List of information sheets

Information sheet 1: diagnosis
Information sheet 2a: Treatment options (for Physiotherapy intervention)
Information sheet 2b: Treatment options (for Shockwave intervention)
Information sheet 3: Monitoring pain
Information sheet 4: Compression and tendon pain
Information sheet 5: High and low tendon loads
Information sheet 6: post-shockwave care
Information sheet 7a: discharge advice (for Physiotherapy intervention)
Information sheet 7b: discharge advice (for Shockwave intervention)

	Shockwave Group	Physio group	When
1	yes	yes	Session 1
2a	No	yes	Session 1
2b	Yes	No	Session 1
3	Yes	yes	Session 1
4	Yes	Yes	Session 1 or 2
5	Yes	Yes	Session 1 or 2
6	yes	No	Session 1
7a	No	yes	Session 6
7b	Yes	No	Session 6

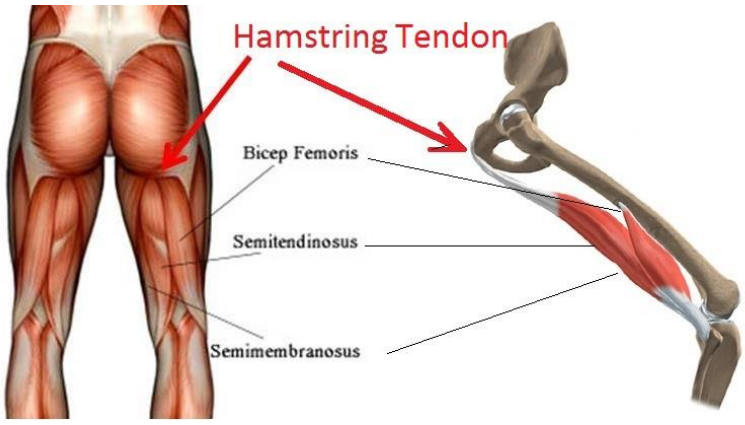
Note: Information sheets can be reviewed in later sessions if needed (e.g., they relate to a barrier for improvement)

1. Proximal hamstring tendinopathy: diagnosis

Your physiotherapist has diagnosed you as having a condition known as proximal hamstring tendinopathy (PHT). This condition is quite common in sporting athletes, particularly those involved in sports that involve running, kicking and lunging. It can also occur in people who are not undertaking vigorous sports.

This information sheet explains the causes of PHT as this is important in understanding the best ways for you to manage this condition.

There are 3 hamstring muscles that sit along the back of your thigh. They generate power across the knee and hip joints in activities such as squatting/going up stairs/running. The hamstring muscles arise from the "sit bones" in your buttock and attach below your knee joint. At either end of the muscle is a tendon.



Activities such as sitting, running, squatting and bending place load on the proximal (or upper) hamstring tendon. Sometimes a rapid change in load can lead to structural changes in the tendon which can cause lower buttock pain or 'tightness', weakness, and difficulty with some activities.

This condition is known as proximal hamstring tendinopathy (PHT). (Tendinitis is the word that was previously used for this condition however tendinopathy is now the accepted term).

Prognosis (will it get better?)

This condition sounds quite serious, but with appropriate treatment most people with this condition develop an increased capacity in their tendon to allow them to undertake their normal activities.

The changes in pain and function related to the hamstring tendon are generally reversible, although they do take time. Changes in function (what you are able to do) can often be seen within 6 weeks of commencing treatment, although full recovery of function and full resolution of pain can often take 3-6 months, or longer, particularly if you have had this condition for a long time.

Some signs of progress include:

- Longer sitting tolerance
- Less pain after simple activities such as walking or ‘easy’ running.
- Feeling of more ‘power’ or ‘strength’ in the hamstring

So, be patient with the treatment, follow the instructions of your physiotherapist and you should see good long-term results.

How does treatment help?

The treatment program you will be undertaking in this trial has been specifically designed for people with PHT to improve both pain and the ability to undertake sporting and other tasks.

For program detail please see the following information sheets.

2a. Treatment options

Broadly speaking there are five main options to manage pain and loss of function due to PHT.

1. Rest
   While short term rest of a painful tendinopathy can sometimes be beneficial, previous research has shown that long term rest has a detrimental effect on the capacity of the tendon to tolerate loads such as in walking, running or squatting. Although you may have less pain during a period of prolonged rest, upon returning to activities that were difficult before, the pain is often worse and exercise is more difficult.

2. Injection therapy
   There are several different types of injections that have been trialed for tendinopathy. These include corticosteroid (cortisone), blood injections (such as "platelet rich plasma" or "autologous blood injection") and injections of substances that damage the vessels in the tendon (polydocinol).

   Unfortunately, there is no strong scientific research showing that any of these injections help, and in fact some of these injections have been shown to have poor long-term results.

3. Surgery
   Surgery is generally considered a 'last resort' for tendinopathy. There is limited evidence that surgery provides a significant improvement in symptoms compared to other treatments, and the rehabilitation time after surgery is very lengthy (up to 6 to 12 months)

4. Shockwave
   Extracorporeal shockwave therapy (or "Shockwave") was originally used in urology, for treatment of kidney stones. Since the 1990s it has been used for treating musculoskeletal conditions including tendinopathy. Shockwave involves using a machine that produces rapid changes in pressure to administer a 'shock' wave of high energy into the affected tissue.

   There are many theories about how shockwave is proposed to help tendon injuries however there are limited studies demonstrating exactly how shockwave effects the structure of human tendon.

   Shockwave is generally provided by a physiotherapist or doctor for 3 to 4 sessions at weekly intervals. Treatment can be painful to apply although the pain usually settles quickly after treatment finishes.

5. Individualised Physiotherapy
   Physiotherapy for tendinopathy generally incorporates multiple interventions including:
   - Education about how the tendon structure and tendon pain works.
   - Education about which activities put a high and low load through the tendon
   - Identification and treatment of barriers to improvement
   - An individualised strength and rehabilitation program.
   - Graded return to activity using pain monitoring principles.

   Previous research has shown that a combination of education and rehabilitation exercises is beneficial for tendinopathy in other areas of the body, such as the hip (gluteal tendinopathy) and elbow ("tennis elbow").

The rehabilitation program you will be undertaking in this trial has been specifically designed for people with PHT.

How do strength exercises help PHT?

This is a common question in people with PHT and other tendinopathies. There are a variety of mechanisms by which strength training helps, some of which are not fully understood yet, although they have been shown to be effective in other tendon problems like those of the Achilles and patellar (knee) tendons. They include:

- Improving muscular strength and power. People with longstanding PHT often have significant weakness in their hamstring muscles and other muscles in their legs like their gluteal and calf muscles. Improving muscle strength and power helps develop a capacity for the hamstring and other leg muscles to do what they need to do – walk, run, squat and lunge etc, which in turn offloads the tendon.
- Improving tendon stiffness. Tendon stiffness sounds like a bad thing, but it's not! – the best tendons are strong and stiff, like a spring. Most people with PHT probably have reduced stiffness of their hamstring tendon. Research has shown that strength exercises improve tendon stiffness which can in turn increase capacity and reduce pain.
- Training the brain. This sounds like a strange idea, but we know from previous research that people with tendon pain have an altered connection between their painful tendon and their brain - the brain can inhibit muscles where there is pain (or fear of pain) present. Additionally the coordination of muscle and tendon contractions can be affected in tendinopathy, which places a higher load on the tendon. Appropriate rehabilitation exercises (such as slow and heavy strength exercises) can improve both of these deficits which can help improve function and pain. Use of an auditory cue (like a metronome) during exercises can further help the results of strength exercises.
- There are other potential mechanisms for how strength exercise helps tendinopathy, these involve cellular mechanisms such as neurochemical and visco-elastic changes within the tendon.

People often ask 'will my tendon heal'? Healing of tendon injuries is <u>not</u> necessary for full recovery. If it does occur, it doesn't correlate to the function and pain from a tendon. There are lots of elite and recreational athletes who have significant tendon changes on ultrasound or MRI, but are able to perform at a high level without pain.

2b. Treatment options

Broadly speaking there are five different ways to manage pain and loss of function due to PHT.

1. Rest
   While short term rest of a painful tendinopathy can sometimes be beneficial, previous research has shown that long term rest has a detrimental effect on the capacity of the tendon to tolerate loads such as in walking, running or squatting. Although you may have less pain during a period of prolonged rest, upon returning to activities that were difficult before, the pain is often worse and exercise is more difficult.

2. Injection therapy
   There are several different types of injections that have been trialed for tendinopathy. These include corticosteroid (cortisone), blood injections (such as "platelet rich plasma" or "autologous blood injection") and injections of substances that damage the vessels in the tendon (polydocinol). Unfortunately, there is no strong scientific research showing that any of these injections help, and in fact some of these injections have been shown to have poor long-term results.

3. Surgery
   Surgery is generally considered a 'last resort' for tendinopathy. There is limited evidence that surgery provides a significant improvement in symptoms compared to other treatments, and the rehabilitation time after surgery is very lengthy (up to 6 to 12 months)

4. Individualised Physiotherapy
   Physiotherapy for tendinopathy generally incorporates multiple interventions including education, strength exercises, and manual therapy.

   Although there is good research supporting the use physiotherapy for other tendon problems (such as Achilles and patellar tendinopathy), no high-quality studies have yet shown that this approach is effective for PHT.

5. Shockwave
   Extracorporeal shockwave therapy (or "Shockwave") was originally used in urology, for treatment of kidney stones. Since the 1990s it has been used for treating musculoskeletal conditions including tendinopathy. Shockwave therapy involves using a machine that produces rapid changes in pressure to administer a 'shock' wave of high energy into the affected tissue.

   There are many theories about how shockwave is proposed to help tendon injuries however there are limited studies demonstrating exactly how shockwave effects the structure of human tendon. However we know it is a safe treatment option.

   Proposed mechanisms for how shockwave therapy helps in tendinopathy are complex but include:

   - Providing a mechanical force to the tendon which stimulates a mechanical response.
   - Release of molecules in the tendon that stimulates specific cell responses.

- Pain ‘blocking’ by stimulating nerve fibres and neurotransmitters in the tendon
- Potentially stimulate ‘healing responses’ within the tendon
- Other biological responses due to tissue and cell stimulation.

Shockwave therapy is generally provided by a physiotherapist or doctor for 3 to 4 sessions at weekly intervals. Treatment can be painful to apply although the pain usually settles quickly after treatment finishes.

A previous study on athletes with PHT from Italy showed that shockwave was effective for reducing pain and improving function.

The treatment you will be receiving in this study is based on the approach used in this Italian study, using four sessions of shockwave therapy over a period of four weeks. You will also be provided with advice on tendon structure and pain, high and low loads for your tendon, and advice on safely returning to your normal activities.

People often ask ‘will my tendon heal’? Healing of tendon injuries is not necessary for full recovery. If it does occur, it doesn’t correlate to the function and pain from a tendon. There are lots of elite and recreational athletes who have significant tendon changes on ultrasound of MRI, but are able to perform at a high level without pain

3. Monitoring pain

Tendon pain behaves differently to other injuries such as a joint or muscle injuries. With tendon injuries, it takes about 24 hours for the tendon to respond to what it has done.

If your symptoms are a lot worse (more than about 2/10 worse) the day following activity (or later in the day after morning activity), it is normally a sign that you've overdone it. This can be the case even if you have no pain during activity.

Here are some examples:

Example A:

John can normally sit for an hour without any pain. On Monday he walks for two hours which is more than he normally does. On Tuesday John has a lot more difficulty sitting and can only tolerate about 10 minutes due to pain.

This is a sign that John has done too much on Monday and should do less next time.

Example B:

Beth works as an electrician and also plays football. She normally has very mild pain (2 out of 10) at work with repeated squatting. On Thursday she trains at football including 30 minutes of jogging, 10 short sprints, and 20 kicks. On Friday at work her symptoms are exactly the same as normal.

This is a sign that Beth's PHT is tolerating the load from football and that she can safely increase her activity at football if she needs.

You can use these examples with activities you are currently having difficulty with. We ask people in this trial to avoid activities that aggravate their symptoms for more than 24 hours until they are given the 'all clear' to return to these from their treating physiotherapist.

Pain during activity and rehabilitation

While a significant increase in pain the day after activity is not a good sign, it is ok to experience some pain when undertaking exercise or any rehabilitation exercise.

As a general guide we say that 4/10 pain or 'moderate discomfort' is the most allowable during exercise. If the pain is bad enough to make you limp or move differently it is a sign you are doing too much.

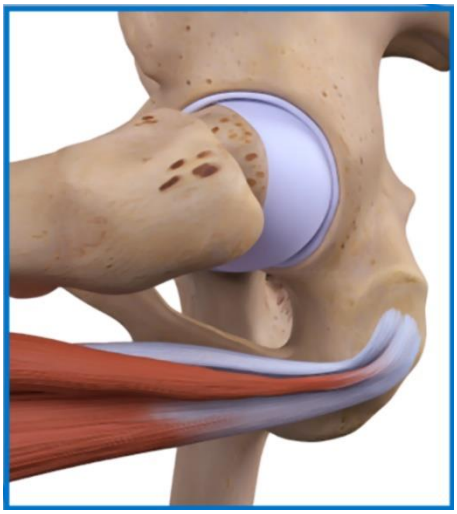
4. The role of compression.

Most tendons in the body 'wrap around' a bone where they attach or insert. This location is often where tendon problems develop.

For example, the Achilles tendon attaches to the heel bone (calcaneum), and the gluteus medius tendon attaches to the outside of the thigh bone (femur)

The hamstring tendon is no different - the tendons attach to the 'sit bones' (or ischial tuberosity) at the base of the pelvis.

The hamstring tendon tends to develop problems at the precise location where the tendon attaches to the bone. Causing compression of the tendon to the bone that it attaches to (the ischial tuberosity) can further aggravate the problem.



The tendon tends to get compressed when the hip is bent (or flexed). Examples of compressing the tendon include:

- Sitting – particularly on hard surfaces or for prolonged periods.
- Stretching of the hamstring
- Walking or running up a very steep hill or steps.
- Deep squatting

It's important to limit compression in the early stages of PHT rehabilitation as it can aggravate symptoms. Eventually compression needs to be reintroduced, particularly if it is required for work or sporting activities. Monitoring pain (see information sheet 3) is particularly important when reintroducing activities involving compression.

Your hamstring tendon should develop the ability to handle compression with time and a graduated approach. However, it's important to limit where you can activities such sitting on hard surfaces, prolonged sitting, and stretching of the hamstring muscles until your symptoms have completely resolved.

Some people find that a seat cushion can be helpful for their sitting symptoms. Some options we have tried previously include:

- Kensington wedge seat cushion (about $37.50, Officeworks)
- Aylio Socket Seat ($200-$300, available through various online retailers)
- Roho Mosaic Cushion ($200-$250, available through various online retailers)

5. High and low tendon loads

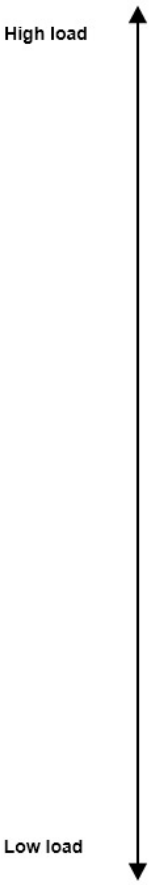
Different activities place a varying amount of load on the hamstring tendon. Understanding high and low load activities can be helpful with planning to gradually increase activity.

There are two types of load with tendon pain. The first is tensile load. There is high tensile load in fast activities where the tendon is required to store and release energy quickly, such as running or brisk walking.

The second type of load through the hamstring tendon is compressive load. Compressive load occurs when the hip is flexed (or bent) – see information sheet 4. Sitting is another example of compressive load.

The highest loads on the hamstring tendon are when these two loads are combined. When reintroducing a new, higher load activity, it's important to undertake a very small amount of this activity first, to make sure the tendon is able to respond.

Examples of high and low load activities are below. There may be some individual variation in how you respond to different activities. Your physiotherapist will be able to guide you on this.



Fast running, sprinting

Ball skills work (e.g. picking up ball off ground at speed), long kicking

Running, rapid lunging (e.g. tennis or squash)

Deadlifts, deep squats

Uphill walking

Flat walking (load is higher with faster walking)

Yoga (*depends on specific postures)

Cycling (*depends on saddle type and individual response)

Cross-trainer

Swimming

6. After shockwave care

Following shockwave treatment, you may experience some discomfort in the area of treatment. Typically this is a 'bruised' sensation and very occasionally you may see a small physical bruise. These side-effects are normal with shockwave therapy and will generally settle within 2-3 days of treatment.

To help minimise post-treatment discomfort, it is recommended that you ice your hamstring for 15-20 minutes every hour for the first four hours after treatment.

There are no specific restrictions after shockwave treatment – you can move as you like afterwards.

Significant side effects from shockwave are very rare. Please call your physiotherapist (or the principal investigator Aidan Rich on 0428 506 126) immediately if you experience severe pain, swelling or weakness in the area of treatment.

7a. Discharge from treatment (physiotherapy)

You have now completed 6 sessions of physiotherapy treatment for your PHT. By now we would expect to see some improvement in your condition with an increase in activities you are undertaking, and less pain.

If you have not had complete resolution of your symptoms, try not to be too concerned. Successful treatment of PHT can often take up to 6-9 months, particularly if the symptoms have been present for a long time prior to commencing treatment.

Regardless of how your symptoms are now, it is important that you continue to be vigilant in monitoring your activity and symptoms in the future to reduce the risk of your symptoms recurring or worsening.

The following are suggestions that you can consider, and discuss these with your treating physiotherapist:

- Be careful with increases in activities with high tendon load (see information sheet 5: high and low loads). It's ok to make changes to your activity but this should be done gradually. Monitoring your pain during and after activity can give you a good guide as to how much activity to undertake (see information sheet 3: monitoring pain).
- You can undertake some hamstring stretching if you like, however we don't normally encourage this as sometimes it can aggravate PHT and previous research has shown static stretching may actually increase injury risk. Some light dynamic stretching (such as leg swings) prior to activity is fine. If you find hamstring stretching aggravates your symptoms it should be avoided.

If your symptoms do return, don't stress out, but look back over the last 2-3 weeks of activity. What's changed? Temporarily reducing the amount of high load activity can help settle a flare-up.

With PHT, it is <u>important to continue strength exercises even after all of the symptoms have resolved</u> and normal activity has resumed. This will reduce the risk of recurrence of symptoms. Your physiotherapist will provide you with an exercise program to continue with after discharge.

7b. Discharge from treatment (shockwave)

You have now completed 6 sessions of treatment (including four sessions of shockwave) for your hamstring condition. By now we would expect to see some improvement in your condition with an increase in activities you are undertaking, and less pain.

If you have not had complete resolution of your symptoms, try not to be too concerned. Some research suggests that some of the effects of shockwave may take up to 3-4 months so you may continue to experience an improvement in symptoms in the future.

Regardless of how your symptoms are now, it is important that you continue to be vigilant in monitoring your activity and symptoms in the future to reduce the risk of your symptoms recurring or worsening.

The following are suggestions that you can consider, and discuss these with your treating physiotherapist:

- Be careful with increases in activities with high tendon load (see information sheet 5: High and low loads). It's ok to make changes to your activity but this should be done gradually. Monitoring your pain during and after activity can give you a good guide as to how much activity to undertake (see information sheet 3: monitoring pain).
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