

## Phase I: Immediate Postoperative/Post Injury Period of Protection

*\*These guidelines are intended to assist the clinician in progression under the direction of the physician, with emphasis on meeting the progression criteria and clearance by the physician before continuation to the next subsequent phase of rehabilitation. Every knee condition is unique and needs to be progressed based on tissue injured, extent of injury, co-morbidities and physiologic healing time frames.*

<b>Appointments</b>	<ul style="list-style-type: none"> <li>Rehabilitation appointments typically begin within 10-14 days of surgery, and continue 2-3 times per week.</li> </ul>
<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>Protect healing of repaired tissues</li> <li>Reduce pain and swelling in the knee, foot and ankle</li> <li>Restore full knee extension</li> <li>Restore quadriceps and surrounding muscle activation</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>Maximum protection of inflamed joint</li> <li>No running, jumping, plyometric activity</li> <li>Modified weightbearing with assistive device (see face sheet for details)</li> <li>See face sheet for further precautions per physician</li> </ul>
<b>Inflammation Control</b>	<ul style="list-style-type: none"> <li>TENS</li> <li>Cryotherapy</li> <li>Compression (garment/bandage)</li> <li>Elevation with straight knee (extra support under ankle)</li> </ul>
<b>Range of Motion (ROM) Interventions</b>	<ul style="list-style-type: none"> <li>Patellar mobility (superior/inferior/medial)</li> <li>Full passive terminal extension equal to contralateral limb             <ul style="list-style-type: none"> <li>Seated or supine low level long duration stretch</li> <li>Emphasize hamstring/gastroc soft tissue mobility</li> <li>Long sitting gastroc stretch</li> </ul> </li> <li>Flexion progression per guidelines             <ul style="list-style-type: none"> <li>Gravity assisted knee flexion/CPM</li> <li>Therapist assisted without overpressure</li> <li>Stationary bike (high seat, no or low resistance)</li> <li>Assisted heel slides (supine or wall with towel/belt)</li> </ul> </li> </ul>
<b>Suggested Therapeutic Exercises</b>	<ul style="list-style-type: none"> <li>Core stabilization             <ul style="list-style-type: none"> <li>Supine core activation</li> </ul> </li> <li>Hip strengthening             <ul style="list-style-type: none"> <li>Straight leg raises (extension/abduction/adduction)</li> <li>Clam shells (within flexion restrictions)</li> </ul> </li> <li>Quadriceps recruitment progression without patellofemoral pain             <ul style="list-style-type: none"> <li>Isometric quad sets</li> <li>Prone TKE (only if WBAT)</li> <li>Short arc quad (*with physician approval)</li> <li>Straight leg raise</li> </ul> </li> <li>Gait (with weightbearing approval)             <ul style="list-style-type: none"> <li>Weightshifting</li> <li>Marching</li> <li>Step over/hurdle walking</li> <li>Retroversion/side stepping</li> </ul> </li> <li>Double limb balance (with weightbearing approval)</li> </ul>

<b>Cardiovascular Fitness</b>	<ul style="list-style-type: none"> <li>• None at this time</li> </ul>
<b>Criteria to Progress to Phase II</b>	<ul style="list-style-type: none"> <li>• Full active knee extension (equal to contralateral side)</li> <li>• Normal gait without compensation (hip hiking, adequate extension during midstance)</li> <li>• No active effusion (negative or trace Brush test)</li> <li>• Normal patellar mobility (superior, inferior, medial)</li> <li>• Ability to complete 20 straight leg raises without extensor lag</li> <li>• Physician clearance to WBAT</li> <li>• Clearance from brace and crutches</li> </ul>

### Phase II: Transitional Phase- Low Impact

<b>Appointments</b>	<ul style="list-style-type: none"> <li>• Rehabilitation appointments continue 1-3 times per week</li> </ul>
<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Restore full knee range of motion (within guidelines on face sheet)</li> <li>• Restore normal weightbearing kinematics</li> <li>• Restore normal balance on the operative/injured limb</li> <li>• Normalize gait pattern without assistive device</li> <li>• Return to light work/ moderately heavy labor (truck driving, etc)</li> <li>• Return to recreational sports (swimming, cycling, walking, linear jogging 2x/week)</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• Clearance required for running, jumping, plyometric activity</li> <li>• Full weightbearing (with the exception of weightbearing past 90 degrees with closed chain exercises)</li> </ul>
<b>ROM Interventions</b>	<ul style="list-style-type: none"> <li>• Maintain knee extension</li> <li>• Progress flexion per restrictions             <ul style="list-style-type: none"> <li>○ Upright/recumbent bike</li> <li>○ Manual interventions</li> </ul> </li> <li>• Aquatic therapy as needed</li> </ul>
<b>Suggested Therapeutic Exercises</b>	<ul style="list-style-type: none"> <li>• Neutral spine/core stabilization             <ul style="list-style-type: none"> <li>○ Plank progression (side/prone)</li> </ul> </li> <li>• Emphasize posterior kinetic chain (hamstrings, glutes, anterior core, gastroc)</li> <li>• Closed chain exercises             <ul style="list-style-type: none"> <li>○ Double limb activity (equal weightbearing, knees stay behind toes, patella in line with 2<sup>nd</sup> toe, stable trunk, no pain through motion)                 <ul style="list-style-type: none"> <li>▪ Leg press</li> <li>▪ Squat progression</li> <li>▪ RDL/deadlift</li> <li>▪ Bridge progression</li> <li>▪ Heel raises</li> <li>▪ Side stepping (with/without resistance)</li> <li>▪ Split squat/lunge</li> </ul> </li> <li>○ Single limb activity (no pelvic drop)                 <ul style="list-style-type: none"> <li>▪ RDL</li> <li>▪ Squat progression</li> <li>▪ Bridge progression</li> <li>▪ Balance progression</li> </ul> </li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>▪ Heel raises</li> <li>▪ Step ups forward/lateral</li> <li>▪ 4 way resisted hip with SLS (flex/ext/abd/add)</li> <li>▪ Hip hikes</li> <li>▪ Lateral step down progression</li> <li>• Open chain exercises           <ul style="list-style-type: none"> <li>○ Hamstring curls</li> <li>○ Straight leg raises with quadriceps activated</li> <li>○ Short arc quad (unweighted)</li> <li>○ Long arc quad (unweighted)</li> </ul> </li> <li>• Begin applying dual task modifiers during exercise (cognitive/visual/balance)           <ul style="list-style-type: none"> <li>○ Spelling, verbalizing days of the week backwards, reciting alphabet, counting, memory recall, etc.</li> </ul> </li> </ul>
<b>Cardiovascular Fitness</b>	<ul style="list-style-type: none"> <li>• Swimming (without frog kicking)</li> <li>• Stationary/level surface biking without resistance</li> <li>• Elliptical without or minimal resistance</li> </ul>
<b>Criteria to Progress to Phase III</b>	<ul style="list-style-type: none"> <li>• Ability to reciprocally ascend/descend 1 flight of stairs without compensation</li> <li>• Soreness lasting no longer than 24 hours after activity</li> <li>• Performs squat to 75 degrees without pain and symmetrical weightbearing</li> <li>• Good understanding &amp; self-correction of exercise techniques</li> <li>• Single leg stance for 30 seconds without loss of balance</li> <li>• Good tolerance of simulated functional/work tasks</li> <li>• Functional Capacity Test (per physician discretion for Tegner activity goal 0-3, see appendix for specifics)</li> </ul>

### Phase III: Intermediate Phase- Linear

<b>Appointments</b>	<ul style="list-style-type: none"> <li>• Rehabilitation appointments continue 1-3 times per week</li> </ul>
<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Maintain full knee range of motion</li> <li>• Restore normal weightbearing kinematics</li> <li>• Restore stability during single limb activities</li> <li>• Restore proprioception of the lower limb</li> <li>• Restore normal running gait</li> <li>• Return to work/heavy labor (construction, etc)</li> <li>• Return to competitive cycling, recreational sports (tennis, racquetball, skiing, jogging 5x/week)</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• No pivoting, cutting activities</li> <li>• No plyometrics</li> <li>• Return to Linear Running Testing performed at beginning of this phase           <ul style="list-style-type: none"> <li>▪ Modified return to sport testing at 3 months               <ul style="list-style-type: none"> <li>• Isokinetic testing                   <ul style="list-style-type: none"> <li>○ <math>\geq 70\%</math> Quad:Quad strength</li> <li>○ <math>\geq 70\%</math> Hamstring:Hamstring strength</li> </ul> </li> <li>• 6" Lateral step down: no more than mild dynamic valgus</li> </ul> </li> </ul> </li> </ul>

<p><b>Suggested Therapeutic Exercises</b></p>	<ul style="list-style-type: none"> <li>• Strength/Endurance (continue phase II exercises with progressions to the following)           <ul style="list-style-type: none"> <li>○ Quadriceps               <ul style="list-style-type: none"> <li>▪ Split squat/lunge</li> <li>▪ Lateral step down</li> <li>▪ Single leg squat</li> <li>▪ Squat progression (including beyond 75 degrees as indicated)</li> </ul> </li> <li>○ Hamstrings/Glutes               <ul style="list-style-type: none"> <li>▪ Single leg RDL</li> </ul> </li> <li>○ Integrated               <ul style="list-style-type: none"> <li>▪ Lateral/posterior kinetic chain strengthening</li> </ul> </li> </ul> </li> <li>• Multiplanar Balance/Stability Training           <ul style="list-style-type: none"> <li>○ Push/pull</li> <li>○ Controlled Rotational</li> <li>○ Uneven/unstable surface progression</li> </ul> </li> <li>• Low velocity, low amplitude agility drills           <ul style="list-style-type: none"> <li>○ Forward/backward skipping</li> <li>○ Side shuffle</li> <li>○ Skaters/carioca/cross overs</li> <li>○ Forward/backward jog</li> <li>○ Shallow double limb jump landings</li> </ul> </li> <li>• Integrated Dual Task Activities           <ul style="list-style-type: none"> <li>○ Cognitive</li> <li>○ Visual</li> <li>○ Balance</li> </ul> </li> </ul>
<p><b>Cardiovascular Fitness</b></p>	<ul style="list-style-type: none"> <li>• Swimming (all strokes, pain free)</li> <li>• Stationary biking with resistance</li> <li>• Elliptical Trainer with moderate resistance</li> <li>• Treadmill/walking (incline/decline)</li> <li>• Jogging/deep water running (linear only, no cutting/pivoting/hopping)</li> <li>• Stair stepper</li> </ul>
<p><b>Criteria to Progress to Phase IV</b></p>	<ul style="list-style-type: none"> <li>• &lt;2/10 pain with weightbearing exercise</li> <li>• Cleared to hop/run/jog per physician discretion (not before 3 months for reconstruction/repair, or 6 weeks for arthroscopy or non-operative knee injury)</li> <li>• Good single leg balance without dynamic valgus</li> <li>• Normal jogging gait pattern</li> <li>• Modified return to sport testing           <ul style="list-style-type: none"> <li>○ Isokinetic testing               <ul style="list-style-type: none"> <li>▪ ≥80% Quad:Quad strength</li> <li>▪ ≥80% Hamstring:Hamstring strength</li> </ul> </li> <li>○ 6" Lateral step down: no more than trace dynamic valgus</li> </ul> </li> </ul>

### Phase IV: Return to Activity Phase- High Impact

<b>Appointments</b>	<ul style="list-style-type: none"> <li>• Rehabilitation appointments continue 1-2 times per week</li> </ul>
<b>Rehabilitation Goals</b>	<ul style="list-style-type: none"> <li>• Progression through running/agility interval program</li> <li>• Normal double leg and single leg landing control without side to side differences or compensations</li> <li>• Return to recreational contact sports</li> <li>• Return to competitive/elite sports (soccer, football, rugby, wrestling, gymnastics, hockey, basketball, track and field events, running)</li> </ul>
<b>Precautions</b>	<ul style="list-style-type: none"> <li>• No pain allowed during any strength or plyometric activity</li> <li>• Soreness lasting &gt;24 hours requires 1 day of rest, repeat last routine at next training day</li> </ul>
<b>Suggested Therapeutic Exercises</b>	<ul style="list-style-type: none"> <li>• Strength/Endurance (continued from Phase III with inclusion of the following)             <ul style="list-style-type: none"> <li>○ Deadlift</li> <li>○ Squat</li> <li>○ Dynamic posterior kinetic chain progression (see appendix*)</li> <li>○ Hip strengthening (prevention of hip adduction at landing &amp; stance)</li> </ul> </li> <li>• Plyometrics/agility/jumping progression             <ul style="list-style-type: none"> <li>○ Double limb to single limb</li> <li>○ Uni-planar to multi-planar</li> <li>○ Hopping to plyometric progression (emphasize appropriate mechanics with landing)</li> <li>○ Skipping/side shuffle/skaters/carioca/cross overs/agility ladder</li> </ul> </li> <li>• Power             <ul style="list-style-type: none"> <li>○ Higher amplitude double leg &amp; single leg landing drills</li> <li>○ Uni-planar to multi-planar</li> </ul> </li> <li>• Neuromuscular Re-Education             <ul style="list-style-type: none"> <li>○ Unanticipated movement control drills, cutting/pivoting</li> <li>○ Balance &amp; proprioceptive drills</li> </ul> </li> <li>• Core strength &amp; stabilization (prevent frontal plane trunk lean during landing &amp; single leg stance)</li> <li>• Sport Specific Training</li> </ul>
<b>Cardiovascular/Endurance Fitness</b>	<ul style="list-style-type: none"> <li>• Interval Running Program</li> <li>• Swimming</li> <li>• Biking</li> <li>• Elliptical/Stair climber</li> <li>• Row machine</li> </ul>
<b>Criteria for Return to Play/Sport</b>	<ul style="list-style-type: none"> <li>• 0/10 pain with all activity</li> <li>• ACL-RSI Questionnaire <math>\geq 65\%</math></li> <li>• No active effusion (negative brush test)</li> <li>• Quadriceps girth within 1.5cm bilaterally</li> <li>• Return to Sport Testing             <ul style="list-style-type: none"> <li>○ Range of Motion equal or within 2 degrees of contralateral limb</li> <li>○ Isokinetic testing                 <ul style="list-style-type: none"> <li>▪ <math>\geq 90\%</math> Quad:Quad ratio</li> <li>▪ <math>\geq 90\%</math> Hamstring:Hamstring ratio</li> <li>▪ <math>\geq 66\%</math> Hamstring:Quad ratio</li> </ul> </li> <li>○ Y-Balance Testing</li> </ul> </li> </ul>

	<ul style="list-style-type: none"><li>▪ Anterior Reach within 4 cm bilaterally</li><li>▪ Composite score <math>\geq 90\%</math> bilaterally</li><li>○ Lateral step down (no dynamic valgus)</li><li>○ Hop Testing (<math>\geq 90\%</math> contralateral limb)<ul style="list-style-type: none"><li>▪ 5-0-5 Test</li><li>▪ Single hop</li><li>▪ Triple hop</li><li>▪ Triple crossover hop</li><li>▪ 6m hop</li></ul></li></ul>
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These rehabilitation guidelines were developed collaboratively by Mizzou Therapy Services and Seth Sherman, MD at the Missouri Orthopaedic Institute.

These guidelines listed are just that, guides to assist the clinician in progression, but at no time are to be taken as concrete for timing or need of progression. Each injury, tear and repair is unique and needs to be progressed based on tissue injured, extent of injury, co-morbidities and physiologic healing time frames.

Updated 03/2019

#### References

Di Stasi S, Myer GH, Hewett TE. Neuromuscular training to target deficits associated with second anterior cruciate ligament injury. JOSPT. 2013 Nov; 43(11): 777-792.

Mohammadirad S, Salavati M, Takamjani IE, Akhbari B, Sherafat S, Mazaheri M, Negahban H. Intra and intersession reliability of a postural control protocol in athletes with and without anterior cruciate ligament reconstruction: a dual task paradigm. IJSPT. 2012 Dec; 7(6): 627-636.