

# Guidelines for Post-operative Rehabilitation of ACL Repair with the *Internal Brace*<sup>TM</sup>

Phase 0: Pre-op				
Criteria for beginning phase Meets surgical criteria for internal brace augmentation				
Range of Motion	Weight Bearing	Exercise	Goals	Guidelines/Restrictions/Precautions
<b>Aim to maintain full extension. Limit flexion to 90</b>	PWB 1-2 elbow crutches	<ul style="list-style-type: none"> <li>Choose exercise, resistance &amp; equipment after establishing severity, irritability and nature of injury</li> <li>Assume unstable knee</li> <li>Body weight open chain quads exercises and lower limb triple extension with theraband resistance</li> <li>Hamstring &amp; calf stretching</li> <li>Glute and core maintenance exercises as able</li> </ul>	<ul style="list-style-type: none"> <li>Protect unstable knee</li> <li>Reduce swelling</li> <li>Maintain quads function</li> <li>Maintain/maximise knee extension</li> <li>Maintain Glute and torso function</li> </ul>	<ul style="list-style-type: none"> <li>Rest leg and elevate where possible when not performing exercises</li> <li>Ice the knee for 20min approx. 5 times per day</li> <li>Use crutches as indicated</li> <li>Wear tubigrip or other compression garment throughout the day and remove at night.</li> </ul>

## Phase 1: Initial Post-op (Days 1-7)

### Criteria for beginning phase

Successful operative outcome | Assumes no or minimal additional structural pathology i.e. meniscal or MCL repair | Surgeon in agreement with post-operative protocol

### Testing

ROM

Range of Motion	Weight Bearing	Exercise	Goals	Guidelines/Restrictions/Precautions
<p><b>Normal hyperextension-100 degrees flexion</b></p>	<p>1 elbow crutch if required for comfort and gait normalisation.</p> <p>Reduce in stages depending on pain and gait pattern</p>	<p>ROM</p> <ul style="list-style-type: none"> <li>Active ROM challenging flexion and extension within phase limits</li> <li>Passive knee extension – patient (prone hangs) and practitioner administered</li> <li>Patellar mobilisations</li> <li>Posterior chain soft-tissue release work</li> <li>Calf &amp; hamstring stretches</li> <li>Ankle pumps</li> <li>Exercise bike up to 10min low resistance</li> </ul> <p>STRENGTH &amp; CONTROL</p> <ul style="list-style-type: none"> <li>Quads setting / Inner range quads / ASLR / long-arc quads</li> <li>Wall slides (0-45°)</li> <li>Calf raises</li> <li>Hamstring strengthening with resistance band or similar</li> <li>NWB hip control/strengthening – focus on extension and ABDuction</li> <li>Core/trunk conditioning without lower limb loading</li> <li>Gait education and drills</li> </ul> <p>PROPRIOCEPTION/BALANCE</p> <ul style="list-style-type: none"> <li>Low grade knee proprioception / joint position sense exercises</li> </ul>	<ul style="list-style-type: none"> <li>Good control of pain</li> <li>Grade 1+ effusion or less</li> <li>Walking without crutches</li> <li>Reinstate optimal gait pattern</li> <li>Achieve full knee hyperextension</li> <li>Maintain quads activation</li> <li>Maintain hip/pelvis and trunk control &amp; stability</li> </ul>	<ul style="list-style-type: none"> <li>Rest the leg and elevate as much as possible when not performing physiotherapy exercises</li> <li>Ice the knee for 20min approx. 5 times per day</li> <li>Use crutches as indicated</li> <li>Wear tubigrip or other compression garment throughout the day and remove at night.</li> <li>No crossing legs, running, jumping, twisting/pivoting.</li> <li>No loaded open chain quads – unloaded only.</li> </ul>

## Phase 2: Early Post-op(from 1 week)

### Criteria for beginning phase

Able To walk without crutches | Knee ROM full hyperextension to 100° | Pain reducing | Effusion grade 1+ or less

### Testing

ROM

Range of Motion	Weight Bearing	Exercise	Goals	Guidelines/Restrictions/Precautions
<b>Full hyperextension</b>  <b>110-120 degrees flexion</b>	FWB	ROM <ul style="list-style-type: none"> <li>Maintain previous ROM exercises</li> <li>Continue with passive mobilisations and soft-tissue release as indicated</li> <li>Increase exercise bike up to 15min still low resistance</li> </ul> STRENGTH & CONTROL <ul style="list-style-type: none"> <li>Maintain previous phase</li> <li>Introduce light open chain quads loading (i.e. 1-2kg ankle weight) as pain and effusion dictate</li> <li>Progress wall slides to 90° flexion as pain allows</li> <li>Light resistance-based closed chain knee extension (i.e. Pilates reformer supine leg press)</li> <li>Small step work</li> <li>Supine hamstring bridges</li> <li>Supine glute bridges</li> <li>Core / trunk conditioning can include lower limb loading as tolerated</li> </ul> PROPRIOCEPTION/BALANCE <ul style="list-style-type: none"> <li>Static single leg stance on stable base – ensure good pelvis/hip positioning</li> <li>Double leg stance with arm movements +/- eyes closed on unstable base (i.e. balance pad/cushion)</li> </ul>	<ul style="list-style-type: none"> <li>Minimal pain</li> <li>Trace effusion or less</li> <li>Begin reciprocal stair ascending and descending</li> </ul>	<ul style="list-style-type: none"> <li>Rest the leg and elevate as much as possible when not performing physiotherapy exercises</li> <li>Ice the knee for 20min approx. 5 times per day</li> <li>No crossing legs, running, jumping, twisting/pivoting.</li> </ul>

### Phase 3: Intermediate Post-op (from week 3)

#### Criteria for beginning phase

Flexion within 30° of uninjured side and full hyperextension | Effusion Trace or less | Achieving stairs reciprocally with good pattern | Completing full rehabilitation exercises from Phase 2 competently and without pain

#### Testing

ROM | KOOS (Symptoms, Pain & ADLs) at end of phase

Range of Motion	Weight Bearing	Exercise	Goals	Guidelines/Restrictions/Precautions
<p><b>Full hyperextension</b></p> <p><b>120-130 degrees flexion</b></p>	FWB	<p>ROM</p> <ul style="list-style-type: none"> <li>Maintain previous ROM exercises</li> <li>Continue with passive mobilisations and soft-tissue release as indicated</li> <li>Graded progression of exercise bike up to 30min with increasing resistance</li> </ul> <p>STRENGTH &amp; CONTROL</p> <ul style="list-style-type: none"> <li>Graded progression of open chain quads loading as clinically indicated</li> <li>Progress closed chain loading (i.e. BW squats, BW split squats, lunges)</li> <li>Supine Pilates reformer work can commence jump-board work for early landing NM control</li> <li>Progression of step work via increased step height and lateral movements</li> <li>Introduce shallow single leg squats up to 45 degrees knee flexion</li> <li>Advancement of hamstring loading (i.e. Swiss Ball curls including fast eccentrics)</li> <li>SL supine glute bridges</li> <li>Continue core / trunk conditioning</li> </ul> <p>PROPRIOCEPTION/BALANCE</p> <ul style="list-style-type: none"> <li>Single leg stance with arm movements +/- eyes closed on unstable base (i.e. balance pad/cushion)</li> <li>Side-stepping, carioca and other entry level agility exercises</li> </ul>	<ul style="list-style-type: none"> <li>Full ROM</li> <li>Introduce agility exercises</li> <li>Sufficient neuromuscular control to commence running program in next phase</li> <li>KOOS (Symptoms &amp; stiffness; Pain; Function &amp; daily living) &gt;75% by end of phase</li> </ul>	<ul style="list-style-type: none"> <li>Ensure symmetrical patterning on squat and lunge-based activities</li> <li>Monitor pain and effusion levels in response to introduction of new activities</li> <li>No running</li> </ul>

**Phase 4: Late Post-op (from week 5)**

**Criteria for beginning phase**  
 Flexion within 20 deg of uninvolved side | Maintaining full hyperextension | Effusion Trace or less | KOOS (Symptoms & stiffness; Pain; Function & daily living) >75% | Completing full rehabilitation exercises from Phase 3 competently and without pain

**Testing**  
 ROM | KOOS (Symptoms & stiffness; pain; daily living) at end of phase | Open chain quads/knee extension strength at end of phase

Range of Motion	Weight Bearing	Exercise	Goals	Guidelines/Restrictions/Precautions
<p><b>Aim for full ROM – no restrictions</b></p>	<p>FWB</p>	<p>ROM</p> <ul style="list-style-type: none"> <li>Continue with previous ROM exercises if there is a perception of 'tightness' or 'stiffness' or a tendency to clinically stiffen</li> </ul> <p>STRENGTH &amp; CONTROL</p> <ul style="list-style-type: none"> <li>Graded progression of open chain quads loading as clinically indicated</li> <li>Advance lunge activities (i.e. multi-directional)</li> <li>Progress closed chain loading (i.e. graded back squat with barbell – 50% range ensuring excellent eccentric control)</li> <li>Progress single leg squat depth up to 90 degrees knee flexion</li> <li>Commence standing landing control exercises (i.e. landing from step, mini jumps)</li> <li>Continue with / advance hamstring, bridge, trunk work</li> </ul> <p>PROPRIOCEPTION/BALANCE</p> <ul style="list-style-type: none"> <li>Single leg – progress level of difficulty and consider sports-specific components (i.e. throw/catch)</li> <li>Progress agility work into tight space movement drills and introduce 'cutting' movements (i.e. figure of 8's, squares)</li> </ul>	<ul style="list-style-type: none"> <li>Full ROM</li> <li>KOOS (Symptoms &amp; stiffness; Pain; Function &amp; daily living) &gt;95%</li> <li>Open chain quadriceps strength &gt;80% uninvolved side</li> </ul>	<ul style="list-style-type: none"> <li>Patient to use 'Soreness rules' (see below) to guide rehab intensity and frequency</li> <li>Monitor kinetic chain ROM and control (i.e. ankle dorsiflexion range &amp; pelvic/hip control) to prevent anterior knee overload</li> <li>No running</li> </ul>

## Phase 5: Transitional Phase (from week 8)

### Criteria for beginning phase

Full ROM | No Effusion | KOOS (Symptoms & Stiffness; Pain; Function & daily living) >95% | Completing full rehabilitation exercises from Phase 4 competently and without pain

### Testing

KOOS (Function, sports & recreation) at end of phase | Open chain quads/knee extension strength at end of phase | Y-Balance Test – at end of phase | Hop Testing – at end of phase

Range of Motion	Weight Bearing	Exercise	Goals	Guidelines/Restrictions/Precautions
Full	FWB	<p>ROM Maintain through lower limb kinetic chain</p> <p>STRENGTH &amp; CONTROL</p> <ul style="list-style-type: none"> <li>Graded progression of open chain quads loading as clinically indicated</li> <li>Progress closed chain loading (i.e. graded increase back squat load &amp; depth; consider introducing Olympic lifts if part of patients normal training)</li> <li>Progress landing control exercises (i.e. increased step height; develop single leg landing control; add rotational or external perturbation components)</li> <li>Commence slide board work if indicated for patients sport</li> <li>Continue with / advance hamstring, bridge, trunk work</li> </ul> <p>PROPRIOCEPTION/BALANCE</p> <ul style="list-style-type: none"> <li>Advanced gility circuits with multi-components (i.e. steps, speedladder, balance pads, cones – mix static with dynamic stability)</li> </ul> <p>RUNNING PROGRAM Commence the running program outlined below.</p>	<ul style="list-style-type: none"> <li>KOOS (Function, sports &amp; recreation) &gt;75%</li> <li>Open chain quadriceps strength &gt;90% uninvolved side</li> <li>Y-Balance Test – composite score &gt;85%</li> <li>Hop testing (single, triple, x-hop, timed lateral, timed forward 6m) &gt; 85%</li> </ul>	<ul style="list-style-type: none"> <li>Patient to use 'Soreness rules' (see below) to guide rehab intensity and frequency</li> <li>Monitor kinetic chain ROM and control (i.e. ankle dorsiflexion range &amp; pelvic/hip control) to prevent anterior knee overload</li> </ul>

## Phase 6: Sport-specific (from week 12)

### Criteria for beginning phase

Full ROM | No Effusion | KOOS (Function, sports & recreation) >75% | Completing full rehabilitation exercises from Phase 4 competently and without pain

### Testing

KOOS (Function, sports & recreation) at end of phase | Y-Balance Test – at end of phase | Hop Testing – at end of phase

Range of Motion	Weight Bearing	Exercise	Goals	Guidelines/Restrictions/Precautions
Full	FWB	<p>ROM Maintain through lower limb kinetic chain</p> <p>STRENGTH &amp; CONTROL</p> <ul style="list-style-type: none"> <li>Graded progression of open chain quads loading as clinically indicated</li> <li>Progress closed chain loading (i.e. graded increase back squat load &amp; depth; consider introducing Olympic lifts part of patients normal training)</li> <li>Progress landing control exercises (i.e. add plyometric components)</li> <li>Continue with / advance hamstring, bridge, trunk work</li> <li>Add more advanced cutting/twisting/turning movements with progressive exposure to training drills. Start with few variables and progress towards open play</li> </ul> <p>PROPRIOCEPTION/BALANCE</p> <ul style="list-style-type: none"> <li>Agility circuits with multi-components – advance to reflect sport-specificity</li> </ul> <p>RUNNING PROGRAM</p> <p>Once the running program is completed – advance to develop relevant components of sport-specific function i.e. increased straight line speed or interval-type.</p>	<ul style="list-style-type: none"> <li>KOOS (Function, sports &amp; recreation; Total score) &gt;95%</li> <li>Open chain quadriceps strength &gt;95% uninvolved side</li> <li>Y-Balance Test – composite score &gt;95%</li> <li>Hop testing (single, triple, x-hop, timed lateral, timed forward 6m) &gt; 95%</li> </ul>	<ul style="list-style-type: none"> <li>Patient to use 'Soreness rules' (see below) to guide rehab intensity and frequency</li> <li>Monitor kinetic chain ROM and control (i.e. ankle dorsiflexion range &amp; pelvic/hip control) to prevent anterior knee overload</li> <li>Patient must adequately demonstrate sport-specific training and sport-specific testing may be indicated to determine return to play readiness alongside the Phase 6 goals.</li> </ul>

## Soreness Rules

<b>1. Soreness during warm-up that continues</b>	2 days off, drop down one level
<b>2. Soreness during warm-up that goes away</b>	Stay at level that led to soreness
<b>3. Soreness during warm-up that goes away but returns during the session</b>	2 days off, drop down one level
<b>4. Soreness the day after session (not muscle soreness)</b>	1 day off, do not advance program to next level
<b>5. No soreness</b>	Advance 1 level per week or as instructed by physiotherapist

## Running Progression

	Treadmill or Outdoors	Track
<b>Level 1</b>	0.2 km walk; 0.2 km jog x 10 (4 km)	Jog straights /walk bend (4 km)
<b>Level 2</b>	0.2 km walk; 0.4 km jog x 7 (4.2 km)	Jog straights / jog 1 bend every 2 <sup>nd</sup> lap (4km)
<b>Level 3</b>	0.2 km walk; 0.6 km jog x 5 (4 km)	Jog straights / jog 1 bend every lap (4 km)
<b>Level 4</b>	0.2 km walk; 0.8 km jog x 4 (4 km)	Jog 1.75 laps / walk 1 curve (2 km)
<b>Level 5</b>	Jog full 4 km	Jog all laps (2km)
<b>Level 6</b>	Jog 5 km	Jog 5km
<b>Level 7</b>	Jog 6 km	Jog 6 km
<b>Level 8</b>	Alternate between running and jogging every 0.5 km x 6	Alternate between running on the straights and jogging on the bends (6km)

Perform no more than 4 times in 1 week and no more frequently than every 2<sup>nd</sup> day. Do not progress more than 2 levels in a 7 day period. Based on running program proposed by Adams et al. (2012).