Bispebjerg Hospital

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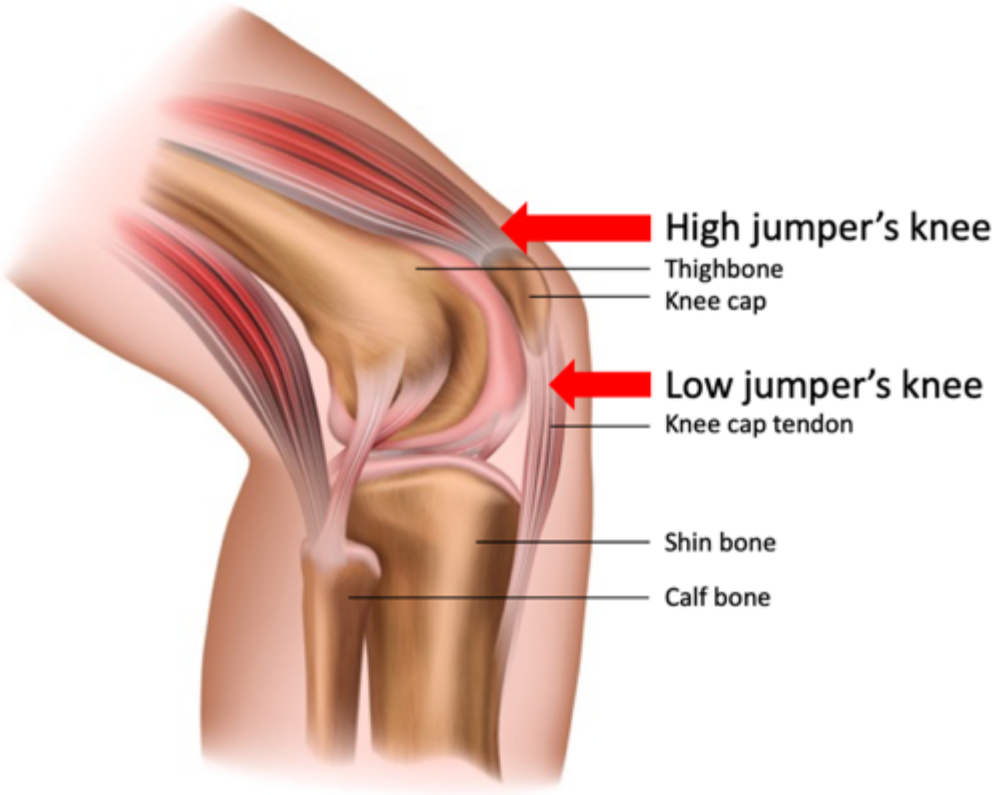
# TEREX Study Part 2: Information and Training Guide

This pamphlet is developed for you, because you have completed the training program in the first part of the TEREX study. When you were seen by the physiotherapist at the start of TEREX study part 2, you were informed about why your patellar tendon hurts, how rehabilitation works, why it is important to continue the rehabilitation, and how you can gradually return to running and jumping activities as well as participating in sports. This brochure summarizes information, tips, and exercises that you can refer to in case you have forgotten anything. On the last page of this pamphlet you will find a schematic overview of the entire rehabilitation process.

# Jumper's Knee

**What is jumper's knee (patellar tendinopathy) and why does it hurt?**
Jumper's knee most often occurs in athletes who do a lot of jumping and turning quickly, where the load on the tendon is high. The pain is usually located in the tendon tissue below the kneecap (low jumper's knee) but can also occur above the kneecap (high jumper's knee).




The exact cause of the injury is not fully known, but it is believed that the tendon structure gradually changes as the tendon becomes overloaded over time (jumping, running, torque caused by turning quickly, landings, etc.). In the early phase of an overuse injury in the tendon, an inflammatory condition occurs, but it is still unclear whether the inflammation is the cause of the injury becoming chronic. Later in the injury process, the tendon can thicken and change structure, partly because blood vessels and nerves can grow into the tendon. These changes are believed to be the cause of the pain.

**Symptoms**

The pain is typically localized to a small area of the tendon, usually just below the kneecap and in some cases just above. Initially, the pain is often present at the beginning and end of training, while later in the process, the pain can be present during daily activities, such as climbing stairs or sitting with bent knees for a long time. Morning stiffness and soreness in the knee can also be experienced, which eases when you get moving. There can also be tenderness when pressing on the lower or upper part of the kneecap.

**Why exercise-based treatment?**

Strength training of the muscle on the front of the thigh and thereby loading the patellar tendon has been shown to reduce pain and promote healing of the tendon tissue. Research recommends strength training as the first choice in the treatment of jumper's knee, but newer research suggests that it is less important how heavy the training is, as long as the total training volume is sufficiently high, and the exercises are performed slowly and controlled.

**What can I expect?**

Treatment of jumper's knee is often long-term, as the tendon responds slowly to training. You may have already experienced improvement and are on your way to return to sports, but you should expect that it can take 6-12 months before you notice a significant difference. If strength training alone does not have an effect, it may be relevant to supplement the training with other treatments. However, the use of other treatment methods is less supported by research.

**Treatment**

To treat your jumper's knee, you need to **1. let the pain guide you, 2. adjust your load,** and **3. do rehabilitation exercises:**

*1. Let the pain guide you*

The pain scale below can be helpful when assessing whether an activity is appropriate or too much. If you can be active and only have pain corresponding to the green area on the scale, you can continue. If you enter the yellow/orange area, you should be more cautious and perhaps consider limiting or stopping the activity. If you experience pain in the red area, you should avoid the activity for a period. The point is that you can do activities where the pain does not affect you significantly, and where the known pain in the knee is not worsened in the morning or in the days after. You can have muscle soreness, as it is a sign that you have trained them.


*2. Adjust your load (active unloading)*

Often, the pain in the patellar tendon disappears when taking a break from running and jumping activities, but the pain is often long-lasting and/or recurring as soon as the activities are resumed. One reason for this may be that sports activities with the same high load that caused the overuse injury are usually continued along with the treatment.

In the first 12 weeks of rehabilitation in the TEREX study (corresponding to stage 1 in the rehabilitation process described below), you have therefore completely avoided the running and jumping activities and other activities that resulted in tendon pain beyond the green area on the pain scale. You may also need to limit the amount of running, jumping, changing directions, and similar activities through stages 2 to 4.

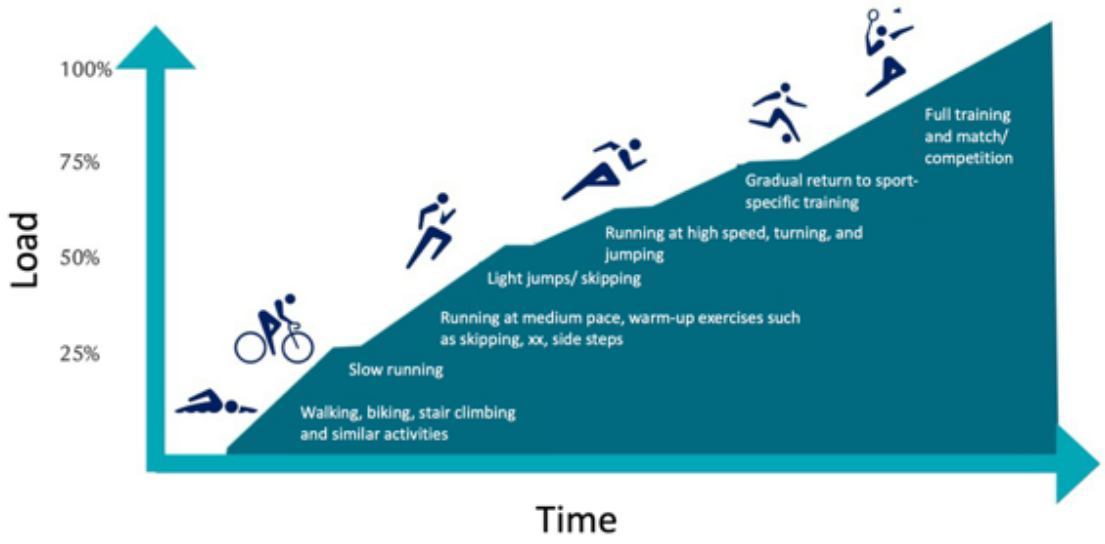
As in the first 12 weeks, you should remain as physically active as possible through all stages of rehabilitation, as long as the pain stays in the green-yellow area on the pain scale and does not worsen afterwards. You can often participate in parts of your regular training such as technical training, throwing exercises, strength and stability training, etc. Additionally, you may be able to cycle, swim, and train on a cross-trainer to maintain your fitness.

*3. Rehabilitation exercises and criteria for progression*

The rehabilitation program is divided into 4 stages:


In TEREX study part 1, you trained corresponding to stage 1. Depending on your response to the training and load reduction, you will either need to continue training at stage 1 for a few more weeks or progress to stage 2.

Stages 2 to 4 are built around gradually increasing the load on the tendon over time as illustrated in the activity ladder below and are a way to find an appropriate activity level while gradually returning to full sports participation.




**Stage 1 rehabilitation exercises and unloading from running and jumping activities**
In this first stage, strength training of the muscle on the front of the thigh is done to reduce pain and promote healing of the tendon tissue avoiding heavy loads on the patellar tendon. At this stage, it is recommended to completely avoid running and jumping activities as well as other activities that result in pain beyond the green area on the pain scale.

You can train with few repetitions with heavy load or with many repetitions and light load. The important thing is that the total training volume is high, i.e., that you train until you get tired in the thigh muscles and that the training consists of slow and controlled movements.

Below are suggestions for a training program where the necessary training volume is achieved with moderate load. If you want to train with heavier load, you can do fewer repetitions and vice versa, if you want to train with lighter load, you should increase the number of repetitions compared to the program shown.

The first two exercises in the program can be done as home training, where you increase the load by using dumbbells or by wearing a backpack with weight in it (e.g., books, bags of flour, water bottles). The last two exercises require access to a gym. You can choose the exercises that suit your training opportunities.

Do at least 2 out of the 4 exercises – you can alternate between the exercises. When doing the exercises, you can have pain up to the yellow area on the pain scale. However, you should experience that the pain quickly subsides after training and is not worsened the next day.

*Typically, this stage takes 8-12 weeks but can last longer for patients with long-term jumper's knee.*

**Training and Training Volume:**

- Train 3 times a week (at least 48 hours of rest between each session). If you are sore in the tendon (more than usual), you should wait an extra day.

- Follow the progression in the table. For example, in the first week, you should train 3 sets of 15 repetitions for each exercise.

*Training Protocol*

| Week | 1 | 2-3 | 4-5 | 6-12+ |
|---|---|---|---|---|
| Set and reps | 3x15 | 3x12 | 3x10 | 4x10 |

- Take a **1-2 minute break** between each set.
- The load should be just heavy enough that you can complete the set number of repetitions (also called "repetitions maximum" or RM). For example, when you go from 15 to 12 repetitions in week 2, you should simultaneously increase the weight you train with so that you still reach fatigue.
- The exercises should be performed **very slowly**. Each repetition should take 6-8 seconds (3-4 seconds each way).

Note: If you suddenly experience more pain in the knee, you should step back to the previous training level (load, repetitions, and sets) that could be performed with the acceptable pain level. Train at this stage until there is no longer a flare-up of symptoms.

**Progression Criteria – Stage 2 can be started when:**

- The rehabilitation exercises can be performed with an acceptable pain level (NRS 2 (green area) out of 10 or below) and without worsening after training and the next day for 1 week.

**Stage 1 exercises that do not require access to exercise machines**

## Exercise 1: Lunge

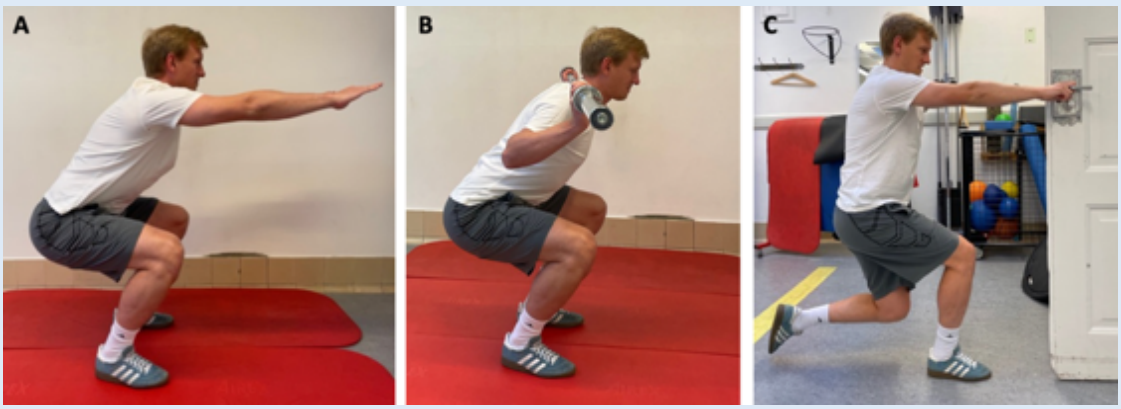
**Instructions:**

- Take a big step forward.
- Slowly bend your knees so that the front knee bends about 90 degrees (3-4 seconds).
- Avoid moving your front knees further forward than the tips of your toes (the movement should be downward and not forward).
- Slowly extend your knees again until they are straight (3-4 seconds).
- Increase the load by using dumbbells or by putting on a backpack with weight in it (e.g. books, bags of flour, water jugs).

**Notes:**

- Keep a slight lumbar sway throughout the exercise.
- Knees move straight out over the foot and do not move inwards.

## Exercise 2: Squat




**Instructions:**

- Slowly bend your knees down (3-4 seconds) to about 90 degrees.
- Slowly extend the knees until they are almost straight (3-4 seconds).
- Can be progressed by using e.g., a barbell (image B) or performing the exercise on one leg with support from e.g. a door frame (image C).

**Notes:**

- Keep a slight lumbar sway throughout the exercise.
- Knees move straight out over the foot and do not move inwards.

**Stage 1 exercises that require access to exercise machines**

| **Exercise 3: Leg press** | |
|---|---|
|  | |
| **Instructions:** | • Add the agreed training weight.<br>• Start by sitting in a leg press machine with both feet on the foot plate, shoulder-width apart and about 90° bend in the knee.<br>• Grasp the handles and keep your entire back against the seat for stability while performing the exercise.<br>• Push the weight with both legs until the knee joint is almost straight and slowly bring the weight back to the starting point.<br>• Perform the exercise at a slow pace, taking 3-4 seconds to extend the leg and 3-4 to bend back to the starting position.<br>• Take a 2-minute break between each set. |
| **Notes:** | • You should push equally hard with both legs.<br>• Ensure the knees move straight out over the foot and do not move inwards.<br>• See if you can avoid the weight plates touching each other between repetitions. |

| Exercise 4: Knee extension | |
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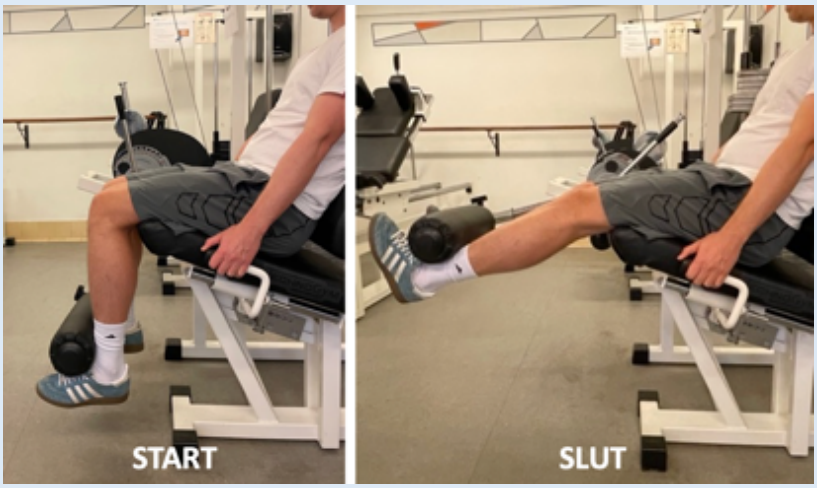
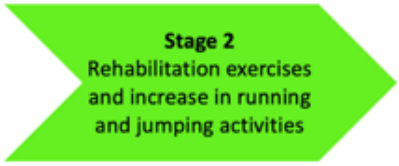
|  | |
| **Instructions:** | • Add the agreed training weight.<br>• Start by sitting in a knee extension machine with one leg (bottom of the shin) under the pole and about 100 degrees of bend in the knee. Allow the opposite leg to move during the exercise.<br>• Grasp the handles and keep your entire back against the seat for stability while performing the exercise.<br>• Lift the weight with one leg until the knee joint is at about 10 degrees and slowly bring the weight back to the starting point.<br>• Perform the exercise at a slow pace, taking 3-4 seconds to extend the leg and 3-4 to bend back to the starting position.<br>• Take a 2-minute break between each set.<br>• That the knees move straight out over the foot and do not move inwards. |
| **Notes:** | • Avoid stretching the knee too much (only up to about 10 degrees).<br>• See if you can avoid the weight plates touching each other between repetitions. |




**Stage 2 - Recovery exercises with pain-guided increase of running and jumping activities jumping activities**

In stage 2, rehabilitation continues with strength training exercises from stage 1, but the focus is also on increasing the patellar tendon's load tolerance by gradually returning to running and jumping activities with increasing intensity.

After reducing running and jumping activities in stage 1, it is important that you return gradually. Symptoms of returning too quickly can be pain and stiffness in your tendon in the morning and worsening pain with everyday activities such as climbing stairs.

We recommend that everyone starts running on flat surfaces following the running program below before starting other jumping and running exercises and these should be individualized depending on which sport you are going back to. For example, if you're going back to basketball and volleyball, the focus will be more on jumping and landing, but if you're going back to soccer and handball the focus will more on sprinting and changing direction. However, we recommend that everyone starts with jump squat and split jump squat exercises. If you suddenly experience a worsening of your knee pain, take a step back and stay there until there are no more flare-ups of symptoms.

*Training exercises and load*

- Start with running, following the running program below as a warm-up to your strength training 2 times a week. You should only move on to the next step when you have almost no pain in your patellar tendon (in the green area) during that activity and the next morning and have been running for a minimum of 4 weeks.
- Start by adding the jump squat and split jump squat exercises once weekly and increase to 2 times a week with at least 48 hours of recovery in between.
- When jump squat and split jump squat can be performed with acceptable pain level (in the green zone) during the activity in question as well as the next morning for 1 week, you can progress onto box jumps or sprint/directional shift exercises depending on the sport you are returning to.
- Start box jumps or sprint/directional change exercises with a load that suitable for you to do 3 sets of 10 repetitions with a two-minute break.

Progress to landing on one instead of two legs for jumping exercises and from interval to turning quickly when running.

- Increase the load further by increasing the jump height for jumping exercises and speed for the running exercises.
- Finally, increase the load by slow progression to 6 sets of 10 repetitions or by initiating sprints from a standing position.

**Continued rehabilitation exercises:**
The stage 1 rehabilitation exercises, performed as home training or in the gym, are continued 2 times a week in combination with the gradually increased activity level.

**Progression criteria - stage 3 can be started when:**
The rehabilitation exercises can be performed for 1 week with acceptable pain level (green area on the pain scale) and without worsening after the end of training or the day after.

**Stage 2 exercises:**

**1. Running training - Getting back to running after an injury**

The program below provides guidelines and advice on how to get you back to running after your overuse injury.

*Build up slowly*

It takes patience to avoid relapse and it's a good idea to follow a structured program in the beginning. Often the heart and lungs can adapt more quickly to the faster than muscles and tendons can. In this pamphlet you will find a suggested program that will get you up to 30 minutes of running in 10 weeks. It's a really good idea to wait until you've built up a good, solid base before adding speed to your running base. We recommend that you increase the amount of running by a maximum of 10% per week when you're recovering from an injury. This also applies when you is adding speed into your program. Most elite runners have around 80% easy running and 20% intensity in their program. This is a good rule to follow, also for recreational runners.

*Running style*

The best running style is the one you find easy and natural and that doesn't cause you pain during the run. If you already have an overuse injury through running, you may want to try changing your running style slightly. It can be a good idea to work on your cadence and take a few more, shorter steps per minute.

*Training plan*

Exercise **twice a week**, preferably as a warm-up to your strength training exercises to give your body time to recover.

NOTE: If you suddenly experience more knee pain, take a step back to the level of your last run that you could perform with acceptable pain (green area on the pain scale), with no worsening at the end of the workout or the day after. Train at this stage until there are no more flare-ups of symptoms.

**Week 1:**
1) 1 min. run, 2 min. brisk walk, 3 repetitions
2) 2 min. run, 2 min. brisk walk, 3 repetitions

**Week 2:**
1) 2 min. run, 2 min. brisk walk, 3 repetitions
2) 3 min. run, 2 min. brisk walk, 3 repetitions

**Week 3:**
1) 3 min. run, 2 min. brisk walk, 3 repetitions
2) 4 min. run, 2 min. brisk walk, 3 repetitions

**Week 4:**
1) 4 min. run, 2 min. brisk walk, 3 repetitions
2) 5 min. run, 2 min. brisk walk, 3 repetitions

**Week 5:**
1) 5 min. run, 2 min. brisk walk, 3 repetitions
2) 5 min. run, 1½ min. brisk walk, 3 repetitions

**Week 6:**
1) 5 min. run, 1½ min. brisk walk, 3 repetitions
2) 6 min. run, 1½ min. brisk walk, 3 repetitions

**Week 7**
1) 6 min. run, 1½ min. brisk walk, 3 repetitions
2) 6 min. run, 1 min. brisk walk, 3 repetitions

**Week 8:**
1) 6 min. run, 1 min. brisk walk, 3 repetitions
2) 7 min. run, 1 min. brisk walk, 3 repetitions

**Week 9:**
1) 7 min. run, 1 min. brisk walk, 3 repetitions
2) 10 min. run, 2 min. brisk walk, 2 repetitions

**Week 10:**
1) 10 min. run, 2 min. brisk walk, 2 repetitions
2) 10 min. run, 1 min. brisk walk, 2 repetitions

**Exercises to start jumping**

| **Exercise 5: Squat jump** | |
|---|---|
|  | |
| **Instructions:** | • Position yourself as shown in the picture with your feet hip-width apart.<br>• Bend both knees while keeping your upper body upright and looking forward.<br>• Explosively jump upwards as high as you can.<br>• Use your arms to generate extra power (try to touch the ceiling).<br>• The exercise can be progressed by landing on one leg only and then increasing the jump height. |
| **Notes:** | • Breathe in as you bend your knees and breathe out as you jump up.<br>• Keep a slight lumbar sway and bend at the hips when you land.<br>• Keep the knees moving straight out over the foot and not moving inwards throughout the exercise. |

| Exercise 6: Split jump squat | |
|---|---|
|  | |
| **Instructions:** | • Position yourself as shown in the picture with your feet hip-width apart.<br>• Explosively jump upwards and land in a split squat position (as in image 3).<br>• Without pausing, jump again and let your legs swap places.<br>• Progress the exercise by first increasing the number of sets from 3 to 6 and then by jumping higher. |
| **Notes:** | • Try landing with the front leg in a 90° knee bend (image 3)<br>• Ensure that the knees move straight out over the foot and do not move inwards. |

**Exercises for training jumping/landing and sprinting/change of direction**

| **Exercise 7: Box jumps (hop/landing)** | |
|---|---|
|  | |
| **Instructions:** | • Position yourself as shown in the picture, with your feet hip-width apart and a comfortable distance from the box.<br>• Make an explosive jump and land softly on the box with bent legs as in image 2.<br>• The knees should be bent at least 60° (as in image 2) or more (maximum 90° knee flexion).<br>• Without pausing, jump again and land with bent legs in front of the box (image 3).<br>• Use your arms to generate momentum in the jump.<br>• The exercise is progressed by first doing the jumping exercise on one leg and then by jumping higher. |
| **Notes:** | • Try to land softly on the box, your landing on the box should be silent. |

| Exercise 8: Running exercises (sprint/ directional change) | |
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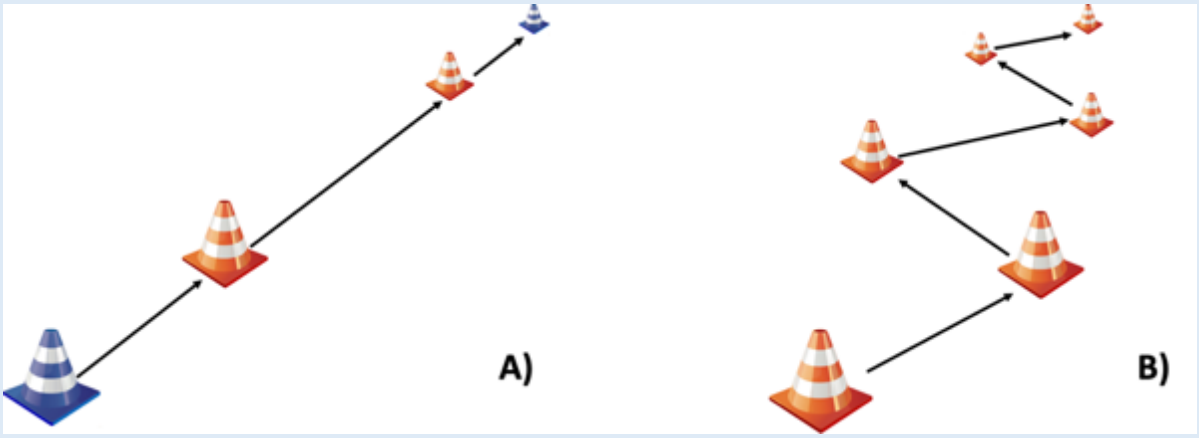
|  | |
| **Instructions for A**<br>(Interval run): | • Approach the first cone (blue) and start jogging to the first orange cone (5 meters).<br>• As you approach the orange cone, increase your running speed towards the second orange cone (30 meters). Start at 60% of your maximum sprint speed.<br>• Jog to the last blue cone and pause for 2 minutes before repeating the exercise.<br>• Progress by gradually increasing your sprint speed to 100%. |
| **Instructions for B**<br>(Zig-zag run) | • Approach the first cone and sprint from cone to cone<br>• Start by jogging (5 meters) before you hit the first cone (exercise A).<br>• Progress by gradually increasing your sprint speed to 100% and start sprinting directly from standing. |
| **Note:** | • Remember to warm up 10 minutes with light jogging and cool down 5 minutes. |


**Stage 3 - Sport-specific exercises**
You can gradually return to sport-specific training when all the relevant running and jumping exercises in stage 2 can be performed with acceptable pain levels (green area on the pain scale) and without exacerbation after completing the exercise or the day after performing stage 1-2-3 exercises.

The sport-specific exercises are ideally performed every 2-3 days to allow for recovery from high-impact exercises on the tendon. The type of sport-specific exercises will be individual depending on the sport you do. For example, basketball players may focus more on dribbling, jumping and cutting
with the ball. Football players may focus more on kicking and passing drills.

**Maintenance rehabilitation exercises:**
The rehabilitation exercises from stages 1 and 2, performed at home or in the gym training center, are continued once a week.

**Progression criteria - stage 4 can be started when:**

- Sport-specific exercises for 1 week can be performed with acceptable pain level (green zone, NRS 2 out of 10 or less) and without aggravation at the end of exercise and the following day.

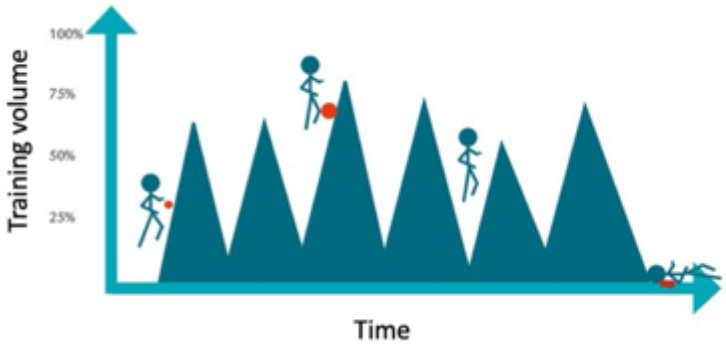

**Stage 4 - Sport and competition**
At stage 4, the focus is on returning to full sports participation and possibly competition with proper progression.

If the individual sport-specific exercises do not cause pain, you can gradually return to full sports participation and competition. It is important that you gradually and slowly increase your training load as shown in the figure below.


**Appropriate rehabilitation**

The figure shows how to slowly increase your training volume to safely return to your sport.

If you return to sport too quickly, it may be necessary to stop your training again as your patellar tendon is not ready to tolerate the load as shown in the figure below.




**Inappropriate rehabilitation**

The figure shows what can happen if you progress too quickly. If you increase training too quickly and too much, you risk having to stop the activity altogether because your knee is not ready for that much strain.

**Return to full participation in sports:**

- Start by participating in the warm-up and about 15 minutes of the workout.
- Then increase your exercise participation by about 5 minutes per session/week if you do not experience worsening of your patellar tendon pain.

**Return to participation in combat/competition:**

If you have not experienced pain during or after training for 2-3 weeks training, you can take part in a match or competition. Start by only partially participating- for example, by only participating in one half of the game.

**Maintenance training:**

The rehabilitation exercises from stages 1 and 2, performed at home or in the gym, are continued once per week.

# OVERVIEW TRAINING IN TEREX STUDY PART 2

| | STAGE 1 | STAGE 2 | STAGE 3 | STAGE 4 |
|---|---|---|---|---|
| FOCUS | Reduce pain and promote healing of tendon tissue. | As stage 1 + increase patellar tendon load tolerance | Back to sports-specific exercises | Back to sport and competition |
| TRAINING | Exercises 3 x weekly<br><br>No running and jumping activities.<br><br>*See page 6* | Exercises 2 x weekly<br><br>Increase running and jumping activities 1-2 x weekly.<br>*See page 10* | Sports-specific exercises every 2-3 days.<br><br>*See page 16* | *Gradual return to full sports participation and competition*<br><br>*See page 16* |
| MAINTE-NANCE | Restricted loading activities – see inspiration for activities at page 4. | Restricted loading activities – see inspiration for activities at page 4. | Rehabilitation exercises from stage 1&2; 1 x weekly | Rehabilitation exercises from stage 1&2; 1 x weekly |
| ACCEPTABLE PAIN | • During rehabilitation exercises: Green/yellow area<br>• Other activity: Green area | |  | |
| PROGRESSION | The rehabilitation exercises for 1 week can be performed with acceptable pain levels (green area on the pain scale) and without aggravation after the training and the next day | The rehabilitation exercises for 1 week can be performed with acceptable pain levels (green area on the pain scale) and without aggravation after the training and the next day | Sport-specific exercises for 1 week can be performed with acceptable pain levels (green area on the pain scale) and without worsening after the exercise and the next day. | If you haven't had any pain during or after training for 2-3 weeks, you can participate in a match or competition. |