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Rehabilitation Protocol for High Tibial/Distal Femoral Osteotomy

PHASE I: *Immediate Postoperative Phase (0-6 WEEKS AFTER SURGERY)*

Rehabilitation Goals	<ul style="list-style-type: none"> ● Protect the anatomic repair ● Monitor wound healing ● Minimize knee effusion ● Increase tibial-femoral and patella-femoral mobility ● Restore quadriceps control ● Gently increase ROM per guidelines – emphasis on extension
Precautions	<ul style="list-style-type: none"> ● No active knee extension ● No resisted closed chain or open chain until 6 weeks post-op
Weight-bearing	<ul style="list-style-type: none"> ● Week 0-4: NWB/TDWB with brace locked in extension ● Week 4-6: TDWB with brace locked in extension progressing to PWB <ul style="list-style-type: none"> ○ Progress to brace unlocked in PWB if have full extension and good quadriceps control
Brace	<ul style="list-style-type: none"> ● Hinged knee brace locked in 0 degrees extension for all mobility and gait until at least 4 weeks post-op, full knee extension achieved and good quad control. ● Brace may be unlocked when sitting or in bed
Intervention	<p><i>Range of Motion</i></p> <ul style="list-style-type: none"> ● Knee AAROM/PROM – Passive extension only <ul style="list-style-type: none"> ○ Week 0-4: 0-90 degrees ○ Week 4-6: 0-120 degrees ○ Prone hangs, supine knee extension with heel prop, heel slides with PROM for knee extension, knee flexion in sitting with P/AAROM for knee extension <p><i>Strengthening</i></p> <ul style="list-style-type: none"> ● Quad sets, co-contraction, ankle pumps ● Gluteal sets ● Ankle pumps ● Side-lying hip ABD – with brace until elimination of quad lag ● Prone Hip Extension – with brace until elimination of quad lag ● SLR – per MD recommendation, depending on surgical approach, may be inappropriate <ul style="list-style-type: none"> ○ Perform with brace locked in extension, D/C brace when performed without a lag ● Side-lying Hip Adduction – with brace until elimination of quad lag ● Clam shell ● Hamstring stretch ● ITB stretch ● Gastroc-soleus stretch ● Bike – No resistance

	<p><i>Aquatic therapy – if available</i></p> <ul style="list-style-type: none"> ● Deep water (chest/shoulder height) – walking and ROM exercises <ul style="list-style-type: none"> ○ Core stability and UE exercises <p><i>Manual Therapy</i></p> <ul style="list-style-type: none"> ● Patella mobilizations – immediately post-op ● Gentle STM – 2-3 weeks post-op <p><i>Modalities</i></p> <ul style="list-style-type: none"> ● NMES for quadriceps re-education/biofeedback. ● Cryotherapy for swelling and pain management. ● Taping – pain and swelling management
Criteria to Progress	<ul style="list-style-type: none"> ● Knee PROM: 0-120 degrees ● Adequate pain control ● Minimal swelling ● Able to perform SLR without quadriceps lag

PHASE II: Protection Phase (7-12 WEEKS AFTER SURGERY)

Rehabilitation Goals	<ul style="list-style-type: none"> ● Increase mobility ● Restore quadriceps control ● Restoration of full ROM by week 8-12 ● Progress weight bearing ● Normalize gait pattern without assistive device – goal of 2 miles at 15min/mile pace on a treadmill ● Gradual progression of therapeutic exercises for strengthening, stretching and balance
Precautions	<ul style="list-style-type: none"> ● No weight bearing stretching into knee flexion until week 8 ● Avoid descending stairs reciprocally until adequate quadriceps control as demonstrated by SLR ● Avoid exercises/activities with excessive patellofemoral compression forces (deep squats, resisted open chain terminal knee extension) ● Avoid medial collapse due strengthening and functional activities ● No running, jumping or plyometrics until 4-6 months post-surgery ● Do not overload the surgical site ● Modify activity level if increased pain, edema or catching occurs
Weight-bearing	<ul style="list-style-type: none"> ● Progress to WBAT per MD, based on X-ray
Brace	<ul style="list-style-type: none"> ● Brace unlocked for ambulation if there is good quad control, crutches as needed ● May wean out of brace as tolerated at 8 weeks
Intervention <i>-Continue with Phase I interventions as needed</i>	<p><i>Modalities</i></p> <ul style="list-style-type: none"> ● NMES for quadriceps re-education – as needed ● Cryotherapy for edema and pain management <p><i>Manual Therapy</i></p> <p><i>Range of Motion</i></p> <ul style="list-style-type: none"> ● Progress PROM/AAROM/AROM of knee as tolerated

	<p><i>Stretching</i></p> <ul style="list-style-type: none"> ● Hamstring ● Gastroc-Soleus ● Prone Quadriceps with strap <p><i>Strengthening</i></p> <ul style="list-style-type: none"> ● TKE – 0-40 degrees ● Leg press ● Partial range wall squats <ul style="list-style-type: none"> ○ 0-45 degrees ● Forward step ups, Lateral step ups ● Forward, Lateral, Retro step downs ● Bridge with physioball ● Romanian Deadlifts – Week 8 <ul style="list-style-type: none"> ○ Standing upright to weight just below knees. ● Band walks – Week 8 ● Stool walks – Week 8 ● BOSU Partial squat – Week 9 <ul style="list-style-type: none"> ○ 0-60 degrees ● Prone Hamstring curl – 10 weeks <ul style="list-style-type: none"> ○ Begin with ankle weights and progress to weight machine <p><i>Cardiovascular Exercise</i></p> <ul style="list-style-type: none"> ● Stationary Bike – light resistance ● Treadmill – week 8, forward and backwards ● Elliptical – week 9-10 <p><i>Aquatic Therapy (if available)</i></p> <ul style="list-style-type: none"> ● Flutter kicks ● Straight leg scissor kicks ● Running in waist deep water <p><i>Balance - week 8</i></p> <ul style="list-style-type: none"> ● Progress from double to single leg balance ● Progress from static to dynamic: <ul style="list-style-type: none"> ○ BAPS ○ Ball toss ○ Body blade ○ Fitter ○ Slide board
<p>Criteria to Progress</p>	<ul style="list-style-type: none"> ● Full range of motion ● Elimination of swelling ● Restoration of normal gait ● Quad strength > 70% of uninvolved leg

PHASE III: *Advanced Strengthening (13-16 WEEKS AFTER SURGERY)*

Rehabilitation Goals	<ul style="list-style-type: none"> ● Normal tibial-femoral and patella-femoral mobility ● Restoration of quadriceps control ● Progress muscle strength, endurance, and balance activities
Precautions	<ul style="list-style-type: none"> ● No running, jumping or plyometrics till 4-6 months post-op
Intervention <i>-Continue with Phase I-II interventions</i>	<p><i>Strengthening</i></p> <ul style="list-style-type: none"> ● Total leg strengthening ● Single leg strengthening ● Hamstring isotonic exercises through full ROM ● Quadriceps isotonic exercises <p><i>Proprioception</i></p> <ul style="list-style-type: none"> ● Single leg balance <ul style="list-style-type: none"> ○ Stable and unstable surfaces ● Single leg balance with leg swings ● Single leg balance with ball toss ● Single leg balance with UE perturbations <p><i>Cardiovascular Exercise</i></p> <ul style="list-style-type: none"> ● Bike, elliptical ● Treadmill walking
Criteria to Progress	<ul style="list-style-type: none"> ● Full, symmetrical pain-free ROM ● Strength: 80%+ of uninvolved leg ● Satisfactory clinical exam

PHASE IV: *Early Return to Sport Phase (16+ WEEKS AFTER SURGERY)*

Rehabilitation Goals	<ul style="list-style-type: none"> ● Progress to higher level activities – based on functional demands ● Return to vocational, recreational and/or sport activities. ● Run 2 miles at easy pace – if appropriate
Interventions <i>-Continue with Phase III interventions</i>	<p><i>Running: begin at 4 months</i></p> <ul style="list-style-type: none"> ● Start with light gentle slow-paced running ● Treadmill running <ul style="list-style-type: none"> ○ Must demonstrate good running form for 5 minutes with equal audibly rhythmic foot strike. ● Aquatic running ● Backwards and forward running ● Initiate Return to running protocol <p><i>Plyometrics: 4.5 –to 5 months</i></p> <ul style="list-style-type: none"> ● Start with double leg drills ● Progress slowly to single leg drills ● Ensure good form and proper hip and knee alignment <p><i>Agility Drills: 4.5 to 5 months</i></p>

	<ul style="list-style-type: none"> ● Sub-max foot placement drills ● Ladder drills ● Line hops
Criteria to Progress	<p>Return to sport/play: 7 to 9 months</p> <ul style="list-style-type: none"> ● Quad and hamstring strength 90% of uninvolved ● Full symmetrical knee range of motion ● No knee joint effusion ● Single leg hop test: Limb symmetry of 90% ● Triple hop test: limb symmetry of 90% ● Crossover hop test: limb symmetry of 90%

Protocol adapted from Mass General Sports Medicine Physical Therapy Rehabilitation Protocols. See <https://www.massgeneral.org/orthopaedics/sports-medicine/physical-therapy/sports-rehab-protocols>