



# Post Surgery Rehabilitation Program for High Tibial Osteotomy (HTO)

This protocol is designed to assist you with your rehabilitation after surgery and should be followed under the direction of a physiotherapist

## Your Personal Rehabilitation Program

Your weight bearing status and brace use will depend on the size of your osteotomy and the type of plate the surgeon used for your surgery. This will differ between patients. Your surgeon will advise you on weight-bearing, brace use and knee range of movement following surgery. You and your physiotherapist will also be able to refer to the following guidelines from your surgeon:

### **Weight Bearing:**

Your weight-bearing status is:

- Non-Weight bearing with crutches for \_\_\_\_\_ weeks, then
- Featherweight bearing (up to 25%) with crutches for \_\_\_\_\_ weeks, then
- Partial weight bearing (up to 50%) with crutches for \_\_\_\_\_ weeks, then
- Full weight bearing as tolerated (with crutches initially)

### **Bracing:**

Your brace use is:

- Locked brace use for \_\_\_\_\_ days, then
- Unlocked brace use for \_\_\_\_\_ weeks
- No brace use

### **Range of Motion:**

Your range of motion goal for the first 6 weeks is:

\_\_\_\_\_

If you are unsure about any of these instructions call the surgeon's office at: 403 760-2897, or wait until your first post-operative visit with your surgeon to clarify

# PHASE 1: Initial Recovery

This phase involves the initial recovery from surgery and usually lasts 3 - 6 weeks. In the first week you should rest and elevate your leg for a significant amount of the time.

## Goals

1. Control inflammation and swelling
2. Range of motion 0° to 110°
3. Quadriceps muscles activation
4. Hip strengthening
5. Core strengthening

## BRACE

If your surgeon has recommended you wear a locked post-operative brace it should be worn at all times. Once you are allowed to unlock your brace it should be worn whenever you are walking; you may remove the brace to ice your knee, if resting quietly or to sleep.

## WEIGHT BEARING

Your surgeon will tell you how much weight you can put through your leg in the first few weeks after surgery. It is important to follow this instruction at all times to protect your knee and to allow healing.

## COLD THERAPY & ELEVATION

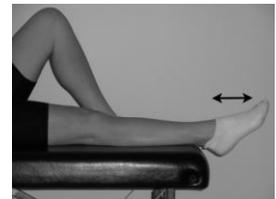
A Cold Therapy Unit or an ice pack should be applied immediately after surgery and used for at least 20 minutes every other hour while you are awake. Your operative leg should be elevated with the knee straight when applying cold therapy and/or when resting.



## Exercises:

### 1. Ankle pumps

- The foot and ankle should be actively “pumped” up and down 10-20 times every hour.



### 2. Range of Motion

- **Flexion** – In lying, bend your knee by sliding your heel towards your buttocks. You can use your other leg to help you as needed. Perform up to 20 times; repeat 2 - 3 times daily.



- **Extension** - In lying, place a roll beneath your ankle to passively (i.e. allow gravity), stretch your knee into extension. Start with 2 minutes at a time and increase as tolerated up to 5 minutes. Perform 2 or 3 times daily. It is very important in this phase to work on straightening your knee.



### 3. Strengthening

- **Quadriceps Contraction** – In sitting with your knee straight and leg supported, tighten your thigh muscle by pushing your leg downwards. Focus on tightening the muscle and avoid lifting your leg from the hip. Perform exercise 5 - 10 times holding each contraction for 5 secs. Progress to 30 times holding each contraction for 10 secs, resting for 5 secs in between reps. The use of EMS (Electric Muscle Stimulation) is recommended for this exercise.



- **Quads over roll** – In sitting with your knee resting on a roll, tighten your thigh muscle by pushing your leg downwards. Focus on tightening the muscle and avoid lifting your leg from the hip. Perform exercise 5 - 10 times holding each contraction for 5 secs. Progress to 30 times holding each contraction for 10 secs, resting for 5 secs in between reps. The use of EMS (Electric Muscle Stimulation) is recommended for this exercise.



- **Straight Leg Raises** – In the position shown, tighten your thigh muscle while keeping your knee straight and lift your leg up 2 inches. Perform exercise 5 - 10 times holding each contraction for 5 secs. Progress to 30 times holding each contraction for 5-10 secs. The use of EMS is recommended for this exercise.



- **Hip Adduction** – In lying with your knees bent as shown, squeeze a soft ball or a pillow between your thighs. Perform exercise 5 - 10 times holding each contraction for 5 secs. Progress to 30 times holding each contraction for 10-15 secs, resting for 5 secs between reps.



#### 4. Stretching

- **Calf** - Sitting with your knee straight, wrap a towel around your foot and gently pull your toes and foot towards you. Hold each stretch for at least 30 secs and repeat 4 times.



- **Hamstring stretch** – In lying, place a towel or belt around your foot and bring your leg up until you feel a stretch at the back of your thigh. Hold each stretch for at least 30 seconds and repeat 4 times.



- **Patellar Mobilisations** – It is important to keep your knee-cap mobile; your physiotherapist will assess this and teach you how to do these exercises if needed.

**\*\* Perform all exercises 2-3 times per day to build your strength and endurance. You should perform all the strengthening exercises on both legs\*\***

#### Also consider:

- Other ROM exercises as tolerated (heel slides on wall/passive flexion in sitting using other leg to push, prone hangs and passive knee extension)
- Core strengthening as tolerated
- Stationary bike – no resistance, start with arc's (swinging) and progress range of motion as tolerated.
- Upper body exercises - weights and arm ergometer

#### **Requirements for progression to Phase 2:**

1. Knee Flexion  $\geq 110^\circ$  (or equal to pre-op ROM if previously limited)
2. Straight leg raise with no lag
3. Knee Extension =  $0^\circ$  (or equal to pre-op ROM if previously limited)
4. Pain and Swelling levels managed to enable exercise progression

## PHASE 2: Muscle Strength and Core Stability

This phase usually starts 4 - 6 weeks post-operative and lasts until 12 weeks. This phase emphasizes progressive activation of the quadriceps muscles with significant core strengthening.

### Goals

1. Manage pain and swelling
2. Range of motion 0° - 135° (or equal to pre-operative range if previously limited)
3. Strengthen quadriceps, hip and core muscles
4. Initiate balance and proprioception exercises

### WEIGHT BEARING

Follow your surgeon's instructions to protect your knee and ensure the best healing. Continue to use your crutches until you can fully weight-bear and have good quadriceps control.

### COLD THERAPY & ELEVATION

Manage your swelling by continuing to use cold therapy and elevation, particularly after exercise or physiotherapy sessions.

### Exercises:

Continue increasing the difficulty of the exercises from phase 1 as well as adding the following new exercise into your program

1. **Range of motion** - Progress flexion using active, active-assisted and pain-free passive exercises.
2. **Strengthening:**

**\* All closed-chain exercises will be consistent with your instructions for weight bearing while walking \***

- **Leg Press** – This exercise should not be commenced until at least 6 weeks post-operative with approval from your surgeon. Start with lowest resistance 10 reps x 3 sets and increase as strength and weight-bearing status allow.
- **Hamstrings (prone)** – Lying on your stomach, place a resistance band around your ankle and also have it attached to an anchor point as shown. Bend your knee slowly against the resistance of the band pulling your foot towards your buttock. Start with 1 set of 10 reps and increase to 3 sets of 15 reps.



- **Hamstrings (sitting)** – In sitting place a resistance band around your ankle and also have it attached to a chair or table leg in front of you as shown. Bend your knee slowly backwards, pulling against the resistance band using the muscles under your thigh. Start with 1 set of 10 reps and increase to 3 sets of 15 reps.



- **Calf Raises** – Both legs: Start with feet shoulder width apart and toes pointed straight ahead, and raise up onto your toes. Start with one set of 10 reps, holding each raise for 5 secs. Increase the number of reps up to 30 with 5 sec holds. Start by using support at a wall or table and progress to no support as strength and balance improve.



- **Mini squats** – Slowly squat with equal weight on each leg. Bend your knees from 0° to a maximum of 45° of flexion, making sure your knees do not move beyond your toes. Start with one set of 10 reps, holding each squat for 5 secs and increase the number of reps as your strength increases, up to 30 reps x 15 sec holds. EMS can be used with this exercise with the 'contraction' time at least double the 'rest' time.



- **Gluteals** – Lying on your back with your knees bent and your arms by your sides. Squeeze your buttocks together and lift up to create a bridge. Keep equal weight on each leg with your pelvis straight. Be careful not to push down on your neck or shoulders – use your buttocks to do the work. Start with one set of 10, holding for 5 secs and increase the number of repetitions as you get stronger. Once you can complete 20 reps holding for 10 secs each, change to single leg bridges.



### 3. Proprioception/Balance

- **Weight Shifting** – Start using some support (i.e. hands on a railing or table) and progress to unsupported. Slowly shift weight from your non-operated to your operated leg. Slowly increase the amount of weight supported through your operated leg. Hold with the weight on your operated leg for 5 seconds and then shift back to your other leg. Repeat 10 times.

#### 4. Stretching

Hold each stretch for at least 30 seconds and repeat twice on each leg:

- **Hamstrings stretch** – continue from phase 1
- **Calf Stretch** – continue from phase 1
- **Iliotibial band stretch** - or use roller on lateral thigh
- **Quadriceps femoris stretch** - in prone
- **Hip Flexors stretch**
- **Hip Rotators stretch**

#### Also consider:

- Clam shells
- Abductor with resistance tubing in prone
- Abdominal strengthening (i.e. curl-ups, isometrics, obliques, transversus abdominis, Pilates)
- Isometric exercises (quadriceps, hamstrings, hip flexors/extensors/rotators)
- Gait Retraining
- Outdoor cycling on a smooth, flat surface, if you have good balance and enough ROM (with approval from your surgeon)
- Deep-water walking (only after wounds are healed with approval from your surgeon)

**\*\* Perform exercises each day to improve your strength and range of motion. You should perform all of the exercises on both legs\***

#### Requirements for progression to Phase 3:

- Full range of motion
- Double leg squat with good motor control
- Good control and alignment during hip and core strengthening exercises

# PHASE 3: Strength and Control

This phase usually starts around 12 weeks and may continue until 6 months following surgery.

## Goals

1. Full weight-bearing with normalized gait
2. Increase quadriceps, hamstrings, gluteal and core strength
3. Improve proprioception and balance
4. Aerobic activity 20 - 30 minutes per day, 3 - 4 times a week

## WEIGHT BEARING

In order to stop using crutches, you must be able to fully weight bear on the operated leg with minimal limping.

## COLD THERAPY & ELEVATION

Manage your swelling by continuing to use cold therapy and elevation, particularly after exercise or physiotherapy sessions.

## Exercises:

1. **Range of motion**: should be full at this stage. Please refer to post-operative information for expected maximum range of motion.

### 2. **Strengthening**

- **Step-ups** – Do graduated heights, starting at 4" and increasing to 8". Stand in front of a stair or stepping stool and place one foot on the step in front of you. Rise up onto the step by shifting all of your weight onto this leg and tighten your quadriceps muscles. Put all of your weight through this leg and do not step up onto the step with your other leg. Start with one set of 10 reps, holding at the top of the step-up for 5 secs. Increase the number of reps as your strength increases, up to 20 reps with 15 sec holds on each leg. Use of EMS is recommended for this exercise.
- **Step-downs** – Do graduated heights, starting at 4" and increasing to 8". Start with one leg standing on the step and slowly bend your knee to lower your other leg to lightly touch floor. Keep all of your weight through the leg that is on the step. Start with one set of 10 reps, holding at the bottom of the step-down for 5 secs. Increase the number of reps as your strength increases, up to 20 reps with 15 sec holds on each leg.



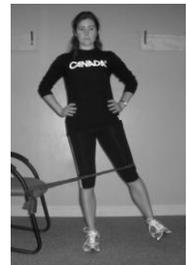
- **Single-leg Calf Raises** – Start on one leg with toes pointed straight ahead, and raise up onto your toes. Start with one set of 10 reps, holding each raise for 5 secs. Increase the number of reps up to 30 with 5 sec holds on each leg. Start by using support at a wall or table and progress to no support as strength and balance improve.



- **Single-leg Squats** - Initially use a chair or railing for support. Stand on one leg and slowly bend your knee from 0° to a maximum of 90° to squat. Bend as far as you can while keeping control. Start with one set of 10, holding the squat for 5 secs; increase the number of repetitions as you get stronger. Work up to performing squats without support with 'contraction' time at least double the 'rest' time on the EMS. (Up to 20 reps x 15 secs each leg).



- **Hip Abduction** – In the position shown, with a resistance band around your outside thigh just above your knee, lift your leg to place slight tension on the band. Move this leg sideways slowly against the resistance of the band using the muscles in your buttock and your hip. Start with 1 set of 10 reps and increase to 3 sets of 15 reps.



- **Hip Extension** - Stand with legs shoulder width apart with a resistance band around one of your thighs just above your knee. Extend your leg to place slight tension on the resistance band. Move the leg backwards slowly against the resistance of the band using the muscles in your buttock and the back of your thigh. Start with 1 set of 10 reps and increase to 3 sets of 15 reps.



- **Lunges** – Standing with feet as pictured, squat down to lunge as shown. Control the descent ensuring your knee that is forward does not move beyond your toes. Start with 1 set of 10, holding each lunge for 5 secs. Increase the number of reps as your strength increases up to 3 sets of 10.



### 3. Proprioception/Balance

- **Single leg stance** (eyes open, eyes closed)
- **Double leg squats on an unstable surface** (thick carpet → foam block → camping mattress → pillow → BOSU)
- **Single leg stance on an unstable surface** (thick carpet → foam block → camping mattress → pillow )



### 4. Stretching

- Continue with stretches from phase 2

**\*\* Perform exercises each day to improve your strength and range of motion. You should perform all of the exercises on both legs\***

#### Also consider:

- Wall squats (with/without ball squeeze)
- Hamstring curls in supine lying with a physio ball
- Double leg squats with ball squeeze
- Core stability exercises (i.e. planks, physio ball exercises, Pilates)
- Wobble board balance and weight shift activities
- Stationary bicycle - increasing resistance and duration
- Swimming
- Elliptical Trainer/X-country ski machine
- Weight training – quadriceps, hamstrings, hip abductors and adductors, gluteals, calves (with approval from your surgeon)

#### Requirements for Progression to Phase 4:

- Single leg squat with good motor control on an unstable surface to 70° flexion
- Ability to demonstrate good core control and posture in single leg stance activities
- Evidence of improvement in strength (hamstrings, hip abductors, hip extensors, hip rotators)

# PHASE 4: Optimising Function

Begins as early as 4 months but may not start until 9 months postoperative. Depending on pre-operative knee function this phase may not be completed by all patients. Realistic goals of what is attainable should be discussed with your surgeon.

## Goals

1. Improve proprioception and balance
2. Increase aerobic endurance
3. Maximize quadriceps, hamstrings, gluteal and core strength with functional exercises
4. Accurately perform plyometric drills
5. Training with sport specific drills

## COLD THERAPY & ELEVATION

Manage any swelling by continuing to use cold therapy and elevation, particularly after exercise or physiotherapy sessions.

## Exercises

### 1. Strengthening / Proprioception

- **Squats on a BOSU** - Slowly squat with equal weight on each leg. Bend your knees from 0° to a maximum of 90° of flexion, making sure your knees do not move beyond your toes. Start with one set of 10 reps, holding each squat for 5 secs and increase the number of reps as your strength increases, up to 30 reps x 15 sec holds.



- **Lunges on a BOSU** – Step forward or back and lunge as shown. Control the descent ensuring your knee that is forward does not move beyond your toes. Start with 1 set of 10 reps, holding each lunge for 5 secs. Increase the number of reps as your strength increases up to 3 sets of 10, for each exercise on each leg.



- **Single leg squats on trampoline** - Standing on one leg, slowly squat bending your knee from 0° to a maximum of 90°, making sure your knee does not move beyond your toes. Start with one set of 10 reps, holding each squat for 5 secs and increase the number of reps as your strength increases, up to 30 reps x 15 sec holds.



- **Single leg stance with ball toss** - Standing on one leg on a BOSU or other unstable surface (i.e. foam block), toss and catch a light ball against a wall. Start with 2 sets of 15 tosses and increase as strength and balance improve.



2. **Cardio** – Maintain or improve aerobic fitness by doing 3 – 4, 30-minute workouts per week. Suggested activities include: walking, hiking, cycling, skating, swimming, cross country skiing, and/or using an elliptical trainer.

3. **Plyometrics** - Depending on goals and surgery results, some patients may not complete this series of exercises. Patient must be able to perform a controlled single leg squat before commencing plyometric exercises.

- **Agility jumping** - start with straight-line jumping, backward/forward/side-to-side and progress to diagonals and combined patterns. Once speed and agility are good with jumping, progress through activities using single-leg hopping on each leg.

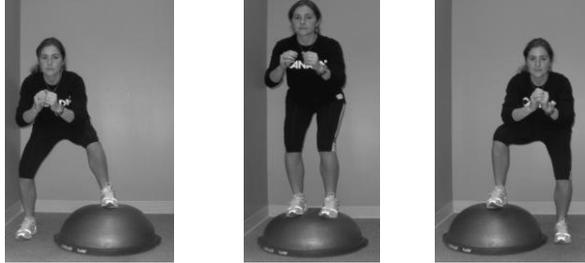
Agility jumping

Agility hopping



- **Straight line jumping activities** (vertical jumps, shuttle jumps, standing long jumps).
- **Straight line hopping activities** (single leg hop for distance, timed single leg hop, single leg vertical hop, zig-zag and figure 8 hopping).

- **Side to side steps on the BOSU** – Perform quick steps in both directions over BOSU. Start with 1 set of 10 steps in both directions and progress to 3 sets of 15 steps in both directions as your strength increases.



- **Jogging: recommended return to running progression:** straight line activity → indoor track → treadmill (walk:run intervals) → outdoor even ground
- **Running:** shuttle runs, wide angle cutting, running and pivoting



**\*\* Perform exercises each day to improve your strength and range of motion. You should perform all of the exercises on both legs\***

**Also consider:**

- Skipping rope – double and single leg
- Cariocas/grapevine
- Box hop up/down (start at 6 inches)
- Tuck jumps

**Requirements for Progression to Phase 5:**

- Able to perform plyometric exercises with good motor and core control
- Improved aerobic endurance and able to run on even surfaces
- Good strength and endurance of core and bilateral lower extremities

# PHASE 5: Sport Readiness

This phase involves return to higher-level functional activities including sports. This phase begins as early as 5 months and continues until 12+ months post-operatively. Depending on pre-operative knee function this phase may not be completed by all patients. Realistic goals of what is attainable should be discussed with your surgeon.

## Goals

1. Sport specific proprioception and agility
2. Progress plyometric exercises
3. Return to sport specific training

## COLD THERAPY & ELEVATION

Manage any swelling by continuing to use cold therapy and elevation, particularly after exercise.

## Exercises:

### 1. Agility:

- Running figure 8's around cones
- Agility ladder
- Grapevine / Cariocas
- Quick Lateral shuttles from cone to cone



### 2. Plyometrics:

- Box jumps / Tuck jumps
- Hopping: 6m timed hop, triple hop for distance, crossover hop for distance

### 3. Running Drills:

- Shuttle sprints/ high knee lifts/ glute kickers/ stop and go drills
- Zig-zag running / sprinting with cutting and pivoting

### 4. Sport specific drills:

- Basketball:** Lay-up drills, lateral shuttle runs while throwing/catching, run-pivot-vertical jump, dodging drills, defence drills (running/jumping backwards)
- Soccer:** dribble around cones, shooting drills, defence drills, lateral shuttle runs while kicking ball, tackling drills
- Football/rugby:** dodging/deking drills, running and throwing drills (all directions), defence tackling drills
- Hockey:** skating figures, stick handling drills, deking drills