Achilles Tendon Injury

E-book
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Achillies Tendinopathy

The term tendinopathy is now widely used to describe conditions previously known as tendonitis, tendinitis, tendinosis and tenosynovitis. All of these terms describe degenerative overuse conditions of the Achilles tendon or sheath-like paratenon (or peritendon) surrounding it. Although there are some differences between these conditions, the term tendinopathy is now used to cover all conditions, to ease confusion and simplify diagnosis.

There is some confusion over the exact pathology of achilles teninopathies. It was previously thought that they were largely inflammatory conditions. This is now known not to be the case due to the absence of inflammatory cells in biopsy samples. Instead the cause is thought to be degenerative, with microtears and a loss of normal fibre structure and collagen fibre disarray.

The Achilles tendon is the strongest and thickest tendon in the body. It is the combined tendon of the Gastrocnemius and Soleus muscles which attaches inferiorly to the Calcaneus (heel bone). The tendon itself does not have a sheath as do most tendons, instead it has a paratenon which is continuous with the perimysium (connective tissue) surrounding the Gastrocnemius and Soleus muscles, and also the Periosteum (connective tissue surrounding the bone) of the Calcaneus.

The calf muscles are among the most powerful muscles in the body. Their function is to plantarflex the ankle (point the toes away from the body). To cause this movement the two calf muscles contract and shorten, placing a pulling force on the Achilles tendon, which in turn pulls the posterior surface of the Calcaneus upwards, resulting in the rest of the foot pointing downwards.

This movement enables us to walk, run, jump and stand on our tip toes and with each step, places the weight of our entire bodies on the Achilles tendon. When we run and jump, the Achilles is subject to between 3 and 12 times our body weight! It is therefore no wonder that runners are 30% more likely to suffer Achilles tendinopathy than their sedentary counterparts!
Achilles tendinopathy is an overuse injury and so symptoms gradually increase over time with repeated strain placed on the tendon. Symptoms can either be insertional (where the tendon meets the bone) or mid-portion (2-3cm above the attachment to the Calcaneus) which is the most common form and responds well to conservative treatment.

Symptoms which are consistant with Achilles Tendinopathies include:

Ø Pain and stiffness in the achilles in the morning especially
Ø Pain often eases after a few minutes
Ø Pain at the start of training which often eases as training progresses and returns sometimes hours later
Ø Tenderness on palpation
Ø Swelling over the Achilles tendon
Ø Red skin over the tendon
Ø Nodules or lumps in the achilles tendon
Ø Crepitus or creaking when you point the toes or push on the tendon
Ø Thickening of the Achilles tendon

Other causes of gradual onset pain in the achilles region include achilles bursitis (inflammation of one of the two bursa surrounding the achilles tendon) and Haglunds deformity (a prominence of the postero-lateral calcaneus which impinges on the bursa and tendon). In adolescents, sever's disease must also be considered. This is an apophysitis, similar to that of Osgood Schlatter's disease at the knee.
Causes

This kind of degenerative injury to the Achilles tendon occurs when an excessive load is placed upon the tendon, usually over an extended period of time. Certain biomechanical and training factors, can predispose an individual to Achilles tendinopathy:

- Sudden increase in activity
- Change of training surface
- New training shoes
- Excessive pronation
- Weak/inflexible calf muscles
- Limited angle range of motion
- Poor or incorrect footwear
- Overtaining and decreased time between sessions
- Weakness of the hip and knee stabilising muscles

Sudden changes in training or daily activity are among the most common causes of Achilles tendinopathy. A rapid increase in training as often occurs when a recreational athlete decides to start to compete is a common trigger. This places additional strain on the tendon which it is not used to. For runners, the rule of thumb is don’t increase your mileage by more than 10% per week.

A change in the type of training, which again the tendon is unaccustomed to, or a change to a less shock absorbing training surface (such as grass to road) places extra strain on the tendon.

Having the correct footwear is also important in avoiding Achilles problems. Old or poorly fitting footwear does not provide enough shock absorbing and support and may rub, causing friction and pressure over the achilles. Similarly brand new footwear should be gradually ‘run-in’ by alternating use of the new and old shoes and slowly increasing the mileage or usage of the new shoes.

Biomechanical factors must also be taken into consideration. Over-pronation is a common issue in overuse injuries of the lower limbs. It is characterised by the foot appearing to roll inwards and the arch shape on the inside of the foot flattening.

As you can see on this photo, the right foot is pronated. It is clear that this foot position takes the Achilles out of alignment, placing strain on the inside of the tendon.
especially. Over-pronation also places an increased load on the Gastronemius and Soleus complex as they now have to act to resupinate the foot (correct the over-pronation). The left foot shows how easily this can be corrected using an orthotic device.

The condition of the calf muscles also has an effect on injury to the Achilles tendon. If the calf muscles are tight, this restricts the movement of the ankle joint into dorsiflexion (pointing the toes up towards the ceiling). If they are disproportionately weak (in comparison to other muscle groups of the lower leg) they do not provide enough force to maintain good alignment of the foot and ankle, therefore placing additional strain on the tendon.

As with many lower limb overuse injuries, Achilles tendinopathies can be the result of the stabilising muscles of the hip and knee failing to control the lower limb in a good posture. If Gluteus Medius and VMO (Vastus Medialis Oblique fibres of Vastus Medialis) are not functioning correctly the thigh has a tendency to internally rotate which transfers through the lower leg causing (or exaggerating) over-pronation which places extra strain on the Achilles tendon as previously mentioned.
Treatment

Treatment for Achilles tendinopathies should include the following:

Ø Rest from aggravating activity
Ø Ice
Ø Temporary use of a heel pad
Ø Taping
Ø Massage therapy
Ø Ultrasound
Ø Correction of biomechanical abnormalities
Ø Rehabilitation exercises
Ø Gradual return to activity

At the onset of pain, the aggravating activity should be stopped as soon as possible and not initiated again until a thorough treatment and rehabilitation program has been completed.

How much rest is needed is a difficult question to answer, due to the variance in symptom severity from case to case. However, if maintaining fitness levels is of importance, other forms of training which do not strain the recovering tendon can be undertaken following only a few days total rest. Perfect examples include cycling, rowing and swimming.

Ice should be applied from the onset of the injury, for the first 48 hours at a duration of 15 minutes every 3 hours. The best method of icing such an injury is by using a simple ice pack in a protective covering (a towel or cloth will suffice), applied directly to the site of pain. Using ice reduces pain and inflammation at the site of the injury and therefore helps to limit the damage.

A heel pad can also be used in the first week or two (at the most) to limit the strain on the tendon during day-to-day activities. A heel pad should be around 1cm thick in order to slightly shorten the tendon while it is healing. Do not wear a heel pad for an extended period and wear one in both shoes to avoid overuse injuries as a result of a leg length discrepancy!
**Taping**

Taping the Achilles tendon in the early stages whilst it is healing can help to ease the strain.

You will need:

- Ø 3.5cm non-stretch zinc oxide tape
- Ø 5cm wide stretch adhesive tape
- Ø underwrap and skin adhesive (optional)

The tape will be more effective if applied directly to the skin. However the skin will need to be free of hair (shaved) to allow the tape to stick effectively and prevent pain when removing. The tape can be applied onto underwrap, which is secured with a skin adhesive, however it is unlikely to be as effective or last as long as tape applied directly to the skin.

**Step 1:** Apply underwrap tape onto sprayed legs or just shave the leg to enable the tape to stick properly

Apply two 'anchor' 5cm tapes above the bulk of the calf muscle and two around the mid foot. Do not apply the tape all the way around the calf but stop 1cm short, as your calf will expand when you use it.

**Step 2:** Lie face down with the lower leg supported to allow the foot to point slightly as shown opposite.

Apply a strip of stretch tape from the foot anchor to the calf anchor applying slight stretch. Do not stick the tape to the tendon.

**Step 3:** Now comes the tricky bit. Apply another strip of stretch tape starting at the outside top of the calf anchor and going down and across, round the back and under the heel, then crossing back across the calf and onto the inside part of the calf anchor strip. Apply another strip of stretch tape around the top to secure the loose ends

**Warning - be aware:** If you are allergic to tape or the latex in some zinc oxide tape, use tape that will not cause a reaction or do not tape at all.
**Massage Therapy**

The following sports massage guide is intended for information purposes only. We recommend seeking professional advice before attempting any self-help treatment.

It is vital when performing any massage techniques to warm the tissues that are being treated by starting lightly and gradually increasing the pressure applied. It is also important to use an oil (specialist massage oil if available but otherwise something such as baby oil should suffice) to allow a smooth gliding movement but also provide enough friction to allow control of your movements and assist in warming the tissues.

Massage therapy is particularly beneficial in the treatment of Achilles tendinopathies. Massage should be applied to both the calf muscles and to the tendon itself. The benefits of massage are vast. For the calf muscles, it helps to increase flexibility, break down trigger points and scar tissue from previous injuries and increase the blood flow to the muscles.

Massaging the tendon itself and applying what are known as frictions to the tendon speeds up the healing process. The most important result of applying massage is to increase the blood flow to the tendon. The achilles tendon itself has a notoriously poor blood supply, and blood and the substances it provides are vital for the healing process to occur.

**Calf Massage**

The most simple massage stroke which should be used at the start of every massage to warm-up the tissues is **Effleurage:**

Ø Stroke lightly but firmly upwards from just above the heel to the back of the knee. Always stroke towards the heart as this is the direction of blood flow.
Ø Then lightly bring the hands down the outside of the leg keeping them in contact but do not apply pressure
Ø Repeat this technique for about 5 to 10 minutes, gradually applying deeper pressure on the up strokes
A second technique that mobilises tissues is called Petrissage:

Ø Apply a firm, kneading technique. Try to pull half the muscle towards you with the fingers of one hand whilst pushing half the muscle away with the thumb of the other hand.
Ø Then reverse to manipulate the muscle in the other direction.
Ø Work your way up and down the muscle, trying to cover as much of the surface as possible.
Ø Apply this technique for around 5 minutes, alternating with effleurage occasionally.

The third technique, used to stretch the muscle fibres and ‘iron out’ any lumps and bumps is Stripping:

Ø With the thumbs, apply deep pressure up the middle of the calf muscle aiming to separate the heads (sides) of the gastrocnemius muscle
Ø This technique should be slow and deliberate to ‘feel’ the muscle underneath.
Ø Repeat this 3 to 5 times in a row, alternating with petrissage for 3 to 5 minutes.

The final technique works specifically on points of tension within the muscle. This is called Circular Frictions:

Ø With a single thumb, apply pressure in a circular pattern to any tight spots, lumps or bumps
Ø Apply 10 to 20 circular frictions at a time and alternate with stripping and petrissage techniques.
Ø Frictions can be applied to a specific point in the muscle, or applied over a small area of muscle moving gradually.
Ø Again, pressure should be firm but not so deep as to cause the muscle to tighten up with pain.
**Achilles Massage**

This should be applied following the calf massage described above.

**Transverse mobilization**

Ø With the first finger of one hand and the thumb of the other hand, alternate to apply transverse pressure. This pulls the tendon across one-way and then the other.

Ø Oil is not really required to perform this technique. If there is too much oil left over from calf muscle techniques then wipe it off to enable a good grip of the tendon. The technique will mobilize the tendon making it more supple.

**Cross frictions**

Ø With the first two fingers apply gentle pressure in a transverse direction to the tendon

Ø Again, too much oil and the therapist will find they are unable to apply the technique correctly

Ø Apply frictions for between 2 and 5 minutes

**Circular frictions**

Ø Place a finger each side of the Achilles tendon and apply pressure in a circular direction. Aim to feel the tendon underneath the fingers

Ø Massage may be uncomfortable but should not be so painful that the athlete tightens up. This is unlikely to be of benefit. Apply frictions for between 2 and 5 minutes

Massage should always end with effleurage, which acts to drain any by-products such as lactic acid and lymph fluids away from the muscles, in the direction of the heart.
Ultrasound

**Warning:** Ultrasound treatment should only be used by a trained therapist. The following is for information purposes only.

Physiotherapists, Sports and Physical Therapists commonly use ultrasound as an adjunct to therapeutic treatment. The benefits of Ultrasound treatment are:

- Increased blood flow to the injured area
- Increased cellular metabolism (speeds healing)
- Increased extensibility of connective tissues (i.e. tendons and ligaments)
- Decreased pain
- Break down of scar tissue
- Reduction in swelling and inflammation

Ultrasound has been used since the 1940’s in the treatment of musculo-skeletal injuries. It is applied using a probe or wand, which is placed in direct contact with the patients skin. A coupling or transmission gel is also used to aid conduction and to help maintain smooth movement over the skin.

The vibration of crystals within the head of the wand/probe causes ultrasonic sound waves when electricity is passed through. The sound waves are directed through the skin, which causes vibrations (known as cavitation) and a warming effect at the tissues. The wand must be kept in constant motion in order to avoid overheating the underlying tissue.

Ultrasound treatment on small areas such at the Achilles tendon typically last for between 3 and 5 minutes.
Rehabilitation

Rehabilitation exercises are vital to preventing a reoccurrence of Achilles tendonopathy. They should focus on:

Ø Improving the flexibility of the calf muscles
Ø Strengthening the calf muscles and achilles tendon
Ø Improving proprioception

Stretching

Flexibility of the calf muscles can be increased in two ways. The first being massage, as already discussed, and the second being stretching.

There are a number of ways of stretching the calf muscles and Achilles tendon. This can be achieved alone or with a partner, although this e-book will focus solely on individual stretches. The following two stretches can be commenced from day 2 of the injury, provided they are performed gently and there is no pain.

Gastrocnemius stretch:

Ø This is done by placing the heel of the back leg on the floor and stretching forwards
Ø Hold for ten seconds, repeat three to five times and repeat the set three times a day
Ø Gradually hold the stretch for longer (up to 45 seconds).

Soleus stretch:

Ø The same principles apply but it is important to bend the stretching leg at the knee.
Ø This takes the Gastrocnemius muscle which attaches above the knee, out of the stretch

As flexibility increases stretching can progress to include the following stretch:
Stretch by standing on the edge of a step and allowing the heel to drop
Hold for 10-45 seconds.
You should feel a gentle stretch. Be careful not to over-do this one
To isolate the Soleus muscle, bend the knee slightly

When stretching any muscle it is important to remain static and avoid ‘bouncing’ or ballistic stretches. The stretch should be gradual and held over 10-45 seconds, increasing the stretch as the stretching sensation eases.

**Never stretch into pain!**

Stretching can be performed at any time and should occur frequently throughout the day, during every day of the rehabilitation program and beyond to help avoid a re-occurrence. It is fine to stretch a muscle from cold, but ensure that you start gently and gradually increase the stretch.

Stretching can also be performed gradually using a slant board as shown below. This allows you to control the degree of stretch and allows you to monitor your level of progress.
**Strengthening**

Strengthening of the calf muscles and Achilles tendon itself must be slowly progressed throughout the rehabilitation process. Exercises may initially cause mild pain and should not be progressed until they are pain free. Apply ice to the Achilles following exercise if you feel any pain.

Concentric exercises (where the muscle being trained shortens) are soon replaced by eccentric strengthening (the muscle lengthens as it contracts) which has a proven track record in the rehabilitation of Achilles injuries. Strengthening of the gluteal muscles should also be undertaken.

Following between 2-7 days total rest (dependant on the severity of the condition) gentle concentric strengthening can be commenced:

**Plantarflexion (with resistance band)**

Ø Hold a loop of resistance band and use it to apply resistance as you plantarflex the ankle (point the toes away)
Ø Start with just 3 sets of 10 once a day and build up to 3 sets of 20 twice a day
Ø If it does not hurt at the time or the next day then increase the load
Ø You may find with this one you can increase the resistance quite quickly

**Calf Raise**

Ø Start on both legs, keeping the knees straight, raise the heels up off the floor as high as is comfortable
Ø Start with 3 sets of 10, once a day and build to three sets of 20 twice a day
Ø Increase the load if there is no pain at the time or the day after
Ø To work the soleus muscle, bend the knee slightly when performing calf raises
Ø Progress this exercise by performing on just the injured leg
Following a period of concentric exercises without pain, eccentric exercises can be introduced:

Heel Drop:

Ø Stand on the edge of a step and lower the heels down, both at the same time.
Ø Start with 3 sets of 10, once a day and build to three sets of 20, twice a day
Ø Progress to performing on the injured leg only

As previously mentioned, weakness in both Gluteus Medius and VMO can be an underlying cause of overuse injuries in the lower limb. Therefore, the following exercises should also be incorporated into a rehabilitation plan:

Side-lying Clam (Gluteus Medius):

Ø Laying on your side with the leg you wish to work on top and the legs together, bent to 90°
Ø Keeping the feet together and knees bent, lift the top knee away from the bottom knee as far as is comfortable
Ø Perform three sets of 10 reps initially, building to three sets of 20
Ø This can be progressed by wrapping a resistance band around the knees to add resistance

VMO Contraction

Ø Sit with the legs straight out in front of you, with a rolled up towel underneath the knee you are exercising (this will cause a slight bend in the knee)
Ø Put your fingers on the area of the VMO (just above and to the inside of the knee cap) to feel if the muscle contracts
Ø Push the knee down into the towel to straighten it. The foot should rise just off the floor. The muscle under your fingers should contract.
Ø If you don’t feel the muscles contract, keep trying
Ø Perform 3 sets of 10 reps, progressing to 3 sets of 20
Squats

Ø Perform squats (either independently or leaning against a swiss ball up against a wall)
Ø Ensure you keep the knees in alignment (without falling inwards)
Ø Concentrate on maintaining VMO contraction
Correction of Biomechanical Abnormalities

As abnormal biomechanics are the most common cause of Achilles tendinopathies, correction of these issues is vitally important in terms of preventing a re-occurrence. If this is not done, the same underlying cause behind the injury is still there, and no matter how much strengthening and stretching you apply, the muscles of the lower limb will still be suffering from additional stress when you return to activity.

As previously mentioned, the most common problem is over-pronated, or flat feet. It can be quite simple to see for yourself if you are affected by this problem. One way is to look at the wear on the sole of your old running shoes, if there is more wear on the inside compared to the outside of the sole, this indicates your feet are over-pronated.

Try looking at the position of your feet or get someone to look for you. In a neutrally positioned foot there is a natural arch along the length of the inside of the foot. Also, the achilles tendon should be positioned in a straight line from the heel up towards the calf muscles. If your feet are in a pronated position, there will be little to no arch and the achilles tendon can appear to be in a curved position, as shown in the diagram below.

If you’re still unsure, wet your feet and walk along a section of paving and look at the footprints you leave. A normal foot will leave a print of the heel, connected to the forefoot by a strip approximately half the width of the foot on the outside of the sole. If your feet are pronated there may be little distinction between the rear and forefoot.
The problem of over-pronated feet is easily corrected. If it is only a minor problem it can normally be corrected by visiting a specialist sports shop where they should be able to advise you on a pair of trainers with built in support to alter your foot position.

If the pronation is more marked you may need to invest in a good pair of orthotics which are placed into the shoes and trainers to correct the foot position. As seen in the diagram above, the left foot is resting on an orthotic which corrects the heel position which in turn allows the mid and forefoot to fall into place. Orthotics can be purchased off the shelf which are pre-moulded, or can be heat-moldable to adjust to your foot shape. Alternatively, a specialist such as a podiatrist can cast orthotics specifically to fit your foot.

On occasion shin splints can be caused by over-supinated feet, or feet with a high arch, due to a lack of shock absorbing. If you have feet with a high arch there will be only a very narrow connection, if any, between the rear and forefoot on the ‘wet foot’ test. A good pair of cushioned, shock absorbing trainers can help. Or a shock absorbing insole which again can be molded to your foot shape, can be placed within the trainer to help ease the stress transmitted through the shin muscles.
Proprioception

Proprioception is the body’s sense of each body part in space and relative position to neighbouring parts of the body. Following injury, proprioception is often affected as sensors which receive and feedback this information are located within the muscles, tendons and ligaments which may have been injured.

Exercises using wobble boards or cushions are the most commonly used to re-train proprioception.

Ø Start by simply balancing on two feet for as long as possible (up to a minute)
Ø Once this is easy, progress to balancing on a single leg
Ø Once this is easy, challenge your balance by closing your eyes, moving your arms above your head (progressively getting faster) or performing mini-squats on the board

Sports Specific and Functional Drills

Before returning to the activity which first aggravated the injury, ensure you can perform other forms of sports specific exercises without pain.

Examples of this include:

- Hill walking (for runners)
- Dribbling and agility ladder drills for soccer (football) players
- Hopping and skipping drills for sports involving jumping (long-jump, high-jump, basketball etc)

It is so tempting at this point in recovery, if everything is going well and sports specific drills are pain free, to jump straight back into your sport.

However, we recommend performing these functional sports-specific drills, (along side the other late stage strengthening and stretching exercises) every other day, for at least a week pain free before beginning a gradual return to sport.
Gradual Return to Activity

This is the final step in successfully treating your Achilles tendinopathy and should only be commenced once all previous exercises have been pain free for a week, an increase in ankle range of motion has been noted and biomechanical issues have been addressed.

Ice should be applied for 10 minutes at the end of the runs/training sessions in the first week. Stretching and strengthening should still be performed on a daily basis and a regular sports massage can help maintain calf flexibility.

If at any point you experience any pain, go back a step, do not attempt to run through it or you could end up back at square one.

Below is an example of a gradual return to running programme. Begin each training session with a 5-minute walk followed by stretching.

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<tr>
<th>Day 1</th>
<th>walk 4 minutes</th>
<th>jog 2 minutes</th>
<th>repeat 3 times</th>
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<tr>
<td>Day 2</td>
<td>rest</td>
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<tr>
<td>Day 3</td>
<td>walk 4 minutes</td>
<td>jog 3 minutes</td>
<td>repeat 3 times</td>
</tr>
<tr>
<td>Day 4</td>
<td>rest</td>
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</tr>
<tr>
<td>Day 5</td>
<td>walk 3 minutes</td>
<td>jog 3 minutes</td>
<td>repeat 4 times</td>
</tr>
<tr>
<td>Day 6</td>
<td>rest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day 7</td>
<td>walk 2 minutes</td>
<td>jog 4 minutes</td>
<td>repeat 4 times</td>
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Following this, gradually continue to increase your mileage, without building by more than 10% per week.
Prevention

To prevent your Achilles Tendinopathy re-occuring, follow the simple advice below:

- Increase training gradually
- Do not run too often on hard surfaces. You can do more training if you run off-road
- Avoid running a lot on your toes. Not easy if you are a sprinter but varying the training surface can help
- Ensure you have the correct footwear and that it is not too old. A pair of running shoes will have lost most of their cushioning after 400 miles. If you run few miles but your shoes are over 6 months old then they still may need replacing
- Continue to stretch daily - especially the calf muscles
- Stretch thoroughly before and after training sessions
- Get a regular sports massage. This will help keep the muscles of the lower leg supple and in good condition
- Apply ice to the Achilles after training. This may help keep inflammation down before it gets bad
- Continue wearing any insoles or orthotics and change them every 12 months