



The Royal
Orthopaedic Hospital
NHS Foundation Trust

Tibial Tuberosity Osteotomy

Guideline Summary

Aims	Regain ROM and strength but protect osteotomy site – traction particularly in the first 3 months and until consolidation achieved on XR e.g. No resisted open chain exercises or plyometrics
ROM	Aim for > 90 degrees flexion and full extension at 6 weeks and FROM by 12 weeks
Mobility	Protected weight bearing with crutches +/- Brace (as post operative instructions) until adequate quadriceps control and pain. Typically, at least 6-8 weeks
Work	Patients may consider return to work at 12 weeks with a phased return recommended if involving manual work. If sedentary job can return as feels able and not detrimental to adhering to rehabilitation (usually after 6 weeks). Need to be mindful of impact on swelling/rehabilitation. Should be guided by consultant and physiotherapist assessment of strength/functional ability
Driving	Not before 6 weeks and Patient must have stopped using crutches, be able to sit comfortably and have ROM/power to perform an emergency stop. The law states patient should be in complete control of the car at all times, and it is their responsibility to ensure this and inform their insurance company.
Sport	
Cycling	Static bike from 7 weeks with no or low resistance. Progress as symptoms allow
Swimming	- Exercise in water e.g. pool walking – when can safely get in and out, wound healed, PWB/FWB and no ROM restriction - Front crawl Not before 7 weeks if symptoms allow - Breaststroke Not before 13 weeks
Jogging/Running	Not before 16 weeks AND Milestones Achieved
Non-Contact Sport	Training Not before 24 Weeks AND Milestones achieved
Contact sport	Not before 12 months AND Milestones achieved
Common Complications	- Stiffness – If not achieved 90 degrees by 6 weeks ensure has clinic review - Metal work irritation - Persistent instability - Anterior knee pain - Fracture /Non-Union - Do not progress out of brace or off crutches until adequate control and strength achieved. - Do not commence impact activities before 16 weeks AND adequate ROM and strength and Consolidation on XR and NO osteotomy site pain

Tibial Tuberosity Osteotomy Guidelines

Rehabilitation Practice Guideline

This is a **general guide** to rehabilitation, the time scales are an approximate guide and may be altered depending on various factors such as pain, swelling, muscle control and healing. The pain experience is very variable Person to Person, it is not unusual to experience pain along the osteotomy site is for up to 4 months postoperatively and should not prevent participation in rehabilitation. The programme should be adapted as required by the patient's symptoms. The patient's management should be tailored to meet individual objectives.

The tibial tubercle is osteotomised and distalised/medialized to either:

1. Correct patella alta and lateral patella tracking
2. To stabilize the patella

Rehabilitation aims to protect the osteotomy in the early Phase s and to maximise the range of motion, strength and function. **Please check the post-operative notes for any variation in management and concomitant other procedures** that may affect the milestones.

Surgery

Rehabilitation variations/ Considerations

The fixation of the tibial tuberosity may vary. Sometimes screw fixations may require longer protection in TROM brace, plate fixations potentially offer stronger fixation and earlier progression, check with post-op instructions.

Preparation for Surgery - Prehabilitation

Aims:

- Achieve full range of movement as preoperative stiffness can lead to post operative stiffness
- Build muscle strength / limit quadriceps and hamstring atrophy
- Maintain cardiovascular fitness
- BMI below 35 to reduce post operative complications
- Stop smoking and restrict alcohol intake
- Consider home circumstances including stairs and access
- Ensure good social support from family and friends
- Patient to understand postoperative rehabilitation
- Build muscle to aid post operative recovery
- Ensure a full range of motion. Preoperative stiffness leads to post-operative stiffness
- Consider home circumstances/stairs/access and support
- Work preparation. Prepare patient for possible length of time off required depending on job
- BMI below 35 to reduce post operative complications

Exercises to consider

- Strengthening
- Squat/leg press/ knee extension as tolerated
- Bridge progressions
- Hip Abduction – resisted
- Calf raises
- Cardiovascular fitness

Post Operative Weight bearing and ROM

Check Post operative instructions and Concomitant procedures.

Depending on fixation may have different post operative guidelines

Phase 1 - Immediate Post Operative (Day 0 - 2 weeks)

Aims:

- Protection of Osteotomy site from traction
- Pain management and control knee effusion
- Restore knee flexion and extension ROM and prevent adhesions
- Gain quadriceps activation
- Safe discharge

Precautions:

- Follow weight bearing / ROM restrictions and bracing as per consultant post operative instructions
- No active through range quads
- If in TROM – care with wound/brace position can cause irritation
- No resisted quads

Milestones for Progression:

- ☐ Successful surgical procedure
- ☐ Safe discharge from hospital
- ☐ Patient understands post operative instructions
- ☐ OPD physiotherapy appointment made
- ☐ Able to complete home exercise programme independently
- ☐ TROM/CPS in situ and safety/care leaflet provided

Rehabilitation:

- Knee braced in extension for mobilisation
- Ensure patient understands post operative instruction for weight bearing, range of movement and brace
- Teach gait with aids +/- stairs as per post operative instructions
- Swelling management strategies – cryotherapy 20 minutes x 3 daily
- Ensure pain controlled +/- pain medication
- Begin ROM as per post operative instructions
- Ensure knee brace is correctly fitted and adjusted appropriately

Exercises to consider:

- Ankle pumps
- Isometric quads, hamstrings and glutes
- Hamstring and calf stretches
- Hip, ankle and upper body strength as tolerated - exercises which do not compromise weight bearing or ROM status

Patient referred to Hydrotherapy by inpatient team where available

Phase 2 – Outpatient Physiotherapy (2-6 weeks)

ROM Restoration

Aims:

- Protection of Osteotomy site from traction
- Pain management and control knee effusion
- Restore knee flexion 90 degrees and full extension ROM
- Gain quadriceps activation
- Normal gait pattern with crutches

Precautions:

- Follow weight bearing / ROM restrictions and bracing as per consultant post operative instructions
- Avoid exercises that cause traction on osteotomy site -
 - ◊ No open chain resisted quadriceps

Milestones for Progression:

- ☐ Full knee extension by 2-3 weeks
- ☐ Independent with HEP
- ☐ Active knee flexion 90 degrees **IF NOT ACHIEVED BY 6/52 DISCUSS WITH SENIOR AND ENSURE HAS REVIEW IN SURGICAL CLINIC**
- ☐ Minimal pain and swelling
- ☐ Good quadriceps contraction
- ☐ Normal PFJ mobility
- ☐ SLR with no lag
- ☐ Wound healed

Complete Outcome Measures and establish patient appropriate goals

Rehabilitation:

- Ensure patient understands post operative instruction for weight bearing, range of movement and brace
- Swelling management strategies – clearance/lymphatic massage, compression, elevation as required
- Ensure pain controlled +/- pain medication
- Careful Patellar mobilisations in all directions
- Consider electrical stimulation for quadriceps
- Brace can be removed when resting in 0 degrees extension and for exercises within restricted ROM
- Brace can be removed at 2-4 weeks if SLR without lag if no additional Post operative restrictions

Exercises to consider:

- Continue previous exercises
- Passive and active knee ROM as tolerated in brace/out of brace - Heel slides
- Knee extension ROM - Heel prop
- Seated knee flexion
- Static quads / Straight leg raise / Prone knee lockouts
- Hamstring isometrics
- Side lying hip abduction
- Hamstring and calf stretches
- Passive ROM mobilisation within post op limitations
- Cross education – Strengthen other limb as able (be aware patient may have contralateral instability)

Introduction to hydrotherapy (approx. 2–6 weeks post-op)

Criteria:

- Protection of Osteotomy site from traction
- Pain management and control knee effusion
- Restore knee flexion 90 degrees and extension ROM
- Gain quadriceps activation
- Normal gait pattern with crutches

Precautions:

- No Flippers for 12 weeks as this can traction the osteotomy site
- No resisted Open chain quadriceps 12 weeks (buoyancy assisted knee extension)

Aims:

- Help restore ROM/prevent stiffness
- Normalise walking pattern and function
- Assist in strengthening

Example Exercises

- **Walking:** Begin with gentle walking in the water, focusing on a normalized gait pattern. Start in deep water and progress to more shallow depths to increase weight bearing. If PWB patient needs to be submerged from there waist or higher.
- **Range of motion (ROM):** Perform within limits of post op restrictions. Avoid buoyancy assisted (BA) knee flexion in standing as may force the joint. Work on hip ROM using BA movement
- **Stretching:** Gentle stretching of the hamstring and calf muscles.
- **Strengthening:** Introduce assisted strengthening with exercises such as:
 - ◊ Mini-squats with support, progressing from a higher water level to a lower one.
 - ◊ Step ups/ step downs/ side step ups in deep water
 - ◊ Hip extension and abduction exercises
 - ◊ Calf raises
 - ◊ Core control in standing i.e. forward lean with float ensuring stability of LL.

Phase 3: Progression and strengthening (approx. 6–12 weeks post-op)

As the osteotomy site heals and the patient gains strength and confidence, Hydrotherapy program can become more dynamic and challenging.

Example Exercises

- **Weight bearing:** Progress toward full weight bearing in the pool, as tolerated and approved by the surgeon in post operative plan and clinic review/XR. Challenge proprioception through turbulence or through adjusting their BOS.
- **Range of motion (ROM):** To full ROM (unless otherwise specified in post op notes). Example of exercise: wobble press down, gentle knee lunge on step, passive stretches by therapist, cycling in sitting (no flippers or resistance).
- **Strengthening:**
 - ◊ Step-ups and step-overs using water steps with reducing support of the wall
 - ◊ Single-leg balance exercises to improve proprioception
 - ◊ Hip strengthening with resistance
 - ◊ Avoid Open chain knee extension until 12 weeks i.e. no buoyancy resisted knee flexion
 - ◊ Core stability and UL work
 - ◊ Kicking on back with straight legs
 - ◊ Cycling with no resistance
- **Swimming:**
 - ◊ Upper body swimming – with pull buoy 6-8 weeks
 - ◊ Front crawl kicking from 8 - 10 weeks with straight legs.
 - ◊ Full front crawl/ back crawl swimming 10-12 weeks post op.
 - ◊ Breaststroke should be delayed until 16 weeks as its leg kick can place rotational forces on the knee.

Precautions:

- No Flippers for 12 weeks as this can traction the osteotomy site
- No resisted Open chain quadriceps 12 weeks (buoyancy assisted knee extension)

Phase 4: Progression and strengthening (approx. 12 weeks post-op)

If struggling with on land physiotherapy continue in pool.

Resistance and flippers can be added to the programme if there is no/minimal

Osteotomy site pain and check XR in clinic is confirmed to be showing consolidation.

Milestones for progression

to on land only

- ROM 0- > 110 degrees
- Minimal swelling and controlled pain
- FWB – normalised gait
- Improving quadriceps contraction and strength

Phase 5 – Early Loading / Strengthening (7 - 12 weeks)

Precautions:

If pain on walking around osteotomy site, tenderness on palpation – DO NOT PROGRESS UNTIL CHECK XRAY AND COMMUNICATION WITH CONSULTANT

If not regained full flexion, include rectus femoris stretches and use appropriate manual therapy and soft tissues techniques to optimise / improve knee flexion range of motion - consider treatment techniques for the tibio femoral joint and patella femoral joint

No breast stroke until 3/12

No impact activities (Running, Jumping , landing , plyometrics or change of direction training at this Phase)

Avoid WB flexion > 90 degrees

No resisted open chain quadreps for 12 weeks

If unsure on progressions liaise with senior Physiotherapist

Aims:

- Protection from excessive load on osteotomy site
- Pain management and control knee effusion
- Achieve full flexion ROM
- Return to FWB and normalise gait pattern
- Progress quadriceps strength and lower limb control
- No/Minimal PFJ instability
- Reviewed in clinic XR

Milestones for Progression:

- ☐ No Pain > 2/10
- ☐ XR in clinic reviewed and satisfactory
- ☐ No effusion
- ☐ Symmetrical ROM
- ☐ Normal gait
- ☐ No Brace
- ☐ 30 min walk with minimal pain or post activity effusion
- ☐ SLR no lag
- ☐ Single leg stance
- ☐ 12 weeks post op

Driving:

Patient must have stopped using crutches, be able to sit comfortably and have ROM/power to perform an emergency stop. Law states patient should be in complete control of the car at all times and it is their responsibility to ensure this and inform their insurance company.

Rehabilitation:

- Normalise gait no aids
- Swelling management strategies if required
- Ensure pain controlled +/- pain medication
- Close kinetic chain exercises as weight bearing allows

Exercises to consider:

Exercises need to be tailored to their functional aim.

Once 100° flexion is achieved and has minimal swelling, can start using a stationary bike on minimal resistance

Begin Progressive, concentric to eccentric exercises within pain limits. Consider modified ROM depending on pain.

Proprioceptive exercises once good control and strength achieved

Proprioception:

- Single leg balance (once FWB)

Swimming—freestyle and pool walking

Start unresisted open chain exercises

Phase 6 – Building Strength/Capacity (13 - 16 weeks if milestones met)

Aims:

- Full pain-free Knee & PFJ ROM
- No instability
- Good quads and pelvic control in single knee dip
- Raise fitness targets and set new goals
- Increase speed of balance reactions and improve
- Coordination for functional activities

Precautions:

- No running until 16 weeks
- No contact sports
- No cutting sports
- Road cycling—no clips or cleats, flat pedals only
- No impact work
- No deep squats

Milestones for Progression:

- ☐ Minimal pain and swelling with rehab
- ☐ Review in clinic approximately 16 weeks or before if ongoing osteotomy pain
- ☐ **XR reviewed and demonstrating consolidation/Union**
- ☐ FROM
- ☐ No instability
- ☐ Pain < 2/10 VAS
- ☐ 16 weeks +
- ☐ QASL questionnaire.
- ☐ Collect outcome measure
- ☐ Good neuromuscular control
- ☐ Double leg squat to 90° flexion with pain/swelling
- ☐ Capacity tests > 70% to non-operated limb:
 - ◊ SL bridge
 - ◊ SL Calf raises
 - ◊ Side plank
 - ◊ Quads using hand held dynamometer or 1 leg 5 max rep leg press 0-40 degrees

Rehabilitation:

- Continue with previous interventions as indicated
- Increase fitness
- Gradual increase in resisted exercises both open and closed chain as pain allows
- Continue with proprioceptive training—
increase rotational control

Exercises to consider:

- Continue with exercise bike
- Single leg calf raise
- Leg press < 90° flexion
- Seated hamstring curl
- Bridge progressions

Proprioception:

- Introduce plyometrics foot landing double
– single as control allows if appropriate to patient goals

Return to work:

Patients may consider return to work at 12 weeks with a phased return recommended if involving manual work. Need to be mindful of impact on swelling/rehabilitation. Should be guided by consultant and physiotherapist assessment of strength/functional ability

Phase 7 – Optimising Function (16 weeks + and met milestones) As patient goals required

Aims:

- Progressive strengthening of lower muscles
- Increase function
- Progress cardiovascular fitness
- Advice on returning to training/sports specific training

Precautions:

- This patient population often do not want participate in higher level sports. Therefore this stage needs to be patient specific
- No running / impact until at least 16 weeks
- Depending on patients goals non impact training initially
- **If pain over osteotomy site with increase loading do not start impact activities until check xray. Refer back to clinic if concerned for earlier review and xray**

Milestones for Progression:

- ☐ No/minimal effusion
- ☐ Able to walk 5-10km unaided with no pain/swelling
- ☐ Single leg squat good control
- ☐ LSI 80% Quads and hamstring (Biodex/HHD)
- ☐ No giving way or instability
- ☐ 6 months post operative

Rehabilitation:

- Graded progression to loaded exercises > 90° flexion
 - Progression of bilateral and single leg exercises
- If patient goals are to return to sport/running -**
- Introduction of impact work—only if a full range, strength, eccentric quadriceps control with correct alignment. No pain on day to day base with weightbearing activity
 - Initiate walk-jog program
 - Continue progressive strength training using both open and closed chain exercise to improve maximal strength

Progressive introduction of dynamic activity if returning to team sport:

- Bilateral plyometric
- jumping/hopping (start on the trampette, emphasis on alignment of both push off and land)
- Change of direction; start single direction and progress to cutting, multidirectional and pivoting
- Stopping/starting and acceleration/deceleration
- Backwards running

Strengthening:

Progress strength

- Progression of squat range and DL to SL as tolerated
- Leg press
- Split squats
- Seated knee extension add resistance
- Deadlift / RDLs
- Stool pulls / chair walking
- Band walks
- Single leg calf raise
- Dynamic balance

Phase 8 – Goals Specific Rehab (6 - 12 months)

Rehabilitation will be dependent on the patients goal and level of functional activity required.

Aims:

- Increase loading
- Initiation of load acceptance work and running
- Progress lower limb strength
- Return to sport

Precautions:

- No return to non contact training before 24 weeks
- No return to contact sport 12 months

Milestones for Progression:

- ☐ Deep squat pain free
- ☐ Tolerates DL/SL impact activity with equal control
- ☐ Completion of jog/run programme without pain or swelling
- ☐ No Pain/swelling after activity
- ☐ Limb symmetry 80% plus Hamstring/glutes/calf
- ☐ Hamstring/Quad ratio 70% (Biodex)

Rehabilitation:

- Continue strength training
- Rehab specific to patient needs

Start landing drills and double leg plyo's:

- CMJ to box
- Tall to short
- DL CMJ
- Step and land
- Step/land/push back
- March in place / jogging on spot
- A skips / B skips
- Vertical jump height (force decks)

Return to running criteria:

- No effusion
- Pain free hopping in place
- Landing mechanics equal to non operated limb
- LSI 70% quads strength
- SL squat x 15
- SL hamstring bridge x 20
- SL heel raise x 20
- SLS x 45 seconds
- At least 9 months post op

Reintroduction to running

- Introduce jogging -> Walk/jog programme
- Shuttles – acceleration / deceleration
- Walk/jog/run/jog/walk
- Steady state running

Phase 9 – Return to Sport (12 – 18 months)

Aims:

- Introduce agility and change of direction
- Introduce goal specific skills
- Maximise lower limb strength
- Increase confidence

Precautions:

- No return to non contact training before 24 weeks
- No return to contact training before 28 weeks

Milestones for Progression:

- ☐ Tolerates change of direction drills
- ☐ Psychologically ready for return to restricted training
- ☐ Symmetrical performance with sport specific drills
- ☐ Safely progress to full sport

ForceDecks / hop testing:

- Countermovement jump / DL Drop Jump:
 - ◊ Peak landing force asymmetry <10% LSI
 - ◊ Jump height <10% LSI
- Single leg jump:
 - ◊ Jump height <10% LSI
- Single leg hop for distance <10% LSI
- Triple hop <10% LSI

Complete Outcome Measures:

- IKDC - >93
- KOOS-Sports Questionnaire >90%

Rehabilitation:

- Continue with strength training – reduce frequency to allow sports specific training
- Return to running programme / increase running speed / acceleration / deceleration
- Include exercises/training from athletes usual repertoire
- Progress speed, add perturbation, reactive, environmental changes and decision making

Introduce change of direction:

- Add change of direction when sufficient control is achieved
- Side stepping
- Side to side jumps

Progress to planned change of direction drills:

- S bends
- Planned cutting drills - 45/90/135/180
- Reactive change of direction – partner drills
- Acceleration/deceleration shuttles

Progress through Control-Chaos Continuum (Taberner et al. 2019)

Graded return to training / sport

- ◊ Non contact → full training → full play (dependent on Consultant opinion)

Scan to see Tibial Tubercle
Transfer information on the
Royal Orthopaedic Website



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