tendon proximal to the distal insertion. The patient underwent an ultrasound-guided adipose cellular procedure using micronized fat to fill in the defect and facilitate pain reduction and tissue healing.

Conclusion: Ultrasound-guided injection of micro-fragmented adipose tissue of Achilles tendon defect can result in significant improvement in pain and function

Keywords: *achilles tendon tear, injections, adipose tissue, ultrasonography*

INTRODUCTION

The Achilles tendon is the strongest in the human body and is commonly affected by spontaneous rupture.[1] Approximately 75% of these injuries occur in recreational activities (primarily men aged 30 to 40), while the remaining 25% occur in more sedentary patients.[2] Although these tears are fairly common, approximately 20% of acute Achilles tears are misdiagnosed, leading to chronic rupture.[3] Chronic ruptures are typically defined by delayed diagnosis and treatment for more than 4 weeks.[1,3] Managing chronic Achilles tears tends to be more challenging than acute injuries because of increased fibrotic pathways and retracted tendon ends.[1,4] Orthopedic surgeons may offer several surgical options, including flap tissue, local tendon transfer, or autologous

graft harvesting.[1,5] Several concerns with these surgical interventions include risk of re-rupture, infection, deep vein thrombosis, suture granulomas, hematomas, prolonged rehabilitation, and delayed wound healing.[6] Recently, more regenerative treatment options, such as platelet-rich plasma (PRP) and adipose cellular injections, have been offered for chronic Achilles tendon injuries. The evidence for PRP to treat Achilles tendon tears has not been substantiated. Alternative orthobiologic options would include the injection of cellular procedures such as bone marrow and adipose tissue.

This case study will examine the effectiveness of an adipose cellular procedure in treating a chronic Achilles tendon tear/defect. Adipose tissue is a common regenerative treatment for various orthopedic conditions such as knee osteoarthritis, rotator cuff tear, etc., because of its relatively large number of mesenchymal stem cells per unit volume of adipose tissue compared to bone marrow.[7] Although there is limited and ongoing peer-reviewed literature on the success of these procedures in tendon repair, they are FDA-compliant and have demonstrated effectiveness in promoting healing and growth factors to the applied location while also delaying and sometimes preventing the need for surgical intervention.[7]

CASE REPORT

A 66-year-old male patient presented with a chief complaint of right Achilles tendon pain. He was referred to the office to evaluate his chronic Achilles tendon tear. The patient states that there was no inciting event, but his injury has been ongoing for one year. He did not have any pain initially; however, the pain increased after he went hiking with his daughter about one year ago. He could hike 4.5 miles at that time before experiencing mild right Achilles pain that resolved on its own. He also noted some weakness in his right ankle which slightly improved with physical therapy, although he continues to experience pain with his daily activities such as driving and walking. Recently, he was seen by an orthopedic surgeon and was offered surgical intervention; however, he wanted to explore other treatment options. He was advised to wear a controlled ankle motion boot, but it caused him more pain, and thus he was no longer using it. The patient is noted to have dull, non-radiating right ankle pain with swelling. He rated his pain as a 7/10 in severity. This was improved with rest and worsened with weight-bearing activities. An MRI of the right ankle without contrast was reviewed, and significant thickening of the Achilles tendon in the traverse and anteroposterior dimension was demonstrated, with an extensive increased T2 signal consistent with large partial-thickness Achilles tendon tear.

On physical examination, he was noted to have thickening of the Achilles tendon without erythema. There was focal tenderness to palpation 3 cm proximal to the insertion of the Achilles. There was increased dorsiflexion of the right foot on passive range of motion compared to the left. There was diminished plantar flexion of the right foot on Thompson's test. He was unable to perform single toe raising on the right.

The patient's right Achilles was evaluated with musculoskeletal ultrasound using a high-frequency, linear transducer (Sonosite Xporte, Fujifilm Sonosite, Bothell, Washington, USA) (Figure 1). The transverse and longitudinal sonogram showed a round anechoic tendon defect measuring 0.97 cm in longitudinal axis with a total tendon length measuring 1.53 cm. Additionally, there was a 0.9 cm defect in the transverse axis surrounded by homogenous tendon fibers consistent with large partial-thickness at the distal Achilles tendon. The tear was measured at approximately 5 cm in length under dynamic ultrasound, and there was mild fluid in the retrocalcaneal bursa. No increase in color flow Doppler was noted.

After reviewing the patient's history, examination findings, and ultrasound findings, it was determined that the patient had a significant intrasubstance tear of his Achilles that measured 80% of the diameter of the tendon and was 5 cm in length. The patient was advised that if he elected to undergo surgery, then the tendon was unlikely to be repaired and would require a tendon transfer from a cadaver or one of his own lower extremity tendons. As an alternative, we discussed the potential of using an adipose cellular procedure injected under ultrasound into the

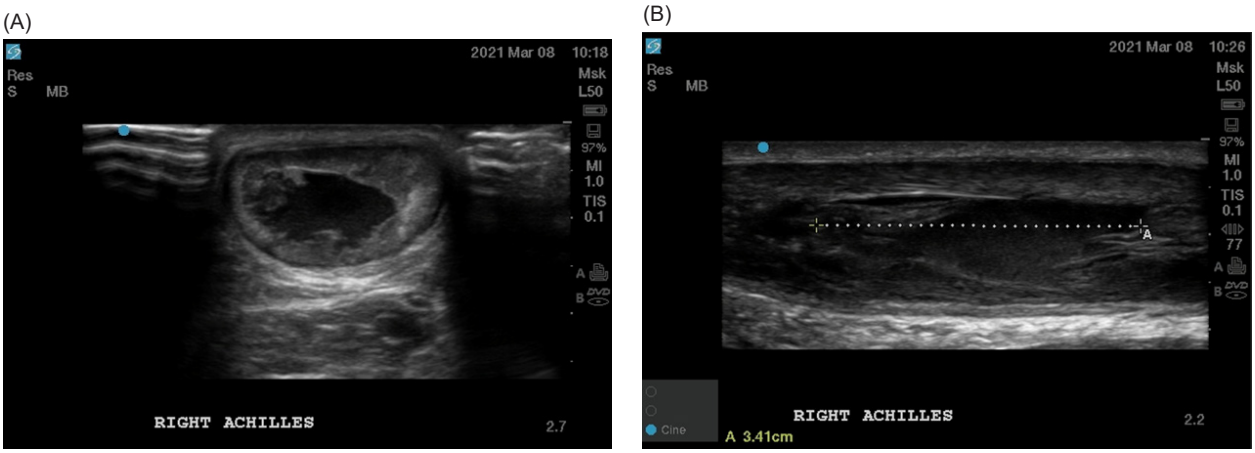

Figure 1. Pre-procedure ultrasound images of Achilles tendon defect: (A) Transverse (B) Longitudinal view.

defect to provide a tissue-filling scaffolding and promote the release of healing factors in this area. We explained that there is limited research to support this treatment; however, there is basic science literature on treating other tendons with adipose cellular injections. The patient ultimately elected to undergo an ultrasound-guided adipose cellular procedure to fill in the defect and promote various healing factors. The patient was informed of the post-procedure rehabilitation, which would likely include a short period of immobilization in a walking boot for one to two weeks, followed by a gradual progression of weight-bearing movements with limited loading (i.e., no running, jumping, or lower extremity weightlifting) for four weeks.

PROCEDURE

The patient was placed in a prone positioning with attention to the left flank area, and the skin was cleansed. A 27 g × 1.25" needle was used to superficially infiltrate the skin and an 18g needle was used to allow skin access. A blunt-tip anesthesia cannula was used with an IV line to infiltrate 180 mL of tumescent anesthesia to the left flank from medial to lateral, and an equivalent amount was used on the other side for a total of 360 mL. Twenty minutes was allowed for the anesthetic to become fully effective. The lipoaspirate cannula was then placed through the puncture site and lipoaspirate was obtained through low-pressure vacuum. When about 30mL of aspirate was obtained, it was transferred from the vacuum syringe to a 30mL syringe via sterile Luer-Lok connector. Care was taken to avoid any air in the syringe. The same procedure was performed on the contralateral region, obtaining additional lipoaspirate and transferring to the 30 mL syringes in the same manner as the contralateral side. The lipoaspirate/syringes were placed in a sterile cup to decant. The tumescent anesthesia was removed, and care was used to prevent air leaking into the graft. Total lipoaspirate that was obtained was 85 mL. The lipoaspirate was then transferred to the adipose tissue processing device (MiniTC, JointTech Labs, Brandon, Florida, USA). It was washed and centrifuged twice per the manufacturer's protocol to break down adipose for injection. The total micro-fragmented adipose tissue obtained was 28 mL. The flank area was cleansed, steri-strips were placed, the puncture sites were dressed with 2×2 gauze and Tegaderm, and tape was placed along the harvest site to minimize swelling, bruising, and post-procedure pain.

The patient was placed in the prone position and the right ankle was cleansed with chlorhexidine. A 27g × 1.25" needle using two mL of 0.05% lidocaine was used to anesthetize the skin and subcutaneous tissue over the right Achilles tendon. Next, an 18g × 1.25" needle was advanced under musculoskeletal (MSK) ultrasound guidance to the Achilles tendon

over the location of tendon defect, after which 2.5 mL of dark red fluid was drained from this location. Then 14 mL of micro-fragmented adipose tissue (MFAT) was injected to the focal defect within the tendon. The patient tolerated the procedure well. Before being discharged, he was instructed to ice the harvest site and treatment areas for 15–20 minutes every hour as needed. The patient was told to use pain medications provided as needed, but to avoid the use of nonsteroidal anti-inflammatories (NSAIDs). The patient was instructed to keep the harvest and injection sites clean and dry for 24 hours, without submerging either area for at least seven days. He was to limit his activity for four days, gradually increasing his pre-procedure activity level and restrictions after that based on his function and pain.

Three days after his procedure, the patient returned complaining of pain and tenderness at the right calf. He noted that he had discontinued wearing his supportive walking boot due to increased pain with use of the boot. On physical exam, his right ankle revealed fullness at the Achilles tendon, consistent with expected post-procedural findings (Figure 2). Upon evaluating the ankle with musculoskeletal ultrasound using linear high frequency (Sonosite XPorte, Fujifilm Sonosite, Bothell, Washington, USA), there was evidence of edema of the soleus and strain of the myotendinous junction. Adipose from the injection into the partial tear was still present without any identifiable pathology, and there was no evidence of autologous adipose leakage. After reviewing the patient's history, imaging, and physical exam findings it was determined that his right ankle pain was likely secondary to a strain at the myotendinous junction with resulting edema and swelling at the soleus. Nothing seemed to be worrisome at the right posterior calf and Achilles tendon. He was instructed at that time to discontinue his walking boot as it was causing him discomfort and practice ankle pumps to enhance the tendon's strength progressively.

At his four-week follow-up appointment, the patient said he felt great and had no pain. He noted 95% improvement from his original pain pre-procedure. His only complaint was mild calf tightness and a calcaneal ache elicited by strenuous activity, which was resolved with rest. His right Achilles tendon was evaluated on physical examination with a musculoskeletal ultrasound with 5–13 MHz linear transducer (Sonosite XPorte, Fujifilm Sonosite, Bothell, Washington, USA). This demonstrated an improved structure of the original tear filled with adipose cellular injection. He was instructed to increase weight-bearing activities pending his function and pain gradually. Given his improved condition, he was scheduled for follow-up in 4 weeks and will consider physical therapy at that time.

At his eight-week follow-up, the patient continued to report intermittent decreased pain, rated at

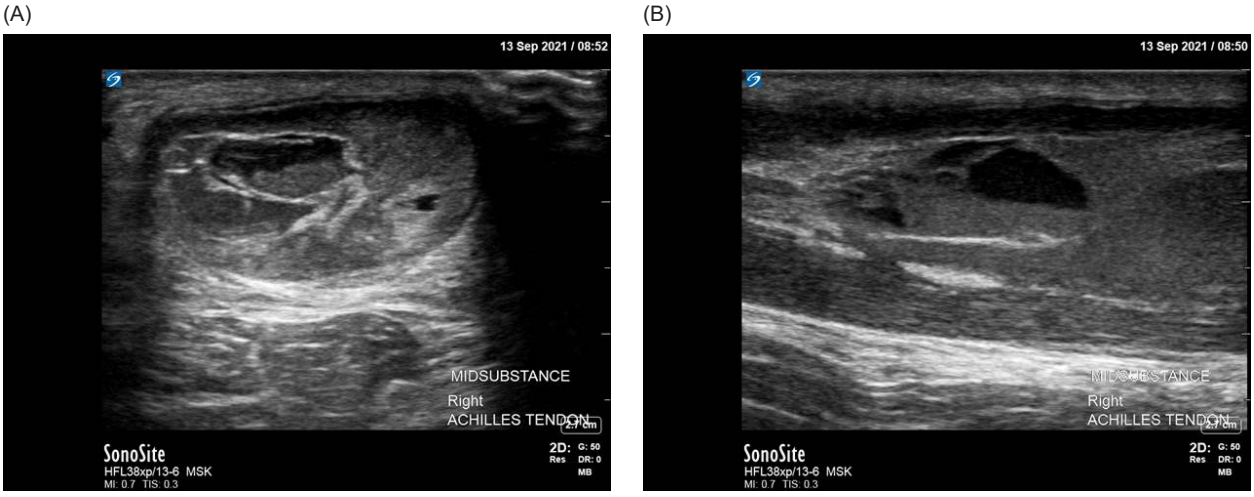

Figure 2. Post-procedure ultrasound images: (A) Transverse (B) Longitudinal view.

a 1/10 in severity. He stated that he had been performing the toe lifts as instructed at his previous visit. The patient reported that he had no barriers to performing his daily living activities. He had been tracking his walking and balance on his phone, which showed great improvement in his gait since the procedure, and even pre-procedure. The patient did note slight numbness at the right posterior heel over the past four weeks. His right Achilles tendon was evaluated on physical examination with musculoskeletal (MSK) ultrasound using 5–13 MHz linear transducer (Sonosite XPorte, Fujifilm Sonosite, Bothell, Washington, USA). This demonstrated similar findings to the ultrasound at the four-week visit, including new tissue growth within the intrasubstance tear that was not previously visualized. Given his improvement, he was provided a prescription for physical therapy (2-3 times/week for four weeks) in addition to his home exercise toe-lift regimen. He was instructed to follow up in 4 weeks.

At his twelve-week follow-up, the patient reported improved strength and the ability to walk 100 feet at physical therapy. He denied pain in his right ankle but admitted to stiffness at the beginning of ambulation that improved after 10 steps. Physical exam revealed slight swelling of the right Achilles tendon that was non-tender to palpation. Active range of motion (ROM) in plantar and dorsiflexion was symmetric compared to the opposite side. Strength was determined to be 5/5 for plantar/dorsiflexion and extension of the great toe. The patient could walk on his toes, with less balance control when isolating on his right foot. He could perform single-leg toe raise with the right foot but not as high nor as stable as the left foot. MSK ultrasound revealed progressive Achilles tendon healing with residual MFAT injectate and no evidence of hypoechogenicity. He was instructed to follow up in three months.

At his fifteen-week follow-up, the patient reported continued improved strength and the ability to walk any distance he desires without pain or dysfunction. He occasionally noted morning stiffness in the ankle (less frequently than in the previous visit). His physical examination was similar to the last exam findings, which included no tenderness on palpation, normal gait pattern, and ability to perform a single toe raise. He could walk on his toes with equal balance (compared to less balance on the right foot at his previous visit). MSK ultrasound findings revealed similar progressive healing of his Achilles tendon with no evidence of hypoechogenicity, similar to his previous scan.

DISCUSSION

In this prospective longitudinal case study, an adipose cellular injection using micro-fragmented adipose tissue successfully treated a large intrasubstance Achilles defect. This treatment allowed for filling in the soft tissue defect and releasing certain growth factors and immune modulators at the lesion in the Achilles tendon to facilitate pain reduction and tissue healing.[7] More specifically, the cells in this adipose cellular preparation encourage tissue repair by regulating extracellular matrix deposition, collagen synthesis, fibroblast proliferation, platelet activation, fibrinolysis, and angiogenesis.[8] These processes typically take several weeks to take effect, as seen with our patient in this study but is also less invasive and less susceptible to more serious adverse events as seen in surgical intervention.

Tears of the Achilles tendon are common. Surgical interventions are often recommended as the risk of re-rupture has historically felt to be lower when compared to non-operative interventions. However, a 2012 meta-analysis comparing the re-rupture rate of these two treatment options revealed no significant difference in rates so long as the nonsurgical treatment protocol included an early ROM.[9] Additionally, surgical repair of tendon ruptures may result in chronic architectural and structural changes, tendon elongation, and persistent functional impairments.[10] In this case report the degree and length of tendon pathology would not have allowed for a surgical repair, and thus, a tendon allograft was recommended by an orthopedic surgeon. This would require either a harvested tendon allograft or a cadaver allograft along with a long period of immobilization and limited weight-bearing activities. There has not been adequate literature comparing allograft versus a cadaver graft tendon in the repair of Achilles rupture; however, these grafts

have been compared in anterior cruciate ligament reconstructions.[11]

As indicated in this case study, the patient treated with a minimally invasive adipose cellular injection has demonstrated almost 100% return to baseline function at only four weeks post-procedure. Although there is very limited literature regarding the efficacy of adipose injections for Achilles tears, this case report provides evidence for the potential benefit. Previous research involving other regenerative treatments such as PRP, which shares some healing mechanisms to adipose cellular injections, has demonstrated effectiveness and durability in treating severe chronic Achilles tendinitis in patients who have failed to respond to traditional non-operative management techniques.[12]

Further research should be conducted on the treatment partial and complete Achilles tendon tears with adipose cellular injection to support the claims made by this prospective longitudinal case study.

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