

# TROCHLEOPLASTY

## Background

A trochleoplasty is a surgical procedure that corrects the femoral trochlea to allow for normal (or more normal) movement of the patella within the trochlear groove during knee flexion and extension. It has been found that 85% of patients with recurrent patellar instability also have trochlear dysplasia, and this procedure is indicated for patients with both of these deficits. Trochlear dysplasia involves an abnormality in the shape and depth of the trochlear groove, which creates inadequate patellar tracking during knee flexion. There are 3 main types of surgical procedures that will address this issue and they are as follows:

- Lateral Facet Elevation
- Sulcus Deepening
- Recession Wedge

*Lateral Facet Elevation* is indicated in patients with decreased lateral facet height, causing the patella to translate laterally during knee motion. This type of procedure involves removing bone in the lateral facet and compaction of the underlying cancellous bone. A bone graft is then implanted into this space, creating a mechanical block that limits lateral patellar translation.

*Sulcus Deepening* involves the removal of a strip of cortical bone followed by the removal of a strip of cancellous bone. This area is then covered by a flap of bone that is shaped to create a V-shaped wedge in the groove. This process creates a deeper groove in which the patella will glide and demonstrate more appropriate tracking mechanics.

*Recession Wedge Trochleoplasty* focuses on reduction of a supratrochlear spur that causes the patella to move laterally during knee flexion/extension. This technique creates an even surface for patellar gliding, but does not change the groove depth or the wide sulcus angle that could be present in patients with patellar instability.

## Disclaimer

Progression is time and criterion-based, dependent on soft tissue healing, patient demographics, and clinician evaluation. Contact Ohio State Sports Medicine at 614-293-2385 if questions arise.



## Summary of Recommendations

<b>Expectations</b>	<ul style="list-style-type: none"> <li>Return to sport: 9-15 months</li> </ul>
<b>Risk Factors</b>	<ul style="list-style-type: none"> <li>Trochleoplasty requires extensive rehabilitation and can often exhaust insurance approved PT visits. Consider decreasing initial visit frequency, use of home NMES unit and daily self-ROM.</li> <li>Long-term quadriceps strength deficits typically present &gt;1 year post-operatively.</li> </ul>
<b>Concomitant Procedures</b>	<ul style="list-style-type: none"> <li>MPFL reconstruction is typically always performed with trochleoplasty: <i>Do not change protocol based on concurrent MPFL reconstruction</i></li> <li>If trochleoplasty is performed in conjunction with osteotomy, rehab progression will be slower and RTS may be delayed. <i>Refer to operative note or contact physician directly for protocol deviations</i></li> </ul>
<b>Weight Bearing Progression</b>	<ul style="list-style-type: none"> <li><b>Phase 1 (weeks 0-4):</b> 25-50% BW – Brace locked at 10-15°, wear brace at all times</li> <li><b>Phase 2 (weeks 4-6):</b> 50-75% BW with brace unlocked to patient's available flexion ROM (90-120°)</li> <li><b>Phase 3 (weeks 6-8):</b> 75% - Full BW with completely unlocked brace. Consider discharging crutches at weeks 6-8 (<i>see criteria to discharge assistive device below</i>)</li> <li><b>Phase 4 (weeks 8-12):</b> Full BW – Brace discharge at 8-10 weeks pending appropriate quadriceps control and normal gait mechanics. <i>May continue brace as needed for adverse weather conditions or ambulation on uneven ground x12 weeks</i></li> <li><b>Phase 5 (weeks 12-16):</b> Full BW, no brace</li> <li><b>Phase 6 (weeks 16 – RTS):</b> Full BW, no brace</li> </ul>
<b>Range of Motion Progression</b>	<ul style="list-style-type: none"> <li>Phase 1 (weeks 0-4): 0-90°</li> <li>Phase 2 (weeks 4-6): Symmetrical hyperextension - 120° of flexion</li> <li>Phase 3 - 6 (weeks 6 - RTS): Full AROM</li> </ul>
<b>Functional Testing</b>	<ul style="list-style-type: none"> <li>Isometric testing: 5 months</li> <li>Isokinetic testing: 6, 9, 12 months and discharge</li> <li>Hop testing (Appropriate after 80% symmetry achieved on isokinetic testing) <ul style="list-style-type: none"> <li>SL hop for distance</li> <li>Triple hop</li> <li>Cross over hop</li> <li>Timed 6m hop</li> </ul> </li> </ul> <p><i>*Functional strength testing and hop testing should be reserved for patients returning high-level activity*</i></p>
<b>Patient Reported Outcomes</b>	<p>Collect the Lower Extremity Functional Scale at each visit</p> <p>Consider addition one of the following at initial evaluation, every 6 weeks and discharge. Be consistent with which outcome tool is collected.</p> <ul style="list-style-type: none"> <li>Knee Injury and Osteoarthritis Outcome Score (KOOS)</li> <li>International Knee Documentation Committee (IKDC)</li> </ul>
<b>Criteria to Discharge Assistive Device</b>	<ol style="list-style-type: none"> <li><u>ROM</u>: Full active knee extension; no pain on passive overpressure</li> <li><u>Strength</u>: Able to perform strong quad isometric with full tetany and superior patellar glide and able to perform 2x10 SLR without quad lag</li> <li><u>Effusion</u>: 1+ or less is preferred (2+ acceptable if all other criteria are met)</li> <li><u>Weight Bearing</u>: Demonstrates pain-free ambulation without visible gait deviation</li> </ol> <p><i>*Patients should be PWBing until week 6, and should continue brace compliance until week 8-10*</i></p>
<b>Criteria to Initiate Running and Jumping</b>	<p><b>*No running until the patient is 6 months post-op and meets the criteria listed below*</b></p> <ol style="list-style-type: none"> <li><u>ROM</u>: full, pain-free knee ROM, symmetrical with the uninvolved limb</li> <li><u>Strength</u>: Isokinetic testing 80% or greater for hamstring and quad at 60°/sec and 300°/sec</li> <li><u>Effusion</u>: 1+ or less</li> <li><u>Weight Bearing</u>: normalized gait and jogging mechanics</li> <li><u>Neuromuscular Control</u>: Pain-free hopping in place</li> </ol>
<b>Criteria for Return to Sport</b>	<ol style="list-style-type: none"> <li><u>ROM</u>: full, pain free knee ROM, symmetrical with the uninvolved limb</li> <li><u>Strength</u>: Isokinetic testing 90% or greater for hamstring and quad at 60°/sec and 300°/sec</li> <li><u>Effusion</u>: No reactive effusion ≥ 1+ with sport-specific activity</li> <li><u>Weight Bearing</u>: normalized gait and jogging mechanics</li> <li><u>Neuromuscular control</u>: appropriate mechanics and force attenuation strategies with high level agility, plyometrics, and high impact movements</li> <li><u>Functional Hop Testing</u>: LSI 90% or greater for all tests</li> <li><u>Physician Clearance</u></li> </ol>



## RED/YELLOW FLAGS

Red flags are signs/symptoms that require immediate referral for re-evaluation. Yellow flags are signs/symptoms that require modification to plan of care.

<b>Red Flags</b>	<ul style="list-style-type: none"> <li>• Signs of DVT (<i>Refer directly to ED</i>)             <ul style="list-style-type: none"> <li>○ Localized tenderness along the distribution of deep venous system</li> <li>○ Entire LE swelling</li> <li>○ Calf swelling &gt;3cm compared to asymptomatic limb</li> <li>○ Pitting edema</li> <li>○ Collateral superficial veins</li> </ul> </li> <li>• Mechanical block or clunk (<i>Refer to surgeon for re-evaluation</i>)</li> <li>• Lack of full knee extension by 4-6 weeks (<i>Refer to surgeon for re-evaluation</i>)</li> </ul>
<b>Yellow Flags</b>	<ul style="list-style-type: none"> <li>• Persistent reactive pain or effusion following therapy or ADLs             <ul style="list-style-type: none"> <li>○ <i>Decrease intensity of therapy interventions, continue effusion management and provide patient education regarding activity modification until reactive symptoms resolve</i></li> </ul> </li> </ul>

## PHASE 1 (Weeks 0-4)

<i>In this phase, goal is to maintain joint mobility and muscle tone while adhering to all post-operative precautions. Emphasis is placed on ensuring proper wound healing and effusion management.</i>	
<b>Precautions</b>	No OKC knee extension
<b>Range of Motion</b>	0-90° <i>Achieved though AAROM/AROM</i> <ul style="list-style-type: none"> <li>• <i>Extension ROM: Seated towel stretch, prone hang, bag hang</i></li> <li>• <i>Flexion ROM: heel slides, wall slides</i></li> <li>• <i>Goal: early AROM though safe range</i></li> </ul>
<b>Weight Bearing</b>	25-50% BW – Brace locked at 10-15°, wear brace at all times
<b>Suggested Interventions</b>	<ul style="list-style-type: none"> <li>• Ankle pumps</li> <li>• Quadriceps, hamstring and gluteal isometrics</li> <li>• SLR in knee brace</li> <li>• Diaphragmatic breathing</li> <li>• Effusion management strategies, including RICE</li> <li>• NMES (with biofeedback as needed)</li> </ul>
<b>NMES Parameters</b>	<ul style="list-style-type: none"> <li>• NMES pads are placed on the proximal and distal quadriceps</li> <li>• Patient: Seated with the knee in at least 60° flexion, shank secured with strap and back support with thigh strap preferred. The ankle pad/belt should be two finger widths superior to the lateral malleoli</li> <li>• The patient is instructed to relax while the e-stim generates at least 50% of their max volitional contraction against a fixed resistance OR maximal tolerable amperage without knee joint pain 10-20 seconds on/ 50 seconds off x 15 min</li> </ul>
<b>Criteria to Progress to Phase 2</b>	By the end of week 4: <ul style="list-style-type: none"> <li>• Pain-free knee flexion of 90°</li> <li>• Pain-free and full passive knee extension</li> <li>• Proficient heel-to-toe gait with 50% BW</li> <li>• Compliance with brace at all times</li> <li>• Reduced and well-controlled post-operative pain and edema</li> <li>• Ability to perform a strong isometric quadriceps contraction (full tetany and superior patellar glide)</li> <li>• Proficiency with home-exercise program</li> </ul>



## PHASE 2 (WEEKS 4-6)

<p><i>During Phase 2, the patient should achieve full and pain-free knee extension. Focus is placed on increasing LE strength, proper mechanics and effusion management.</i></p>	
<b>Precautions</b>	No OKC knee extension
<b>Range of Motion</b>	<p>Symmetrical hyperextension - 120° of flexion  <i>Achieved though AAROM/AROM</i></p> <ul style="list-style-type: none"> <li>• <i>Extension ROM: Seated towel stretch, prone hang, bag hang</i></li> <li>• <i>Flexion ROM: heel slides, wall slides</i></li> </ul>
<b>Weight Bearing</b>	50-75% BW with brace unlocked to patient's available flexion ROM (90-120°)
<b>Suggested Interventions</b>	<ul style="list-style-type: none"> <li>• Continue phase 1 interventions as needed</li> <li>• Prone TKE</li> <li>• SLR-4 way – without brace if quadriceps lag is not present</li> <li>• Double leg CKC interventions with brace             <ul style="list-style-type: none"> <li>○ Shuttle press</li> <li>○ Mini-squats</li> <li>○ Bridges</li> <li>○ Sit to stands</li> <li>○ Side steps</li> <li>○ Wall sit</li> </ul> </li> <li>• <b>Patellar mobilization in superior and inferior directions only</b> <ul style="list-style-type: none"> <li>○ Initiate medial and lateral patellar glides at 6 weeks</li> </ul> </li> <li>• Gait training</li> <li>• Upright cycling- for ROM only</li> <li>• Trunk stability interventions             <ul style="list-style-type: none"> <li>○ TrA isometric progression</li> <li>○ Prone/side planks</li> </ul> </li> <li>• Continue effusion management and NMES (seated with tibia fixed at 60° of knee flexion)</li> </ul>
<b>Criteria to Progress to Phase 3</b>	<p>By the end of week 6:</p> <ul style="list-style-type: none"> <li>• Pain-free Symmetrical hyperextension - 120° of flexion</li> <li>• Proficient heel-to-toe gait with 75% BW with brace unlocked to 120° of flexion</li> <li>• Reduced and well-controlled post-operative pain and edema</li> <li>• Ability to perform SLR without quadriceps lag without knee brace</li> <li>• Proficiency with home-exercise program</li> </ul>



## PHASE 3 (WEEKS 6-8)

<p><i>During Phase 3, the patient works toward movement independent of ambulation devices. Full ROM should be achieved and balance/proprioception interventions are initiated. Progression towards SL CKC interventions is appropriate during Phase 3.</i></p>	
<b>Precautions</b>	No OKC knee extension
<b>Range of Motion</b>	Full AROM
<b>Weight Bearing</b>	75% - Full BW with completely unlocked brace. Consider discharging crutches at weeks 6-8 (see <i>criteria to discharge assistive device</i> )
<b>Suggested Interventions</b>	<ul style="list-style-type: none"> <li>• Continue Phase 1 and 2 interventions</li> <li>• SLR-Flexion progressions             <ul style="list-style-type: none"> <li>○ Semi-reclined or seated</li> <li>○ Add ER</li> <li>○ Perform with eyes closed (cortical training)</li> <li>○ Speed</li> <li>○ Isometric holds at end-range</li> </ul> </li> <li>• Initiate single leg CKC interventions with brace on             <ul style="list-style-type: none"> <li>○ Single leg sit to stand</li> <li>○ Single leg wall sit</li> </ul> </li> <li>• Initiate SL balance and proprioceptive interventions</li> <li>• Upright cycling for strength and endurance</li> <li>• Continue effusion management strategies and NMES (seated with tibia fixed at 60° of knee flexion)</li> </ul>
<b>Criteria to Discharge Assistive Device</b>	<ol style="list-style-type: none"> <li>1. <u>ROM</u>: Full active knee extension; no pain on passive overpressure</li> <li>2. <u>Strength</u>: Able to perform strong quad isometric with full tetany and superior patellar glide and able to perform 2x10 SLR without quad lag</li> <li>3. <u>Effusion</u>: 1+ or less is preferred (2+ acceptable if all other criteria are met)</li> <li>4. <u>Weight Bearing</u>: Demonstrates pain-free ambulation without visible gait deviation</li> </ol>
<b>Criteria to Progress to Phase 4</b>	<p>By the end of week 8:</p> <ul style="list-style-type: none"> <li>• Pain-free full AROM</li> <li>• Pain-free gait with full BW with unlocked brace</li> <li>• Discharged crutches, pain-free ambulation without visible gait deviation</li> <li>• Proficiency with home exercise program</li> </ul>



## PHASE 4 (WEEKS 8-12)

<i>During Phase 4, the majority of patients return to work either on a part-time or full-time basis. Patients should continue skilled physical therapy to progress functional, CKC strengthening (DL and SL).</i>	
<b>Precautions</b>	No running or impact activities
<b>Range of Motion</b>	Full AROM
<b>Weight Bearing</b>	Full BW – Brace discharge at 8-10 weeks pending appropriate quadriceps control and normal gait mechanics. <i>May continue brace as needed for adverse weather conditions or ambulation on uneven ground x12 weeks</i>
<b>Suggested Interventions</b>	<ul style="list-style-type: none"> <li>• Continue Phase 2 and 3 interventions</li> <li>• Continue ROM interventions until symmetrical ROM is achieved</li> <li>• Continue to progress single leg interventions per patient's tolerance</li> <li>• Progress proprioceptive and core interventions per patient's tolerance</li> <li>• Multi-angle isometrics</li> <li>• SAQ</li> <li>• Unresisted LAQ</li> <li>• Continue NMES (seated with tibia fixed at 60° of knee flexion)</li> <li>• Continue effusion management strategies as needed</li> </ul>
<b>Criteria to Progress to Phase 5</b>	By week 12: <ul style="list-style-type: none"> <li>• Full and pain-free active ROM</li> <li>• Pain-free ambulation without visible gait deviation</li> <li>• Full and pain-free ADLs (including stair negotiation), with proper technique</li> <li>• Able to perform single leg balance x60 seconds without complaints of pain</li> <li>• Able to perform x5 single leg squats 60-90°</li> <li>• Proficiency in home exercise program</li> </ul>

## PHASE 5 (WEEKS 12-16)

<i>During Phase 5, patient progresses OKC interventions and can initiate cardio training via elliptical or stair stepper. Full return to unrestricted IADLs and vocational duties should be achieved during this phase.</i>	
<b>Precautions</b>	No running or impact activities. Continued emphasis on mechanics to avoid patellofemoral pain.
<b>Range of Motion</b>	Full AROM
<b>Weight Bearing</b>	Full BW, no brace
<b>Suggested Interventions</b>	<ul style="list-style-type: none"> <li>• Continue Phase 3 and 4 interventions</li> <li>• Continue to progress single leg interventions per patient's tolerance</li> <li>• Progress proprioceptive and core interventions per patient's tolerance</li> <li>• Bridging</li> <li>• Resisted OKC quadriceps strengthening               <ul style="list-style-type: none"> <li>○ Partial ROM (90-45°) – weeks 12-13</li> <li>○ Full ROM – weeks 14-16</li> </ul> </li> <li>• Lunges</li> <li>• Step Ups</li> <li>• Heel Taps</li> <li>• Elliptical/stair stepper</li> <li>• Outdoor cycling if desired</li> <li>• Rowing ergometry as tolerated</li> <li>• Continue NMES until 80% symmetry is obtained (seated with tibia fixed at 60° of knee flexion)</li> <li>• Continue effusion management as needed</li> </ul>
<b>Criteria to Progress to Phase 6</b>	By 4 months: <ul style="list-style-type: none"> <li>• Ability to negotiate stairs and mild gradients without pain or reactive effusion</li> <li>• Return to work, depending on the demands of the job</li> <li>• Ability to perform 3x10 heel tap on 6" step with neutral frontal and sagittal plane alignment</li> <li>• Proficiency in home exercise program</li> </ul>



## PHASE 6 (WEEKS 16 - RTS)

<p><i>In Phase 6, strength assessments are utilized to determine readiness to return to running/jumping. Care is taken to emphasize mechanics and functional movement patterns to safely transition back to sport.</i></p>	
<b>Precautions</b>	Running should not be initiated until 6 months post-op. The surgeon must provide final clearance for RTS
<b>Range of Motion</b>	Full AROM
<b>Weight Bearing</b>	Full BW, no brace
<b>Suggested Interventions</b>	<ul style="list-style-type: none"> <li>• Continue phase 2-5 interventions</li> <li>• Progress and increased difficulty of OKC exercises</li> <li>• Continue to progress SL eccentric strengthening through body weight and machine interventions</li>   <li>• Once strength criteria have been met:             <ul style="list-style-type: none"> <li>○ PBW jumping on the shuttle</li> <li>○ Step-hold progression to SL hop progressions</li> <li>○ Walk-jog program</li> <li>○ Sports-specific training</li> <li>○ Agility</li> <li>○ Plyometric training</li> </ul> </li> </ul>
<b>Strength Testing</b>	<p>Isometric testing is appropriate at 5 months            Isokinetic testing is appropriate at 6, 9 and 12 months, and RTS</p> <p>SL hop testing battery (<i>appropriate once the patient has achieved 80% LSI on isokinetic testing</i>)</p> <ul style="list-style-type: none"> <li>• SL hop for distance</li> <li>• Triple hop for distance</li> <li>• Cross over hop for distance</li> <li>• 6m timed hop</li> </ul> <p><i>*Functional strength testing and hop testing should be reserved for patients returning high-level activity*</i></p>
<b>Criteria to Initiate Running and Jumping</b>	<ol style="list-style-type: none"> <li>1. <u>ROM</u>: full, pain-free knee ROM, symmetrical with the uninvolved limb</li> <li>2. <u>Strength</u>: Isokinetic testing 80% or greater for hamstring and quad at 60°/sec and 300°/sec</li> <li>3. <u>Effusion</u>: 1+ or less</li> <li>4. <u>Weight Bearing</u>: normalized gait and jogging mechanics</li> <li>5. <u>Neuromuscular Control</u>: Pain-free hopping in place</li> </ol>
<b>Criteria to Return to Sport</b>	<ol style="list-style-type: none"> <li>1. <u>ROM</u>: full, pain free knee ROM, symmetrical with the uninvolved limb</li> <li>2. <u>Strength</u>: Isokinetic testing 90% or greater for hamstring and quad at 60°/sec and 300°/sec</li> <li>3. <u>Effusion</u>: No reactive effusion ≥ 1+ with sport-specific activity</li> <li>4. <u>Weight Bearing</u>: normalized gait and jogging mechanics</li> <li>5. <u>Neuromuscular control</u>: appropriate mechanics and force attenuation strategies with high level agility, plyometrics, and high impact movements</li> <li>6. <u>Functional Hop Testing</u>: LSI 90% or greater for all tests</li> <li>7. <u>Physician Clearance</u></li> </ol>
<p><i>Most patients who undergo this procedure have limited sports goals and have not routinely engaged in jumping and pounding sports. Define patient goals and expectations upfront, and work with the surgeon to modify protocol accordingly.</i></p> <p><i>Full RTS expected between 9-15 months post-operatively</i></p>	





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