Fasciotomy and Surgical Tenotomy for Chronic Achilles Insertional Tendinopathy

A Retrospective Study Using Ultrasound-Guided Percutaneous Microresection

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Background: Achilles insertional tendon pathology is a common condition affecting a broad range of patients. When conservative treatments are unsuccessful, the traditional open resection, debridement, and reattachment of the Achilles tendon is a variably reliable procedure with significant risk of morbidity. Fasciotomy and surgical tenotomy using ultrasound-guided percutaneous microresection is used on various tendons in the body, but the efficacy has not been examined specifically for the Achilles tendon.

Methods: A retrospective review evaluated 26 procedures in 25 patients who underwent Achilles fasciotomy and surgical tenotomy. The Foot Function Index was used to quantify pain, disability, activity limitation, and overall scores.

Results: Mean Foot Function Index scores were as follows: pain, 8.53%; disability, 7.91%; activity limitation, 2.50%; and overall, 6.97%. Twenty index procedures were successful, and two patients repeated the procedure successfully for an overall 84.6% success rate in patients with chronic insertional pathology with mean surveillance of 16 months. There were no infections or systemic complications.

Conclusions: Ultrasound-guided percutaneous microresection is a safe and minimally invasive percutaneous alternative that can be used before proceeding to a more invasive open procedure. (J Am Podiatr Med Assoc 109(1): 1-8, 2019)

Achilles tendinopathy is a common condition that affects a variety of individuals from professional and recreational athletes to the more sedentary population. Over a lifetime, approximately 24% of competitive athletes will be affected, with the incidence for runners reaching 30% to 52%.[1] Although common in active individuals, 33% of Achilles tendinopathy cases involve those who are more sedentary.[2] The condition can be debilitating for many, limiting their athletic ability or leading to loss of occupational capacity. Efforts at conservative modalities often prove insufficient, but surgical treatment can be extensive and may require lengthy postsurgical rehabilitation.

Ultrasonic microtenotomy allows for focused removal of degenerative tendon substance and microresection of intratendinous calcifications and enthesiophytes. Using ultrasonic guidance, real-time visualization of diseased and pathologic tissue is possible. Using the TX1 system (Tenex Health, Lake Forest, California), such percutaneous microresection has been documented to be effective for the treatment of multiple tendinopathies throughout the body,[3] but the efficacy has not been documented for chronic insertional Achilles tendinopathy.

Methods

A retrospective cohort study was performed to determine the effectiveness of ultrasound-guided percutaneous tenotomy using the TX1 System for the treatment of Achilles tendinopathy. The TX1

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system (Fig. 1) was specifically developed for the treatment of chronic refractory tendinopathy and has been used for soft-tissue pathology involving the rotator cuff, lateral and medial epicondyles, patellar tendon, Achilles tendon, and plantar fascia.[3-7] The technique uses standard ultrasound imaging to visualize tendon pathology and to assist in directing the ultrasonic probe to areas of diseased tissue. The proprietary handpiece is able to deliver ultrasonic energy at desired settings as well as aspirate detritus. The procedure is performed under local anesthesia in an ambulatory surgical facility or even in the office environment.

This study included patients aged 18 to 85 years with documented chronic Achilles tendinopathy confirmed by persistent Achilles tendon pain for a minimum of 3 months. These patients must have failed at least four conservative, nonoperative treatment modalities before being treated with the percutaneous tenotomy microresection.

The exclusion criteria included a history of osseous fracture or previous surgical procedure to the ipsilateral lower extremity in the past 6 months, a history of Achilles tendon rupture, compartment syndrome, arthrofibrosis, infection, regional pain syndrome, peripheral neuropathy, malignancy, and an arthritic or dermatologic condition of the ipsilateral lower extremity. Patients with known coagulopathy, current pregnancy, or absence of a targetable hypoechoic region in the Achilles tendon or absence of enthesiopathy on radiographs, ultrasound, or magnetic resonance imaging were excluded, as were patients who were unable or unwilling to complete the questionnaire (Table 1).

Patient medical records from two senior surgeons were reviewed between July 13, 2012, and November 12, 2013. Patient privacy was ensured in accordance with the Declaration of Helsinki. All of the patients with chronic Achilles tendinopathy who had failed conservative therapy and undergone the therapeutic percutaneous tenotomy technique were selected from the patient records. Collected data included age, sex, height, weight, body mass index, onset, laterality, location and duration of symptoms, notable findings on physical examination and imaging studies, conservative treatments attempted before the index procedure, overall treatment time during the procedure, and symptoms and complications after the procedure. Patients were contacted via telephone to notify them of the study, and consent was obtained for this minimal-risk protocol. Patients were then asked to complete the Foot Function Index (FFI), a validated self-questionnaire[8-10] consisting of 23 items divided into three subcategories to help quantify the impact of foot and ankle pathology on pain, disability, and activity limitation in patients. Patients were also asked to score their likelihood on a scale from 1 to 10 whether they would be willing to repeat the procedure if symptoms recurred or were incompletely resolved, and the likelihood of them recommending the procedure to friends or family members.

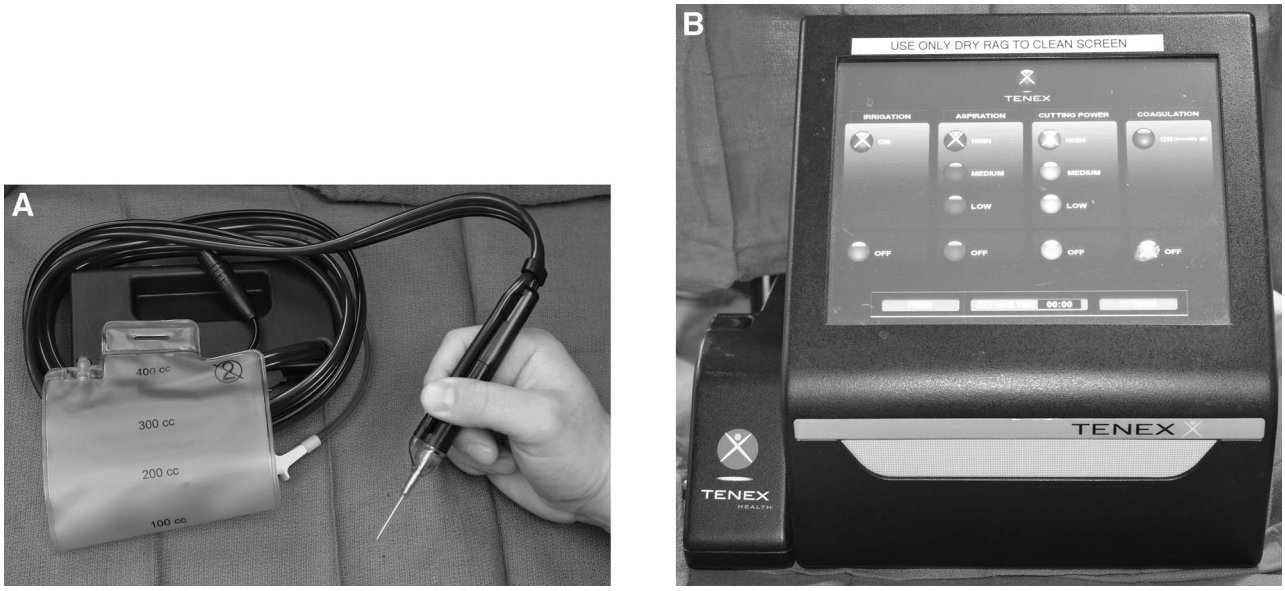


Figure 1. A, The Tenex TX1 MicroTip handpiece (Tenex Health, Lake Forest, California). B, The Tenex control unit.

Table 1. Criteria for Inclusion and Exclusion

Inclusion Criteria	Exclusion Criteria
Clinical diagnosis of chronic Achilles tendinopathy	History of broken bone or surgery to the lower extremity within 6 months
Patients who underwent a procedure for Achilles tendinopathy between July 13, 2012, and November 12, 2013	History of the following for the ipsilateral lower extremity: - Achilles rupture - Compartment syndrome - Regional pain syndrome - Peripheral neuropathy - Malignancy - Arthritic condition - Dermatologic condition
Aged 18–85 years	Known coagulopathy
Failure of conservative treatment (attempted for $\geq$3 mo)	Current pregnancy
Male/female	Unable or unwilling to complete the Foot Function Index questionnaire

Procedure

During the procedure, ultrasonic guidance and percutaneous needle tenotomy are performed by one of two senior surgeons (L.F. and T.B.H.). Although the patient is still alert and sensate, the symptomatic areas are identified and marked. The procedure is then performed under intravenous sedation or local anesthesia according to patient preference and medical necessity. The patient is placed in a prone position. The procedure site is then prepared with isopropyl alcohol and injected with an anesthetic solution to achieve local anesthesia. The agent used for local anesthesia varies between surgeons; however, no intraoperative cortisone or vasoconstrictive agents are used. On obtaining adequate anesthesia, the extremity is prepared in an aseptic manner. Ultrasound inspection is performed to visualize pathology. One to four stab incisions are made using a number 11 scalpel blade and are deepened through the deep fascia toward the region of pathologic tissue. The percutaneous ultrasonic needle (16 gauge) is then inserted. Under ultrasound localization, the needle tip is directed toward hypoechoic areas of tendon. Activation of the ultrasonic handpiece is accomplished by stepping on a footplate. Tendon pathology and localization of the needle tip are visualized via ultrasound imaging in both the longitudinal and transverse planes. Microresection of pathologic tissue is then performed with the machine set to an intermediate frequency designated for soft-tissue cutting and debridement. Through the same handpiece, ultrasonic energy is delivered as well as irrigation and aspiration of detritus along the degenerative tendon until there is visual evidence of complete resolution of the hypoechoic areas. On completion, the stab incisions are dressed with reinforced adhesive skin closures (Nexcare Steri-Strip; 3M, St. Paul, Minnesota), followed by dry gauze and transparent dressing (Tegaderm; 3M). Patients are prescribed an analgesic or a nonsteroidal anti-inflammatory drug (NSAID) for pain and are encouraged to apply ice to the area and elevate the extremity for the first several days after the procedure. They are allowed to be weightbearing while fully protected in a surgical shoe or short-leg boot but are advised to remain sedentary for the following week. All follow-up examinations were performed by the two senior surgeons.

Results

Medical records were reviewed, and 43 consecutive patients were identified who had undergone the ultrasonic microresection procedure for Achilles tendinopathy between July 13, 2012, and November 12, 2013, by the two senior surgeons. Patients were further stratified into those with midsubstance tendinopathy versus insertional pathology. Because these two conditions are different, the present study focused on those with insertional pathology, leaving 26 procedures performed on 25 patients in the study group: seven men and 18 women aged 45 to 81 years (mean, 58.24 years). Procedures were performed on eight right and 18 left extremities. In 11 patients, both tendons were symptomatic, and the more painful side was treated. One patient underwent the procedure on each lower extremity sequentially. Patient-reported etiologies were reported to be from low-impact activity, specifically walking, hiking, treadmill, stretching, or golf, in six patients; from higher-impact activity, specifically sand volleyball, triathlon, step aerobics, or martial arts, in four patients; and from recent fluorquinolone use in two patients. The remaining 13 patients reported an

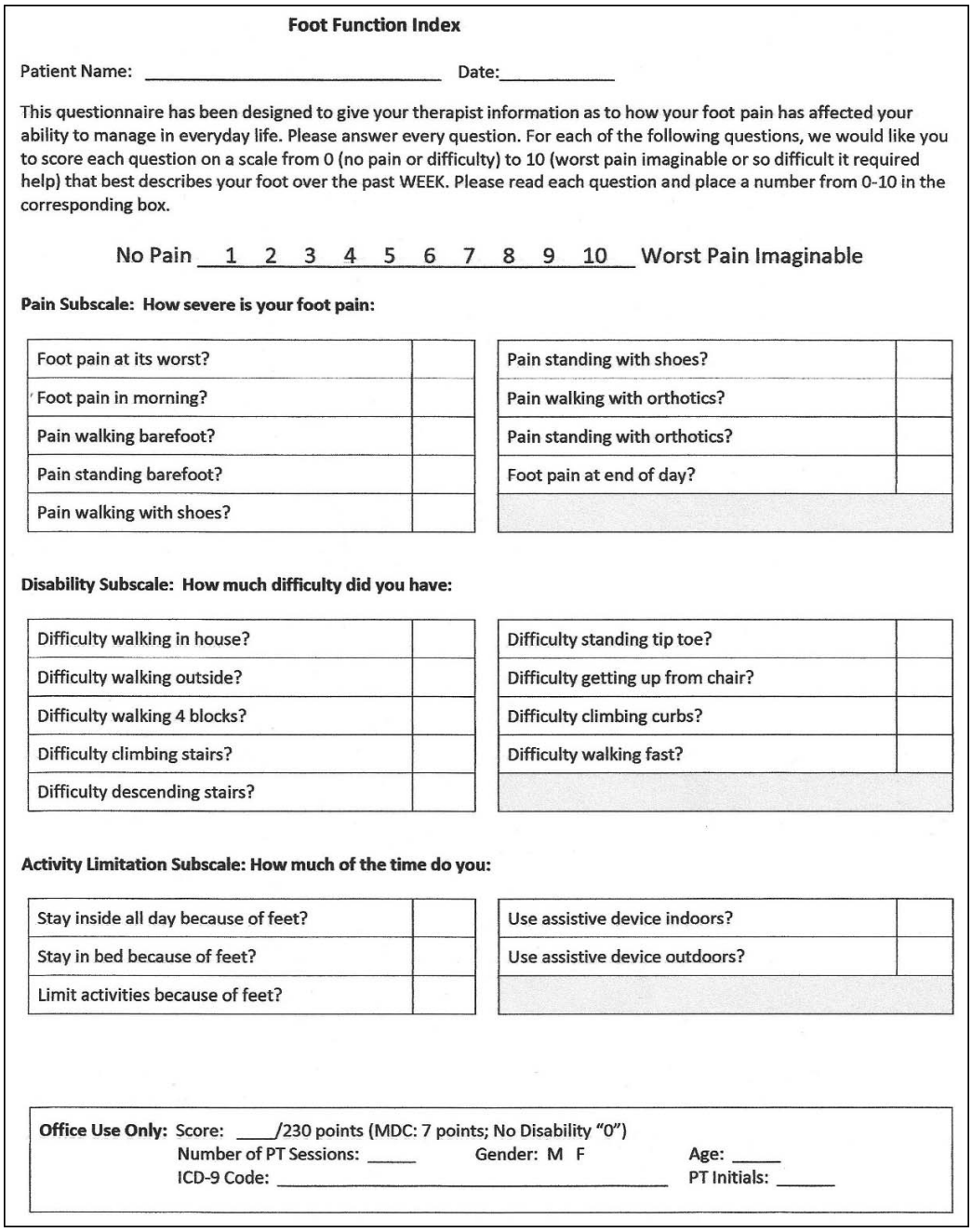
unknown etiology. Patients had failed an average of 5.28 (range, 4–8) different conservative treatment modalities over a mean of 19 months before undergoing the procedure. These failed treatments included activity modification, rest, immobilization in a boot or brace, ice, stretching, topical or oral NSAIDS, physical therapy, massage, ionophoresis, transcutaneous electrical nerve stimulation, protein-rich plasma injection, corticosteroid injection, acupuncture, dry needling, prolotherapy, extracorporeal shockwave therapy (ESWT), low-level laser therapy (cold laser), Traumeel injections (MediNatura, Berwyn, Pennsylvania), heel lifts, gel sleeves, orthoses, and shoe modifications (Table 2).

At final surveillance, 21 of 25 patients (84%) with insertional Achilles tendon pathology who underwent the procedure reported that they felt that the intervention was a success. Interestingly, 22 of the 25 patients (88%) reported that they were strongly likely (9–10 of 10) to have the procedure performed again if needed and were strongly likely (9–10 of 10) to recommend the procedure to friends or family members.

The FFI is a patient-completed questionnaire consisting of 23 questions grouped into three subcomponents (pain, disability, and activity limitation) and a total score (Fig. 2). A lower score conveys less pain/disability/activity limitation.[8-10] Comparison of scores from patients who considered their procedure a success versus those who did not demonstrate a quantifiable assessment of their results in each subcategory. Preoperative FFI scores were not obtained because the questionnaire was not available at that time and retrospectively collected patient responses to subjective items from the query would be biased by their outcome.[11] The first category reports pain. The mean pain subscale score was 8.53% for all of the patients, 4.52% for self-reported successful treatments, and 30.56% for self-reported failed treatments. The second category of disability was 7.91% overall, 4.72% for self-reported successful treatments, and 25.42% for self-reported failed treatments. The third category of activity limitation showed 2.5% overall, 1.0% for self-reported successful treatments, and 10.75% for self-reported failed treatments. Overall FFI scores revealed 6.97% overall, 3.83% for self-reported successful treatments, and 24.24% for self-reported failed treatments. Twenty procedures (76.9%) were considered successfully treated by the initial operation. Two patients underwent retreatment that ultimately resulted in self-reported successful treatment, for overall success of 84.6% at final surveillance. Of these two patients, one reinjured the same Achilles tendon 4 months after the procedure; note that there was no pain in the Achilles tendon before the reinjury, and magnetic resonance imaging showed that the previously injured area had healed and that there was a new partial tear in a different location from the original location. A second percutaneous ultrasonic microresection was performed resulting in complete resolution of symptoms and uneventful follow-up. The other of the two patients who had retreatment reported continued discomfort and localized edema in the area during

Table 2. Demographic Characteristics of the 25 Study Participants

Characteristic	Value
Age (mean [range] [years])	58.24 (45–81)
Body mass index (mean [range])	33.35 (25.85–43.0)
Sex (No. [%])	
Male	7 (28)
Female	18 (72)
Laterality treated, right/left (No.)	8/18
Patients with bilateral symptoms (No.)	11
Etiology (No.)	
Low impact	6
High impact	4
Recent fluoroquinolone use	2
Unknown	13
Time from onset of symptoms to procedure (mean [range] [months])	19 (6–96)
Previous treatments (mean [range] [No.])	5.28 (4–8)
Procedure date	7/13/12 to 11/12/13
Elapsed treatment time (energy delivered) (mean [range])	4 min 32 sec (2–10 min)
Surgeon of record, L.F./T.B.H. (No.)	21/4
Follow-up (mean ± SD [months])	16 ± 5.89



Foot Function Index

Patient Name: _____ Date:_____

This questionnaire has been designed to give your therapist information as to how your foot pain has affected your ability to manage in everyday life. Please answer every question. For each of the following questions, we would like you to score each question on a scale from 0 (no pain or difficulty) to 10 (worst pain imaginable or so difficult it required help) that best describes your foot over the past WEEK. Please read each question and place a number from 0-10 in the corresponding box.

No Pain 1 2 3 4 5 6 7 8 9 10 Worst Pain Imaginable

Pain Subscale: How severe is your foot pain:

Foot pain at its worst?		Pain standing with shoes?	
Foot pain in morning?		Pain walking with orthotics?	
Pain walking barefoot?		Pain standing with orthotics?	
Pain standing barefoot?		Foot pain at end of day?	
Pain walking with shoes?			

Disability Subscale: How much difficulty did you have:

Difficulty walking in house?		Difficulty standing tip toe?	
Difficulty walking outside?		Difficulty getting up from chair?	
Difficulty walking 4 blocks?		Difficulty climbing curbs?	
Difficulty climbing stairs?		Difficulty walking fast?	
Difficulty descending stairs?			

Activity Limitation Subscale: How much of the time do you:

Stay inside all day because of feet?		Use assistive device indoors?	
Stay in bed because of feet?		Use assistive device outdoors?	
Limit activities because of feet?			

Office Use Only: Score: ____/230 points (MDC: 7 points; No Disability "0")
Number of PT Sessions: _____ Gender: M F Age: _____
ICD-9 Code: _____ PT Initials: _____

Figure 2. The Foot Function Index Questionnaire.

initial follow-up. The repeated procedure resulted in complete relief.

Mean elapsed treatment time during which energy was delivered was 4 minutes 32 seconds (range, 2–10 min). There were no procedure- or device-related adverse events. Patients were allowed protected weightbearing in a boot after the procedure, which was discontinued at the patient's discretion. The first postoperative encounter was within 1 week. Patients were then seen periodically as dictated by their symptoms. Average time elapsed from onset of symptoms to date of procedure was 19 months. Average follow-up was 16 months. There were no tendon ruptures, infections, hypertrophic scars, or systemic complications and only a few mild patient-reported complaints of stiffness, mild tenderness, etc.

Discussion

Insertional Achilles tendinopathy is characterized by posterior heel pain at the insertion of the Achilles tendon on the calcaneus and may be associated with early inflammation, degeneration of the tendon, or impaired performance. It is postulated that the pathogenesis is related to microtrauma and may involve some initial injury followed by multiple minor reinjuries that lead to chronic symptoms.[12] From a clinical perspective, the exact delineation between tendinitis and tendinosis can be difficult to pinpoint; however, it is generally described as the difference between an acute and chronic tendon condition. Tendinitis/tenosynovitis exhibits inflammation with the tendon sheath. Tendinosis involves a degeneration of the tendon with or without clinical and histologic signs of inflammation. Without histologic confirmation to differentiate between the two, pathology at the Achilles insertion is generally viewed as tendinopathy.[12] Whereas normal tendon is composed of tight, parallel bundles of primarily type I collagen, tendon degeneration involves separation, malformation, and disorganization of collagen fibers. There are changes in the cellular components of the tendon, namely, the density of tenocytes compared with extracellular matrix and the absence of lymphocytes and macrophages. A proliferation of capillaries and arterioles can also be observed.[13,14] Achilles tendinopathy is typically due to excessive, repetitive mechanical overload of the tendon. This can be due to a multitude of factors both intrinsic and extrinsic, such as muscular imbalance, limb-length discrepancy, malalignment, training error, rapid increase in activity level, training on slopes or uneven paths, and poorly supportive shoes.[13,15] Age, sex, weight, anatomical or biomechanical variations, diabetes mellitus, inflammatory and autoimmune conditions, and metabolic diseases such as dyslipidemia are also known factors.[2] Achilles tendinopathy can involve the paratenon, the midportion of the tendon (2–6 cm proximal to insertion), the insertion onto the calcaneus, and the bursa. Intratendinous degeneration leads to ectopic calcification and ossification at the Achilles insertion.[16]

Conservative supportive treatment is initiated on diagnosis and consists of NSAIDS, icing, rest, soft-tissue mobilization, taping, therapeutic ultrasound, tendon loading/physical activity, splinting/bracing, concentric exercises, eccentric exercises, topical glyceryl trinitrate, low-level laser therapy, orthoses, and ESWT. Conservative supportive treatment may show improvement in up to 50% of patients.[17] Such measures are usually attempted for 3 to 6 months before adjunctive modalities are considered,[2] including sclerosing injections, high-volume image-guided injection, prolotherapy, autologous blood injections, platelet-rich plasma injections, radiofrequency coblation, and minimally invasive to open surgical procedures.[13,18-20] A literature review provided by Rowe et al[2] summarized the evidence available for many of the treatment modalities for midportional Achilles tendinopathy. This review revealed that eccentric loading exercises and ESWT are consistently beneficial, and there is moderate evidence demonstrating the benefits of splinting/bracing, active rest, low-level laser therapy, and concentric exercises. Another systematic review by Wiegerinck et al[21] for the treatment of insertional Achilles tendinopathy showed ESWT to be effective for noncalcified tendinopathy. In contrast to midportion Achilles tendinopathy, eccentric training had lower patient satisfaction in this review. Of all of the treatment modalities, only NSAIDS, eccentric exercise, glyceryl trinitrate patches, sclerosing injections, aprotinin injections, ultrasound, and shockwave treatment have had high-level randomized controlled studies published.[17-21]

Ultimately, many patients will fail conservative therapy and require surgical intervention. According to Paavola et al,[22] conservative measures are usually attempted in combination for 3 to 6 months; however, they may be unsuccessful in up to 25% of patients. Maffulli et al[13] reported that 24% to 45.5% of patients with Achilles tendinopathy who fail to respond to conservative management undergo operative management. Operative treatment involves excising fibrotic adhesions, intratendinous calcifications, and nonviable tissue and seeks to restore vascularity, encourage new protein synthesis, and promote healing. Options for treatment include percutaneous longitudinal ultrasound-guided internal tenotomy, radiofrequency microtenotomy, neovessel destruction, endoscopic-assisted debridement, and open surgical treatment.[14] Open techniques typically involve gross inspection with resection of the posterosuperior calcaneal prominence, intratendinous calcifications, and retrocalcaneal bursa. Most require partial or complete detachment of the Achilles tendon with bone anchor reattachment[21] and may need augmentation with plantaris or flexor hallucis longus tendons.[16,23] Although the results of open surgical procedures are often successful, there can be significant complications, including skin necrosis, wound infection, seroma, hematoma, scarring, sural nerve

irritation or damage, delayed healing, recovery tendon rupture, and recurring symptoms.[24] In addition, these patients are frequently immobilized in a splint, cast, or boot and kept nonweightbearing for several weeks. Such treatment has problems with compliance and raises the potential for falls, deconditioning, pressure sores, neurologic injury, thermal injury, compartment syndrome, deep vein thrombosis, and pulmonary embolism.[25]

The present study provides the first data of its kind using percutaneous ultrasonic tenotomy specifically focusing on the definitive treatment by removal of the degenerated tendon of Achilles insertional tendinopathy. Postoperative recovery times varied, but patients were allowed protected weightbearing in a boot for the first 2 to 4 weeks. They were then gradually returned to their regular activity level as symptoms dictated, typically within 2 to 4 months. This is in sharp contrast to the open procedure, which may entail lengthy periods of nonweightbearing,[12,16,23] and although most patients have improvement in pain they are not pain free and may have lingering pain or delayed return to full activities for 6 to 12 months.[11,12,24,26,27] There were no significant complications such as rupture or infection, but there were two repeated procedures: one from failure to improve after the initial treatment and the other for an independent event causing reinjury after initial healing. Patients reported that the pain from the local anesthetic injections was the most uncomfortable part of the procedure. The data did not show a correlation of outcomes with bilaterality of symptoms, age, sex, BMI, reported etiology, treatment time, or time from onset of symptoms. Postprocedural management was important. Of the two patients to repeat the procedure, one experienced return of symptoms while progressing to full unprotected weightbearing. One of the self-reported failed procedures was reinjured during high-impact martial arts.

Of particular interest is that patients who had previous open procedures on the contralateral lower extremity before the percutaneous ultrasonic tenotomy procedure strongly favored the percutaneous microresection. One of these two patients reported higher-than-typical scores on each of the FFI categories yet noted that the pain was not in the Achilles tendon or its insertion and noted previous ankle pathology that did not resolve with arthroscopy. Although the scores on the FFI refer to pain, disability, and functional limitation in a general sense, this patient reported no pain in the Achilles tendon or its insertion, felt that the microresection procedure was successful, and strongly recommended it. The two patients who previously had the open procedure and who strongly favored the ultrasonic percutaneous mircroresection procedure are significant case studies in comparing the functional outcomes, recovery, and patient satisfaction between the two procedures.

Limitations to this study are that it was retrospective in nature without a control group. Recall bias is possible when using the FFI questionnaire. Apart from initial follow-up visits, recovery and return to activity were largely symptom-driven and varied among patients. Nevertheless, the obvious benefits of this procedure, with minimal comparative recovery time and significantly lower morbidity, show the usefulness of the procedure but also suggest the need for prospective study.

This pilot study of percutaneous tenotomy via ultrasound-guided microresection documents attractive features of this procedure and, thus, provides an additional treatment option in the algorithm of Achilles tendinopathy management. The morbidity features are similar to those of injections, but the treatment concept is similar to an open debridement in that the diseased tissue is removed, but without the morbidity of formal surgical debridement. Our experience has found that this is an extremely safe and effective minimally invasive option for patients who have failed less invasive conservative techniques. The technique is simple and can be performed in an ambulatory setting without a tourniquet using local anesthesia. The precise nature of the intervention allows for repetition of the procedure if needed and does not preclude further traditional open procedures if indicated.

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Conflict of Interest: None reported.

References

1. Kujala UM, Sarna S, Kaprio J: Cumulative incidence of Achilles tendon rupture and tendinopathy in male former elite athletes. Clin J Sport Med **15:** 133, 2005.
2. Rowe V, Hemmings S, Barton C, et al: Conservative management of midportion Achilles tendinopathy: a mixed methods study, integrating systematic review and clinical reasoning. Sports Med **42:** 941, 2012.
3. Koh JS, Mohan PC, Howe TS, et al: Fasciotomy and surgical tenotomy for recalcitrant lateral elbow tendinopathy: early clinical experience with a novel device for minimally invasive percutaneous microresection. Am J Sports Med **41:** 636, 2013.
4. Elattrache NS, Morrey BF: Percutaneous ultrasonic

tenotomy as a treatment for chronic patellar tendinopathy—jumper's knee. Operative Techniques Orthop **23:** 98, 2013.
5. Pourcho AM, Hall MM: Percutaneous ultrasonic fasciotomy for refractory plantar fasciopathy after failure of a partial endoscopic release procedure. PM R **7:** 1194, 2015.
6. Langer PR: Two emerging technologies for Achilles tendinopathy and plantar fasciopathy. Clin Podiatr Med Surg **32:** 183, 2015.
7. Farin PU, Räsänen H, Jaroma H, et al: Rotator cuff calcifications: treatment with ultrasound-guided percutaneous needle aspiration and lavage. Skeletal Radiol **25:** 551, 1996.
8. Budiman-Mak E, Conrad KJ, Roach KE: The Foot Function Index: a measure of foot pain and disability. J Clin Epidemiol **44:** 561, 1991.
9. Budiman-Mak E, Conrad KJ, Mazza J, et al: A review of the foot function index and the foot function index-revised. J Foot Ankle Res **6:** 5, 2013.
10. Saag KG, Saltzman CL, Brown CK, et al: The Foot Function Index for measuring rheumatoid arthritis pain: evaluating side-to-side reliability. Foot Ankle Int **17:** 506, 1996.
11. Watson AD, Anderson RB, Davis WH: Comparison of results of retrocalcaneal decompression for retrocalcaneal bursitis and insertional Achilles tendinosis with calcific spur. Foot Ankle Int **21:** 638, 2000.
12. Easley ME, DeOrio MJ: "Insertional Achilles Tendinopathy," in *Operative Techniques in Foot and Ankle Surgery*, edited by ME Easley, p 943, Lippincott Williams & Wilkins, Philadelphia, 2011.
13. Maffulli N, Wong J, Almekinders LC: Types and epidemiology of tendinopathy. Clin Sports Med **22:** 675, 2003.
14. Maffulli N, Longo UG, Denaro V: Novel approaches for the management of tendinopathy: current concept review. J Bone Joint Surg Am **92:** 2604, 2010.
15. Kader D, Saxena A, Movin T, et al: Achilles tendinopathy: some aspects of basic science and clinical management. Br J Sports Med **36:** 239, 2002.
16. Watson AD: "Surgical Management of Calcific Achilles Tendinopathy Using a Lateral Approach," in *Operative Techniques in Foot and Ankle Surgery*, edited by ME Easley, p 943, Lippincott Williams & Wilkins, Philadelphia, 2011.
17. Shalabi A, Kristoffersen-Wilberg M, Svensson L, et al: Eccentric training of the gastrocnemius-soleus complex in chronic Achilles tendinopathy results in decreased tendon volume and intratendinous signal as evaluated by MRI. Am J Sports Med **32:** 1286, 2004.
18. Scott A, Huisman E, Khan K: Conservative treatment of chronic Achilles tendinopathy. CMAJ **183:** 1159, 2011.
19. Management of chronic Achilles tendinopathy. Drug Ther Bull **50:** 93, 2012.
20. Lopez RG, Jung HG: Achilles tendinosis: treatment options. Clin Orthop Surg **7:** 1, 2015.
21. Wiegerinck JI, Kerkhoffs GM, van Sterkenburg MN, et al: Treatment for insertional Achilles tendinopathy: a systematic review. Knee Surg Sports Traumatol Arthrosc **21:** 1345, 2013.
22. Paavola M, Kannus P, Jarvinen TA, et al: Achilles tendinopathy. J Bone Joint Surg Am **84:** 2062, 2002.
23. McGarvey WC, Clanton TO: "Flexor Hallucis Longus Tendon Augmentation for the Treatment of Insertional Achilles Tendinosis," in *Operative Techniques in Foot and Ankle Surgery*, edited by ME Easley, p 943, Lippincott Williams & Wilkins, Philadelphia, 2011.
24. Schneider W, Niehus W, Knahr K: Haglund's syndrome: disappointing results following surgery: a clinical and radiographic analysis. Foot Ankle Int **21:** 26, 2000.
25. Maquirrian J: Surgical treatment of chronic Achilles tendinopathy: long term results of the endoscopic technique. J Foot Ankle Surg **52:** 451, 2013.
26. Maffulli N, Testa V, Capasso G, et al: Surgery for chronic Achilles tendinopathy yields worse results in nonathletic patients. Clin J Sport Med **16:** 123, 2006.
27. Krishna Sayana M, Maffulli N: Insertional Achilles tendinopathy. Foot Ankle Clin **10:** 309, 2005.