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Current Concepts Review Update: Insertional Achilles Tendinopathy

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Introduction

Approximately 6% of the general population reports Achilles tendon pain during their lifetime.[63] Of these patients, roughly one-third will have insertional Achilles tendinopathy (IAT).[55,58,63,83] Patients with IAT often report stiffness that is aggravated by prolonged rest as well as pain that is aggravated by physical activity. Patients often report that their symptoms limit their activity at work and participation in sports. In addition, because of sensitivity over the posterior heel, many struggle with shoewear.

This Current Concepts Review provides an update to Dr Irwin's review and highlights evidence on treatment published since the previous 2010 publication.[50] In addition, this update provides Levels of Evidence and Grades of Recommendation for treatment recommendations (Table 1) that are consistent with the previous and recently published reviews.[20,50]

Pathophysiology

The Achilles tendon originates from the aponeuroses of the gastrocnemius, soleus, and plantaris muscles.[88] The tendon progressively twists as it descends from its origin, causing

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the gastrocnemius fibers to insert posterolaterally on the calcaneus while the fibers of the soleus insert anteromedially.[7,76] The plantaris tendon has variable insertion patterns as it joins on the anteromedial-side Achilles.[105] The tendon is composed primarily of type I collagen,[96] and is surrounded by a paratenon (ie, a false sheath).[96] The Achilles inserts 2 cm distal to the posterosuperior calcaneal prominence with an anterior-posterior diameter of 5 to 6 mm.[69,97,105] The insertion has medial and lateral projections, forming a crescent shape to dissipate stress.[69,105] The blood supply for the Achilles tendon insertion is primarily from an arterial plexus along the calcaneus that is supplied by the fibular and posterior tibial arteries.[61,120] Immunohistochemical analysis in cadavers and laser Doppler flowmetry have been able to detect vascularization within the loose connective tissue surrounding the collagen fibers of the Achilles tendon insertion.[3,120] However, these vessels are rarely detectable in healthy adults using color Doppler and power Doppler ultrasonography.[21,91] Finally, subcutaneous and retrocalcaneal bursae surround the tendon and reduce friction between the tendon and adjacent tissues.[7,8]

Healthy tendons are essentially aneuronal,[98] yet the close proximity of the sural nerve to the Achilles is relevant in considering differential diagnoses, such as irritation or neuroma of the sural nerve, and decisions about operative approaches.[115] As the nerve descends distally, it travels close to the tendon sheath in the subcutaneous tissue and crosses the lateral border of the tendon sheath approximately 10 cm above the enthesis.[88,115] In addition, the peripheral nervous system can become more sensitive in painful tendinopathy as a result of nerve in-growth, altered neurotransmitters and mediators (eg, glutamate, substance P, CGRP), and increased sensitivity of the nociceptive receptors.[25] Although studies specific to IAT are currently lacking, evidence indicates that sensitization of the central nervous system may also contribute to chronic Achilles tendinopathy pain.[47,103,109] Evidence of central sensitization in patients with Achilles tendinopathy include decreased efficacy of descending pain inhibitory pathways[109] and increased sensitivity to mechanical and thermal stimuli.[47]

Degenerative changes within the Achilles insertion is the hallmark of IAT. Tendon degeneration is marked by a loss of parallel collagen structure, loss of fiber integrity, fatty infiltration, and capillary proliferation.[59,79] Tendon degeneration is manifested by increased tendon thickness and abnormal appearance on imaging. A tendon thickness >6 mm has been used as a diagnostic criterion for IAT.[55,58,83] With ultrasound imaging, a lower echogenicity (ie, a lower mean grayscale value) indicates less organization and altered composition of the tendon microstructure.[15] Nicholson et al (2007) developed a grading system for Achilles tendon pathology based on MRI in which the severity was associated with prognosis for conservative care. The grading system was based on tendon diameter and the presence of degeneration in the tendon: Grade I: anteroposterior diameter of 6 to 8 mm and nonuniform degeneration; Grade II: diameter of >8 mm with uniform degeneration of <50% of tendon width; and Grade III: tendon diameter >8 mm and uniform degeneration of >50% tendon width.[83] The authors found that individuals with Grade I disease were much less likely to require surgery (13%) than individuals with Grade II or Grade III pathology (91% and 70%, respectively).[83]

Bone spurs are common among people both with and without foot pain. Evidence from prehistoric human data[117] and an animal model[6] suggests that the development of

osteophytes is a normal response to cumulative mechanical loading with aging and activity. Using plantar fasciitis as an example, plantar heel spurs are common both in persons with plantar fasciitis (53%-85%) and without plantar fasciitis (41%-46%).[78,87] Similarly, for patients with unilateral IAT, a recent study by Chimenti et al[13] demonstrated that enthesophytes were nearly as common on the asymptomatic side (55%) as the symptomatic side (65%, $P = .642$). Nevertheless, insertional Achilles spurs appear to be more common in patients with IAT (65%-80%)[54,104] than people without foot pain (25%-35%).[13,104] Chimenti et al[13] also found that on average the spurs were significantly longer on the symptomatic side (12.9 mm) compared to the asymptomatic side (8.9 mm, $P = .01$) and controls (3.5 mm, $P = .03$). Together these findings indicate that the size of the osteophytes, rather than the presence of osteophytes, may be a contributing factor to the development of symptoms in IAT.

The effect of calcaneal shape on IAT symptoms has not been well supported in the literature. The posterior-superior calcaneal prominence, known as Haglund deformity, may theoretically compress against the Achilles tendon and the retrocalcaneal bursa, which can contribute IAT symptoms.[66,102] However, recent literature questions the utility of measuring calcaneal shape, such as the Fowler-Phillip angle,[38] Bohler's angle and Chauveaux-Leit angle,[11] given the lack of association with IAT.[54,104] Specifically, studies have shown no differences in the Fowler-Phillip angle[54,104] or Bohler angle[54] between persons with and without IAT. Although statistically the Chauveaux-Leit angle differed between persons with IAT and persons without heel pain in one case-control study,[104] the clinical relevance of this difference is unclear because of high variability in this measurement.

Pathomechanics

Mechanical overloading may contribute to IAT symptoms. At the tissue level, both the magnitude of force and tendon strain associated with an activity contribute to the stress on the tendon insertion. For example, running imposes loads of 4 to 6 times the force of body weight on the Achilles tendon,[2,118] and approximately 8% strain along the entire length of the tendon.[34] Although the load on the tendon is less with walking, this task still imposes approximately 7% strain along the tendon length.[39] Because of the anatomy of the Achilles tendon insertion, different regions of the tendon are subjected to different types of force. The superficial side of the tendon is subjected to greater axial tensile strain, as the tendon elongates because of pull from the gastrocnemius and soleus muscles.[12,70] In contrast, the deep side of the tendon is subjected to greater transverse compressive strain, as the posterior superior-surface of the calcaneus impinges against the deep side of the tendon. Variability in the location of IAT pathology may depend on if overloading occurs more because of compressive or tensile forces.

With regard to joint mechanics, functional use of ankle dorsiflexion and plantarflexor power may be altered in patients with IAT. One recent study examined ankle biomechanics during stair ascent.[16] Patients with IAT used greater end-range dorsiflexion, less plantarflexion, and lower peak ankle plantarflexor power than controls. Patients with greater IAT symptoms also demonstrated decreased use of the ankle plantarflexors during function.[16] These findings may be related to increased tensile forces on the tendon insertion with contraction of the

plantarflexor muscles and the increase in compressive and tensile forces that occur at the tendon insertion with increased dorsiflexion.[12]

Clinical Presentation

The diagnosis of IAT is based primarily on history and physical examination. Patients typically have tenderness to palpation within the distal 2 cm of the Achilles tendon. Upon visual inspection, patients commonly have an area on the back of the heel with swelling and redness. It is useful to test for limited ankle dorsiflexion range of motion (including a Silversköld test to assess for isolated gastrocnemius contracture) and plantarflexor weakness, although interpretation of findings may be complicated by the presence of pain with testing. Patients report pain that is aggravated by activity and stiffness that is associated with prolonged periods of rest.

Imaging

Imaging is routinely used to examine for pathophysiology associated with IAT. Lateral weightbearing radiographs of the foot can be used to evaluate the presence and size of enthesophytes, intratendinous calcifications, and a Haglund deformity. The shape and lucency of the Kager triangle on radiographic imaging can also be used to assess for retrocalcaneal bursitis.[112] Ultrasound imaging and magnetic resonance imaging (MRI) can be used to examine for soft-tissue (tendon degeneration, neovascularization, bursitis, paratendinitis) as well as bony (enthesophytes, intratendinous calcification) changes.[13] Signs of tendinopathy on imaging do not necessarily indicate the presence of IAT and vice versa, as demonstrated in several level IV* and level II studies.[4,23] For example, the reported percentage of asymptomatic tendons with signs of Achilles tendinopathy on imaging range from 0% to 35%† and the percentage of symptomatic tendons without signs of Achilles tendinopathy range from 0% to 19%.[4,24,37,101,106,111]

Nonoperative Treatment

Eccentric Exercises

Progressive strengthening designed to load the Achilles tendon is a key component of nonoperative treatment. The traditional eccentric exercise program that utilizes full range of ankle dorsiflexion motion (ie, lowering the heel below the step) has a relatively low rate of patient satisfaction, with 28% to 33% of patients with IAT rating the intervention as excellent or good (Level IV evidence).[33,93] An alternative eccentric exercise program that utilizes a limited ankle range of motion with heel lowering to a past neutral standing position has been more successful for patients with IAT. In a single case series study, Jonsson and colleagues[53] had 67% (18/27) of patients reporting excellent or good satisfaction with the treatment, and on average participants' pain rating decreased from 72 to 33 on the VAS at 4-month follow-up (Level IV evidence). Because of this limited and conflicting evidence, eccentric exercise was given a Grade I recommendation by Dr Irwin's review in 2010.[50]

*References 9, 24, 29, 31, 37, 100, 106, 111.
†References 4, 9, 24, 31, 37, 100, 101, 106, 111.

Since 2010, 2 RCTs have compared traditional eccentric exercise to other treatments, including extracorporeal shock wave[92] and stretching.[57] Traditional eccentric exercise does have some therapeutic benefit, with an average decrease in pain ratings at the 3- to 4-month follow-up being 1.8 to 2.2 on the VAS (Level I evidence).[57,92] The modified eccentric exercise program also reduces pain when performed alone (average 2.4 decrease at 12 weeks and 4.4 at 52 weeks, n=8) and when combined with a soft-tissue treatment (Astym, average 2.9 decrease at 12 weeks and 3.9 at 52 weeks, n=7; Level II evidence).[74]

Although eccentric exercise is supported by several Level I, II and level IV studies[33,53,57,60,74,92] (Grade B recommendation), there is currently a shift in clinical theory on the importance of such factors as maximum load, speed of contraction, and frequency of sessions, rather than mode of contraction (eccentric vs concentric).[18,72] Although evidence specific to IAT is currently lacking, restricting the range of motion (ie, avoiding ankle DF) in which the exercise is performed as well as contraction (eg, isometric) may be useful mechanisms to progressively maximize tendon loading including other modes.

Extracorporeal Shock Wave Therapy

Because of limited evidence and variation in published ESWT protocols, this intervention was given a Grade I recommendation in Dr Irwin's 2010 review.[50] In 2008, a randomized controlled trial by Rompe and colleagues[92] found that extracorporeal shock wave therapy (ESWT) was more effective at reducing pain and IAT symptoms than a traditional eccentric exercise program at 4-month follow-up (Level I evidence). In 2006 Furia[40] reported that ESWT in conjunction with anesthetics had an average pain reduction of 5 points on the VAS compared to 1.4 points in a control group treated nonoperatively (Level III evidence).

More recently, a retrospective study found that ESWT resulted in a greater decrease in pain than a traditional eccentric exercise program at 6-month follow-up (average decrease in VAS, ESWT: 3.9, Eccentrics: 1.6) and 18-month follow-up (average decrease in VAS, ESWT: 3.6, Eccentrics: 1.5; Level III evidence).[116] One risk of ESWT is high pain during the treatment, for example 6/30 patients in the study by Wei and colleagues[116] discontinued the ESWT treatment due to "intolerable pain." The use of an anesthetic may help patients tolerate the treatment, but it is unclear if this variation in application alters patient outcomes. Two recent Level IV studies have also supported the use of shockwave therapy for IAT,[65,108] yet the authors question the effectiveness for patients with enthesophytes. Based on the accumulation of studies supporting EWST,[40,65,92,108,116] this modality now has a Grade B recommendation.

Night Splints

Because the force of the stretch from night splints is significantly less than body weight, they may be less painful and better tolerated than a weightbearing calf stretch. Further, they require little to no time commitment from the patient. On the other hand, if a patient can tolerate weight-bearing exercise then night splints may add no additional therapeutic benefit. In one Level II study, night splints did not provide any additional benefit added to eccentric exercise in patients with noninsertional Achilles tendinosis (Level II).[22] The evidence with regard to night splints and insertional disease is lacking. In one Level II study examining

physical therapy, the effect of night splints could not be separated from the concurrent effects of other components of treatment.[57] As such, this modality has a Grade I treatment recommendation.

Injections

As of Irwin's 2010 review, there were no studies on the use of corticosteroid or glucocorticoid injections specifically for the insertional form of Achilles tendinopathy (Grade I recommendation).[50] For sclerosing therapy, using polidocanol to target neovascularization, there was one pilot study of patients with chronic IAT in which 8/11 patients reported decreased pain (Level IV evidence).[85] Yet another case study cautioned against the use of sclerosing agents because of the risk of tendon rupture in an elite athlete (Level IV evidence).[46]

In current clinical practice, corticosteroid injections have largely fallen out of favor for treatment of tendinopathy at any location, and there is particular concern around the Achilles tendon for fear of contributing to further tendon degeneration and potential tear.[17] In cases of isolated retrocalcaneal bursitis, corticosteroid injection may be considered, but care should be taken to avoid intratendinous injection. Other potential types of injection include those targeting neovascularization, such as the sclerosing agent polidocanol or simple mechanical disruption with high-volume saline, and hyperosmolar dextrose (prolotherapy). Although several small trials have studied these agents, most were not specific to IAT and provide insufficient high-quality evidence to support their use in routine clinical practice.[56] Quality evidence is therefore lacking regarding long-term efficacy for insertional Achilles disease (Grade I recommendation).

Platelet-Rich Plasma (PRP) Injection

To date, the majority of studies using PRP for AT have been in patients with midportion AT or mixed cohorts, and its use remains controversial.* A 2012 prospective case series by Monto[77] found PRP to be effective in a mixed cohort of 30 patients with AT (8 insertional, 22 midportion) leading to satisfaction with treatment in 28/30 patients at 2-year follow-up (Level IV evidence). However, both treatment failures in this study occurred in patients with IAT (2/8).[77] Two retrospective case series examining the use of PRP for IAT have recently been presented but not published (Level V evidence).[81,84] Reported patient satisfaction was just 53% (10/19)[81] and 57% (8/14)[84] at 6-month follow-up. Higher-level studies with randomization and blinding are needed before determining a level of treatment recommendation for PRP (Grade I recommendation).

Other Pain-Relieving Options

Clinicians may recommend wearing a shoe with a slight heel or using a heel lift within the shoe. There is some biomechanical evidence to suggest that heel lifts can reduce the amount of tendon elongation (tensile strain) and compression (compressive strain) that occurs at the tendon insertion during daily activities that require ankle dorsiflexion.[12,14] In addition, nonsteroidal anti-inflammatory medications, iontophoresis, and ice may be useful if there is

*References 19, 28, 35, 36, 41, 44, 73, 90, 94, 95.

substantial inflammation present, such as retrocalcaneal bursitis or paratendonitis. Further research on each of these approaches is necessary (Grade I recommendation).

Operative Treatment

Operative intervention may be considered in patients with recalcitrant IAT. A number of different operative techniques have been described with differences in approach and intervention. Most operative procedures include removal of pathologic tendon and calcifications, the posterosuperior calcaneal prominence, and the retrocalcaneal bursa.

Open Debridement and Decompression

For open debridement and decompression of the Achilles tendon insertion, a longitudinal midline incision is a popular approach. It is favored by many surgeons because it allows for good visualization of all pertinent structures, including the bursa, calcaneal exostosis, and Achilles intrasubstance.[27] This central tendon-splitting approach is thought to result in minimal vascular disruption of the posterior tibial vessels and peroneal artery branches. There may also be less risk of sural injury compared to the Cincinnati and lateral incision.[42] Furthermore, this approach allows access to the FHL if augmentation is required. Nevertheless, scar irritation is more of a concern compared to the other approaches.[27] Alternatively, a lateral longitudinal incision has been described at the midpoint between the lateral border of the Achilles and the superior crest of the calcaneus with the sural nerve protected anteriorly.[119] Watson et al (2000) noted that post-operative avulsion may be less likely when the lateral Achilles insertion is elevated given that the medial insertion is more extensive.[114] Alternatively, a transverse Cincinnati incision grants adequate exposure with the benefits of cosmetic satisfaction and minimal scar problems as the transverse scar may be less prone to tethering and contracture compared to longitudinal incisions.[10] Although this semi-circumferential incision is made perpendicular to the course of the sural nerve, Carmont et al (2007) did not report any complications of distal numbness in their case series, likely because the sural nerve has split into small branches at the level of the incision. [10] Although a number of other approaches have been described in the literature,[48,113] there is insufficient evidence to support the use of one approach over another.

The amount of acceptable detachment for debridement of the Achilles insertion varies considerably in the literature. Kolodziej et al (1999) concluded that up to 50 percent of the tendinous insertion can be safely detached.[62] For those with greater than 50 percent detachment, reinsertion with double-row fixation has been recommended.[5,71] A recent retrospective case series by Ettinger et al (2016) found that patients who were treated with double-row fixation or 2-suture anchors showed significantly greater postoperative AOFAS scores compared to single-row anchors (79.6 vs 90.2, $P < 0.05$, Level IV evidence).[32]

The consistently good postoperative outcomes, despite variations in approach and reattachment techniques, across a range of Level II, III, and IV studies* continue to support the use of operative treatment for IAT (Grade B recommendation).[50] Postoperative outcomes, including patient satisfaction and self-reported function, for operative

*References 1, 30, 32, 42, 43, 49, 52, 67, 68.

debridement are generally positive. Postoperative AOFAS ankle-hindfoot scores range from 81 to 96 and patient satisfaction is generally greater than 87 percent.† Yet there are potential complications including superficial would infection, scar abnormalities (hypersensitivity, hypertrophy, and numbness), skin necrosis, hematoma, delayed wound healing, sural neuritis, tendon avulsion, deep vein thrombosis, and recurrence of pain.[50] Complications resulting from this procedure have ranged from 6 to over 30 percent in the literature and are most commonly due to wound healing issues, painful scar, or sural nerve injury.[32,42,43,49,67,68]

Endoscopic/Minimally Invasive Procedures

In 2010 there was insufficient evidence to support the use of endoscopic procedures in the treatment of IAT (Grade I recommendation).[50] Endoscopic procedures of the calcaneus and Achilles tendon may result in fewer wound-healing complications compared to open procedures.[66] Leitze et al (2003) reported a prospective cohort study (Level II evidence) in which 33 patients underwent endoscopic decompression of the retrocalcaneal space and were compared to 14 patients who underwent an open procedure.[66] Compared to the open group, patients in the endoscopic group had greater AOFAS scores and fewer complications, including infection, altered sensation, and scar tenderness. However, a limitation of the endoscopic approach is that it may not be possible to entirely remove the bone spur or all diseased tissue in patients with full-thickness intratendinous calcifications. As such, it may be a more appropriate treatment for patients with disease characterized primarily by enlargement of the posterior superior calcaneal tuberosity. Among patients who are candidates for this technique, there have been several case series studies, with 87% to 95% of patients reporting good to excellent results with endoscopic calcaneoplasty (Level IV evidence).[51,86,110] To our knowledge, no additional studies have been published since 2010 on the use of endoscopic techniques in patients with IAT.

Flexor Hallucis Longus (FHL) Tendon Transfer

FHL tendon transfer is often used to provide augmentation when there is severe degeneration of the Achilles tendon and it was supported by Level IV evidence (Grade B recommendation).[50] McGarvey et al (2002) found that in adults with IAT, those over the age of 50 had a greater amount of degeneration, inflammation, and overall percentage of tendon involvement.[75] Therefore, it has been suggested that FHL augmentation may be of additional benefit in this age group. Den Hartog (2003) reported on a case series of 26 patients (29 procedures) that underwent FHL transfer with tendon debridement and decompression. The study found that FHL transfer improved patient outcomes in patients older than 50 with more advanced tendinosis (Level IV evidence).[26]

However, a recent randomized, prospective trial (Level I evidence) consisting of 39 patients greater than 50 years of age suggests that FHL transfer may not result in better outcomes in this patient population.[49] Eighteen patients in the control group underwent Achilles decompression and debridement and 19 patients in the FHL transfer group underwent decompression and debridement along with FHL augmentation for chronic IAT. The 2

†References 1, 30, 32, 42, 43, 49, 52, 67, 68.

groups demonstrated no differences in pain, functional outcomes, or patient satisfaction. However, ankle plantar flexor strength was significantly improved with FHL transfer. No patients complained of functional weakness in their great toe. FHL tendon transfer appears to be safe and may result in greater plantar flexor strength; however, this may not be necessary for primary procedures. Moreover, medial or lateral plantar nerve may be at risk for transection with this procedure.[80]

To date there is no high-level evidence that an FHL transfer results in superior patient outcomes compared to debridement of the tendon alone in most circumstances (Grade I Recommendation). Further study is required to demonstrate the value of FHL transfer in a subset of patients who may benefit from FHL transfer such as those with failed previous surgery or extensive tendon degeneration.

Gastrocnemius Recession

For patients with a gastrocnemius contracture, a gastrocnemius recession procedure may be performed in combination with open debridement or as an isolated procedure. Conflicting low-level evidence exists regarding the use of isolated gastrocnemius release for the treatment of IAT. Isolated gastrocnemius recession has the benefit of a shorter recovery time than open debridement. Tallerico et al (2015) found that 10/11 (91%) of patients with chronic IAT had good to excellent results with significant improvement in AOFAS score postoperatively with minimal complications, including 2 sural nerve paresthesias that resolved (Level IV evidence).[107] In contrast, Gurdezi et al (2013) reported a small case series using proximal medial gastrocnemius release in 10 patients with insertional or noninsertional Achilles tendinopathy (Level IV evidence). Patients in the insertional group experienced less improvement in VISA-A and AOFAS scores.[45] The authors noted that patients without spurs tended to have greater improvement than patients with spurs.[45] A recent case-control study by Nawoczenski et al[82] found that the Strayer procedure provided significant pain reduction, which was maintained at 18-month follow-up for 11 patients with chronic IAT. However, patients who underwent a gastrocnemius recession did exhibit deficits in plantarflexion power and endurance when compared with 10 healthy controls (Level III evidence). For this reason, gastrocnemius recession may not be appropriate for athletic patients.

Based on the above evidence, there is insufficient evidence to provide a recommendation for isolated gastrocnemius recession as the sole treatment of IAT (Grade I Recommendation). Further study is required to elucidate the role of gastrocnemius recession in the subset of patients with gastrocnemius contracture, failed previous reconstructions, or as an adjunct procedure combined with tendon debridement and/or FHL transfer.

Percutaneous Procedures

Percutaneous ultrasonic debridement of regions of degenerative/calcific tendinosis have shown promise in other anatomic locations.[64,89,99] Potential advantages include decreased wound complications and accelerated recovery; however, as with endoscopic techniques, there will be limitations regarding spur removal as this technique targets soft tissue

structures. Ultrasound-guided microinvasive techniques for treatment of IAT are emerging, but there are no reports to date in the available literature (Grade I recommendation).

Summary of Graded Evidence

A brief summary of all treatments and their grade of recommendation are listed in Table 2.

Nonoperative Treatment Recommendations

- Eccentric exercise through a limited range of motion (ie, avoiding loading the tendon during ankle dorsiflexion) has been demonstrated to reduce pain and have a high level of patient satisfaction (Grade B recommendation).
- Extracorporeal shock wave therapy can reduce pain at 4-month to 18-month follow-up (Grade B recommendation). However, there is currently no evidence-based standardized ESWT protocol for IAT, some patients may not be satisfied with the treatment due to pain during the treatment, and effectiveness may be limited in patients with enthesophytes.
- There is currently insufficient evidence to make a recommendation about the use of night splints as one component of a home exercise program (Grade I recommendation).
- Injections may be used to target inflammation in tissues surrounding the tendon or neovascularization within the tendon. However, there is insufficient evidence in patients with IAT to support long-term efficacy (Grade I recommendation).
- Although only supported by theoretical and anecdotal evidence (Grade I recommendation), there are additional pain-relieving options that can be used in the clinic. Changes in footwear, such as using a heel lift, are often recommended to alleviate pain in patients with IAT. Anti-inflammatories, iontophoresis, and/or ice can also be used to alleviate pain due to inflammation associated with IAT. However, there is insufficient evidence to support more than a Grade I recommendation.

Operative Treatment Recommendations

- After failure of conservative care, open debridement and decompression for IAT is supported by many studies that report high postoperative function and patient satisfaction (Grade B recommendation).
- Patients who are candidates for endoscopic/minimally invasive procedures may have fewer wound-healing complications than open procedures, but there is currently insufficient evidence on postoperative outcomes to make a recommendation about the routine use of this procedure (Grade I recommendation), especially in patients with insertional calcification.
- Although an FHL transfer can be used to augment the Achilles tendon after debridement, there is currently insufficient evidence to support the routine use of

this procedure when initially operating on patients with IAT (Grade I recommendation).

- There is conflicting, low-level evidence on the effectiveness of isolated gastrocnemius recession to reduce pain and improve function in patients with IAT (Grade I recommendation). More research is needed to understand the efficacy of a gastrocnemius recession as an adjunct to other operative procedures.
- There is currently no literature on the efficacy of percutaneous procedures in patients with IAT (Grade I recommendation).

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Table 1

Levels of Evidence and Grades of Recommendation.

Levels of Evidence (given to individual studies)
Level 1: High-quality prospective randomized clinical trial
Level II: Prospective comparative study
Level III: Retrospective case-control study
Level IV: Case series or case study
Level V: Expert opinion
Grades of Recommendation (given to treatment options)
Grade A: Treatment options are supported by strong evidence (consistent with Level I or II studies)
Grade B: Treatment options are supported by fair evidence (consistent with Level III or Level IV studies)
Grade C: Treatment options are supported by either conflicting or poor-quality evidence (Level IV studies)
Grade I: Insufficient evidence exists to make a recommendation

Table 2

Summary of Grades of Recommendation for Treatment Options.

Nonoperative	
Strengthening exercises	Grade B
Extracorporeal shock wave therapy	Grade B
Night splints	Grade I
Injections	Grade I
Platelet-rich plasma injection	Grade I
Other pain relieving options	Grade I
Operative	
Open debridement and decompression	Grade B
Endoscopic/minimally invasive procedures	Grade I
Flexor hallucis longus (FHL) transfer	Grade I
Gastrocnemius recession	Grade I
Percutaneous procedures	Grade I